JOHNS HOPKINS
U N I V E R S I T Y

Zanvyl Krieger School of Arts and Sciences
Whiting School of Engineering

Undergraduate and Graduate Programs 2011–2013

Johns Hopkins

Arts and Sciences / Engineering *2011–2013*

Calendar 2011–2012

Fall 2011

August 24–August 28	Orientation for all new undergraduates
August 29	First day of classes
September 5	Labor Day—classes suspended
October 10	Fall Break Day—classes suspended
October 11	Classes meet according to Monday schedule (Tuesday's classes will not meet on this day)
November 14–December 4	Undergraduate registration for spring term
November 23–27	Thanksgiving vacation
December 2	Last day of classes
December 3–6	Reading period
December 7–16	Final examination period
December 17–January 8	Midyear vacation

Spring 2012

January 9–27	Intersession
January 16	Observance of Martin Luther King's birthday; No Intersession Classes
January 30	First day of classes
March 19–25	Spring vacation
April 9–29	Undergraduate registration for fall term
May 4	Last day of classes
May 5–8	Reading period
May 9–17	Final examination period
May 24	University Commencement

The university reserves the right to change without notice any programs, policies, requirements, or regulations published in this catalog. The catalog is not to be regarded as a contract.

The Unique Appeal of Johns Hopkins

The fusion of learning and research is the hallmark of graduate and undergraduate study at the Zanvyl Krieger School of Arts and Sciences and the Whiting School of Engineering of The Johns Hopkins University. The pages that follow present the university's unique intellectual life and educational philosophy. The academic programs described here, and the faculty who teach them, constitute the strengths that have long distinguished Hopkins as a private, selective institution.

The unique educational philosophy of Johns Hopkins was first articulated more than a century ago by Daniel Coit Gilman, the university's first president. Gilman believed that the highest quality education can only be carried out in a research environment, and that the best training, whether undergraduate or graduate, takes place under the supervision of an active researcher. This belief in the inseparability of education and research has become the distinguishing feature of the university's academic programs. In both the School of Arts and Sciences and the School of Engineering, undergraduate education, graduate education, and the conduct of primary research are interrelated in an organic way. There has never been a separate undergraduate college at Hopkins.

This educational philosophy has also led to the remarkably low student-faculty ratio on the Homewood campus, for it requires the kind of close interaction between faculty and students that occurs in small seminars, in the supervision required for independent projects, or in the research laboratory. Academic requirements for undergraduates are highly flexible and designed to enhance rather than restrain creativity. Like graduate students, undergraduates are largely free of university-wide curricular requirements, so that every scholar can proceed at his or her own speed. As a result, many Hopkins undergraduates quickly find themselves enrolled in advanced seminars, engaged in independent study projects, or incorporated into research teams with faculty, graduate students, and postdoctoral fellows. Courses that focus on some well-defined objective in depth are more characteristic of the Hopkins curriculum than broad introductory surveys. Upper-level courses are heavily attended by both undergraduates and graduates in a continuation of the Hopkins tradition of relaxing the distinction between the two groups.

Beyond the classroom, the learning experience continues in research laboratories, on playing fields, in theater and art workshops, and through a wide range of contacts with professors, administrators, and other students. What you read here should give you a sense of the unique spirit and appeal of Hopkins and a sense of how your educational goals might be fulfilled here. If you are interested in further information on any particular course offerings or on the nature of student life, please contact the academic departments or the Office of Undergraduate Admissions.

Contents

The Johns Hopkins University

The Zanvyl Krieger School of Arts and Sciences and the Whiting School of Engineering are the heart of a small but unusually diverse coeducational university. Privately endowed, The Johns Hopkins University was founded in 1876 as the first true American university on the European model: a graduate institution with an associated preparatory college, a place where knowledge would be created and assembled, as well as taught. The men and women on the Hopkins faculty achieve a balance between their activities in scholarship and research and their commitment to teaching. Their active involvement as leaders in their professional fields cannot help but benefit their students.

Divisions of the University

The university as a whole comprises 10 divisions, nine of which are degree-granting schools. The schools of Arts and Sciences and Engineering share the Homewood campus. The Carey Business School and the School of Education also offer courses at Homewood, as well as in Columbia, downtown Baltimore, and Montgomery County; and the Advanced Academic Programs of the Krieger School of Arts and Sciences offers courses in Washington, as well as in Montgomery County and at Homewood. The schools of Medicine and of Public Health are in East Baltimore, next to the renowned Johns Hopkins Medical Institutions (JHMI). In 1984 these two schools were joined by the School of Nursing. The Peabody Institute, one of the leading professional schools of music in the United States, became a formal affiliate of the university in 1977. It is located in the historic Mount Vernon section of Baltimore, about one mile from the Homewood campus. The Paul H. Nitze School of Advanced International Studies (SAIS) is in Washington, D.C., with centers for foreign study in Bologna, Italy, and Nanjing, China. The one university division that does not offer formal courses is the Applied Physics Laboratory (APL), noted for its contributions to the applied sciences in a variety of research fields. APL headquarters are midway between Baltimore and Washington.

Homewood Campus

The two divisions represented in this catalog—the School of Arts and Sciences and the School of Engineering—are located on a wooded, 140-acre campus of great beauty in a residential area of north Baltimore. Originally the home of Charles Carroll Jr., son of a signer of the Declaration of Independence, the Homewood estate was given to the university in 1902. The Faculty of Philosophy began instruction on the campus in 1915.

While the number of academic programs has grown substantially since that time, the schools of Arts and Sciences and Engineering have managed to maintain a small student body and a low student-faculty ratio. They presently have a combined enrollment of approximately 4,723 undergraduates, 1,663 graduate students, and 225 postdoctoral fellows, and a combined faculty of more than 450.

Thanks to the favorable student-faculty ratio, most upper-level undergraduate and graduate classes are small, giving students an excellent opportunity for advanced training and creative investigation. The large introductory undergraduate classes that students must take before moving on to more advanced work are smaller here than at other universities and are usually taught by outstanding members of the faculty.

Undergraduate students fully participate in the shaping of their own programs, with the help of faculty advisors. The flexibility that is characteristic of Johns Hopkins requires the student to make choices and take responsibility for constructing a course of study that will offer the greatest intellectual rewards and challenges.

The graduate student is expected to master a field of study and demonstrate an ability to do creative research. Departments do not have formal requirements measured in numbers of courses or credits. Each program is planned by the student in consultation with the department or a committee after his/her attainments and areas of interest have been reviewed.

Student Affairs

Homewood Student Affairs supports the university's educational mission by providing a safe, supportive environment in which students are integrally involved with faculty and staff at all levels of the institution. The division is led by the Vice Provost for Student Affairs, who oversees major components within the area. The areas under the Vice Provost's purview include Enrollment and Academic Services, Student Life, and Business Operations and Administrative Services.

The Vice Provost and the areas reporting to the Vice Provost are committed to a student-centered approach and meet both individually and jointly with students to hear their concerns, to support their activities, and to receive feedback on the multiplicity of the division's programs.

The Office of the Dean of Enrollment and Academic Services, located in Mason Hall, is directly responsible for services supporting students' admission, financial aid, and registration, as well as pre-professional advising, career services, and the Office of International Students and Scholars. The Office of the Dean of Enrollment and Academic Services strives to recruit, finance, enroll, register, serve, advise, educate, and graduate a diverse group of students who will be active and contributing members of society. It provides leadership, guidance, and support in the maintenance, development, and evaluation of programs which serve students, parents, alumni, faculty, staff, and trustees, and which contribute to a community characterized by mutual caring, respect, and responsibility.

The Office of the Dean of Student Life is responsible for the co-curricular programs on campus. The dean and her staff are accessible advocates for the individual and group needs of students. On a campus where academic expectations are rigorous, the dean of student life and all her staff strive to provide an atmosphere in which responsive program activities and services for students can flourish. The Office of the Dean of Student Life is located in the Mattin Center, Suite 210. Students are encouraged to stop by to schedule an appointment or to send an email to offer their suggestions or concerns.

The Office for Business Operations and Administrative Services assists the division in the overall fiscal management of student affairs. The office also administers the areas of housing and dining, ID card services, student accounts, and student employment. Additionally, the office oversees the human resources component for the division.

Orientation

An orientation period is scheduled for the four days prior to the start of the academic year. All incoming undergraduates participate in this program. It allows them to get to know other students, faculty, and staff and to learn about academics, support services, and campus life. Specific activities are designed for incoming freshmen and their parents, commuters and transfer students, and international students. Each new student is guided through orientation by a student advisor who serves as a first friend and source of information.

Departmental and faculty advisor meetings, special sessions with the deans, and a variety of informative programs introduce students to their programs of study and to academic expectations, opportunities, and resources. An array of recreational and social events fosters new friendships and acquaints new students with the campus, the neighborhood, and the city.

Entering graduate students normally take part in informal events in their departments during the fall pre-registration period. A mandatory orientation session for all new graduate students is scheduled the Friday morning before classes begin and provides an overview of the variety of campus services available. The Graduate Representative Organization (GRO) sponsors numerous social and educational events and has a website listing information specific to graduate students, **www.jhu.edu/gro**.

Student Activities

Once students are accustomed to the academic schedule, they are encouraged to become involved in co-curricular activities. Leadership opportunities are available through participation in student organizations, which plan and implement social, cultural, recreational, and educational programs for the campus community. Entertainment, including plays, lectures, concerts, and cultural events, abounds in the Baltimore area and on campus.

Information about specific student activities and organizations is available from the Office of Student Activities, 410-516-4873 (Mattin Center, Ross Jones North Building, Room 120), **www.jhu.edu/studentactivities**.

Baltimore

As an urban center, Baltimore has undergone tremendous revitalization in recent years. The city showplace is the Inner Harbor, which has bou-

tiques and cafes, as well as the National Aquarium, the Maryland Science Center, and the Pier 6 Concert Pavilion. Throughout the summer, the city sponsors ethnic festivals of every description. Special resources in cinema are available through the International Film Festival and the Maryland Film Guild. The performing arts in Baltimore range from experimental theater to Broadway hits and from classical symphony to modern rock.

Many of our students enjoy spending time in the surrounding neighborhoods such as Little Italy, Fell's Point, and Hampden. Baltimore is full of historical sites that are often free to visit, or if you are in the mood you can take a boat cruise around the Inner Harbor. For sports fans, the Ravens are a huge draw, and the Orioles have weekly "College Nights" that offer discounted tickets to Hopkins students for every Friday home game.

The Baltimore Museum of Art, which adjoins the campus, is known for its collections of primitive and modern art, as well as its sculpture garden. The collections of the Walters Art Museum in downtown Baltimore represent the span of civilization from Egypt to the 19th century. Many smaller museums, local galleries, and outdoor showings feature local artists. Washington, D.C., with its treasure trove of monuments, museums, libraries, parks, and theaters, is only an hour away.

While Baltimore may not be thought of as a college town, there are 16 other colleges and universities in close proximity to the Homewood campus to enhance a student's academic and social life, with opportunities that range from joint degree programs to intramural sports competitions. The Baltimore Collegetown Network connects college students to numerous resources like restaurants, nightlife, internships, roommate matching services, and local festivals. In addition, Collegetown sponsors a shuttle to places like the Inner Harbor, other colleges, and local shopping centers. The Collegetown website can be accessed at **www.colltown.org**.

Student Centers and Programs

The Levering Union, a multipurpose student center, offers space for relaxation and conversation, diversion, cultural enrichment, a quick snack, or a hot meal. The Levering Union desk sells newspapers and provides general campus information. The Glass Pavilion, the Great Hall, and Arellano Theatre are the sites of a variety of social activities. Levering Union also has a comfortable lobby area with a coffee shop and fireplace, meeting rooms, a new study lounge, and a food court.

The Mattin Center is the location for the Office of Student Activities and the work areas for student groups. It also houses classrooms for the Homewood Art Workshops, the Digital Media Center, the fully equipped Swirnow Theater, 11 individual music practice rooms, two group rehearsal rooms, three meeting rooms, a darkroom, and a dance studio. A café in the theater lobby offers Asian-inspired cuisine and computer terminals for student use. During the early summer, there is a Performing Arts Series of regional professional groups in the Swirnow Theater.

The Hopkins Organization for Programming (the HOP) offers informal programs for relaxation. Just as much fun are the impromptu lacrosse and football games on the campus grounds, ultimate Frisbee games, picnics, and live music.

Graduate students find that their academic and social lives tend to center around their departments. The off-campus apartment buildings and weekend social activities provide ample opportunities for students and their families in different disciplines to meet and enjoy a feeling of community.

Student Organizations

Over 300 student organizations cater to interests including academic and research, advocacy and awareness, community service, cultural, fraternities and sororities, graduate, honor and professional societies, performing arts, publications and journals, religious and spiritual, special interest and hobby, sports, student government, student services and support. For a full list of all Hopkins student groups, go to **http://johnshopkins. collegiatelink.net**. The majority of registered student organizations fall under the Student Government Association (SGA). The SGA is the elected body that meets weekly to serve as the undergraduate voice to the university's faculty and administration. Graduate students are represented by the Graduate Representative Organization (GRO). The GRO sponsors an annual academic symposium and casual happy hours, and publishes a graduate newsletter and handbook. For more information, go to **www.jhu.edu/gro**.

Writing and Publishing

Those interested in writing or publishing can participate in one of our 16 publications. Some examples of our many publications include *News-Letter*, a weekly student newspaper; the *Black and Blue Jay*, a humor magazine; *Thoroughfare*, a digital publication; *East Asian Forum and Review, Film Society*, a publication that discusses film and cinema; or *Zeniada*, a student-run literary magazine.

Performing Arts

Hopkins has a long history of supporting the arts; the Peabody Preparatory School as well as Homewood students take advantage of the many programs that we offer for our performing arts groups. Many of our performing arts students can be found in the Mattin Center practicing their instruments in the practice rooms, or on stage in the Swirnow Theatre. The Band, the Choral Society, and the Gospel Choir are open to all students with an interest in instrumental or choral music. The Hopkins Symphony Orchestra has many student players, and auditions are held each September. A cappella groups, including both co-ed and single gender, are also very popular. For dancers, there is a variety of student groups, each focusing on a specific type of dance. Opportunities to act or direct and produce plays are numerous. The Barnstormers, Witness Theatre, and Dunbar Baldwin Hughes Theater undergraduate groups put on many performances throughout the year, including the ever-popular Freshman One Act Plays in the fall, student-written original plays, and the spring semester musical. Theatre Hopkins, a company under professional direction, performs plays with actors from the university and community.

Cultural and Religious

The 35 cultural groups and 12 religious and spiritual groups represent a wide diversity of Homewood student-sponsored programs, films, concerts, and lectures. Cultural groups include the Chinese Student Association, Black Student Union, Caribbean Cultural Society, South Asian Society of Hopkins, Organizacion Latina Estudiantil, and DSAGA (Diverse Sexuality and Gender Association). Religious and spiritual groups include Agape Campus Ministry, Catholic Community, Hindu Students Council, Hopkins Hillel, Muslim Association, and Hopkins Christian Fellowship.

Special Interest and Hobby

There is a wide range of special interest and hobby groups on campus. These groups include Model United Nations Conference, Foreign Affairs Symposium, and the Woodrow Wilson Debate Council. If you have an interest in sports or recreation, the university offers cycling, soccer, table tennis, numerous martial arts, or the Outdoors Club, just to name a few. For most activities, the only requirement is the initiative to join and the interest to participate. Any full-time student who believes that a new organization is needed can apply to start a new group.

Honor and Professional Societies

Along with various co-curricular activities, Johns Hopkins has organizations to foster academic achievement and recognize students for their accomplishments. In addition to Phi Beta Kappa, which honors scholarship of a high order, there are honor societies in student leadership; sciences, such as chemistry, psychology, and premedicine; drama; language; journalism; engineering; political science; military science; and literary studies.

Special Events and Programs

The university sponsors many events simply for pleasure, including Fall Fest, Homecoming, and the hugely popular Spring Fair weekend. The Hopkins Organization for Programming (HOP) is always looking for volunteers to help plan and implement social, cultural, and educational programs for the Hopkins community.

Shriver Hall Concert Series

Praised by *The Sun* as "Baltimore's finest importer of classical music talent" and five times awarded *Baltimore* magazine's "Best Concert Series," Shriver Hall Concert Series for 46 years has been presenting to Maryland music enthusiasts world-class chamber music and solo recitals by the world's most famous artists. All series subscription events are free to all Johns Hopkins students. For more information, stop by 105 Shriver Hall, call 410-516-7164, or visit **www.shriverconcerts.org**.

Symposia, Lectures, and Seminars

The nationally known Milton S. Eisenhower Symposium has achieved a significant reputation since it began in 1968. Entirely student organized and directed, the symposium explores a different theme each year. Recent topics have included "Global Network," "A Transition Between Generations in a Changing America," and "Finding Our Voice: The Role of America's Youth." The symposium attracts outstanding speakers from all over the world.

The Martin Luther King Jr. and Kennedy lectureships have brought to the campus in recent years such speakers as Coretta King, Thomas Eagleton, Walter Mondale, Joseph Heller, Cornell West, Michael Eric Dyson, C.T. Vivian, and Roger Wilkins. The Black Student Union and the Student Council help plan these lectureships.

Spring Fair

The annual Johns Hopkins Spring Fair is a student-organized event. The three-day fair features a major outdoor arts and crafts exhibition, numerous food booths, and entertainment. Spring Fair is in its 40th year.

Art Workshops

Drawing, painting, photography, and other visual arts courses are offered on a credit basis in the studios of the Mattin Center. Directed by artist Craig Hankin, the workshops are open to all full-time undergraduates without charge. Most classes are geared to students with little or no previous studio experience. Further information is available in the section on Art Workshops (see page 82) and at **www.jhu.edu/artwork**.

Athletics and Recreation

The Department of Athletics and Recreation is responsible for intercollegiate athletics, sports clubs, and the campus recreational programs for students, staff, and faculty. The facilities of the Newton H. White Jr. Athletic Center include a competition-sized swimming pool, numerous basketball and volleyball courts, a wrestling room, a fencing room, and varsity weight training room. The Ralph S. O'Connor Recreation Center facilities include a large multipurpose court for basketball, volleyball, and badminton, racquetball/squash courts, a 30-foot climbing wall, a fitness center for strength and cardiovascular conditioning, an indoor jogging track, and a multipurpose room for group fitness and martial arts training.

The Office of Recreation directs an extensive array of programs for the Hopkins community. The intramural sports program is organized into coed, women's open, men's open, residence hall and Greek divisions. Currently, the sports club program offers competition and instruction in the following groups: badminton, body building, Brazilian jujitsu, capoeira, cheerleading, cricket, cycling, field hockey, golf, men's ice hockey, karate, kung fu, men's and women's lacrosse, men's rugby, men's and women's soccer, women's softball, soo bahk do, swim, taekwondo, table tennis, tennis, men's and women's ultimate, men's and women's volleyball, water polo, and wrestling. Additionally, a fun and social opportunity for fitness is offered through various group fitness classes. Held in the Evans multipurpose room, the group fitness schedule runs year-round and offers a variety of exercise sessions including yoga, step aerobics, muscle conditioning, Spinning, pilates, and others.

The Experiential Education Program oversees Outdoor Pursuits, Hopkins Outdoor Leadership Training (HOLT), Pre-Orientation Outdoor Program, Hopkins Teambuilding, the Outdoors Club, Indoor Climbing Wall, and Bouldering Cave. Outdoor Pursuits runs backpacking, canoeing, climbing, hiking, ice climbing, mountaineering, mountain biking, sea kayaking, and white water kayaking trips. All trips are reasonably priced and can be registered for online at **www.jhu.edu/op**. Hopkins Teambuilding runs interactive initiatives to build stronger teams. Our facilitators have increased the effectiveness of student groups, business classes, sports teams, and professional staff offices.

For undergraduates interested in more competitive activities, the university has 13 varsity intercollegiate teams for men (lacrosse, football, soccer, cross country, basketball, wrestling, swimming, water polo, fencing, baseball, indoor and outdoor track, and tennis) and 11 varsity intercollegiate teams for women (tennis, fencing, swimming, basketball, lacrosse, field hockey, cross-country, indoor and outdoor track, soccer, and volleyball). All the Hopkins sports squads, with the exception of men's and women's lacrosse, play in Division III of the NCAA, and primarily in the Centennial Conference. The men's and women's lacrosse teams are perennial contenders for national honors in NCAA Division I.

Student Services

Living Accommodations

An important element of a Hopkins education is the interchange of ideas beyond the classroom, as students share intellectual, social, and recreational activities with fellow students of diverse backgrounds and interests.

Residence Requirement

The Homewood Schools' freshman and sophomore residence requirement applies to students engaged in their first two years of full-time undergraduate study. Transfer students entering the university with freshman or sophomore status are subject to this same requirement. Since students cannot complete their residence requirement in the middle of the academic year, transfer freshmen entering the university in January must live in the residence halls their entering semester and the following academic year. Transfer sophomores entering in January fulfill the residence requirement by living in the residence halls their entering semester. Exceptions to this policy are made for individuals living at home in the Baltimore area with parents or guardians.

The benefits of the residence requirement are many. It is designed to provide the students with a variety of services and conveniences. Living on-campus supports the academic mission of the university and affords students the opportunity to interact, socialize, and unwind with their classmates.

Campus Residence Halls

Freshmen and sophomores are housed in the campus residence halls or apartments, which are designed to offer far more than simply a room for sleeping and studying. Resident advisors assigned to various wings or floors are available to act as a resource for information, to initiate diverse programs and opportunities for student interaction, and to provide general support in all aspects of residence living. Through representation in the Residence Advisory Board, students are able to plan for a wide range of activities in the student living areas.

The Alumni Memorial Residence complex includes four residence halls: the two Alumni Memorial Residences and Buildings A and B. Each of the Alumni Memorial Residences contains rooms for student activities and study areas. The halls are further subdivided into residence units called houses, which offer coeducational living accommodations. Although the houses maintain their own particular character and name, they are both physically and ideologically a part of the entire residence hall. Single and double rooms are available with shared bathrooms on each floor. Buildings A and B are adjacent to the Alumni Memorial Residences. These buildings offer suites consisting of either a single and a double room or two double rooms, both with shared bath facilities. Both male and female students are housed in the buildings, but suites are assigned on a single-sex basis.

McCoy Hall and Wolman Hall provide suite-style residential living. Approximately 40 students live in each wing of the buildings, sharing a common lounge. These buildings offer suites consisting of either two double rooms or a double and one or two singles, all with shared bath facilities and a small kitchenette. The suites are assigned on a single-sex basis, but the wings are coed. As is the case in the Alumni Residences and Buildings A and B, student amenity space in Wolman and McCoy includes social lounges, study lounges, and student meeting space.

The residence halls are served by one central (all-you-care-to-eat) dining hall. The Fresh Food Café is located between the Alumni Residences and Buildings A and B. Nolan's, in Charles Commons, is a retail dining location, and on the first floor of Wolman Hall is the Charles Street Market. The market is a small grocery/convenience store with an Einstein's Bagel Shop, ready-to-eat foods, and a wide array of produce, frozen, and packaged items. Each residence hall has its own laundry facilities and lounge space. Residence hall rooms are rented for nine months.

Other Sophomore Year Options and Upperclass Housing

In their sophomore year, and as upperclassmen, students may also have the opportunity to choose space in Charles Commons or the university apartments. Charles Commons is the newest residential facility housing over 600 students in suites with two or four single rooms and one or two bathrooms. There are kitchenettes in each unit with a sink, refrigerator, and two-burner stove top. All of the four-bedroom suites and some of the two-bedroom suites have a living room. There is ample community space in Charles Commons including a community kitchen, exercise room, numerous study rooms, meeting rooms and lounges, music rooms, computer cluster, laundry room, and game room. In addition to the large dining facility (Nolan's), Charles Commons houses the university bookstore. Both nine- and 11-month contracts are offered in Charles Commons. The Bradford and Homewood apartments offer modern living facilities in an area of older apartment buildings next to campus. Homewood and Bradford apartments range in size from efficiencies to four-bedroom units. All of these buildings offer wall-to-wall carpeting, air conditioning, and wiring for cable TV and Internet. All utility costs and Ethernet connections are included in the rent. In the multiple-occupancy units, students are financially responsible only for their own space; the Housing Office fills any vacant spaces.

The Homewood apartment building houses approximately 220 undergraduate students and the Bradford houses approximately 150 undergraduate students. Each building is conveniently close to the campus. The Homewood also houses a number of university offices, the Student Health and Wellness Center and the Counseling Center, and space for student-oriented retailers. University housing affords students the opportunity to establish residence without having to rent through a commercial landlord. The apartment buildings are fully furnished and offer 11-month contracts only. The apartments contain a private bedroom for each occupant, plus a common living room, kitchen, and bath(s). Furniture includes a bed, desk, chest of drawers, mirror, sofa, table, and chairs. All university housing is maintained by the university's Maintenance Department and patrolled by Campus Security.

Off-Campus Housing

After sophomore year, some students choose to participate in the room selection process to remain in university housing while other students find suitable non-university housing in the area surrounding the university. Available housing ranges

from row houses subdivided into apartment units to high-rise buildings where individual apartments are available for a student alone or for groups of students. Rental accommodations vary in price and range from single rooms to houses.

The Off-Campus Housing Office provides comprehensive services to upperclass students looking for off-campus housing. Up-to-date listings are available on various types of living accommodations, and referral services and lease information are provided. Students are able to locate housing from a distance by visiting the Off-Campus Housing website at **www.jhu.edu/~hds/offcampus /index.html**.

Housing Information

Further information on the Alumni Memorial Residences I and II or Buildings A and B can be obtained from the Housing Office in the Alumni Memorial Residence II, 3400 N. Charles St., Baltimore, MD 21218, 410-516-8282. Information on Wolman, McCoy, Charles Commons, Homewood, Bradford or off-campus housing can be obtained from the Housing Office in Wolman Hall, 3339 N. Charles St., Baltimore, MD 21218, 410-516-7960.

Homewood Campus Dining and Vending Services

Dining Options

Homewood campus dining options reflect the diversity of our community, and have been designed to provide quality, variety, and convenience. Many dining choices abound—from early morning each day until the wee hours of the next—as there's always a convenient dining option just steps from wherever you may be on campus.

Freshman Dining at the Fresh Food Café (FFC)

Considered a fundamental element of the freshman experience, communal dining at the Fresh Food Café provides freshmen with a number of dining choices all under one roof in a comfortable, congenial environment. Fresh, seasonal, and locally sourced ingredients are the foundation of every meal served at the FFC.

Fresh Food Café Stations include:

- A self-serve deli featuring Boar's Head brand meats, house-made premium salads, a selection of premium cheeses, and a variety of artisanal breads;
- A char grill offering chicken breast, sirloin burgers, Hebrew National brand hot dogs, and an ever-changing offering of daily specials;

- An extensive salad station featuring a bounty of fresh, seasonal fruits, vegetables, and toppings;
- A dedicated grill at the salad station provides guests with daily variety of grilled salad toppers including vegetables, fish, shellfish, poultry, and beef;
- A homestyle station providing hot, homestyle entrees including hand-carved meats, made-from-scratch soups and farm-fresh vegetables;
- A hearth station baking pizzas, pastas, and calzones;
- A separate and distinct vegan and vegetarian station offering made-to-order stir fry specials, baked casseroles, and soup;
- A dessert island offering fresh fruits and berries, cakes, cookies, pies, and ice cream;
- A dazzling variety of beverages, both cold and hot, including soy milk, rice milk, lactose-free milk, cappuccino, no-sugar-added juices, sodas, teas, and of course, pure filtered water.
- Taam Tov, the university's Star K certified kosher servery, provides a wide array of tempting, wholesome kosher meals.

Beyond the culinary, the dining experience at the Fresh Food Café includes a 510-seat dining room furnished with bamboo tables, comfortable maple seating, indirect lighting, and a light contemporary color scheme.

Nolan's at Charles Commons: The New Campus Living Room

Named in honor of the contribution made to the university by the David Nolan Family, this campus eatery is located on the third level of the university's Charles Commons complex. Nolan's has quickly become a favorite dining, meeting, and social space for students.

Both the dining room and menu options at Nolan's were conceived and designed as upscale and sophisticated—with the dining room featuring high banquettes and intimate, comfortable seating while the menu features the freshest premium ingredients each season has to offer.

Those premium ingredients result in unparalleled quality and variety with a variety of options. In addition to retail dining, Nolan's includes ample soft seating, a two-sided cozy fireplace, a private dining room accommodating groups up to 40, a performance stage, two pool tables, and a balcony for seasonal al fresco dining.

Levering Food Court and Pura Vida Coffee: The right place at the right time

The Levering Food Court provides a variety of lunchtime dining options right in the middle of campus. Stations include:

Levering Leaves—a tossed-to-order salad station with the freshest veggies of the season;

Peppercorn Grill—burgers, both traditional and veggie; chicken, fries, onion rings, and more;

Bella Gusta Pizza—piping hot pizza, calzones, and crispy-farm fresh salads;

Savory Deli— Great subs made with Boar's Head brand meats, cheeses on artisanal bread;

Grab and Go—for those on the run, sandwiches and snacks ready to just grab and go;

Pura Vida Coffee—100% organic shade grown coffees in many flavors, tempting pastries, grab and go sandwiches and salads.

The Charles Street Market

From gluten-free pasta to kosher salami to hand-rolled sushi, the Charles Street Market at Johns Hopkins University has everything the campus community could ever need or want.

Developed, designed, and built to serve a diverse university population, the Charles Street Market provides the campus community with an unending variety of fresh produce, grocery items, frozen foods, and health and beauty aids. Also, a special "Hot & Not" section offers both hot, ready-to-enjoy meals and an extensive chilled salad bar. And last, but not least, a made-to-order submarine sandwich station turns out great subs and sandwiches all day long. Located in the university's Wolman residence hall, the Charles Street Market provides customers with unprecedented convenience, variety, and quality. Operating from early morning to late night, the JHU campus community now has a retail store befitting the Johns Hopkins name. In addition to the variety of items offered, the Charles Street Market is home to Einstein Bros. Bagels, offering a selection of freshly baked bagels, pastries, sandwiches, salads, and the best coffee around.

Please note:

- All freshmen are required to participate in a campus meal plan
- All Students who enroll in a meal plan do so for the entire academic year.
- Students will be allowed to change meal plans during well-publicized specified change periods twice each academic year.
- Dining Dollars can be used in JHU Dining by Aramark facilities and are non-taxable.

- Additional Dining Dollars can be purchased in $200 increments at any time throughout the year.
- Dining Dollars can only be purchased by meal plan participants.

Vending Services

With more than 40 locations throughout the Homewood campus, vending is available in virtually every major building. Bottled water, juices, and other soft drinks are available in addition to a wide variety of snacks. *JCard (some locations), $.*

Questions?

Contact Housing & Dining Services, 410-516-3383 or at **www.dining@hd.jhu.edu**.

Campus Ministries

JHU Campus Ministries, located in the Bunting-Meyerhoff Interfaith and Community Service Center, promotes and supports spiritual development, theological reflection, religious tolerance, and social awareness within the university community. A collaborative effort of the university chaplain and the Campus Ministries staff, the denominational campus ministers, and the student-led Interfaith Council, JHU Campus Ministries seeks to enhance the spiritual and ethical educational experience of the whole person—mind, body, and soul. It offers prayer services, religious reflection series, and interfaith education and dialogue opportunities, as well as special community and fellowship events. Further information may be obtained by calling 410-261-1880, by visiting our website **www.jhu.edu/~chaplain**, or by stopping by the center at the corner of University Parkway and North Charles Street.

Disability Support Services

Johns Hopkins University is committed to recruiting, supporting, and fostering a diverse community of outstanding faculty, staff, and students. As such, Johns Hopkins does not discriminate on the basis of gender, marital status, pregnancy, race, color, ethnicity, national origin, age, disability, religion, sexual orientation, gender identity or expression, veteran status, or other legally protected characteristics in any student program or activity administered by the university, or with regard to admission or employment. Questions regarding Title VI, Title IX, and Section 504 should be referred to the Office of Institutional Equity Programs, 130 Garland Hall, 410-516-8075, 410-516-6225 (TTY).

A person with a disability is defined by the Rehabilitation Act of 1973 and by the Americans with Disabilities Act of 1990 as an individual who has a

physical or mental impairment that substantially limits one or more major life activities, has a record of such an impairment, or is regarded as having such an impairment. Persons with disabilities who are interested in receiving accommodations from the university must provide the university with a comprehensive evaluation of the disability in question from an appropriately qualified diagnostician. This evaluation must: (a) identify the type of disability, (b) describe the current functional impact of the disability in an academic or employment setting, and (c) list recommended accommodations for this setting. All individuals seeking accommodations are encouraged to make an appointment with an appropriate staff member (see below) at least two weeks prior to the start of the semester to ensure that accommodations are provided in a timely manner.

Full-time undergraduate and graduate students in the Krieger School of Arts and Sciences or the Whiting School of Engineering with questions and concerns regarding physical and programmatic access, specific campus accommodations, resolution of complaints and problems, and identification of other support services, should contact:

Dr. Brent Mosser, Director
Academic Support and Student Disability Services
bmosser1@jhu.edu
410-516-4720
web.jhu.edu/disabilities

All others with questions and concerns regarding physical and programmatic access, specific campus accommodations, resolution of complaints and problems, and identification of other support services should contact:

Peggy Hayeslip, Director,
ADA Compliance and Disability Services
Office of Institutional Equity
phayeslip@jhu.edu
410-516-8949 (voice), 410-516-6225 (TTY)

Student Health and Wellness Center

The Student Health and Wellness Center (SHWC), located in the Homewood Apartment Building at 3003 N. Charles (N200, 2nd floor, entrance on 31st street), provides comprehensive, confidential health services to students enrolled in the schools of Arts and Sciences and Engineering. Staffed by clinicians (physicians and nurse practitioners) credentialed through the Johns Hopkins Hospital, the SHWC offers the following services: management of acute and chronic illnesses, laboratory testing, reproductive health care for women and men (contraceptive counseling, emergency contraception,

gynecologic care, and testing for sexually transmitted infections including HIV), health education, and international travel consultations (including immunizations). A part-time nurse midwife is also on staff. Allergy shots are offered by appointment. Services rendered within the Health Center are free of charge; there is a charge for prescription medications purchased from our pharmacy service and for some medical supplies (crutches, wrist splints, etc).

When necessary, students are referred to an extensive network of community-based and Johns Hopkins specialists. A limited pharmacy service is available to students who receive their health care directly from SHWC staff. During the academic year (freshman move-in to May), the center is open Monday through Friday and on Saturday mornings; complete hours are listed on the SHWC website (**www.jhu.edu/studenthealth**). We encourage students to schedule appointments when possible (410-516-8270) but students with acute problems can almost always be seen the same day through our same day appointment system. After hours advice (for use when the center is closed) is provided by a nationally certified nurse triage system. This system can be accessed through the University Security Office (410-516-4600); students will need their six character alphanumeric JHU ID to confirm their student status when calling. Our website www.jhu.edu/studenthealth contains up-to-date information on our services and policies and on a wide variety of health topics. The SHWC is a "Safe Place" for all students regardless of race, ethnicity, gender, or sexual orientation.

Center for Health Education and Wellness (CHEW at JHU)

The Center for Health Education and Wellness (CHEW), a subdivision of the Student Health and Wellness Center, promotes and supports a healthy campus community by focusing on risk reduction and prevention initiatives. CHEW at JHU is your leading source for health information and programs to support a healthier JHU community. The *CHEW CREW* of health promotion professionals and trained student volunteers is dedicated to make the most of teachable moments to influence student health practices. Their vision is to create and sustain a learning environment where healthy behaviors are an integral component of academic and individual success.

CHEW provides programming and health promotion on college health issues such as stress management, alcohol and other drugs, sexual health, nutrition, physical activity, and sleep management

to foster and promote a healthier JHU community. The *CHEW CREW* offers a variety of programs that promote and affirm student health and wellness through the delivery of fun and interactive programming. CHEW student groups include the Stressbusters, PEEPs (peer health education), and Hopkins Kicks Butts, an anti-tobacco coalition.

Information on programming, resources, and individual consultation may be obtained by calling 410-516-8396, stopping by the office in Levering Hall, Suite 115, or on the Web at **www.jhu.edu/health**.

Counseling Center

Mission
The mission of the Counseling Center is to facilitate the personal growth and development of full-time undergraduate and graduate students enrolled in the Krieger School of Arts and Sciences, the Whiting School of Engineering, the Peabody Conservatory of Music, and the Post-Baccalaureate Premedical Program. The counseling services and outreach programs offered are designed to enhance the personal and interpersonal development of students and to maximize students' potential to benefit from the academic environment and experience. The Counseling Center also strives to foster a healthy, caring university community, which is beneficial to the intellectual, emotional, and physical development of students.

Individual Counseling Services
The Counseling Center offers brief individual therapy and group counseling services to eligible students free of charge. Severe emotional problems are not a prerequisite for coming to the Counseling Center. Students may avail themselves of counseling services for personal growth and enrichment. All eligible students are encouraged to utilize the services offered by the center. Some typical concerns that might lead a student to contact the Counseling Center are:

- Feeling overwhelmed/having difficulty coping
- Difficulties in interpersonal relationships
- Academic anxieties and pressures
- Problems with family members
- Inability to make decisions
- Loneliness or depression
- Grief over death or loss
- Concerns about sexuality
- Problems adjusting to college life
- Alcohol/drug concerns
- Eating disorders, weight control
- Desire to understand and feel better about oneself

- Motivational or time management problems
- Concerns relating to career direction

Students who come to the Counseling Center for counseling will meet individually with a professional staff member to determine which center services may best suit their needs. Individual counseling sessions generally occur once a week and last 50 minutes. The number of sessions per student per year is almost always limited to less than a semester.

Psychotropic Medication
In the event that psychotropic medication may be indicated, a consulting psychiatrist is available to evaluate the student and prescribe and monitor medication, upon referral by a Counseling Center staff counselor. Students can meet with a Counseling Center consulting psychiatrist only if they are in ongoing treatment with a Counseling Center staff counselor. If more extensive, more accessible, or more specialized psychiatric care is needed than the psychiatric consultant can provide, the Counseling Center will help you find a private psychiatrist who can meet your needs.

Group Services
Each semester a variety of counseling groups, support groups, and skills-building groups are offered. Counseling groups might be thematic such as "Substance Abuse Education and Recovery," "Parent Loss," or "Survivors of Sexual Abuse," or more general, such as a "Personal Growth" group. Groups usually meet for 75 to 90 minutes weekly, and may run for a few weeks, a semester, or longer.

Workshops/Outreach Programs
Workshops are offered each semester to enhance personal growth and development. Examples of workshops are 'Assertiveness Training' and 'Stress Management'. Additional programming is available to residence halls and to other organizations and departments on campus that deal with student life issues.

Referral
If a student's needs can be better met by another agency or person, the student is referred, on a voluntary basis, to that resource.

Confidentiality
All contacts in the center are strictly confidential (no information is released on or off campus without the student's prior written authorization), and all therapy, counseling, and referrals are strictly voluntary. However, there are some situations in which the Counseling Center is legally obligated to disclose information or take action to protect

you or others from harm. Please note that exceptions to confidentiality are extremely rare. If they should occur, it is the Center's policy that, whenever possible, we will discuss with you any action that is being considered.

Counseling Center Staff

The Counseling Center is staffed by licensed, professional psychologists, consulting psychiatrists, and social workers. Services are also provided by advanced doctoral students in professional psychology who work under the supervision of senior staff.

Appointments

Students desiring Counseling Center services can make appointments in person at 3003 N. Charles Street, S200, or by telephone at 410-516-8278. In addition, a professional staff member is on duty each day for immediate assistance in case of an emergency. Further information about our services can be found at **www.jhu.edu/counselingcenter**.

Career Center

The Career Center is actively involved in assisting students as they explore potential careers. In the Career Center, students of all class years receive individual guidance as they clarify their career directions, explore their career options, seek internships, or search for opportunities. Career workshops teach students how to conduct an effective job or internship search, create job and internship search documents (resumes and cover letters), develop interview skills, and gain effective networking and search strategies. Intersession trips offer students an in-depth view into industries and organizations. Additionally, the Career Center offers vocational assessments that are designed to assist students with translating a major into a career choice.

The center's resources include a career library, extensive online job and internship offerings, and on-campus recruiting. Annual job and internship fairs bring representatives from business, industry, government agencies, and nonprofit organizations to campus.

The center also emphasizes the importance of interacting with alumni. Students may access a nationwide database of graduates who stand ready to offer career information. The "Breaking Into…" series, the Engineering Career Night, and a range of career panels bring Hopkins graduates back to campus to discuss career opportunities and trends in a broad range of fields.

Information is available at **www.jhu.edu/careers**, by calling 410-516-8056, or by stopping by the office on the third floor of Garland Hall.

Student Employment Services

Working while attending college is among the most universal experiences of college students, and we are proud to say that the JHU Office of Student Employment Services sets the standard. Located in Garland Hall, Student Employment Services plays an intricate role in the student's career development and academic achievements while helping to ease his or her financial demands.

The student employment program provides students the opportunity to apply their academic learning while developing professional skills in real work settings. The office offers a multitude of part-time work and career experiences year-round. Positions range from Research Assistant at JHMI to Web Manager at a local library; from Lab Assistant in Arts & Sciences to Tutoring a local elementary school student. For students who want to work within the community, Student Employment Services works with area businesses to develop student job opportunities in a variety of fields in and around the Baltimore area.

The office offers a comprehensive website where, among other things, students can search for a job, create an online application, download tax forms, view their pay stubs, and print their W-2 form. Annually, the Office of Student Employment Services hosts a Campus Job Fair and National Student Employment Week celebration.

For more information about Student Employment visit **www.jhu.edu/stujob** or call us at 410-516-8421.

Office of Multicultural Affairs

The primary goals for the Office of Multicultural Affairs (OMA) are to enhance the educational experience and success of students of color and support the University's efforts to promote diversity. OMA achieves these goals by providing direct services to students and collaborating with members of the University and Baltimore communities to create an inclusive campus environment.

OMA's specific programs and services include (but are not limited to) the following:

• Peer Mentoring Program
• Student Diversity Educators
• Student Leadership Programs and Opportunities
• Cultural Programs
• Study Abroad Opportunities
• Advising for Multicultural Student Organization
• Individual consultation and referrals as needed

Multicultural Affairs Student Center (MASC): The MASC is a place where all members of the university community can participate in academic and social events in a relaxed environment. The MASC also provides meeting rooms for campus offices and student organizations. Residents of the MASC include several of the university's multicultural student organizations and the Office of Multicultural Affairs.

Contact information for OMA and MASC
3303 North Charles Street, Suite 100
Phone: 410-516-8730
Website: **web.jhu.edu/studentprograms/ multicultural/**

Office of International Student and Scholar Services

The Office of International Student and Scholar Services (OISSS) assists students, fellows, researchers, and faculty who are citizens of other countries and are in the United States for a designated period of time for study, research, or teaching purposes. The office aids international visitors in maintaining their non-immigrant status while at the university. All international students, fellows, researchers, and faculty are required to contact the OISSS immediately after their initial arrival on campus, and before leaving the United States for any reason. International visitors are invited to contact the office at any time for information on immigration policies and for any problems or concerns that may arise. The office is located at 135 Garland Hall. Information can be obtained by calling 410-516-1013, by email: theworld@jhu.edu, or on our website at **ww2.jhu.edu/isss/**.

Admissions and Finances

Undergraduate Admission

Every year The Johns Hopkins University enrolls a freshman class of approximately 1,250 men and women from all parts of the United States and many foreign countries. In addition, transfer students from other colleges and universities are admitted to the sophomore and junior classes.

Intellectual interests and academic performance are of primary importance in the admissions decision. The Admissions Committee carefully examines each applicant's complete scholastic record and aptitude test results. Essays and recommendations from secondary school officials and other sources about a student's character, intellectual curiosity, seriousness of purpose, and range of extracurricular activities and leadership are also considered.

Campus Visits

Because a visit to the campus is an important step in the process of determining where a student should begin his/her undergraduate studies, the Admissions Committee encourages students to see the Homewood campus and take advantage of the opportunity to speak with students, faculty, and members of the Admissions staff.

Information on undergraduate admission to Johns Hopkins can be located on the web at **http://apply.jhu.edu**.

Interviews

Interviews are not required for admission, but they can be a helpful way for applicants to learn more about Johns Hopkins. On-campus interviews are scheduled by appointment only on weekdays between 9 a.m. and 3 p.m. throughout the year with some exceptions during the university holiday season and the month of January. Students should request on-campus interviews at least two weeks in advance, and may check availability, by visiting **http://apply.jhu.edu/visit/interviews.html**. On-campus interviews are conducted by a member of the Admissions staff or by a student Admissions representative. National Alumni Schools Committees have been established in many parts of the United States to assist the Admissions Committee by interviewing students who have applied for freshman admission. For information about off-campus alumni interviews, visit **http://apply.jhu.edu/visit/aluminterviews.html**. Off-campus interviews are for high school seniors only and can be requested during the fall semester.

Information Sessions

Information sessions provide an opportunity for prospective students and their families to learn about the university. They are conducted by a member of the Office of Undergraduate Admissions or a student Admissions representative. These sessions are held Monday through Friday throughout the year and on selected Saturdays in the fall. Special Saturday Hopkins Preview programs in the summer offer an extended two-hour information session and a campus tour. Information about dates and times can be obtained from the Office of Undergraduate Admissions and the website.

Campus Tours

Tours of the historic Homewood campus are conducted by the Blue Key Society, a voluntary organization of undergraduates. Tours are offered on weekdays during most of the school year and summer, as well as on selected Saturdays in fall. Tours are not offered during examination or vacation periods, but students are welcome to visit the campus at any time. Information about dates and times can be obtained from the Undergraduate Admissions Office and the website.

Open Houses and Overnight Visits

Special Open House programs are offered in the fall. Seniors participating in an Open House program may have the opportunity to spend an overnight visit with a student host the evening before an Open House. Space is limited, and online reservations are required.

Placement and Standing

Advanced Placement Program

Johns Hopkins participates in the Advanced Placement Program conducted by the College Board and grants academic credit for scores of 4 or 5 (or, in some cases, 3) on certain Advanced Placement (AP) examinations. Students who take any AP examinations should have the results forwarded to the Undergraduate Admissions Office. For an updated list of credits awarded for a particular AP examination, please visit **http://apply.jhu.edu/apply/apib.html**.

International Baccalaureate Placement

Students may receive college credit for higher level International Baccalaureate (IB) courses if they attain IB grades of 6 or 7 for some subjects. For an updated list of credits awarded for a particular IB course, please visit **http://apply.jhu.edu/apply/apib.html**.

Students who obtain grades of A or B on G.C.E. Advanced Level exams are eligible for credit commensurate with the comparable course at Johns Hopkins. International curriculum students interested in receiving credit for other advanced-level studies may have their work evaluated by the appropriate academic departments.

Please note: In addition to allowable credits from AP or IB higher-level exams, entering freshmen may transfer up to 12 credits from course work taken at other colleges. If a student enters the university with AP or IB credits for a specific course and then takes an equivalent course offered by the university, his or her AP or IB credits are disallowed.

Application Procedures for Freshmen

Applications for admission to the freshman class must be filed by November 1 for Early Decision (ED) and January 1 for Regular Decision (RD). The applicant should also arrange to take the required standardized tests by the October test date (ED) or the December test date (RD).

Additional application information and required forms can be found at **http://apply.jhu.edu/ apply/application.html**. The Common Application and the Universal Application are both accepted; a Johns Hopkins Supplement is required for both. The completed application should be submitted with a nonrefundable $70 application fee. If applicable, a College Board fee waiver certificate must be submitted with the application. The university will also consider requests written on high school letterhead by counselors.

Early Decision applicants are notified of their decision by December 15, Regular Decision applicants by April 1. Those who have applied for financial assistance will be notified of financial aid decisions at that time. Students must notify the Undergraduate Admissions Office of their intention to enroll and submit a nonrefundable $600 enrollment and housing deposit by the Candidate Reply Date of January 15 for Early Decision and May 1 for Regular Decision.

Please note this important policy: Students wishing to enroll in the biomedical engineering (BME) major must indicate BME as their first-choice major on their applications. Students are admitted specifically into the BME major, based on evaluation of credentials and space available. Students can be admitted to the university without acceptance to the BME major. No separate application is required. Notification of acceptance into the BME major is given at the time of decision notification. A limited number of transfer majors for matriculated students may be available through the Biomedical

Engineering Department at the close of each academic year. (For more information, see Biomedical Engineering, page 409.)

Secondary School Preparation

Applicants are responsible for seeing that all supporting materials, including two recommendations and a complete transcript of work in high school, are submitted to the Office of Undergraduate Admissions by the appropriate deadline. The Midyear School Report is also provided in the application materials and must be returned by February 15 with the first-semester/trimester grade record. See all requirements at **http://apply.jhu.edu/ apply/deadlines.html.**

Johns Hopkins does not have rigid course requirements for entrance. Students are expected to have completed a course of study in a secondary school that provides both a sound basic education and a solid preparation for the Johns Hopkins academic program. While the university recommends a broad preparation in high school, the Admissions Committee realizes that individuals have different strengths and welcomes applications from students with varied academic backgrounds. The quality of course preparation is considerably more significant than the number of courses completed. In all cases, students are expected to be skilled in the use of the English language (including writing) and to have a solid foundation in mathematics.

A candidate's preparation should also reflect strengths in his/her particular areas of academic interest. Students in the humanities should acquire a strong background in composition, literature, and history. Students interested in the social and behavioral sciences should have as much preparation as possible in history and social studies. Students planning to concentrate in engineering, mathematics, or the natural sciences should take as much mathematics as possible, including calculus.

Standardized Testing

All freshman applicants must submit scores from all SAT tests (including subject tests) taken or all ACT tests taken; the Office of Undergraduate Admissions strongly recommends taking standardized tests by October for Early Decision applicants and December for Regular Decision applicants. Results of tests taken before the senior year are acceptable. The applicant must request that an official report of all required test results be sent to Johns Hopkins from the Educational Testing Service or ACT Inc.

The SAT Reasoning Test or the ACT with Writing Test is required. For those submitting SAT scores, Johns Hopkins recommends submitting

SAT subject test scores and, if submitted, requests the results of three.

Students who choose to take SAT subject tests are recommended to take tests in areas directly related to their academic interests. Applicants interested in an engineering major are strongly encouraged to submit scores from the Mathematics Level 2 SAT subject test, at least one science SAT subject test, and one other SAT subject test.

Early Decision Plan

Students whose first choice is Johns Hopkins are encouraged to apply under the Early Decision Plan. Each year, more than 30 percent of the university's entering freshmen have taken this option. Students may apply under Early Decision to only one college or university. To do so at Johns Hopkins, they must file their application by November 1, signing the Early Decision Agreement with their parents and counselors. Candidates should take the required standardized tests no later than the October test date. (While students applying Early Decision to Johns Hopkins may not apply early decision elsewhere, they may apply under early action or regular decision plans to other colleges or universities.)

Early Decision candidates receive notification by December 15. Students accepted under Early Decision must notify the Undergraduate Admissions Office of their intention to enroll and submit a nonrefundable deposit by the Candidate Reply date of January 15. Accepted Early Decision candidates must immediately withdraw their applications to other schools.

Students who are accepted ED and qualify for assistance will receive an estimated aid offer along with their acceptance packets. This offer is based on information submitted on the College Scholarship Service PROFILE form.

A final aid offer will follow in the spring, pending receipt of the student's Free Application for Federal Student Aid (FAFSA), and the student's parents' prior calendar year federal income tax returns. In the unlikely event that information on the FAFSA and tax returns varies significantly from original estimates, the financial aid package could change.

Some students who are not admitted Early Decision are deferred and re-evaluated as Regular Decision candidates. The Admissions Committee can also deny admission at the ED review.

Early Decision applicants who applied to but were not admitted to the BME major are released from the Early Decision contract to enroll at Johns Hopkins and may apply to other colleges but must make a decision about enrollment at Johns Hopkins University and return their Candidate Reply Form to the Office of Undergraduate Admissions by January 15.

Deferred Entrance Option

The deferred entrance option is designed to give students a chance to take a break in their studies. Some students benefit from a change of pace between high school and college. To let students take full advantage of work and travel opportunities, the university allows some students to defer their entrance into the freshman class for one year or, in certain cases, two years, after graduation from high school. Requests for deferment are evaluated and approved on an individual basis. Students seeking deferrals must notify the dean of undergraduate admissions of their intention to defer entrance as soon as possible and submit the nonrefundable deposit by the Candidate Reply Date. Students who take advantage of this option can enter the university only in the fall semester. They must confirm in writing, by February 15, their intention to enroll the following September and must submit all required financial aid applications by that date.

Admission of Transfer Students

Each year a number of highly qualified students from other colleges and universities are accepted into the university's sophomore and junior classes. Decisions on transfer applications are usually announced in May. Applicants should show evidence of strong academic preparation in courses comparable to those offered at Johns Hopkins, and above-average performance (at least a B+ average) in college. Consideration is also given to the availability of space in the university's academic programs; there are times when additional students cannot be accepted in specific programs. Applicants to the Whiting School of Engineering should have a solid curriculum background in science and engineering to assist them in the transition to Johns Hopkins. In addition to the application and nonrefundable application fee of $70, applicants must submit official transcripts from all secondary schools and colleges they have attended and a letter of recommendation from a professor or academic counselor. Official results of the SAT or ACT are not required for transfer admission. For full requirements and deadlines, visit **http://apply. jhu.edu/apply/faq_transfer.html**.

Advanced Standing for Transfer Students

The Office of Academic Advising or the Office of Academic Affairs will make a formal evaluation of credit accepted toward a Johns Hopkins degree after the transfer student has been accepted and final transcripts have been received. Credit is nor-

mally transferred for courses comparable to those offered at Johns Hopkins that have been completed with grades of C or better, when taken at another college or university campus. While every effort is made to evaluate this course work realistically, there are cases when students have not covered the same material as is covered in similar courses at Johns Hopkins. These courses cannot be applied to requirements of a particular department. All transfer candidates should be familiar with the four-semester residence requirement for a degree from Johns Hopkins. Candidates for the bachelor's degree must complete a minimum of 60 semester hours in the School of Arts and Sciences or the School of Engineering, regardless of the number of credits accepted from other colleges. (See Credit and Residence Requirements, page 43.)

Admission of International Students

Johns Hopkins welcomes students from all around the world, and each year accepts international students from many different countries. The application for admission, along with the nonrefundable $70 fee, must be received by the November 1 deadline for Early Decision candidates and the January 1 deadline for Regular Decision candidates. Each candidate is also responsible for ensuring that all supporting materials, including an official transcript of academic work for the years equivalent to the 9th, 10th, 11th, and 12th grades in the U.S. system, are sent directly to the Office of Undergraduate Admissions by the appropriate school official. If the transcript is in another language, it must be accompanied by an official English translation, certified as a true copy by the proper school official. Two letters of recommendation in English or with an English translation are also required.

International students seeking to transfer to the university must submit the application with fee by the deadlines noted above under Admission of Transfer Students.

An international candidate who is pursuing the G.C.E. Advanced Level studies, the French Baccalaureate, the Abitur, the International Baccalaureate, or any similar program, but who has not begun studies at the university level, is considered for admission as a freshman applicant. A candidate who has begun, but not completed, university-level studies is considered for admission as a transfer applicant.

All international students must submit the Certification of Finances form, available online at **http://apply.jhu.edu/apply/application.html**. While international students are ineligible for federal financial aid at the undergraduate level, Johns Hopkins does provide limited need-based financial assistance. Visit **www.jhu.edu/finaid** for details.

All international candidates must arrange to take and have official scores for the ACT or SAT sent directly to the Office of Undergraduate Admissions. Freshman candidates taking the SAT are encouraged to also submit scores for at least three SAT subject tests.

The Test of English as a Foreign Language (TOEFL) is required of all applicants who do not speak English at home AND have not attended an English-language school for five years or longer. All other international applicants are not required to submit TOEFL scores but may do so to supplement their applications.

Johns Hopkins prefers a score of 600 on the written test. The preferred sub-scores for the Internet-based TOEFL (iBT) are 26 (Reading), 26 (Listening), 22 (Writing), and 25 (Speaking). A score of 670 or higher on the Critical Reading section of the SAT Reasoning Test waives the TOEFL requirement for all students.

Test results must be sent to us directly from the testing agency. We cannot accept photocopies of test scores.

Graduate Admission

The Graduate Affairs and Admissions Office is available to answer questions about the graduate application process, respond to general admissions inquiries, and assist with requests for information. For more information, please visit **www.grad.jhu.edu**.

Campus Tours
The Graduate Affairs and Admissions Office offers campus tours to prospective graduate students, postdocs and faculty. Tours begin at Mason Hall on the Homewood campus. Each tour, guided by a current graduate student, lasts one hour. A schedule of tours can be found at **www.grad.jhu.edu/admissions/visit**.

General Admissions Checklist
Please visit **www.grad.jhu.edu/academics/programs** for specific departmental requirements.
- Application
- Application Fee ($75)
- Statement of Purpose
- Transcripts
- Letters of Recommendation
- GRE Scores
- TOEFL or IELTS
- Samples of Work
- Financial Assistance

- Applied Mathematics: Supplementary Application Form
- Chemical Biology: Supplementary Application Form
- Humanities: Supplementary Application Form
- Statement of Financial Resources

Application

Our online application is designed for admission to full-time graduate study in the schools of Arts and Sciences and Engineering only. Students applying to more than one program must submit separate applications. The application is available at **www.grad.jhu.edu**.

All application documents must be provided in English (either the original or translations of the original documents). English translation services are available at World Education Services.

Application Policy

Accuracy is expected in all documents provided by applicants. Applicants for full-time graduate admission must not make inaccurate statements or material omissions on their applications, nor submit any false materials related to or in connection with seeking admission. Violation of this requirement may result in official background checks or the application being rejected. If a violation is discovered after an applicant has been admitted but prior to matriculation, admission may be rescinded. If a violation is discovered after a full-time graduate student has registered, the case will be reviewed by the Vice Dean of Graduate Programs for the Krieger School of Arts and Sciences or the Vice Dean of Academic Affairs for the Whiting School of Engineering, who will determine what action is to be taken, up to and including dismissal from the University. If the discovery occurs after a degree has been awarded, the University may revoke the degree and/or take other appropriate action.

Applications and supporting documents for graduate admissions to The Johns Hopkins University Krieger School of Arts and Sciences and the Whiting School of Engineering become the property of the university. The university does not return documents to applicants, nor does it forward documents to third parties. Applicants who anticipate a need for documents submitted to the university are advised to retain photocopies or to obtain duplicate copies.

Application Fee

A nonrefundable fee of $75 is required for each application to the Krieger School of Arts and Sciences and the Whiting School of Engineering, with the following exceptions: the departments of Civil Engineering, Computer Science, Mechanical Engineering, Chemical and Biomolecular Engineering, and the Information Security Institute charge a non-refundable $25 application fee. Materials Science and Engineering waives the application fee for U.S. citizens and U.S. permanent residents. (Application fees are subject to change.)

Payment may be made online via Visa, Mastercard, or Discover. Wire transfers are also an option.

Statement of Purpose

The statement of purpose should articulate and demonstrate an applicant's specific qualifications for a program of study. Programs are interested in an applicant's intended course of study, why that applicant wishes to pursue that field, what research or academic experience the candidate will bring to Johns Hopkins University and finally, what that applicant's end goal might be once their work is completed.

In lieu of the Statement of Purpose, Writing Seminars M.F.A. applicants should include in their writing sample a two-page introduction and critique of their work. This statement should give admissions faculty an insight into the scope and thoughtfulness of the work submitted and a sense of the student's ability to contribute to the Writing Seminars program.

Transcripts

Applicants must submit official transcripts of all college and university study in sealed envelopes. Students applying to more than one department do not need to send duplicates, but must indicate on their mandatory cover sheet that they wish to use the materials toward multiple applications, listing each department to which they are applying. Applicants should also send a list of current courses and any other courses that will be taken before beginning graduate study at Johns Hopkins that do not appear on their transcripts.

We accept and consider official electronic transcripts delivered through Scrip-Safe, Interfolio, and WES. Please consult with your institution to see if it participates in these delivery options. If an email address is required, please use graduate admissions@jhu.edu.

Letters of Recommendation

Applicants should ask faculty members to write letters of recommendation on their behalf. The preferred method of delivery is for the letter to be submitted through our online application system. Otherwise, please send recommendations directly to the Graduate Admissions Office.

Please note: Letters of recommendation must be on letterhead and have an original signature.

The following departments require **TWO** letters of recommendation:

- Computer Science (M.S.E.)
- Earth and Planetary Sciences
- Economics
- Information Security Institute
- Materials Science and Engineering
- Near Eastern Studies
- Philosophy

The following departments require **THREE** letters of recommendation:

- Applied Mathematics and Statistics
- Anthropology
- Biology
- Biomedical Engineering (M.S.E.)
- Biophysics
- Chemical and Biomolecular Engineering
- Chemistry
- Chemical Biology
- Civil Engineering
- Classics
- Cognitive Science
- Computer Science (Ph.D.)
- Electrical and Computer Engineering
- Engineering Management
- English
- Geography and Environmental Engineering
- German and Romance Languages
- History
- History of Art
- History of Science and Technology
- Humanities Center
- Mathematics
- Mechanical Engineering
- Physics and Astronomy
- Political Science
- Public Policy
- Psychological and Brain Sciences
- Sociology
- Writing Seminars

Graduate Record Examination (GRE)

Applicants are required to request recent GRE scores from ETS and submit them to Johns Hopkins before the application deadline. Results should be sent directly to the Graduate Affairs and Admissions Office by the Educational Testing Service (ETS). In order for the scores to be delivered successfully, the applicant must use the correct institution code (5332) when requesting

the scores from ETS. Information about the GRE General and Subject Exams are available at **www.grad.jhu.edu/admissions/apply/** and at the ETS website **www.ets.org/gre**.

English Proficiency (TOEFL and IELTS)

Johns Hopkins University requires graduate students to have adequate English proficiency for their course of study. Graduate students must be able to read, speak, and write English fluently upon their arrival at the university. Successful study demands the understanding oral lectures and taking comprehensive notes during lectures. Applicants whose native language is not English must submit proof of their proficiency in English before they can be offered admissions and before a visa certificate can be issued. Applicants have a choice of taking either the TOEFL or IELTS exam to satisfy this requirement. Johns Hopkins prefers a minimum score of 600 (paper-based), 250 (computer-based), and 100 (internet-based) on the Test of English as a Foreign Language (TOEFL) and IELTS Academic Band Score equal to 7. Results should be sent directly to the Graduate Affairs and Admissions Office by the Educational Testing Service (ETS) which administers TOEFL or captured by IELTS Global Recognition System. Further information about the TOEFL and the IELTS can be found at **www.grad.jhu.edu/admissions/apply**.

Test of English as Foreign Language (TOEFL)

If submitting a TOEFL score, applicants must submit an original TOEFL score report (not a student or photocopy). A TOEFL Bulletin of Information and Registration Form can be obtained in a number of cities outside the United States.

Students who cannot obtain a TOEFL bulletin and registration form locally should write well in advance of their intended test date to: TOEFL Services, Educational Testing Service, P.O. Box 6151, Princeton, New Jersey 08541-6151, U.S.A. Applications for taking the examination must be received in Princeton, New Jersey, at least four weeks prior to the date on which the test is given. For up-to-date information, please visit the TOEFL website at **www.ets.org/toefl/**. Results should be sent directly to the Graduate Affairs and Admissions Office by the Educational Testing Service (ETS). In order for the score to be delivered successfully, the applicant must use the correct instiution code (5332) when requesting the score from ETS.

International English Language Testing System (IELTS)

The IELTS examination is offered jointly by University of Cambridge ESOL Examinations (Cam-

bridge ESOL), The British Council, and IDP: IELTS Australia. Information about the IELTS, its test centers and times are found at **www.ielts.org**.

Samples of Work

Some departments require each applicant to submit a sample of work, such as a paper, thesis, or publication. Applicants should consult the department before submitting any documentation. Further details about departmental guidelines can be found at **www.grad.jhu.edu/admissions/apply**.

Please note: We only accept samples of work in English, except for the German and Romance Languages Department. (For this department, we accept samples of work in French, German, Italian, and Spanish.)

Financial Assistance

Applicants need to indicate a need for financial assistance on the electronic application for admission. Federal loans and work study are available on the basis of financial need to U.S. citizens and permanent residents. Interested students should contact Student Financial Services, at **www.jhu .edu/finaid**.

Mailing Instructions

If a document cannot be uploaded through the online application, originals may be mailed to the Graduate Affairs and Admissions Office. We require that supporting documentation should be mailed, in one envelope, to the address listed at **www.grad.jhu.edu/admissions/mailing**.

We also require the use of the mailing label and cover sheet. This can be found at **www.grad.jhu .edu/admissions/apply**.

Please note: The Graduate Affairs and Admissions Office will only accept regular mail, certified mail, UPS, DHL and Fed Ex deliveries. If applying to more than one department, please indicate on the cover sheet the number of applications you have, and to which departments you are applying.

Additional Resources

Graduate applicants may consider reading the Frequently Asked Questions page on the graduate admissions website (**www.grad.jhu.edu/admissions/ faq**), making a visit to the campus and taking a tour (**www.grad.jhu.edu/admissions/visit**) or completing the online Information Request Form (**www. grad.jhu.edu**) before applying to our graduate programs. All of these resources are helpful in learning more about the application process, life in Baltimore and making the transition to graduate life on the Homewood campus.

Visiting and Volunteer Graduate Student Information

The schools of Arts and Sciences and Engineering recognize and appreciate the contributions of volunteers and visiting graduate students to its mission of education and research. These policies enable both schools to retain and set forth requirements pertaining to volunteers and visiting graduate students. Please visit **http://grad.jhu.edu/visitingstudent/index.php** for more information.

Undergraduate Financial Aid

The cost of higher education is a major concern to students and parents in their selection of a college. The Johns Hopkins University welcomes all students of superior academic ability and provides need-based financial assistance to those who qualify.

Financial aid is based on the premise that parents and students are expected to contribute to educational costs to the extent that they are able. A family contribution, using a federal formula with institutional adjustments, consists of student and parent components. This family contribution is subtracted from the total college cost for the year. The net amount is the student's financial aid eligibility or need. The student's financial aid award will meet this eligibility on a funds-available basis, through a combination of grants, loans, and work opportunities.

A college education is a major investment. It is important that both the student and the family plan ahead, investigate funding alternatives, apply for aid carefully and on time, and, most importantly, ask questions. Applicants and their families should not hesitate to call the Office of Student Financial Services at 410-516-8028 or visit us at **www.jhu.edu/finaid** or email fin_aid@jhu.edu for more information.

Application Process

Each year, students must apply for financial aid by submitting the following documents by the published deadlines: November 15 for Early Decision applicants, March 1 for Regular Decision applicants, and March 1 for transfer applicants.

- The CSS/Financial Aid Profile application which is available online at **https://profileonline.college board.com**. Johns Hopkins school code is 5332.

- The Free Application for Federal Student Aid (FAFSA) at **www.fafsa.ed.gov**. The Johns Hopkins school code is E00473.

- Signed copies of prior year federal individual tax returns (student and parents'), all pages, includ-

ing W-2s and other supplemental documents as required by the College Board's Institutional Documentation Service (IDOC). These documents are submitted in a single packet to IDOC along with the IDOC coversheet.

- If parents are involved in a business, partnership, or corporation, signed copies of the appropriate tax returns for the prior year must also be submitted to IDOC.

- Other documents required if applicable: CSS Non-Custodial PROFILE; CSS Business/Farm Supplement; appropriate corporate tax returns.

Application status may be viewed online at **www .jhu.edu/finaid/self_service.html**.

Renewal of Financial Aid

Students reapply for financial aid each year. Financial aid awards cover one academic year and are not automatically renewed. The deadline for returning students to submit completed applications is May 1. Limited Hopkins Grant assistance is available for the summer. Students must complete the Summer Aid Application online to be considered.

Students may expect comparable awards for a total of eight semesters if they meet all the following conditions:

- Family financial situation remains the same.

- The student submits all the required documents on time.

- The student maintains satisfactory academic progress.

Based on written appeal, a ninth semester of grant aid may be awarded to students with extenuating circumstances. Federal and state aid may be available for additional semesters.

Academic Progress

The typical time-to-degree for a full-time undergraduate student is four years; the university considers completion within five years to be satisfactory.

A student who has amassed 24 credits is considered to have sophomore standing; 54 credits gives junior standing; 84 credits gives senior standing. These credits include both Hopkins and transferable off-campus credits.

Satisfactory academic progress refers to minimal standards for grades and cumulative credits required to remain in good academic standing. Eligibility for financial aid is linked to satisfactory academic progress.

Eligibility to Register

Each semester, students are expected to pass at least 12 credits with a grade point average of at least 2.0. Students who fall short of these criteria will be placed on academic probation. Failure to meet these minimal standards for two consecutive semesters will make a student ineligible to register and result in academic dismissal for a minimum of one semester and one summer.

Students are also expected to accumulate total credits at the rate of at least 12 credits per semester. Students who fall behind in credit accumulation will be subject to the academic probation and dismissal policies stated above. In addition, if a student falls behind in credit accumulation by 24 or more credits, that student will be ineligible to register and will be dismissed from the university for failure to make satisfactory academic progress.

An academic appeals committee will consider student appeals of these decisions. The appeals committee will have the authority to rescind a decision to dismiss a student and/or to establish new satisfactory progress terms for individual students who have fallen behind in credits.

Minimal Satisfactory Credit Accumulation Table		
At the end of semester ___	___ credits should have been earned	Students with ___ credits or less will be dismissed permanently
1	12	-
2	24	0
3	36	12
4	48	24
5	60	36
6	72	48
7	84	60
8	96	72
9	108	84
10	120	96

Students may be approved to register for fewer than 12 credits in a given semester because of illness, disability, or other unusual circumstances. Less than full-time status may affect some types of financial aid.

Semesters need not be consecutive. Leave-of-absence semesters do not affect academic standing.

Academic progress will be reviewed at the conclusion of each regular term (fall and spring). A student's academic performance during the summer term or intersession will not affect his/her academic standing except that credits and grades will count in the cumulative measures.

Repeated courses count only once toward the cumulative credit requirements.

For a student entering the university as a freshman, credits approved for transfer from another institution will count toward the cumulative credits required for meeting satisfactory academic progress standards. If a student studies abroad or attends another approved program off campus, the semesters attended at the other institution are counted in the assessment of whether the student is making progress toward his/her degree the same as if the student had attended Johns Hopkins.

For transfer students, satisfactory academic progress will be based only on work done after matriculation at Johns Hopkins in accordance with the eligibility-to-register requirements above.

Eligibility for Financial Aid

Financial aid eligibility is based on a federal formula that considers the family income as well as other factors, including the number of family members, the number of children in college, and the assets of both the student and the parents. Institutional parameters may be added to the federal calculation to determine eligibility for Johns Hopkins aid.

Undergraduate Student Budget, 2011–2012
(see **www.jhu.edu/finaid** for current cost of attendance)

Tuition	$ 42,280
Matriculation Fee	500 *
Room and Board	12,962 **
Allowance for Commuting Students	4,657
Personal and Books	2,200
Travel (varies depending on home state)	200–1,400

  * Charged to first-time students only.
** Based on double room in typical university housing and an average cost for a meal plan for entering students.

These expenses represent both direct charges and out-of-pocket expenses. Tuition, matriculation fees, and university housing costs are direct charges for which the student receives a bill. Out-of-pocket expenses include personal and book costs, travel, and a commuting allowance. Students living in private, off-campus apartments should budget $9,000 for nine months of room and board expenses.

Financial Aid Package

Once a student's eligibility has been established, Johns Hopkins University will attempt to meet that eligibility through a combination of grants, loans, and Federal Work-Study (FWS) awards. Self-help or the loan and FWS components of the financial aid package are applied against eligibility first. Remaining eligibility is met by grants or scholarships, including Federal Pell Grants, state scholarships, and Hopkins grants. The average self-help award, typically includes a $2,500 work opportunity, plus a loan amount based on year of study as follows:

First-Year Students	$ 3,500
Sophomores	$ 4,500
Juniors	$ 5,500
Seniors	$ 5,500

The amount of the loan in a student's aid package will increase in the upperclass years as eligibility increases.

Financial Aid Types

The financial aid package may include four different types of financial aid: grants, self-help, merit-based scholarships, and private scholarships.

Grants

Grants are awards that do not have to be repaid. These gifts come from a variety of sources: state and federal governments, individuals, corporations, and the university.

Baltimore Scholars

Baltimore Scholars are citizens or permanent residents admitted from Baltimore City public high schools who make their residence in the city (three consecutive years minimum residency required). Scholars receive full-tuition scholarships for undergraduate study, and additional assistance for remaining need. No separate application is required.

Bloomberg Scholarship

Bloomberg Scholarships are awarded annually to entering freshmen. The Bloomberg Scholarship provides an additional grant to replace the normal loan expectation in the financial aid award. The value of the Bloomberg Scholarship will vary, depending on need, but will meet the scholar's full financial need in grant, minus a work-study requirement. No separate application is required. Selection will be based on need, superior academic performance and test scores, and demonstrated leadership in school or community activities.

Hodson-Gilliam Success Scholarship

The Hodson-Gilliam Success Scholarship is awarded annually to entering freshmen with demonstrated financial need who are outstanding students from underrepresented minority groups and others. This competitive scholarship replaces loan in the

financial aid package. No separate application is required. Selection is based upon outstanding academic performance and test scores, and demonstrated leadership in school and community activities.

Hopkins Grant
Hopkins provides grants to assist students who have demonstrated eligibility. These are awarded from institutional funds and endowments. The amount of the grant varies and may be renewed each year according to the level of financial need.

Federal Pell Grant
If a student meets the strict eligibility criteria, she/he is entitled to this federal grant. Currently, the maximum Pell Grant is $5,550 per academic year.

Federal Supplemental Educational Opportunity Grant (FSEOG)
The Federal SEOG program provides grants to students who demonstrate exceptional need. When awarding FSEOG, priority is given to Federal Pell Grant recipients and other students with exceptional need. Hopkins matches this federal grant with institutional funds.

Reserve Officers' Training Corps (ROTC)
Any Hopkins student that meets ROTC eligibility requirements can compete for a federal merit-based two-, three- and four-year scholarship that includes full tuition, books, fees, and a tiered monthly stipend: **www.jhu.edu/rotc**.

State Scholarships
Students from certain states may be eligible for state grants or scholarships to help fund their education at Hopkins. Hopkins expects all eligible financial aid applicants to apply for these state funds. Failure to apply for these scholarships may result in a reduction of Hopkins grant. The student should apply early, as each state has a specific deadline and application process. Some states also have a separate scholarship application.

Students may contact their state higher education agency via the web at the following address: **www.ed.gov**, click on State Information.

Federal Work-Study (FWS)
The Federal Work-Study program, including community service and America Reads, allows students to earn money by working part time on or off campus or in a community service setting. FWS is federally funded, and only students with demonstrated financial need are eligible for this employment program. Unlike funds from other aid programs, FWS earnings are not applied as a direct credit to a student's college expenses; they are an allotment of money that the student may earn in a given year.

A wide variety of jobs are offered, with hourly rates from $7.25 per hour and up. Most students work an average of eight to 10 hours per week. Students are paid on a weekly basis. These funds are generally used to help cover the student's out-of-pocket expenses such as books and personal travel costs. FWS job openings are available on the web at **www.jhu.edu/stujob**, through the Annual Job Fair in early September, and at the Office of Student Employment Services in 72 Garland Hall.

Federal Perkins Loan
This federal loan is available to students who demonstrate exceptional financial need. The Federal Perkins Loan program is administered by Hopkins, and the money borrowed is paid back to Hopkins. The present rate of interest is 5 percent. Interest does not accrue until the loan goes into repayment, which begins nine months after completion of studies and may extend up to 10 years. Deferment and repayment information is sent to all borrowers.

Hackerman Loan
The Hackerman Loan is an interest-free loan that may be offered as part of the financial aid package to Whiting School of Engineering students. Funds are limited. Borrowers are expected to repay the loan over a period of eight years after completion of studies.

Federal Direct Student Loan
Johns Hopkins University participates in the Federal Direct Student Loan Program. Students obtain a Direct Loan from the federal government.

Interest-subsidized Direct Loans are need-based and available to students who demonstrate eligibility. The interest rate is fixed at 4.5 percent. The government pays the interest on the loan until it goes into repayment, six months after the student leaves school.

Unsubsidized Direct Loans are available for students who do not qualify for a need-based loan. The interest rate fixed at 6.8 percent. Interest accrues on these loans immediately and may either be capitalized or paid while the student is in school. All other terms of the loan are identical to the subsidized program.

Students must file the Free Application for Federal Student Aid (FAFSA) form to determine eligibility for either type of Federal Direct Loan. A Master Promissory Note must be signed by all first-time borrowers. Loan proceeds will be credited directly to the students' accounts.

Merit-Based Scholarships

All merit-based scholarships require superior academic achievement in a challenging program, the highest test scores, and demonstrated leadership in school and/or community, state, regional, or national activities.

Hopkins offers the **Hodson Trust Scholarship**, to approximately 20 first-year students. The value of the scholarship for 2011–2012 will be $28,500. The scholarship is renewable for up to three additional years of undergraduate study if the recipient maintains a 3.0 GPA including the first semester of freshman year. (Letter grades from that semester are covered, but a GPA is still calculated to determine eligibility for scholarships.) All admitted students are considered for this award.

Charles R. Westgate Scholarships provide full tuition for up to two first-year engineering students. The scholarship is renewable for up to three additional years of undergraduate study if the recipient remains enrolled in the Whiting School of Engineering and maintains at least a 3.0 GPA. There is no separate application required, and all Whiting School of Engineering candidates will be considered.

Outside/Private Scholarships

Scholarships from private organizations are an additional or alternative method for the student to help finance a Hopkins education. Many agencies and organizations offer scholarships to students continuing their education at a college or university. Links to some of the free scholarship search engines are available on the web at **www.jhu.edu/ finaid** and through high school guidance offices, local libraries, and community organizations.

Students must report outside/private scholarships received to the Office of Student Financial Services. All scholarship checks should be sent to that office. Need-based scholarships, Johns Hopkins University Grant, and Johns Hopkins University funded, merit-based scholarships will not be reduced <u>for freshmen</u> receiving private scholarship unless they exceed the student's financial need or cost of attendance. Holding a need-based grant "harmless" from reduction is intended to provide a financial incentive for obtaining private scholarships the freshman year. If an outside scholarship is renewed for subsequent years, the amount of the scholarship will <u>reduce</u> the student's Bloomberg Scholarship and/or Johns Hopkins University Grant. For more information about outside/private scholarships, please review the Student Financial Assistance Brochure online at **www.jhu.edu/finaid**.

Graduate Financial Aid

Fellowships

Two types of fellowships are awarded to matriculated graduate students in the Krieger School of Arts and Sciences and the Whiting School of Engineering.

Full and partial fellowships for graduate students are provided from general funds of the university. They are awarded by the university each year and may be renewed on the recommendation of the student's academic department. New students should contact the department in which they are interested for more information.

Other fellowships are awarded to the student directly by government agencies, private foundations, and business and industrial corporations. Too numerous to be listed here, they constitute an important source of financial assistance. Students may get information about them from the department, public libraries, or **www.grad.jhu.edu/ admissions/diversity/fellowships**.

Other Programs

Graduate students may also receive aid through the Federal Perkins Loan program, the Federal Direct Student Loan program, alternative loan programs, and the Federal Work-Study program (FWS), which the Office of Student Financial Services administers. Further information is available at the Office of Student Financial Services or at **www.jhu.edu/finaid**.

Graduate Student Budget, 2011–2012

Tuition	$42,280
Room and Board (9 mo.)	$14,230
Personal Expenses	$1,000
Transportation	$500
Books and Supplies	$1,200
Matriculation Fee	$500*
Health Insurance	$1,627

* Charged to first-time students only.

Refer to **www.jhu.edu/finaid/self_service.html** or **www.jhu.edu/finaid/grads_cost.html** for updated costs.

Fees and Expenses

Initial Fees and Deposit

Application Fee

Undergraduate students, graduate students, and visiting students must each pay a nonrefundable $70 fee when submitting an application for admission for academic year 2011–2012.

Deposit

A nonrefundable $600 deposit is due from prospective first-year undergraduate students by May 1 and from Early Decision candidates and undergraduate transfer students at the time of acceptance. This deposit is credited to the student's account and is applied toward first-semester charges.

Matriculation Fee

A fee of $500 is payable on or before the date that a student enters the Krieger School of Arts and Sciences or the Whiting School of Engineering as a regular matriculated degree candidate in the 2011–2012 academic year. Special or visiting students who later become degree candidates will be assessed the matriculation fee at that time.

Tuition

Tuition is set by the Board of Trustees on the recommendation of the president of the university. In addition to the cost of instruction and supporting services, tuition includes the cost of a number of other items such as the basic health service, sports and recreation programs, and certain student activities. Over the past decade, tuition charges of American private universities have been increasing, though the rate of growth has slowed in recent years. Entering students should be prepared for small increases in tuition during their years at the university.

Undergraduate students who have not completed degree requirements after eight full-time semesters (with appropriate consideration for transfer students) may pay for courses on a per credit basis. Any student registering for 12 or more credits will have full-time status. Students who need less than 12 credits to graduate in their eighth semester must register as full-time students, paying full tuition.

Full-Time Students

Tuition for the 2011–2012 academic year is $42,280 for undergraduate and graduate students alike. Undergraduate and graduate students must make arrangements to pay each term's tuition two weeks before the start of classes. Late registration students must pay each term's tuition on or before registration.

Part-Time Students

Tuition is $1,410 per credit hour for students enrolling in courses numbered 1-599 and $4,230 per course for students enrolling in courses numbered 600 and above. Students enrolled in Advanced Academic Programs in Arts and Sciences, or in

Engineering for Professionals, should consult the appropriate catalogs for tuition charges.

Administrative Fees

Fee for Undergraduate Study Abroad

Undergraduates who meet certain eligibility requirements and who obtain approval from the assistant dean of academic advising may study abroad during the junior year. An administrative fee of 12 percent of the university's undergraduate tuition is added to the host school's costs to students who undertake study abroad. The Johns Hopkins University sponsors certain programs for study abroad for which financial aid may be used. The study abroad counselor in the Office of Overseas Studies has a list of these programs.

Predoctoral Nonresident Status Fee

Graduate students with nonresident status must pay a fee of 10 percent of the university's graduate tuition for each semester they are on nonresident status during 2011–2012.

Postdoctoral Fee

All postdoctoral fellows are assessed a fee of $800. A postdoctoral fellow may apply to his/her department for a scholarship to cover this fee.

Laboratories

Ordinarily there is no fee for the use of laboratories. Charges are made for supplies and breakage, for apparatus not returned in good condition, and for special apparatus. Some film courses carry a lab fee to help defray the cost of film rentals and projection.

Late Registration

A student who for any reason does not complete his/her registration until after the prescribed registration period will be required to pay a late registration service fee before that registration may be finalized by the Registrar. The fee for registering after the end of the registration period in the prior semester is $100. For registrations completed from the first day of classes through the end of the first week of classes, the fee is $150; for registrations completed during the second week of classes, a $200 late fee is assessed; and a $300 fee is required for registrations completed after the end of the second week of classes.

Returned Check Fee

A fee of $25 is assessed without exception for any paper or electronic check returned to the school by a banking institution. The university reserves the right to no longer accept future payments by

personal checks from any student once a fee has been assessed.

Dossier Charges

The Career Center will charge graduate students for dossiers sent to academic institutions. A setup fee includes five free dossiers; an additional charge per dossier is assessed thereafter.

Doctoral Dissertation Fee

Doctoral candidates are charged a fee for the microfilming and binding of dissertation manuscripts.

Student Health Insurance

All students, without exception, must be covered by a current health insurance plan. The university will provide information about its student health insurance plan for students who are not covered under another plan. Students who must obtain health insurance through the university should notify the Office of Student Financial Services if they need assistance with this expense.

Room and Board

First-year undergraduate students and sophomores are required to live in university residence halls unless they reside at home in the Baltimore area with their parents or guardians. All residence hall students are required to participate in one of the meal plans.

Residence Halls and Food Plans

For 2011–2012 the room charges are $7,408 for a double-occupancy room in the Alumni Memorial Residences and $8,152 for a double-occupancy room in Buildings A and B, Wolman Hall, and McCoy Hall. Single room charges are $8,558 in the Alumni Memorial Residences and $9,258 in Buildings A and B, Wolman Hall, and McCoy Hall. Freshman meal plan charges are $5,554. Sophomore plans range from $3,354 to $5,554.

University-Owned Apartment Buildings

Rates are determined on an apartment-by-apartment basis.

Payment

Educational expenses require careful planning. In order to assist families with financial planning, the university offers the following financing options:

Federal Parent Plus Loan

Federal Parent Loan for Undergraduate Students (PLUS) are federally guaranteed loans available to parents of undergraduates regardless of financial need. A credit history review is required; however, there is no "debt to income" review. Credit checks typically are valid for a maximum of 120 days. Parents may borrow up to the total cost of attendance for the year minus financial aid the student is eligible to receive. Disbursement will be in two installments scheduled at the beginning of each semester.

A 2.5 percent origination/default fee will be deducted from loan proceeds. Interest on the PLUS loan is fixed at 7.9 percent.

Repayment begins 60 days after the loan is fully disbursed although interest accrues from the day of first disbursement. The repayment period must be at least five years, but not more than 10 years. Delayed principal payments while the student is enrolled may also be available, but interest will accrue.

Johns Hopkins University is a direct lending school which means that parents do not need to contact a lender; these loans are made directly with the U.S. Department of Education.

To apply for a PLUS loan, parents must complete the Free Application for Federal Student Aid (FAFSA) online at **www.fafsa.ed.gov**. Parents must also complete the Federal Direct Parent PLUS Request Form which is available on the web at **www.jhu.edu/finaid/elecserv/index.html.** The request form is submitted directly to the Office of Student Financial Services for processing.

Hopkins Monthly Budget Plan

Hopkins offers the option of paying annual tuition, room, and board costs in five equal monthly installments per semester, beginning in June prior to the start of the academic year, through the Tuition Management Systems Payment Plan. An $80 fee is assessed. No interest is charged. Further information on the TMS Plan may be obtained from TMS at 1-888-216-4268 or on the web at **www.afford.com**.

The policy of the Krieger School of Arts and Sciences and the Whiting School of Engineering is to require that all students pay university bills (tuition, room and board, library fines, etc.) in full and on time as billed by the university's Office of Student Accounts. Invoice notifications are emailed to students as far in advance of actual due dates as is practical.

The university may assess a late fee charge for any student whose student account bill is in arrears. Students who have unpaid balances are not allowed to register; they may not have records prepared and released for purposes of participating in graduation exercises or certifying that all degree requirements have been met; and their transcripts may not be released.

Administrative Regulations and Registration

Undergraduates should consult the Undergraduate Handbook for additional information about administrative regulations.

Categories of Students

Undergraduate (Prebaccalaureate)

Usually undergraduate students are full-time students and are charged full tuition. The office of the deans must approve any exceptions.

A few special students (those not candidates for a Johns Hopkins baccalaureate degree) may be enrolled on a full- or part-time basis. An application and acceptance process must first take place through the Undergraduate Admissions Office.

Graduate (Predoctoral), School of Arts and Sciences

Graduate students are also full-time students and are charged full tuition. The office of the deans must approve any exceptions other than those listed below.

A few special or visiting graduate students (those not candidates for a Johns Hopkins advanced degree) may be enrolled on a full- or part-time basis with the approval of the chair of the department and the dean. Special graduate students will be limited to two consecutive terms of either full- or part-time study.

A few part-time graduate students may be enrolled with the written approval of the chair of a department or director of a degree program and the documented confirmation of the dean. Students will generally not be eligible if they are working primarily on the Homewood campus or working full-time on research for the degree. Part-time graduate students must meet one of the residence requirements listed below before they receive an advanced degree.

Graduate (Predoctoral), School of Engineering

Most graduate students enrolled in the research-oriented degree programs (M.S.E., Ph.D.) in Engineering are full-time students. However, part-time study consistent with residency requirements is common in many engineering departments. Students should consult with individual departments to determine the possibilities for part-time study.

Postdoctoral Appointments

Postdoctoral fellows are at the university to undertake a research program in cooperation with a member of the faculty. All appointments are arranged through the individual departments.

Registration

All students must complete registration at the beginning of each term in accordance with instruction issued by the registrar before they can attend classes or use university facilities. Detailed instructions about registration will be emailed to all students before the registration period each term. If the student has not received this information at least two weeks before the start of classes for any fall or spring term, perhaps because of a change in address or status in the university, the Registrar's Office should be contacted immediately.

Students who for any reason do not complete their registration until after the prescribed registration period will be required to pay a late registration service fee before that registration will be finalized by the registrar. The fee is $150 for registrations completed from the first day of classes through the end of the first week of classes, $200 for registration completed during the second week of classes, and $300 for registration completed after the second week. The undergraduate student will not be allowed to register later than the fourth week of classes in a fall or spring term or the first week of classes in January Intersession, except with the permission of the assistant dean of academic advising (Arts & Sciences) or the associate dean for academic affairs (Engineering). Graduate students must obtain permission from the chair of their department.

Students will not be allowed to register if there are unpaid bills from a previous term such as tuition, rent, library fines, or campus parking fines. The student is required to pay tuition or make financial arrangements with the business management office before registering for a given term.

Changes in Registration

After completing registration a student can add or drop a course or change sections by accessing ISIS for Students (**https://isis.jhu.edu**) or in person at the Registrar's Office. There is no fee for changing a completed registration. The Student Handbook lists the situations that require the approval of the undergraduate's advisor or the dean.

A student who wishes to withdraw from all registered courses should follow the procedures outlined under Withdrawal (see page 31).

Veterans

Johns Hopkins is approved by the Maryland Higher Education Commission for the training of veterans and the widows and children of deceased vet-

erans under the provisions of the various federal laws pertaining to veterans' educational benefits. Information about veterans' benefits and enrollment procedures may be obtained at **www.jhu.edu/ registrar/veterans.html** or the Office of the Registrar, 75 Garland Hall, 410-516-7071.

Students eligible for veterans' benefits register and pay their university bills in the same manner as nonveteran students. The Department of Veteran Affairs determines the educational benefit a veteran is eligible to receive. Veterans educational benefits payments cover only a portion of assigned course fees. To receive veterans educational benefits the student must comply with the following procedures:

Initial Enrollment

Once admitted to the university, the student must complete an Application for Program of Education or Training (VA Form 22-1990) from the Department of Veterans Affairs at **www.gibill.va.gov**. A copy of the completed application, along with a certified copy of the DD-214, is sent to the Veterans Desk, Office of the Registrar, 75 Garland Hall, The Johns Hopkins University, Baltimore, Maryland 21218.

The student who is transferring from another university or college will need to obtain a Request for Change of Place of Training (VA Form 22-1995) from the Department of Veterans Affairs at **www .gibill.va.gov**. The completed form should be sent to the Veterans Desk at the university.

Re-enrollment

Students who received veterans' benefits at the university the preceding semester and plan to enroll with no change of objective should inform the Registrar's Office at the time of registration that they want to be recertified under the provisions of their original VA Form 22-1990.

Students receiving veterans' benefits must take courses that lead toward the exact objective (usually a specific degree) on the original VA application. Otherwise, they must submit a Request for Change of Program (VA Form 22-1995). Students utilizing veterans' benefits must let the registrar know immediately of any change in their program or status that might affect the amount of their VA payment. If they fail to do so, the Department of Veterans Affairs will seek reimbursement from the student for any overpayment.

Standards of Progress

Continuation of VA payments depends on the student's meeting the university's academic standards for all students. (See Academic Information for Undergraduates, page 42.) The student must also meet any standards of progress which may be established by VA regulations.

Residence Requirements

(For undergraduate residence requirements, see Credit and Residence Requirements, page 43.)

To receive a full-time master's degree in the School of Engineering, a student must be a full-time graduate student for at least two semesters or satisfy an equivalent requirement approved by the appropriate department. Students who begin working toward an advanced degree before receiving the baccalaureate degree may count their full-time residence toward both degrees. This applies to students who accept the baccalaureate degree before the master's degree as well as those who accept both degrees at the same time.

To receive the doctoral degree in the School of Arts and Sciences or the School of Engineering, a student must be a full-time graduate student for at least two consecutive semesters.

(For information on graduate study abroad status and predoctoral nonresident status, see Academic Information for Graduate Students, page 51.)

Withdrawal

A student who wants to withdraw from all courses must file a written notice and follow the procedure specified by the university. Before doing so, undergraduates should consult their faculty advisors and their academic advisors. Students who withdraw after the final date for withdrawing from a course will receive failures for their incomplete courses. Graduate students should consult the chair of their department.

Enrolled students who withdraw from school shall obtain a prorated refund, which must first be applied to all federal student loans and grants. The refund extends to all university charges if the student withdraws at any point up to 60 percent of the first enrollment period.

These percentages will be calculated from the date the student submits a written statement of withdrawal.

No refund will be granted to students suspended or dismissed for disciplinary reasons. The university reserves the right to exclude at any time a student whose academic standing or general conduct is considered unsatisfactory.

Leave of Absence

Any undergraduate student may be placed on leave of absence for personal reasons. The school specific office of academic advising may grant approval for a term leave of absence for an undergraduate

student in Arts and Sciences/Engineering; graduate students need the approval of their department chair and the Graduate Board. A term leave of absence is given for a specified period of time, normally not to exceed two years. There is no fee for a term leave of absence: the period is simply an approved interruption of the degree program.

See pages 51–55, Academic Information for Graduate Students, for information regarding graduate student leaves of absence and nonresident status.

Readmission

The departure of students from the university without a term leave of absence or nonresident status will be considered as withdrawal. The dean will have to readmit them formally before they can return. Readmitted students will not have to pay another matriculation fee.

The residence requirements listed earlier in this section must be satisfied following readmission. The dean may reduce these requirements for undergraduates if the total of full-time residence is at least four semesters and if 60 credits are completed.

Concurrent Bachelor's/Master's (Predoctoral)

Students in either the School of Arts and Sciences or the School of Engineering must be accepted into a concurrent program no later than the first semester of their senior year (some departments set an earlier application deadline).

School of Arts and Sciences

Concurrent students are also full-time students and are charged full tuition. This category is reserved only for current JHU full-time undergraduate students who are accepted into a concurrent graduate program. Concurrent students are eligible to become full-time graduate students upon completion of their undergraduate degree requirements. See page 56 for a listing of departments that offer a concurrent program.

School of Engineering

The registration status of Whiting School of Engineering students who have been admitted into a concurrent bachelor's/master's degree program will switch from undergraduate to graduate once they obtain clearance from their respective departments and either: (1) complete the requirements for a bachelor's degree, or (2) complete eight semesters of full-time study, whichever comes first. As soon as this occurs, a student is guaranteed health insurance benefits and becomes eligible for a partial tuition waiver and research and teaching assistantships (the graduate program determines the student's level of support).

Graduation

Degrees completed during the preceding academic year are conferred and diplomas are issued at the end of summer, fall, and spring semesters. Students who complete degree requirements and who have been formally recommended for the degree by the faculty body or department may participate in the annual commencement ceremonies each spring.

Requirements are considered fulfilled when the student's dissertation is submitted to the library, and when the department chair submits an appropriate report and certification.

Each student expecting to graduate will receive a final bill from the university. It is university policy that all outstanding accounts must be paid in full before a student's diploma may be released.

The university does not guarantee the award of a degree or a certificate of satisfactory completion of any course of study or training program to students enrolled in any instructional or training program. The award of degrees and certificates of satisfactory completion is conditioned upon (1) the satisfaction of all current degree and instructional requirements at the time of such award, (2) compliance with university and divisional regulations, and (3) performance in meeting the bona fide expectations of faculty. No member of the faculty is obliged to provide a student or graduate with an evaluation or letter of recommendation which does not accurately reflect that faculty member's true opinion and evaluation of that student's or former student's academic performance and conduct.

Transcripts

Students who want transcripts of their academic records at Johns Hopkins or who want them forwarded elsewhere should submit a written request to the Office of the Registrar three to five days before the transcript is needed. Transcripts may also be requested online at **www.jhu.edu/registrar/transcript.html**. Partial transcripts of a student's record will not be issued.

Transcripts are normally issued only at the request of the student or with his/her consent. The only exception to this policy is the issuance of transcripts to offices and departments within the university.

Official transcripts of work at other institutions that the student has presented for admission or evaluation of credit become the property of the university and cannot be copied or reissued. If a transcript of this work is needed, the student must get it directly from the institution concerned.

Accreditation

The Johns Hopkins University is accredited by The Middle States Commission on Higher Education, 3624 Market Street, Philadelphia, PA 19104-2680; 215-662-5606.

Graduation Rates

In compliance with the federal Student Right-to-Know Act of 1990 (Public Law 101-542, Sec. 668.46), the Johns Hopkins University provides the following information to prospective and currently enrolled undergraduates in the schools of Arts and Sciences and Engineering:

Entering Freshman Class, September 2003: 1048

returning as sophomores	96%
graduating within 4 years	83%
graduating within 5 years	90%
graduating within 6 years	91%

Questions about these data should be addressed to the coordinator of institutional research, 205 Garland Hall, 410-516-8094.

University Policies for Students

Policy on Alcohol and Drugs

Johns Hopkins University recognizes that alcoholism and other drug addictions are illnesses that are not easily resolved by personal effort and may require professional assistance and treatment. Faculty, staff, and students with alcohol or other drug problems are encouraged to take advantage of the diagnostic, referral, counseling, and preventive services available throughout the university. Procedures have been developed to assure confidentiality of participation, program files, and medical records generated in the course of these services.

Substance or alcohol abuse does not excuse faculty, staff, or students from neglect of their employment or academic responsibilities. Individuals whose work or academic performance is impaired as the result of the use or abuse of alcohol or other drugs may be required to participate in an appropriate diagnostic evaluation and treatment plan. Further, use of alcohol or other drugs in situations off campus or removed from university activities that in any way impairs work performance is treated as misconduct on campus. Students are prohibited from engaging in the unlawful possession, use, or distribution of alcohol or other drugs on university property or as a part of university activities.

It is the policy of Johns Hopkins University that the unlawful manufacture, distribution, dispensation, possession, or use of controlled substances is prohibited on university property or as a part of university activities. Individuals who possess, use, manufacture or illegally distribute drugs or controlled dangerous substances are subject to university disciplinary action, as well as possible referral for criminal prosecution. Such disciplinary action of faculty and staff may, in accordance with the university policy on alcohol abuse and maintenance of a drug-free workplace, range from a minimum of a three-day suspension without pay to termination of university employment. Disciplinary action against a student may include expulsion from school.

As a condition of employment, each faculty and staff member and student employee must agree to abide by the university Drug-Free Workplace Policy, and to notify the divisional human resources director of any criminal conviction related to drug activity in the workplace (which includes any location where one is in the performance of duties) within five days after such conviction. If the individual is supported by a federal grant or contract, the university will notify the supporting government agency within 10 days after the notice is received.

Policy on Possession of Firearms on University Premises

The possession, wearing, carrying, transporting, or use of a firearm or pellet weapon is strictly forbidden on university premises. This prohibition also extends to any person who may have acquired a government-issued permit or license. Violation of this regulation will result in disciplinary action and sanction up to and including expulsion, in the case of students, or termination of employment, in the case of employees. Disciplinary action for violations of this regulation will be the responsibility of the vice president for human resources, as may be appropriate, in accordance with applicable procedures. Any questions regarding this policy, including the granting of exceptions for law enforcement officers and for persons acting under the supervision of authorized university personnel, should be addressed to the appropriate chief campus security officer.

Policy on the Privacy Rights of Students

The Johns Hopkins University complies with the provisions of the Family Educational Rights and Privacy Act of 1974 (P.L. 93-380), as amended, and regulations promulgated thereunder. Eligible students, as defined in the regulations, have the following rights: (1) to inspect and review their education records, as defined in the regulations; (2) to request the amendment of their education records if they are inaccurate or misleading; (3) to consent to the disclosures of personally identifiable information in their education records except to the extent permitted by law, regulation, or university policy; and (4) to file a complaint with the United States Department of Education if the university has failed to comply with the requirements of law or regulation. Copies of the university's policy on Family Educational Rights and Privacy are available from the Registrar's Office or may be accessed on the JHU website.

Annual Security Report

In accordance with the Crime Awareness and Campus Security Act of 1990 (P.L. 102-26), as amended, and regulations promulgated thereunder, the university issues an Annual Security Report, which describes the security services at each of the university's divisions and reports crime statistics for each of the campuses. Copies of the report are available from the university's Security Department, 14 Shriver Hall, 410-516-4600.

Equal Opportunity/Nondiscrimination Statement

The Johns Hopkins University admits students of any race, color, gender, religion, age, national or ethnic origin, disability, marital status or veteran status to all of the rights, privileges, programs, benefits, and activities generally accorded or made available to students at the University. It does not discriminate on the basis of race, color, gender, marital status, pregnancy, ethnicity, national origin, age, disability, religion, sexual orientation, gender identity or expression, veteran status, or other legally protected characteristic in any student program or activity administered by the University, including the administration of its educational policies, admission policies, scholarship and loan programs, and athletic and other University-administered programs or in employment.

Questions regarding Title VI, Title IX, and Section 504 should be referred to the Office of Institutional Equity, 130 Garland Hall, Telephone: 410-516-8075, (TTY): 410-516-6225.

General Anti-Harassment Policy

A. Preamble

The Johns Hopkins University is committed to providing its staff, faculty and students the opportunity to pursue excellence in their academic and professional endeavors. This opportunity can exist only when each member of our community is assured an atmosphere of mutual respect. The free and open exchange of ideas is fundamental to the University's purpose. It is not the University's intent in promulgating this policy to inhibit free speech or the free communication of ideas by members of the academic community.

B. Policy Against Discriminatory Harassment

1. *The University is committed to maintaining learning and working environments that are free from all forms of harassment and discrimination. Accordingly, harassment based on an individual's gender, marital status, pregnancy, race, color, ethnicity, national origin, age, disability, religion, sexual orientation, gender identity or expression*, veteran status, or other legally protected characteristic is prohibited. The University will not tolerate harassment, sexual harassment or retaliation in the workplace or educational*

environment whether committed by faculty, staff, or students, or by visitors to Hopkins while they are on campus. Each member of the community is responsible for fostering civility, for being familiar with this policy, and for refraining from conduct that violates this policy.

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* For the purposes of this policy, "gender identity or expression" refers to an individual's having or being perceived as having a gender-related self-identity, self-image, appearance, expression, or behavior, whether or not those gender-related characteristics differ from those associated with the individual's assigned sex at birth.

2. *For purposes of this policy, harassment is defined as:*

   a) *any type of behavior which is based on gender, marital status, pregnancy, race, color, ethnicity, national origin, age, disability, religion, sexual orientation, gender identity or expression, veteran status, that*

   b) *is so severe or pervasive that it interferes with an individual's work or academic performance or creates an intimidating, hostile or offensive working or academic environment.*

3. *Harassment when directed at an individual because of his/her gender, marital status, pregnancy, race, color, ethnicity, national origin, age, disability, religion, sexual orientation, gender identity or expression, personal appearance, veteran status, or any other legally protected characteristic may include, but is not limited to: unwanted physical contact; use of epithets, inappropriate jokes, comments or innuendos; obscene or harassing telephone calls, emails, letters, notes or other forms of communication; and, any conduct that may create a hostile working or academic environment.*

4. *Sexual harassment, whether between people of different sexes or the same sex, is defined to include, but is not limited to, unwelcome sexual advances, requests for sexual favors, sexual violence and other behavior of a sexual nature when:*

   a) *submission to such conduct is made implicitly or explicitly a term or condition of an individual's employment or participation in an education program;*

   b) *submission to or rejection of such conduct by an individual is used as the basis for personnel decisions or for academic evaluation or advancement; or*

   c) *such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creates an intimidating, hostile or offensive working or educational environment.*

Sexual harassment may include, but is not limited to: unwelcome sexual advances; demands/threats for sexual favors or actions; posting, distributing, or displaying sexual pictures or objects; suggestive gestures, sounds or stares; unwelcome physical contact; sending/forwarding inappropriate emails of a sexual or offensive nature; inappropriate jokes, comments or innuendos of a sexual nature; obscene or harassing telephone calls, emails, letters, notes or other forms of communication; and any conduct of a sexual nature that may create a hostile working or educational environment.

5. *Retaliation against an individual who complains of discriminatory harassment under this policy, is strictly prohibited. Intentionally making a false accusation of harassment is also prohibited.*

C. Responsibilities Under this Policy

The University is committed to enforcement of this policy. Individuals who are found to have violated this policy will be subject to the full range of sanctions, up to and including termination of his/her University affiliation.

1. *All individuals are expected to conduct themselves in a manner consistent with this Policy.*

2. *Staff, faculty and/or students who believe that they have been subject to discriminatory harassment are encouraged to report, as soon as possible, their concerns to the Office of Institutional Equity, their supervisors, divisional human resources or the Office of the Dean of their School.*

3. *Individuals who witness what they believe may be discriminatory harassment of another are encouraged to report their concerns as soon as possible to the Office of Institutional Equity, their supervisors, divisional human resources or the Office of the Dean of their School.*

4. *Complainants are assured that reports of harassment will be treated in a confidential manner, within the bounds of the University's legal obligation to respond appropriately to any and all allegations of harassment.*

5. *Managers, including faculty managers, who receive reports of harassment should contact human resources or the Office of Institutional Equity for assistance in investigating and resolving the issue.*

6. *Managers, including faculty managers, are required to implement corrective action where, after completing the investigation, it is determined corrective action is indicated.*

7. *The University administration is responsible for ensuring the consistent application of this policy.*

D. Procedures for Discrimination Complaints Brought Within Hopkins

Inquiries regarding procedures on discrimination complaints may be brought to Caroline Laguerre-Brown, Vice Provost for Institutional Equity for the university; Allison J. Boyle, Director for Equity Compliance & Education, Garland Hall 130, Telephone: 410-516-8075, TTY: Dial 711.

Policy on Sexual Harassment

A. Preamble

The Johns Hopkins University is committed to providing its staff, faculty and students the opportunity to pursue excellence in their academic and professional endeavors. This can only exist when each member of our community is assured an atmosphere of mutual respect, one in which they are judged solely on criteria related to academic or job performance. The university is committed to providing such an environment, free from all forms of harassment and discrimination. Each member of the community is responsible for fostering mutual respect, for being familiar with this policy and for refraining from conduct that violates this policy.

Sexual harassment, whether between people of different sexes or the same sex, is defined to include, but is not limited to, unwelcome sexual advances, requests for sexual favors, sexual violence and other behavior of a sexual nature when:

1) *submission to such conduct is made implicitly or explicitly a term or condition of an individual's employment or participation in an educational program;*

2) *submission to or rejection of such conduct by an individual is used as the basis for personnel decisions or for academic evaluation or advancement; or*

3) *such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creates an intimidating, hostile or offensive working or educational environment.*

Fundamental to the University's purpose is the free and open exchange of ideas. It is not, therefore, the University's purpose, in promulgating this policy to inhibit free speech or the free communication of ideas by members of the academic community.

B. Policy

The University will not tolerate sexual harassment, a form of discrimination, a violation of federal and state law and a serious violation of university policy. In accordance with its educational mission, the university works to educate its community regarding sexual harassment.

The University encourages reporting of all perceived incidents of sexual harassment, regardless of who the alleged offender may be. Individuals who either believe they have become the victim of sexual harassment or

have witnessed sexual harassment should discuss their concerns with the university's equity compliance director. Complainants are assured that problems of this nature will be treated in a confidential manner, subject to the University's legal obligation to respond appropriately to any and all allegations of sexual harassment.

The University prohibits acts of reprisal against anyone involved in lodging a complaint of sexual harassment. Conversely, the university considers filing intentionally false reports of sexual harassment a violation of this policy.

The University will promptly respond to all complaints of sexual harassment. When necessary, the university will institute disciplinary proceedings against the offending individual, which may result in a range of sanctions, up to and including termination of university affiliation.

Complaints of sexual harassment may be brought to Caroline Laguerre-Brown, Vice Provost for Institutional Equity for the university; Allison J. Boyle, Director for Equity Compliance & Education, Garland Hall 130, Telephone: 410-516-8075, TTY: Dial 711.

Sexual Assault Policy

A. Preamble

The Johns Hopkins University is committed to providing a safe educational and working environment for its faculty, staff and students. The University has adopted a policy addressing sexual assaults and offenses involving sexual violence in order to inform faculty, staff and students of their rights in the event they are involved in an assault and of the services available to victims of such offenses.

B. Policy

Members of the University community who are the victims of, or who have knowledge of, a sexual assault occurring on University property, or occurring in the course of a University sponsored activity, or perpetrated by a member of the University community, are urged to report the incident to campus authorities promptly. Persons who are victims of sexual assault will be advised by campus security of their option to file criminal charges with local police of the jurisdiction where the sexual assault occurred. Campus security and the Office of the General Counsel will provide assistance to a complainant wishing to reach law enforcement authorities.

A victim of an assault on University property should immediately notify campus security who will arrange for transportation to the nearest hospital. Persons who have been sexually assaulted will be taken to a hospital in Baltimore City designated as a rape treatment center. Mercy Hospital, 301 St. Paul Place 410-332-9000 is the current designated center for adult examination and treatment. This hospital is equipped with the State Police Sexual Assault Evidence Collection Kit.

The University will provide counseling to any member of the Hopkins community who is a victim of sexual assault and also will provide information about other victim services. Students can seek the assistance of counseling through their divisional counseling offices, and members of the faculty and staff can seek assistance through the Faculty and Staff Assistance Program (FASAP). A student who is a victim of sexual assault may request a transfer to alternative classes or housing if necessary to allay concerns about security. The University will try to accommodate the request if such classes and housing are reasonably available.

Persons who are the victims of sexual assault also may pursue internal University disciplinary action against the perpetrator. The University's disciplinary process may be initiated by bringing a complaint of sexual assault to the attention of a dean, department chairman or director, supervisor, divisional human resources office, or security office. The University's Office of Institutional Equity also is available to render assistance to any complainant. Allegations of sexual assault will be investigated by the appropriate security offices and any other offices whose assistance may be valuable for gathering evidence. The University reserves the right to independently discipline any member of the student body, staff or faculty who has committed a sexual or other assault whether or not the victim is a member of the University community and whether or not criminal charges are pending.

Disciplinary actions against students accused of sexual assaults will be processed by the appropriate student affairs office of the School or campus attended by the accused student in accordance with established disciplinary procedures pertaining to the School in which the student is enrolled. Disciplinary actions against staff members will be governed by the procedures set out in the University's personnel policies. Disciplinary actions against members of the faculty will be processed by the offices of the dean of the appropriate academic division according to the procedures established by that division. Both a complainant and the person accused of a sexual assault will be afforded the same opportunity to have others present during a University disciplinary proceeding. Attorneys, however, will not be permitted to personally participate in University disciplinary proceedings.

Both the complainant and the accused will be informed of the resolution of any University disciplinary proceeding arising from a charge that a sexual assault has been committed. The disciplinary measures which may be imposed for sexual assault will vary according to the severity of the conduct, and may include expulsion of a student from the University and termination of the employment of a member of the staff or faculty.

Photography and Film Rights Policy

The Johns Hopkins University reserves the right from time to time to film or take photographs of faculty, staff, and students engaged in teaching, research, clinical practices, and other activities, as well as casual and portrait photography or film. These photographs and films will be used in such publications as catalogs, posters, advertisements, recruitment and development materials, as well as on the university's website, for various videos, or for distribution to local, state, or national media for promotional purposes. Classes will be photographed only with the permission of the faculty member.

Such photographs and film—including digital media—which will be kept in the files and archives of The Johns Hopkins University, will remain available for use by the university without time limitations or restrictions. Faculty, students, and staff are made aware by virtue of this policy that the university reserves the right to alter photography and film for creative purposes. Faculty, students, and staff who do not want their photographs used in the manner(s) described in this policy statement should contact the Office of Communications and Public Affairs.

Faculty and students are advised that persons in public places are deemed by law to have no expectation of privacy and are subject to being photographed by third parties. The Johns Hopkins University has no control over the use of photographs or film taken by third parties, including without limitation the news media covering university activities.

Undergraduate Studies

Arts and Sciences freshmen enter in the fall semester without declaring a major. They may be undeclared until their sophomore year but will be asked to make an initial choice at the end of freshman year. Engineering freshmen usually select a major upon entry or they may decide to enroll as an "undecided engineering" student.

Undergraduates at The Johns Hopkins University have the freedom to plan the academic program that is right for them. Almost all programs can be worked out within the framework of an existing major. If, however, students have special interests that fall outside these regular majors, they and their advisors can plan an individual program to meet their needs, if the program conforms to the requirements of the interdisciplinary studies major.

The natural sciences area major does not require submission of a proposal because students have less freedom in choosing the course requirements for this area major.

The university offers both bachelor of arts and bachelor of science degrees, depending upon the student's major. The B.A. is most common in the School of Arts and Sciences, and the B.S. is most common in the School of Engineering. See the list of degree programs on page 56 for more information. The decision about which degree to pursue can be postponed until the sophomore year, or changed. In some departments, undergraduates of exceptional ability and motivation can do graduate work and qualify simultaneously for the bachelor's and master's degrees at the end of four years.

The high degree of flexibility that an undergraduate has in planning four years at Johns Hopkins carries with it the responsibility of designing a course of study that is integrated and meaningful. The student must ask, "What do I want from my undergraduate education?" and, as was the case in choosing a school, select the program that offers the greatest intellectual rewards and challenges, turning to the academic or faculty advisor for help when the choices are difficult. Those whose interests are not covered sufficiently in regularly scheduled classes can study independently under the guidance of a faculty member in their field. This independent study might take the form of a directed reading course or of conducting or assisting in a research project. Students may do only one independent project per semester.

While it is possible for qualified students to complete their degree requirements in less than four years or to take part in accelerated programs for advanced degrees, the undergraduate years are more than a prelude to graduate or professional school; they are an experience in themselves. Undergraduate life can be a time of discovery and adventure, both in and out of the classroom, with opportunities limited only by individual ability, capacity, and initiative.

Planning a Program

Many Hopkins undergraduates arrive with a clear idea of their academic interests, ready to specialize immediately. Others, equally serious, want to explore several areas of study, broadening their interests and satisfying their intellectual curiosity for its own sake. Such students will find that the best course of study is one that initially exposes them to a variety of disciplines. With the help of their academic or faculty advisors, they can wait until the beginning of the sophomore year to declare a major and still have sufficient time to delve into all facets of their chosen field. The student whose academic goal requires graduate or professional education will need to prepare, during the undergraduate years, to undertake specialized study. Those who plan to work for a graduate degree in an academic discipline will want to begin to familiarize themselves with the scope and character of their field. Students who want to enter a professional school after they graduate should consider the requirements of such schools when they plan their programs.

On the following pages are some suggestions for planning a course of study which will lead to a particular career. The course schedule itself should be worked out with help from the academic advisor and the Office of Academic Advising or the Engineering Office of Academic Affairs.

Major Fields of Study

Engineering

The Whiting School of Engineering offers programs leading to the bachelor of science in the fields of biomedical engineering, chemical and biomolecular engineering, civil engineering, computer engineering, computer science, electrical engineering, engineering mechanics, environmental engineering, materials science and engineering, and mechanical engineering. These programs, which are all accredited by ABET (the Accreditation Board for Engineering and Technology), are designed to provide a knowledge of the fundamental principles underlying individual fields, enabling graduates to remain on the cutting edge of technology and the professional training to excel in a spe-

cific engineering discipline. The Whiting School also offers a B.S. degree in applied mathematics and statistics, giving students the opportunity to explore this field in depth.

The Engineering School offers the bachelor of arts degree, which can be earned either with a major in general engineering or through the departments of Biomedical Engineering, Computer Science, Electrical and Computer Engineering, Geography and Environmental Engineering, or Applied Mathematics and Statistics. The B.A. in engineering is a true liberal arts degree but offers the student the ability to focus on a course sequence tailored to suit the student's intellectual needs.

During the first two years, the engineering curricula stress the physical, mathematical, and computational sciences as a foundation for more advanced study. Students are also exposed to engineering as a profession and to the fundamentals of various engineering disciplines. As students become more certain where their talents and interests lie, they will undertake intensive study in their chosen engineering field. To function as problem solvers and leaders, engineers must be broadly educated and be able to communicate effectively. To do so, engineers are required to take the equivalent of more than one semester of humanities and social science courses.

The engineering student's program of course work is enhanced by a rich intellectual environment that includes membership in student chapters of the professional engineering societies, elective courses, laboratory exercises, engineering design projects, and independent research under the direction of members of the faculty. Intersession courses featuring topics in business, management, and leadership complement the more technical and formal course work completed during the fall and spring semesters.

Engineering, like other professions, entails lifelong learning. Upon receiving the baccalaureate, approximately equal numbers of Johns Hopkins engineers enter graduate study as are employed in industry or government. Ultimately, however, nearly all Hopkins engineers pursue graduate degrees. The Whiting School's honors bachelor's/master's program, under which talented students typically complete both degrees in five years—receiving 50 percent tuition fellowships during the fifth year—is an especially attractive option.

Humanities

The student will find areas of study in the humanities at Johns Hopkins that either were not available in secondary school or were encountered only at an elementary or introductory level. Courses are offered in philosophy, classical Latin and Greek, history of art, creative writing, comparative literature, area studies in Africa, East Asia, the Near East and Jewish culture, film and media studies, and history of science and technology, as well as in the more familiar areas of English and American literature, history, and modern foreign languages. A departmental major allows the student to study a specific discipline in depth and generally leads to advanced study beyond the baccalaureate degree.

Students should plan on a fairly broad program in the humanities for the first two years. As their interests begin to focus on some specialty, students normally devote the last two years to intensive study in their major or concentration. The humanities faculty is made up of eminent scholars, helpful both as teachers and advisors. Advanced courses are usually small, permitting the development of good teacher-student relationships.

Natural Sciences

For the student considering a career in the sciences, Johns Hopkins has much to offer at the undergraduate level. The departments of Biology, Biomedical Engineering, Biophysics, Chemical and Biomolecular Engineering, Chemistry, Civil Engineering, Cognitive Science, Computer Science, Earth and Planetary Sciences, Electrical and Computer Engineering, General Engineering, Geography and Environmental Engineering, Materials Science and Engineering, Mathematical Sciences, Mechanical Engineering, and Physics and Astronomy offer programs leading to bachelor's degrees. All programs offer a sound foundation in the sciences and mathematics and require course work in the humanities and social sciences. Some require a degree of proficiency in a modern foreign language.

Research has always played an important role in the development of scientific ideas and in technological advancement. Most of the faculty members in the natural sciences are actively engaged in research, most often with graduate students. Undergraduates are also encouraged to undertake research under the direction of faculty members.

While many of the programs and activities of the science departments are geared to preparation for graduate studies, the breadth and flexibility of the basic programs assure the student of an able preparation for any career in the sciences or related fields as an undergraduate.

Quantitative Studies

Quantitative studies are concentrated in the departments of Mathematics (School of Arts and Sciences) and Applied Mathematics and Statistics (School of Engineering), but several other departments, in par-

ticular Computer Science and Physics and Astronomy, offer courses on applications of mathematics. The student whose interests lie mainly in classical areas of pure mathematics such as algebra, analysis, number theory, and topology should consider the program of the Department of Mathematics. The Department of Applied Mathematics and Statistics emphasizes several areas in modern applied mathematics, including discrete mathematics, operations research, probability/statistics, and scientific computation and has programs leading to the B.A. or the B.S., depending on choice of electives. This major prepares one for work as an applied mathematician, provides quantitative background for a career in business or management, or leads to graduate study in the mathematical or computer sciences.

Social and Behavioral Sciences

The student who is interested in the social or behavioral sciences will find a variety of programs available in anthropology, economics, geography, history, political science, psychological and brain sciences, and sociology. As in most of the other academic areas at Johns Hopkins, the departments are oriented toward research, and the curricula are primarily designed to lead to graduate study. Programs in the social and behavioral sciences are useful as preparation for advanced study in law, medicine, government, business, and urban problems. Independent work is encouraged. A program in the social and behavioral sciences should cover the basic courses in related areas during the first two years. Courses in mathematics, statistics, and computer science will also be helpful, as most department programs have quantitative applications.

Preparation for a Career

Choosing a Career

Students will find that faculty members and academic advisors can be very helpful to those who seek their advice. An academic advisor in Arts and Sciences or a faculty advisor in Engineering can help them become a part of the campus academic life more rapidly than they could on their own. A permanent faculty advisor is assigned when the student decides on a definite major—for Arts and Sciences students, in the sophomore year; Engineering students may declare their major in the freshman year.

The Office of Preprofessional Programs and Advising—offering health professions and pre-law advising—offers excellent preprofessional as well as general advice. The Career Center and the Counseling Center also offer career counseling.

College or University Teaching and Research

A major function of The Johns Hopkins University has always been to educate future teachers and scholars. The university is, in many ways, admirably suited to the task. Its undergraduate and graduate studies are intimately connected. The same faculty members—among them, some of the nation's foremost scholars—devote their efforts to both. Creative scholarship at the undergraduate as well as the graduate level is a strong tradition here. Exceptional scholars, research scientists, writers, and teachers have studied at Johns Hopkins and have gone on to teach and do important work in their fields all over the world. The student who is interested in a career in college or university teaching and research should probably plan on a departmental major leading to graduate study.

Medicine and Other Health Professions

Johns Hopkins graduates are well prepared for careers in the health professions. There is no specific premedical major at Johns Hopkins. Medical schools value a broad undergraduate experience. Beyond a few basic courses (typically, general and organic chemistry, biology, physics and their appropriate laboratories, English, and calculus or statistics), students are encouraged to major in what they enjoy, with the result that successful applicants to medical schools come from nearly every major. Majors in public health studies and the history of science and technology are popular because their flexibility allows students to take courses across the curriculum.

Pre-medical students are able to pursue their research interests on the Homewood campus and also at the Johns Hopkins University Medical Institutions. The office offers tutorials at the Johns Hopkins Medical School offered to sophomores, juniors, and seniors to provide them a better understanding of the medical profession.

The Office of Pre-Professional Advising assists students interested in allopathic medicine, dental medicine, veterinary medicine, podiatric medicine, osteopathic medicine, public health, and other health professions. Through this office, students receive advising and the support of the Health Professions Committee, which serves as a resource during the application process to medical and other health professions schools. More information can be found on the office website at **jhu.edu/prepro**.

Law

Law schools do not as a rule have specific academic requirements for admission, but they are usually impressed by applicants who can demonstrate that

they have challenged themselves in a diverse course of study. No one curricular path is the ideal preparation for law school. With the complexity of legal issues today, both nationally and internationally, a broad liberal arts curriculum is the preferred preparation for law school.

The undergraduate course selection should support development of critical thinking, logical reasoning, and effective writing. It should also demonstrate academic rigor. Unlike a pre-medical curriculum, most law schools are not necessarily impressed by "law" related courses taken at the undergraduate level, as they are different from those offered in law school. Focusing on "law" courses as an undergraduate may not allow the breadth and depth of challenging course work otherwise available—and may result in a less diverse and enjoyable undergraduate experience.

However, there are courses students may take to improve the skills required to succeed in law school. For example, reading and writing skills are very important. Courses in disciplines such as history, for instance, may help a student build these important skills.

The Office of Pre-Professional Programs and Advising assists students interested in pursuing a Juris Doctor (law degree), or joint Juris Doctor programs. This office serves as a resource, providing advising and support throughout a student's entire undergraduate career, particularly during the application process. Students should meet with a pre-law advisor from time to time to determine whether they are taking the best steps for them on their path to law school.

Government Service

Johns Hopkins has many advantages for students planning a career in government, not the least being its proximity to Washington, D.C. This is especially useful for those interested in a career in foreign service or international business. Experience in state and city government is also possible through several internship programs. The Aitchison Public Service Fellowship in Government allows students to study public policy in Washington, D.C. for a semester.

The student thinking about government service might choose a broad program in an area major or concentrate in political science, economics, or international studies. An interest in international studies could lead to graduate work in the field, possibly through the accelerated B.A./M.A. program with the Nitze School of Advanced International Studies (SAIS) in Washington, D.C. or with the Sciences Po program in Paris. Those enrolled in these programs can receive the B.A. and M.A.

degrees in five years instead of the usual six. For more information on these opportunities, see the international studies major. Students planning to take the Foreign Service Examination will need a strong general background in such subjects as history, political science, economics, geography, philosophy, literature, and foreign languages.

A program in urban or environmental studies prepares the student to work in local government agencies. Another form of government service—a career as an officer in the armed forces—is open through the Army ROTC program on campus.

Business and Management

Most business executives agree that a fundamental education in the arts and sciences is good preparation for a career in business or industry.

A minor in entrepreneurship and management, sponsored by the Center for Leadership Education in the School of Engineering, helps prepare students for careers in business, marketing, social entrepreneurship and finance, or to continue to business graduate school programs. The minor allows students, upon completion of three core courses, to develop an individual program in specialty areas of finance and accounting, marketing and communication, business law, or leadership and management.

Teaching

The School of Education offers a Master of Arts in Teaching (MAT), which prepares students for initial certification in Maryland. The following teacher certification areas have been approved by the Maryland State Department of Education: Early Childhood (grades pre-K to 3); Elementary (grades 1–6); Secondary (grades 7–12) in English, math, foreign language (French and Spanish), social studies, and science (biology, chemistry, earth science, and physics); and English for Speakers of Other Languages (ESOL) (grades pre-K to 12). This 39-credit master's program is designed for individuals who have already earned a bachelor's degree. Highly qualified Johns Hopkins undergraduates may also be considered for early admission into the Accelerated Master of Arts in Teaching (AMAT) program during their junior or senior years or after completion of 60 credits. Students accepted into the AMAT program may take up to 12 graduate credits (which also count toward their bachelor's degree) before their undergraduate graduation and complete the remaining teacher certification requirements in one of the MAT graduate program options.

For further information, students should contact Ms. Veronique Gugliucciello at 410-516-9759 or visit the School of Education website at **http:// education.jhu.edu/**.

Academic Information for Undergraduates

Academic Advising

Office of Academic Advising

The Office of Academic Advising (OAA) promotes academic excellence and intellectual exploration. The advising staff wants every student at Johns Hopkins to take full advantage of a Hopkins education by exploring a variety of disciplines and sharpening necessary skills. OAA believes in the power of a liberal education and recognizes that a successful and fulfilling education must be managed well. Among the many programs OAA offers are:

- Freshman advising—All freshmen in Arts and Sciences receive advising through OAA. OAA has a unique perspective across disciplines to help students find an academic home that is challenging and interesting.
- Counseling to choose a major—At the end of their first year, freshmen choose a major. OAA helps them with this process by looking at their record, interests, and expectations. (Upperclassmen have faculty advisors to guide them through the major.)
- Workshops—OAA sponsors targeted workshops throughout the year on topics such as studying abroad, study habits, and preparing for graduate school.
- Academic support—OAA offers tutors and study consultants to help students succeed. OAA handles all cases of academic difficulty.

Study Abroad Office

The Study Abroad Office helps undergraduates in Arts and Sciences and in Engineering find exciting and challenging educational opportunities overseas. Students will find many resources through the office: a website with listings around the world, personal advising to match their interests with programs, program brochures and information, and years of feedback from students who have returned from abroad. The office, in partnership with a standing faculty committee, works to ensure that students will study in programs that are as rigorous as those at Hopkins. The office also supports programs run by Hopkins faculty and departments, such as that now offered in Madrid, Spain.

Office of Engineering Advising

The Office of Engineering Advising has general responsibilities for all engineering majors in the Whiting School of Engineering. The Assistant Dean for Academic Advising and her staff coordinate faculty advising, maintain student records, assist students with academic problems, and provide information concerning academic regulations. It also provides support for Hopkins' chapters of cross-departmental organizations such as the Society of Women Engineers, the National Society of Black Engineers, Society of Hispanic Professional Engineers, and Engineers Without Borders.

Undergraduate Student Handbook

The Undergraduate Student Handbook is updated annually online as a supplement to the catalog for undergraduates. This handbook, available online through **www.advising.jhu.edu** and **http://eng.jhu.edu/wse/page/current_undergraduates**, contains academic information, policies, and requirements in more detail than the catalog. All undergraduates are responsible for the information in this handbook.

Academic Ethics

The university expects its students to have academic ethics of the highest order. The Undergraduate Academic Ethics Board, composed of 10 students and eight faculty members, is responsible for implementing its constitution. This includes formal hearings of suspected violations. All members of the Hopkins community are responsible for the academic integrity of the university and should inform the Ethics Board of any suspected violations of the constitution, which is appended to the Undergraduate Student Handbook. In addition, a guide on "Academic Ethics for Undergraduates" is available to help students and faculty better understand the rules and procedures. The Ethics Guide is available at **http://eng.jhu.edu/wse/page/ethics**.

Grades and Grade Reports

The scale of marks for official grade reports is as follows: A+, A, A- (Excellent); B+, B, B- (Good); C+, C, C- (Satisfactory); D+, D (Passing); F (Failure); I (Incomplete); R (Course is repeated); S (Passing in an S/U course); U (D or F in an S/U course. U grades will not be computed in the G.P.A.); YR (for yearlong course). For the freshman grading policy see page 43.

Grade reports are prepared at the end of each term for all undergraduates. The report provides the student's semester record of courses, credits, and grades, as well as the semester and cumulative grade point averages.

Grade reports can be viewed and printed online. Students can request that grade reports be sent to their parents by completing a Grade Report

Release Form at the Registrar's Office. For more detailed information, refer to Important Notices at **www.jhu.edu/registrar**.

Academic Difficulty

The records of all students are reviewed at the end of each term. A student whose term grade point average is below 2.0 or who has completed fewer than 12 credits will be placed on academic probation, and a letter of academic probation is sent to the student. Copies are also sent to the parents and to the faculty advisor. Academic probation is regarded as a warning action rather than academic censure.

Continued inability to maintain a 2.0 average for two consecutive semesters, or if a student falls behind in credit accumulation by 24 or more credits, will result in academic dismissal. Students with serious academic problems should talk with the Assistant Dean of Academic Advising in either Engineering or Arts and Sciences.

Satisfactory/Unsatisfactory Option

All students, except first-term freshmen, can take one course each semester on a satisfactory/unsatisfactory basis. The course must be outside the student's major or minor. The purpose of the satisfactory/ unsatisfactory option is to encourage students to investigate subjects other than their major concentration without fear of receiving a poor grade. If a student takes a mandatory satisfactory/unsatisfactory course, he/she cannot select an additional satisfactory/unsatisfactory course for that semester. Rules for the satisfactory/unsatisfactory option are included in the Undergraduate Student Handbook and in the advising manuals for engineering programs.

First-Term Grades

In the first semester of their first year, students entering from high school receive a grade (A+, A, A-, B+, B, B-, C+, C, C-, D+, D, F) in each course taken. The official transcript does not show the specific letter grades for the first semester. The letter grades are covered by S, UCR, or U notations according to the following rules:

- Courses completed in the first semester with a grade of C- or better receive a grade of S (for Satisfactory). Courses with grades of D or D+ receive the grade of UCR (for Unsatisfactory with Credit). Courses with the grade of F receive the grade of U.
- First-semester grades are not included in a student's permanent grade point average, although the grades are used by the advising offices to determine if students have made satisfactory

academic progress during the first semester. All students are required to earn a term GPA of 2.0 or better, and complete a minimum of 12 credits, to be in good academic standing. The Registrar's Office also uses the first-term grades in order to determine eligibility for Dean's List honors (minimum 3.5 term GPA in at least 12 graded credits).

- A record of first-term grades is neither printed for the student nor mailed to the student's parents, and is not released to anyone outside the School of Arts and Sciences or Engineering. Students can view an unofficial report of first-semester grades online using their ISIS account. Academic advisors and faculty advisors receive copies of the first-term grades of their advisees. Students are encouraged to meet with their advisor to discuss these grades.
- The official student transcript carries the S, UCR, and U notations for the first semester. Beginning in the second semester, letter grades are recorded and displayed on the student's official transcript.

Absolving a Grade

Students may retake a course to absolve a grade of C+ or lower. The grade for the second attempt and the associated credits are recorded on the transcript and are calculated in the GPA. The original grade remains along with the notation "R" to indicate the course was retaken. Such R grades do not affect grade point calculations; they do not carry credit toward graduation. Only the grade in the retaken course accrues credit and applies to the GPA, even when the retaken grade is lower than the original grade. A student may retake a course once. Taking the same course a third time or retaking another course requires permission of the student's academic advising dean.

Academic Requirements

Credit and Residence Requirements

A candidate for a baccalaureate degree must complete a minimum of four semesters as a full-time student in Arts and Sciences/Engineering and must accumulate no fewer than 60 degree-credits while a student in Arts and Sciences/Engineering. A student is expected to be a full-time student in Arts and Sciences/Engineering in the semester in which the requirements for the baccalaureate degree are completed. The bachelor of arts degree requires a minimum of 120 credits; no program may require more than 120 credits. The bachelor of science degree requires between 120 and 130 credits, depending on the major; no program may require more than 130 credits. The standard

undergraduate course load is 15 credits for Arts and Sciences majors and 16-17 credits for Engineering majors.

- No more than a total of 12 transfer and summer credits from other schools may be applied toward graduation, whether earned before or after matriculation.
- Exclusions from the 12-credit limit:
  - exam credit (Advanced Placement, GCE, IB)
  - JHU Summer Session
  - approved study abroad credits taken after matriculation.
- Although credits earned in the JHU Summer Session count toward graduation, summer terms cannot be applied toward the four semesters required for residency.
- No more than 18 credits of D or D+ work can be applied toward the minimum credit requirements.

Course Loads

The following regulations apply to course overloads:

- **Sophomores, juniors, and seniors:** Upperclass students in the School of Arts and Sciences will be permitted to take a maximum of 18.5 credits per semester and 19.5 credits in the School of Engineering.
- **Freshmen:** The credit limits for both first- and second-semester freshmen will be 16.5 credits in the School of Arts and Sciences and 18.5 in the School of Engineering (see the Undergraduate Student Handbook).

Minors

Students may complete requirements for a minor in Africana Studies, Anthropology, Applied Mathematics and Statistics, Bioethics, Civil Engineering, Classics, Computer Integrated Surgery, Computer Science, Economics, Engineering for Sustainable Development, English, Entrepreneurship and Management, Environmental Engineering, Environmental Sciences (for students trained in other science disciplines), Environmental Studies (for social science majors), Film and Media Studies, Financial Economics, French Cultural Studies, French Literature, German, History, History of Art, History of Science and Technology, Italian, Jewish Studies, Latin American Studies, Linguistics, Mathematics, Museum and Society, Music, Philosophy, Physics, Psychology, Robotics, Russian, Spanish for the Professions, Spanish Language and Hispanic Culture, Theatre Arts, and Women, Gender, and Sexuality. Students should consult the Undergraduate Student Handbook, Office of Academic Advising, or individual departments for the guidelines for minors.

Writing Requirement

All undergraduates are required to fulfill the university writing requirement. Students in Arts and Sciences and candidates for a B.A. degree in Engineering are required to complete 12 credits in writing-intensive (W) courses before graduation; students pursuing a B.S. in biology or physics must also complete 12 credits in W courses. Candidates for a B.S. in Engineering are required to complete 6 credits in W courses.

Writing-intensive courses (which require 20 pages of finished writing, over multiple assignments, with opportunities for critique and revision) are found across the curriculum and at every level. Expository Writing courses (060.100 and 060.113/114) introduce students of all majors to the concepts and strategies of academic argument. These courses count toward the writing requirement. All writing-intensive (W) courses in the disciplines, taken in fulfillment of the university writing requirement, as well as Advanced Expository Writing (060.215), must have a grade of C- or higher; they may not be taken on a satisfactory/unsatisfactory basis.

Foreign Languages

Requirements or recommendations for the study of a foreign language will be found in the description of the various undergraduate majors. Language requirements can be met by university course work, by the Advanced Placement language test or SAT II test passed at a specified level.

A student whose native language is not English will not be granted credit for his/her native language. In some instances, native language proficiency may be used to waive major language requirements, though this varies by program.

Except for the courses offered by the Language Teaching Center, both semesters of language elements must be completed with passing grades in order to receive any credits for the courses. Language elements courses may not be taken on a satisfactory/unsatisfactory basis. Students in the School of Arts and Sciences do not receive an area designation for these elements courses. For students in the School of Engineering, language elements courses can be substituted for humanities courses in meeting the distribution requirement.

Language courses must be taken in sequence. Credit will not be awarded for a lower-level course taken after an upper-level course. Credits will not

be awarded to a lower-level course if taken concurrently with an upper-level course.

Study Abroad

Qualified students may want to undertake a program for study abroad, normally during the junior year. Seniors may participate in their final term only if the program is administered by Johns Hopkins. In order to be eligible, a student should have a B average. Students should submit, with their faculty advisor's approval, a planned program of study showing how study abroad will advance their education without delaying their graduation. Information on opportunities for foreign study is available in the Study Abroad Office.

Bologna Center

The School of Arts and Sciences sponsors a one-year program for selected upper-level undergraduates at the Bologna Center of The Johns Hopkins University in Bologna, Italy. The program is open to students majoring or concentrating in history, international studies, political science, or economics. This opportunity for interdisciplinary study in a European-American setting offers small classes, close contact between faculty and students, and a series of guest lecturers and study trips.

Students pay the regular Johns Hopkins tuition charges, a student activity fee, an intensive language course fee, their transportation to Italy, and their room and board in Bologna. Financial aid based on need is available on a competitive basis. Interested students should consult the Study Abroad Office for additional information.

JHU Summer Session

The JHU Summer Session offers a wide selection of undergraduate courses in two five-week terms. Summer courses, sponsored by the same academic departments that oversee the university's full-time degree programs, are designed to reproduce, as closely as possible, similar courses offered during the spring and fall semesters. In most cases, Johns Hopkins students can count summer courses toward fulfillment of departmental degree requirements. There is no limit to the number of credits Hopkins students may earn in the JHU Arts and Sciences Summer Session. Summer courses are also open to visiting undergraduates and academically talented high school students admitted to the Arts and Sciences Pre-College Program.

Arts and Sciences Pre-College Program

Each year, Johns Hopkins Summer Programs brings academically talented high school students to the Hopkins campus to take college courses and preview college life. To be admitted, high school students must demonstrate the ability to complete college-level work, as evidenced by the rigor of their high school program, standardized test scores, letters of recommendation, and an application essay. Open to commuters in both terms and to residential students in the second term, participants earn college credit, supported by special workshops and advisors, to ease the transition from high school to college.

Graduation

To be approved for graduation the student must:

- complete an online application for graduation (May and December degree candidates) or a paper application for graduation (August degree candidates).
- complete the requirements of a departmental major or area major as listed later in this section. (Specific requirements are stated in the descriptions of the individual majors.)
- achieve a C (2.0) grade point average in the major. (Some departments do not count C-, D+, or D credits toward the major.)
- earn the minimum number of credits required for the degree, not including incomplete grades.
- fulfill the minimum residence requirement. A student is also required to be enrolled as a full-time student in Arts and Sciences or Engineering during the semester in which the requirements for the baccalaureate degree are completed.
- pay all fees and charges, including any campus traffic and parking fines.
- resolve all outstanding charges of misconduct and violations of academic ethics.

It is the student's responsibility to notify the registrar and the Office of Academic Advising (Arts and Sciences) or the Office of Engineering Advising (Engineering) of his/her eligibility for graduation. Students should apply for graduation at the end of the spring semester of the junior year.

Cooperative Programs

Other Colleges

Johns Hopkins participates in cooperative programs with the following colleges in the Baltimore area: Goucher College, Loyola College in Maryland, Morgan State University, College of Notre Dame of Maryland, Towson University, and the University of Maryland, Baltimore County. Hopkins sophomores, juniors, and seniors can

take courses at these institutions (normally one a semester) if the courses are substantially different from those offered at Johns Hopkins. Similar arrangements on a limited basis are in effect with the Maryland Institute College of Art. Details of these programs are contained in the Undergraduate Student Handbook.

Long-standing cordial relations with Goucher College have resulted in cooperative arrangements in both academic and nonacademic areas. Goucher faculty give courses in Russian on the Homewood campus. Students of both schools combine their talents in various nonacademic activities, particularly dance.

Peabody Institute

The Peabody Institute, a division of The Johns Hopkins University, comprises the Conservatory of Music and a noncredit preparatory school. Through cross-registration, full-time undergraduate degree candidates in the schools of Arts and Sciences and Engineering are eligible to participate in classes, lessons, and ensembles at Peabody on a space-available basis. At the Conservatory, auditions are required for assignment to private lessons and ensembles. There is a per-credit charge each semester for private lessons at the Peabody Conservatory. Please see the Peabody Conservatory website for current rate.

Peabody faculty also teach selected music courses on the Homewood campus.

Accelerated Graduate Study

Opportunities for accelerated study exist for exceptional students. In some departments they can work toward an M.A., M.S., or M.S.E. at the same time as a B.A. or B.S.E. degree in the same or another field. The bachelor's degree is usually awarded after four years of study, and the master's after the fourth or fifth year. (see Degree Programs, page 56.)

The student can also apply for admission to a graduate program after two years of undergraduate work. Application should be made through the Office of Graduate Admissions, Mergenthaler Hall, after consultation with the department concerned.

The Whiting School requires that a student apply for concurrent student status no later than the end of the first semester during the senior year, but individual departments may have earlier deadlines. Please check with the department to determine its application deadline and degree requirements for a concurrent degree program.

The registration status of Whiting School of Engineering students who have been admitted into a concurrent bachelor's/master's degree program may switch from "undergraduate" to "graduate" once they obtain clearance from their respective departments and either: (1) complete the requirements for a bachelor's degree, or (2) complete eight semesters of full-time study, whichever comes first.

B.A./M.A. Program in International Studies

This opportunity for accelerated graduate study is open to outstanding students after their sophomore year. Those selected complete three years on the Homewood campus and two years at The Paul H. Nitze School of Advanced International Studies in Washington, D.C. (see International Studies, page 256.)

Independent Study/Research/Internships

Independent work is a significant feature of the Hopkins undergraduate program. Research or study of material not included in a regularly offered course can be done under faculty supervision as part of a student's program. In general, independent work is an individual rather than group activity, but this does not preclude students from working together on a common project. Credits for independent work do not fulfill distribution requirements but do count as credits toward graduation. Six credits a year in independent study, internships, and research may be credited toward an undergraduate degree. Detailed rules and instructions for independent work are given in the Undergraduate Student Handbook.

Grants and Fellowships

Major Grants Administered by the Office of Academic Advising

The scholarships below empower students to go to graduate school, to study abroad, to serve the public, and to enjoy world travel. Visit the OAA website for more information and links to other resources at **www. advising.jhu.edu**. Graduate students interested in grants other than the Fulbright, NSF, and Luce should see their department advisors.

Name	To Fund
BEINECKE	A graduate degree in the arts, humanities, or social sciences
COOKE	A graduate degree in any field
DAAD	One year of study in Germany in any field after graduation
FREEMAN-ASIA	Funding for undergraduate study abroad in Asia
FULBRIGHT	One year of study in one of a hundred countries in any field after graduation
GATES	Graduate study at Cambridge University, England
GOLDWATER	One to two years of undergraduate study in mathematics, natural sciences, or engineering
HERTZ	Up to five years of graduate study in applied physical science
HUNTINGTON	One year public service project in U.S. or abroad
JAVITS	Up to four years of graduate study in certain fields, leading to M.F.A. or Ph.D.
LUCE	One year of internship work in East Asia
MADISON	A master's degree to teach government and the Constitution in high schools
MARSHALL	Two years of graduate study in United Kingdom
MELLON	One year of graduate study in certain "humanistic" fields
MITCHELL	Funding for graduate study in Republic of Ireland or Northern Ireland
NIH *(undergrad)*	Up to four years of undergraduate study in biomedical and health research
NSEP/BOREN	Semester or year of undergraduate study abroad with public service commitment
NSF	Up to three years of graduate study in science, mathematics, or engineering
PICKERING	Two years of graduate study with obligation to serve in the U.S. Foreign Service
RHODES	One to three years of graduate study anywhere in the world
ROTARY	One to three years of graduate study anywhere in the world
TRUMAN	Four years of undergraduate and graduate study with a public service commitment
UDALL	Undergraduate study in the environment and for Native Americans in certain fields
WALSH/SDS	One year of international travel, reserved for graduating seniors from Hopkins

General Requirements for Departmental Majors

Bachelor of Arts

B.A. Programs in Arts and Sciences

Students enrolled in a departmental major must meet the following general program requirements to qualify for the B.A. degree:

- Complete the program of study outlined by the major department or departmental advisor.
- Fulfill the university writing requirement (see page 44).
- Fulfill the university distribution requirement of earning at least 30 additional credits in courses coded for areas outside the area that includes their own department, *excluding courses that are prerequisites for required courses for the major.*
- Complete additional courses needed to meet the minimum degree requirement of 120 credits.

Distribution Requirement

Courses that satisfy the distribution requirement are coded as follows: Natural Sciences (N), Mathematics or other Quantitative Studies (Q), Humanities (H), Social or Behavioral Sciences (S), and Engineering (E). For a departmental major in any one of these areas, courses having a different distribution coding than those in his own department are "outside" courses. For example, a biology major must take at least 30 credits coded (H),(Q),(S),(E), but not (N).

For science, math, and engineering majors, at least 18 credits of the required 30 must be in (H),(S) courses. For humanities and social science majors, at least 12 credits must be in (N),(Q),(E) courses, in any combination. At least 6 distribution credits should be earned in each of the first two years. Credits for independent study, independent research, and internship do not fulfill distribution requirements but do count as credits toward graduation.

B.A. Program in Engineering

Although there are general requirements for the B.A. in an engineering discipline, the curriculum is tailored to each student's individual needs. Students take a core of five fundamental engineering courses, an engineering concentration, broad course work in mathematics and the natural sciences, and more than one-quarter of their total courses in the humanities and social sciences. Planned by the student and his/her advisor, the engineering concentration consists of six or seven courses (at least two at an advanced level) related either departmentally or thematically. Examples of interdepartmental concentrations are biotechnology, systems engineering, and computer technology.

Bachelor of Science

B.S. Programs in Arts and Sciences

Bachelor of science programs are offered in the Physics and Astronomy Department and the Biology Department. The B.S. in physics degree program is designed for students who plan to apply for scientific or technical positions in industry immediately after graduation, or who intend to pursue graduate study in engineering. The program requires 126 credits for graduation.

The Biology Department offers a B.S. degree in Molecular and Cellular Biology designed to increase the breadth of undergraduate training and afford greater educational possibilities and career options. The program requires 120 credits for graduation.

B.S. Programs in Engineering

Each bachelor of science program is offered by a department in the Whiting School of Engineering, which is responsible for the degree requirements. A student working for the B.S. degree must meet the following general requirements:

- Complete the program of study outlined by the department offering the major.
- A minimum of 75 credits earned in courses coded (E),(Q),(N), with at least 30 credits in courses coded (N) or (Q), with no course counted twice. At least 30 of these credits must be earned outside the student's major department.
- A minimum of six courses coded (H) or (S) (at least 3 credits each for a minimum of 18 credits).
- Two writing-intensive (W) courses (at least 3 credits each).

Credits for independent study, independent research, and internship do not fulfill distribution requirements but do count as credits toward graduation. The student's major department or departmental advisor must approve all course selections.

General Requirements for the Interdisciplinary Studies and Natural Sciences Area Major

Interdisciplinary Studies

The School of Arts and Sciences has replaced the area majors in humanistic studies and in social and behavioral sciences with a major in interdisciplinary studies. The school allows students to combine two or more of the disciplines in Arts and Sciences to develop a major focused on a particular topic or intellectual theme. Therefore, courses proposed for this interdisciplinary major must have coherence and build toward a rich exploration of a clear set of principles or questions.

Students design their own academic programs with the assistance of a faculty advisor, who must be a full-time faculty member in Arts and Sciences, and in consultation of the Assistant Dean of Academic Advising, who oversees the program. Students write a proposal explaining the theme or topic to be explored. The proposal must include a list of courses and an explanation of how each course relates to the major's themes. This proposal must be presented no later than the second semester of junior year, and must be approved by the Arts and Sciences Curriculum Committee. Once approved, students may not change the proposed requirements without additional approval.

Major Requirements

- All courses for the major must be taken for a grade. Students must earn a C- or better in all courses. Courses taken S/U or P/F do not count.

- Students must earn at least 45 credits in the completion of the major.

- At least 21 credits must be completed at the 300-level or higher and may not be counted toward another major or minor.

Distribution Requirements

- Students must complete 30 credits that meet distribution requirements outside the major.

- Students must complete no fewer than 12 credits of N, Q, or E courses either in the major or as an elective.

- Students must complete no fewer than 12 credits of H courses either in the major or as an elective.

- Students must complete no fewer than 12 credits of S courses either in the major or as an elective.

Natural Sciences

The natural sciences area major offers students an opportunity to fashion a major according to their needs from appropriate upper-level courses in two different areas of natural science. The student may elect to construct a program bridging biology and chemistry, chemistry and physics, or some other combination. The student is free to select the courses to be taken as long as the program forms a sensible, coherent whole.

The area major in natural sciences can be used as preparation for a career in medicine, dentistry, or veterinary science, if the introductory courses chosen by the student include those prescribed for admission to these professional schools. Students selecting the natural sciences area major can also go on to do graduate work in natural science, though they may find that they will have to take some remedial work in graduate school if their undergraduate program does not include the courses that are usually required by a traditional major in a particular subject.

Requirements

The requirements of the natural sciences area major are the following:

Introductory Science Courses
One year of introductory chemistry with laboratory, one year of general physics with laboratory, one year of calculus, and 20 credits of other introductory and/or upper-level science (N) and mathematics (Q) courses. Premedical students normally take one year of organic chemistry with laboratory and one year of biology with laboratory.

Upper-Level Science Courses
Five one-semester courses at the 300-level or higher, totaling at least 15 credits. These courses are to be divided between two different science departments. Courses used to satisfy the introductory science requirement above cannot be used to fulfill this requirement. Three of the courses must be taken in one of the following departments: Biology, Biophysics, Chemistry, Earth and Planetary Sciences, or Physics and Astronomy. Two of the courses may be taken in appropriate areas of engineering, mathematics, mathematical science, or (N)-coded psychology.

Laboratory courses may not count as upper-level science courses but do count for lower-level sci-

ence courses. Further information is available in the Office of Academic Advising.

Humanitie and Social Science Courses

A minimum of 30 (H) and (S) credits. These credits must include five courses at or beyond the 300-level, totaling at least 15 credits, to be taken in at most three different departments.

Electives

Elective courses from any area can be used to fulfill the minimum degree requirements of 120 credits.

Foreign Language

Proficiency is required in a modern foreign language equivalent to one year of an elementary college-level course or at least one semester of an intermediate-level course. An SAT Achievement Test score of 450 or above can be presented to fulfill the language requirement.

Writing Requirement

(see page 44.)

Academic Standards

Students must maintain an overall grade point average of 2.0 in their major. The requirement of five 300-level science courses and five 300-level humanities and social science courses must be fulfilled using courses taught during the regular academic year at Hopkins or in the Johns Hopkins University Arts and Sciences Summer Session. They cannot include Carey Business School or School of Education research, internship, or independent study credits. Satisfactory/unsatisfactory courses (except for the 300-level humanities and social science courses) may not count toward these requirements. (*Checksheets are available in the Office of Academic Advising.*)

Academic Information for Graduate Students

Graduate Student Handbook

The Graduate Student Handbook is issued annually to all incoming graduate students and departments. This handbook, available online through **www.grad.jhu.edu/student-life/policies**, contains academic information, policies, and requirements in more detail than is in this catalog. All graduate students are responsible for the information in this handbook. Graduate students with specific questions about policies and procedures should contact the Graduate Affairs and Admissions Office at graduateaffairs@jhu.edu or 410-516-8477.

Doctor of Philosophy

- A minimum of two consecutive semesters as a full-time, resident graduate student.
- Completion of registration in the semester that degree requirements are met.
- Certification by a department or program committee that all departmental or committee requirements have been fulfilled.
- A dissertation approved by at least two referees appointed by the department or program committee and submitted to the library.
- Successful completion of a Graduate Board oral examination. As determined by the department or program committee, this is classified as either a preliminary or a final examination.
- Though time-to-degree is determined by the department and may not exceed 12 years, continuation in the program will be based/contingent upon satisfactory academic progress after eight years of enrollment.

Krieger School of Arts and Sciences Master's Degrees (M.A., M.F.A., M.S.)

- A minimum of two consecutive semesters as a full-time, resident graduate student.
- Completion of registration in the semester that degree requirements are met.
- Certification by a department or program committee that all requirements have been fulfilled.
- A thesis approved by at least one referee and submitted to the library when the department requires a thesis.
- Meets the requirements of the school's time-to-degree policy (see **www. grad.jhu.edu/student-life/policies**).

Whiting School of Engineering Master's Degrees (M.A., M.C.E., M.S., M.S.E., M.S.E.B.I.D., M.S.E.F.M., M.S.E.M.)

1. Every student must register as a full-time graduate student for at least two semesters or satisfy an equivalent requirement approved by the appropriate department. (Concurrent bachelor's-master's degree students are exempt, as are those who enter a WSE master's degree program after two or fewer semesters following completion of a JHU undergraduate degree.)
2. Every student must be registered in the semester that degree requirements are met.
3. Every student must provide certification by a department or program committee that all departmental or committee requirements have been fulfilled.
4. If the student is submitting a formal essay to the MSE Library to help complete master's degree requirements, the essay must be approved by at least one reader. (See the Homewood Academic Council Faculty Status table, under "Thesis Supervision of Graduate Students," to determine who may serve as the reader/advisor. Additional readers, if required by program, need only program approval.)
5. All courses applied to the master's degree must be at the 300-level or higher. At their discretion, individual graduate programs may institute a higher course level as the minimum for their own students.*
6. Every student must earn the master's degree within five consecutive academic years (10 semesters). Only semesters during which a student has a university-approved leave of absence are exempt from the 10-semester limit; otherwise, all semesters from the beginning of the student's graduate studies—whether the student is resident or not—count toward the ten-semester limit.*

Applies to all students who enter during the fall 2005 semester or later.

Graduate Board Oral Examinations

With the approval of the department chair, a Graduate Board oral examination may be scheduled at any time during the academic year. Requests for a Graduate Board oral examination must be submitted to the Graduate Board a minimum of three weeks before the exam is to take place. More information can be found at **www.grad.jhu.edu/academics/graduateboard/**.

Dissertation/Thesis Instructions

The student is responsible for obtaining and observing the detailed instructions concerning submission of their dissertation/thesis from their departmental office, the Graduate Board Office (**www.grad.jhu.edu/academics/graduateboard/**), and the Commercial Binding Office of the Milton S. Eisenhower Library.

After submitting their dissertation to the Commercial Binding Office, students are required to send an email to homewoodgradboard@jhu.edu with the following items:

- A scanned copy of their receipt from the Commercial Binding Office.
- The title of their dissertation typed in the body of the email with correct spelling and punctuation.

The degree requirements are not complete unless the final dissertation/thesis is submitted to the library by the published deadline and the above information is provided by the student to the Graduate Board Office.

Transcripts

Transcripts are available for all graduate students. Students concerned about their graduate course records may obtain a copy at the Registrar's Office in Garland Hall or through the ISIS Student Information System's self-service component at **isis.jhu.edu**.

Course Changes

Full-time resident graduate students have access to add and drop courses and register for credit or audit online at **isis.jhu.edu**. Part-time students must submit the Graduate Course Change Form to the Office of the Registrar to add or drop courses. Approval of changes after the deadline must be submitted to the Graduate Affairs and Admissions Office.

Graduate Study Abroad

Krieger School of Arts and Sciences
Graduate Study Abroad (GSA) is usually limited to those students in the Humanities Center and the departments of Anthropology and German and Romance Languages and Literatures, who are required as a part of their regular degree program to complete a semester or more of full-time study at a foreign university. Although in their case it is not a general requirement, many graduate students in the History of Art Department also go abroad to conduct dissertation research. The category of Graduate Study Abroad presumes a continuation of the student's full-time resident status during this period of foreign study. The use of this category for situations other than the ones noted above requires the approval of the chair of the Graduate Board.

A Graduate Study Abroad student will be required to pay 10 percent of the full-time tuition rate for each semester abroad. The Study Abroad application is available at **www.grad.jhu.edu/academics/graduateboard/**.

Whiting School of Engineering
Graduate Study Abroad status applies to degree-seeking WSE master's and doctoral students engaged in graduate education at a different institution (coursework and/or research) with departmental/advisor approval. These students will be required to pay 10 percent of the full-time tuition rate for each semester abroad. The remaining 90 percent will be paid for by the Dean's Office. As this is not a fulltime resident status, health insurance benefits are not guaranteed and semesters away do not count towards the residency requirement. Graduate Study Abroad students should discuss this with their department/advisor. The Graduate Study Abroad Application is available at **www.graduateboard.jhu.edu**.

Nonresidency

Students will be eligible for nonresident status if they:

- have completed all course work and requirements for the graduate degree other than the presentation and defense of the master's essay* or doctoral thesis;
- have reached the end of their departmental support period or have exhausted support from grants and cannot be fully supported by the department;
- are working 19.9 hours per week or fewer during the academic year if employed by Johns Hopkins University in any capacity (intersession or summer employment can be full-time, however). If working, students cannot be on salary (or stipend) but must be paid hourly on a semi-monthly basis.

Note: Research or teaching assistants expected to work more than 19.9 hours per week do not qualify for nonresident status.

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* In the Whiting School, this may also include the master's project.

Tuition

All students on nonresident status will be charged 10% of full-time tuition per semester. Nonresident students are not required to carry health insurance but are eligible to purchase the University-sponsored plan.

Restrictions

Nonresident students are awarded the same privileges as all full-time students—there are no additional restrictions on access to campus, faculty advising, or JHU services for those with this status; however, nonresident students are not permitted to enroll in any courses, with two exceptions. Under certain circumstances, international students who file for Curricular Practical Training F1 (CPT1) through the Office of International Students and Scholars Services may register for a course titled Research and Teaching Practicum (KSAS) or Engineering Research Practicum (WSE). Non-residents may also register for "Responsible Conduct of Research," which is required by federal funding agencies, including the National Science Foundation and the National Institutes of Health. The maximum amount of time that a student may retain nonresident status is four semesters for master's students and 10 semesters for doctoral students. Upon reaching this limit, the student will be required to register for either part-time status (WSE only) or full-time resident status until degree completion.

Application Procedures

To be awarded nonresident status, students will be required to complete and sign a form indicating that they meet the requirements as stated above. A letter from the applicant detailing his/her current status toward completing the thesis/dissertation, as well as the progress the student expects to make while on nonresident status must accompany this form. The form will need to be signed by the department and the Office of International Student and Scholar Services (if applicable) prior to its submission to the Graduate Affairs and Admissions Office. The final decision is made by either the Chair of the Graduate Board (for Krieger/Whiting School doctoral candidates and Krieger School master's candidates) or the Whiting School Vice Dean for Education (for engineering master's candidates). Students should apply for nonresident status well in advance of the first semester for which it is desired. When requesting a change of status for the current term, such petitions should be submitted no later than the end of the second week of the semester.

Reporting Responsibilities

Departure of a student from one of the Homewood Schools without prior arrangement of nonresident status will be deemed a permanent withdrawal from the student's program. While on nonresident status, students are expected to provide the Office of the Registrar and their department with an updated current address and are expected to respond to all communications and mailings (e.g., the Annual Report Form) within the deadlines specified. Failure to return these forms will be deemed a withdrawal. Students who withdraw from their programs must be formally readmitted, at the discretion of the department, before they may return to the university. If readmitted, they need not pay a second admission fee but must satisfy the residency requirements for the degree following readmission (even if previously satisfied) and pay all outstanding nonresident fees.

Further information about nonresidency can be found at **www.grad.jhu.edu/academics/graduate board/**.

Leave of Absence

To petition for a leave of absence (LOA), Homewood graduate students must submit an Application for Leave of Absence to their department chair and, in the case of international students, to the Director of International Student and Scholar Services for approval, prior to its final submission to the Homewood Graduate Affairs and Admissions Office. The application form can be found at **www.grad.jhu.edu/academics/graduateboard/**. A letter of explanation addressing one of the permitted reasons a graduate student would qualify for a leave of absence (listed below) must accompany this form. The final decision is made by either the Chair of the Graduate Board (for Krieger/Whiting School doctoral candidates and Krieger School master's candidates) or the Whiting School Vice Dean for Education (for engineering master's candidates).

Graduate students may be approved for up to four semesters of leave of absence when medical conditions, compulsory military service, or personal or family hardship prevents them from continuing their graduate studies. To be approved for a leave of absence, graduate students must provide the proper documentation for their given situation, as indicated below:

Medical Condition: a letter from a physician (this may be a letter from a doctor at the Student Health and Wellness Center), the Counseling Center, or the Office of Student Disability Services

Military Duty: a letter or verification from the armed forces

Personal or Family Hardship: a letter from the applicant

Any additional letters of support (e.g., from an advisor, department chair, etc.) are welcome.

Financial difficulty alone does not warrant a leave. A leave of absence will be granted for a specific period of time, not to exceed a total of two years. When approved for a leave of absence, the

Chair of the Graduate Board or the Whiting School Vice Dean for Education will notify the applicant. During the leave period, graduate students may not be enrolled at another university. Before applying, graduate students should consult their department for information regarding funding upon return. When on an approved LOA, there is no tuition charge; the period of leave is simply regarded as an interruption of the degree program.

Please note: While on leave of absence, graduate students do not have student privileges—access to university services or facilities and student employment; however, graduate students on LOA are eligible for employment through the university's Human Resources Office. Degree requirements may not be completed by students while on a leave of absence—including work done on their dissertation or the submission of the dissertation to the Binding Office. Taking a leave of absence may affect a student's Johns Hopkins Student Health Insurance. It is recommended that students interested in applying for a leave contact the Registrar's Office to find out how their coverage will be affected should they be approved for a leave of absence. For federal aid purposes, a student on a leave of absence is considered to be withdrawn from Johns Hopkins University and will go into repayment on education loans once the grace period is exhausted. For more information, visit **www.jhu.edu/finaid/grads_loans. html** or contact your financial aid advisor at **www. jhu.edu/finaid/contact.html**.

Return from Leave of Absence

When returning from leave of absence, a graduate student must complete and submit the Application to Return from Leave of Absence before registering for classes (this form can be found at **www.grad.jhu. edu/academics/graduateboard/**). The form must be accompanied by a letter (from one of the sources below) that explains what progress has taken place in the student's absence that would enable him/ her to be successful upon return.

Medical Condition: a letter from a physician (including the Student Health and Wellness Center), the Counseling Center, or Office of Student Disability Services

Military Duty: a letter or verification from the armed forces

Personal or Family Hardship: a personal letter

Any additional letters of support (e.g., from an advisor, department chair, etc.) are welcome.

Further information about leave of absence can be found at **www.grad.jhu.edu/academics/graduate board/**.

Advanced Academic Programs

Drawing upon over a century of research and teaching expertise, the Krieger School of Arts and Sciences Advanced Academic Programs offer advanced instruction in scientific fields of current interest and innovative graduate study in the humanities and social sciences. While based on the latest scientific and scholarly knowledge, course work emphasizes the application of such knowledge to practical problems. Classes are designed to provide individual attention, relevant application and to encourage student contribution.

Courses are offered on a part-time basis at the Homewood campus in Baltimore; the Montgomery County Campus in Rockville, MD; the Arts and Sciences Washington Center in Washington, D.C.; the HECC (Higher Education Conference Center) Center in Aberdeen, MD; and online. Several degrees in AAP may be completed partially or fully online.

The School of Arts and Sciences recognizes the intellectual strength and education requirements of working adults and offers master's degrees through the Advanced Academic Programs. Students can earn their master's degree in Applied Economics, Biotechnology, Bioinformatics, Bioscience Regulatory Affairs, Communication, Energy Policy and Climate, Environmental Sciences and Policy, Government, Global Security Studies, Liberal Arts, Museum Studies, and Writing. Two new programs are pending internal approval and MHEC endorsement at the time of printing for this publication: MA in Public Management and a Masters in Bioscience Enterprise and Entrepreneurship. There is also a variety of certificates and concentrations from which to choose, including the Certificate in National Security Studies, Certificate in Geographic Information Systems, Certificate in Biotechnology Education, and Certificate in Biotechnology Enterprise as well as a number of joint MBA programs with the Carey Business School.

Further information, applications, and catalogs may be obtained by calling 1-800-847-3330; by visiting **www.advanced.jhu.edu** or by writing to:

Advanced Academic Programs
Zanvyl Krieger School of Arts and Sciences
Johns Hopkins University
Office of Admissions
1717 Massachusetts Avenue, NW, Suite 101
Washington, D.C. 20036.

Johns Hopkins Engineering for Professionals

Engineering began at Hopkins in 1913, when university leaders decided to establish a curriculum that focused on professional education but included significant exposure to the liberal arts and scientific inquiry. Fostering interdisciplinary creativity, this unique approach to engineering education was in turn emulated by many engineering schools throughout the United States.

Over the intervening decades, thousands of working engineers and scientists earned engineering degrees at Hopkins through part-time study, achieving professional goals without interrupting their careers. That tradition continues today through the Whiting School's Engineering for Professionals program, which offers more than 400 part-time graduate courses in 15 disciplines that address industry trends and the latest advances in engineering and applied science. Classes are scheduled at convenient times during late afternoons, evenings, and Saturdays at campuses throughout the Baltimore-Washington region, including Aberdeen, Baltimore, Elkridge, Laurel, Rockville, Southern Maryland, Washington, D.C., and Crystal City, VA. More than 75 courses are also available online. Depending on their academic program, students earn either a master's degree or a graduate or postgraduate certificate upon completing their studies.

Further information, applications, and catalogs may be obtained by calling 1-800-548-3647; visiting **www.ep.jhu.edu**; or writing to Johns Hopkins Engineering for Professionals, 6810 Deerpath Road, Suite 100, Elkridge, MD 21075. Email inquiries may be sent to jhep@jhu.edu.

Degree Programs

Degree Programs in Arts and Sciences and Engineering
See program descriptions for the specific degrees offered.

Program Major	Bachelor's	Accelerated Bachelor's/ Master's	Master's	Doctor of Philosophy
Arts and Sciences				
African Studies	x			
Anthropology	x		x^5	x
Archaeology	x			
Behavioral Biology	x			
Biology	x	x	x^9	x
Biophysics	x	x	x^{14}	x
Chemical Biology				x
Chemistry	x		x^5	x
Classics	x	x	x^5	x
Cognitive Science	x		x^{13}	x
Earth and Planetary Sciences	x			x
East Asian Studies	x			
Economics	x	x	x^4	x
English	x		x^3	x
Film and Media Studies	x			
French	x		x^{13}	x
German	x	x	x^5	x
Global Environmental Change and Sustainability	x			
History	x	x	x^2	x
History of Art	x		x^8	x
History of Science and Technology	x		x^2	x
Humanities Center			x^4	x
International Studies	x	x		
Italian	x		x^{13}	x
Latin American Studies	x			
Mathematics	x	x	x^2	x
Molecular and Cellular Biology	x			
Near Eastern Studies	x		x^2	x
Neuroscience	x	x^9		
Philosophy	x		x^{13}	x
Physics and Astronomy	x^{12}		x^5	x
Political Science	x			x
Psychology	x	x	x^{13}	x
Public Health Studies	x	x		
Public Policy		x	x	
Romance Languages	x			
Sociology	x		x^{13}	x
Spanish	x		x^{13}	x
Writing Seminars	x		x	

Program Major	Bachelor's	Accelerated Bachelor's/ Master's	Master's	Doctor of Philosophy
Engineering				
Applied Mathematics and Statistics	x[12]	x	x	x
Biomedical Engineering	x	x	x	x[17]
Bioengineering Innovation & Design			x[15]	
Chemical and Biomolecular Engineering	x	x	x[1]	x
Civil Engineering	x	x	x[1,7]	x
Computer Engineering	x			
Computer Science	x[12]	x	x[1]	x
Electrical Engineering	x	x	x	x
Engineering Management		x	x	
Engineering Mechanics	x			
Financial Mathematics		x[16]	x[16]	
General Engineering	x[11]			
Geography and Environmental Engineering	x[10]	x	x	x
Information Security Institute		x	x	
Materials Science and Engineering	x	x	x[6]	x
Mechanical Engineering	x	x	x	x
Area Majors				
Natural Sciences	x			

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Notes on the Master's Degrees

1. Candidates for the master's as a terminal degree are accepted, but financial aid generally is not available.
2. Candidates for the master's as a terminal degree may be accepted in special cases, but financial aid generally is not available.
3. Candidates are admitted to the Ph.D. program only, but the M.A. is awarded to students who (a) complete one year of courses, pass an examination in one foreign language, and submit an acceptable master's essay to a member of the faculty or (b) complete two years of courses and pass an examination in two foreign languages.
4. Candidates are accepted only for the accelerated bachelor's-master's program.
5. Candidates for the master's as a terminal degree are not accepted. However, a student is awarded a master's degree en route to the Ph.D. after the successful completion of the Graduate Board oral examination.
6. Both a master of science in engineering and a master of materials science and engineering are offered.
7. Both a master of science in engineering and a master of civil engineering are offered.
8. See department listing.
9. B.A./M.S. or B.S./M.S.—Available only to Arts and Sciences baccalaureate students.
10. B.A. in geography and B.S. in environmental engineering.
11. B.A. only.
12. B.A. or B.S. available.
13. Candidates are admitted to the Ph.D. program only, but the M.A. is awarded to students who complete requirements set by the director of graduate studies.
14. Applicants must currently be JHU undergraduates who will receive their B.A. from the university prior to admission. Financial aid is not available.
15. Within the Department of Biomedical Engineering.
16. Within the Department of Applied Mathematics and Statistics.
17. Within the School of Medicine.

Advanced Degree Programs in Other Hopkins Divisions

See division catalog for the specific degrees, certificates, and programs offered.

Carey Business School

Master of Business Administration Degrees (part-time)
Weekend MBA for Emerging Leaders
Executive MBA
Flexible MBA
Master of Business Administration in Medical Services Management
Master of Business Administration in Organization Development

Master of Business Administration Degrees (full-time)
Johns Hopkins Global MBA
Master of Business Administration/ Master of Public Health

Master of Science Degrees
Finance
Information Systems
Marketing
Real Estate (full- and part-time)

Joint Degrees
Master of Business Administration/ Master of Arts in Communication
Master of Business Administration/ Master of Arts in Government
Master of Business Administration/ Master of Science in Biotechnology
Master of Business Administration/ Master of Science in Nursing

Graduate Certificate Programs
Business of Medicine
Business of Nursing
Competitive Intelligence
Financial Management
Investments
Leadership Development Program for Minority Managers

School of Education

Master of Arts in Teaching
Early Childhood Education
Elementary Education
Secondary Education
English for Speakers of Other Languages (ESOL)

Master of Education
Health Professions *(pending approval)*

Master of Science in Education
Educational Studies
Reading
School Administration and Supervision
Technology for Educators

Master of Science in Special Education
Early Childhood Special Education
General Special Education Studies
Mild to Moderate Disabilities (Elementary/ Middle, Secondary/Adult, Differentiated and Inclusive Education)
Severe Disabilities
Severe Disabilities: Emphasis in Autism Spectrum Disorders
Technology in Special Education

Master of Science in Counseling
Mental Health Counseling
School Counseling

Graduate Certificate Programs in Education
Adolescent Literacy Education
Advanced Methods for Differentiated Instruction and Inclusive Education
Assistive Technology
Biotechnology Education
Clinical Community Counseling*
Cooperative Learning Instructional Practices
Data-based Decision Making and Organizational Improvement
Early Intervention/Preschool Special Education Specialist
Earth/Space Science
Education of Students with Autism and Other Pervasive Developmental Disorders
Education of Students with Severe Disabilities
Educational Leadership for Independent Schools
Effective Teaching of Reading
Emergent Literacy Education
English as a Second Language (ESL) Instruction
Evidence-Based Teaching in the Health Professions *(pending approval)**
Gifted Education
K-8 Mathematics Lead-Teachers
K-8 Science Lead-Teachers
Leadership for School, Family, and Community Collaboration
Leadership in Technology Integration
Mind, Brain, and Teaching
Online Teaching and Learning for Adults
School Administration and Supervision

Teacher Leadership: Instructional Leadership in
   School Settings
Teaching the Adult Learner
Urban Education

Certificate of Advanced Graduate Study*
Counseling

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*Open only to students with master's degrees.

Doctor of Education
Special Education
Teacher Development and Leadership

Division of Public Safety Leadership

Master of Science in Management
Master of Science in Intelligence Analysis

School of Advanced International Studies

International Relations

School of Public Health

Master of Public Health
Schoolwide degree program

Master of Health Administration
Health Policy and Management

Master of Health Science
Biochemistry and Molecular Biology
Biostatistics
Environmental Health Sciences
Epidemiology
Graduate Training Program in Clinical
   Investigation
Health Behavior and Society
Health Policy and Management
International Health
Mental Health
Molecular Microbiology and Immunology
Population, Family and Reproductive Health

Master of Science
Biochemistry and Molecular Biology
Biostatistics
Environmental Health Sciences
Epidemiology
Health, Behavior and Society
Molecular Microbiology and Immunology

Master of Science in Public Health
Environmental Health Sciences
Health, Behavior and Society
Health Policy and Management
International Health
Population, Family and Reproductive Health

Doctor of Philosophy
Biochemistry and Molecular Biology
Biostatistics
Environmental Health Sciences
Epidemiology
Graduate Training Program in Clinical
   Investigation
Health, Behavior and Society
Health Policy and Management
International Health
Mental Health
Molecular Microbiology and Immunology
Population, Family and Reproductive Health

Doctor of Public Health
Environmental Health Sciences
Epidemiology
Health, Behavior and Society
Health Policy and Management
International Health
Mental Health
Population, Family and Reproductive Health

Doctor of Science
Epidemiology
Health, Behavior and Society

Combined Programs

BA/MHS or MSPH
MA/MSPH
MPH/JD
MPH/MBA
MPH/MD
MPH/MSW
MPH/MSN
MPH/RD
MPH/General Preventive Medicine Residency
MPH/Occupational Medicine Residency
MSPH/RD
MD/PhD
ScM/PhD
MHS or MSPH/doctoral

School of Medicine

Doctor of Philosophy
Biochemistry/Cellular and Molecular Biology
Biological Chemistry
Biophysics and Biophysical Chemistry
Cell Biology
Cellular and Molecular Medicine
Cellular and Molecular Physiology
Functional Anatomy and Evolution
History of Medicine
Human Genetics
Immunology

Molecular Biology and Genetics
Neuroscience
Pathobiology
Pharmacology and Molecular Sciences

Interdivisional Programs
Biomedical Engineering
Program in Molecular Biophysics

Master of Science
Applied Health Sciences Informatics
Health Sciences Informatics

Master of Arts
Medical and Biological Illustration

Certificate Program
Certificate in Health Sciences Informatics

Libraries

University Libraries

The Johns Hopkins library network includes the principal research library on the Homewood campus as well as libraries specializing in medicine, public health, music, and international relations, and earth and space science located on other JHU campuses. Regional campus librarians serve the centers operated by the Carey Business School, the School of Education, the Krieger School of Arts and Sciences, the Whiting School of Engineering, and the Bloomberg School of Public Health. In addition to the print resources available to all students and faculty in these distributed collections, the libraries provide 24/7 access to a rich collection of electronic resources, including over 70,000 e-journals and more than 800,000 full-text electronic books. Students have access to all of the libraries throughout the university.

Sheridan Libraries

The Sheridan Libraries encompass the Milton S. Eisenhower Library and its collections at the John Work Garrett Library, the Albert D. Hutzler Reading Room, the George Peabody Library, and the Montgomery County and Washington, D.C. regional sites.

Eisenhower Library

Located on the Homewood campus, the Milton S. Eisenhower Library is Johns Hopkins' main research library and a university-wide resource supplementing the specialized libraries on other campuses.

The library's materials and services reflect the development and increasing diversification of resources used for teaching, research, and scholarship. Librarians with subject expertise serve as liaisons to the academic departments, build electronic and print collections, and provide research consultation and instructional services to meet the teaching and research needs of the university.

The collection includes over 3.7 million printed volumes, more than 70,000 print and electronic journals, 12,000 videos and DVDs, and over 217,000 maps.

Complementing the library's general research collections are numerous specialized collections. The U.S. government documents collection is particularly strong in congressional and statistical material. United Nations e-resources and materials from international organizations are also accessible. Geographic Information System software is available for compiling and analyzing demographic data.

Other special collections materials include rare books, manuscripts, archives, sheet music, maps, and photographs. Notable digital collections provide enhanced access to American sheet music and medieval manuscripts. The library is open 24/7 during the academic year. For more information, visit **www.library.jhu.edu**.

The Peabody Library

The George Peabody Library is located in downtown Baltimore at Mount Vernon Place. The 300,000 volume collection is remarkable for its depth and breadth and includes 15th-century books, Greek and Latin classics, British and American history and literature, works on decorative arts and architecture, the history of science, and an extensive map collection. The library's magnificent interior features an atrium surrounded by five tiers of ornamental cast-iron balconies. An exhibition gallery is located adjacent to the reading room. For more information, visit **www.georgepeabody library.jhu.edu**.

The Garrett Library

The John Work Garrett Library is located at Evergreen Museum, built in the 1850s, and now one of the university's house museums. Located approximately one mile north of the Homewood campus, the Garrett Library's 30,000 volume collection contains 16th- and 17th-century English literature and history, works on natural history, architectural history, American colonial travel and history, and maps.

Washington Metropolitan Regional Library Services/System

The Montgomery County Campus Library, located on the university's Rockville campus, and the Washington, D.C. Resource Center, located at 1717 Massachusetts Avenue, serves the needs of primarily part-time graduate students in business, education, engineering, arts and sciences, and public health. These libraries offer access to the university libraries' extensive collections of print and electronic resources and maintain small onsite print, video, and DVD collections. Professional staff provide services for faculty and students studying at the centers or online.

Albert D. Hutzler Reading Room

The newly renovated Hutzler Reading Room, located in Gilman Hall on the Homewood campus, is a popular study space.

Library provides resources that support teaching, research, and patient care at the Johns Hopkins Medical Institutions. Since 2001, Welch has been organizing library services around the all-digital collection of the future, creating state-of-the-art interfaces to these collections and redefining the role of librarians supporting the digital collection.

WelchWeb (**www.welch.jhu.edu**) guides users to a rich array of electronic information resources and library services. The Welch Library offers a wide range of services to the Medical Institutions including liaison consultation, classes and online tutorials, document delivery, and an editing referral service. Authors at the Medical Institutions can find open access publishing resources from WelchWeb or directly from the university's Scholarly Communications Group-sponsored website (**http://openaccess.jhmi.edu**).

With an emphasis on providing services at the point of use, a number of "information suites" (**www.welch.jhu.edu/services/information_suites. html**) such as the Population Center (**http:// poplibrary.jhmi.edu**) are being created for Hopkins communities to provide a range of library services and digital resources supporting teaching, research, and patient care.

The Welch Library also operates the Lilienfeld Library, a satellite library in the Bloomberg School of Public Health. The Lilienfeld is an important resource for information in public health, management science and social sciences. For more information, visit **www.welch.jhu.edu**.

The **Institute of the History of Medicine**, located within the Welch Library, houses a collection of 50,000 volumes and 80 current journals. It is one of the most comprehensive collections of secondary literature in the history of medicine.

The Friedheim Library
The Arthur Friedheim Library of the Peabody Institute is located on the Plaza level of the Peabody campus at 17 E. Mount Vernon Place. University bus service brings the resources of this distinguished music library of over 100,000 books, journals, and musical scores; 35,000 audiovisual materials; and 5,500 linear feet of archival material and special collections within easy reach of the Homewood community. For more information, visit **www.peabody.jhu.edu/library**.

Applied Physics Laboratory–Information Group
The Applied Physics Laboratory is located in Howard County. The Information Group of the Information Technology Service Department conducts information research and manages special collections that support Laboratory staff in their work with the Department of Defense, NASA, and other government agencies.

The Mason Library
The Sydney R. and Elsa W. Mason Library of the Nitze School of Advanced International Studies (SAIS) in nearby Washington, D.C., offers comprehensive library services to SAIS students, faculty, and staff. The library has a specialized collection in international relations of 110,000 print volumes, over 900 print journals and newspapers. For more information, visit **www.sais-jhu.edu/library**.

In addition to the Mason Library in Washington, SAIS also has libraries in Italy and China. The Bologna Center Library (Bologna, Italy) supports the full-time graduate program in international relations and contains approximately 75,000 volumes and 1,000 periodicals. For more information, visit **www.jhubc.it/library-services**.

The Hopkins-Nanjing Center for Chinese and American Studies Library (Nanjing, China) supports the graduate-level program in Chinese and American studies. The only uncensored, open-stack library in the People's Republic of China (Hong Kong excepted), the Nanjing Center Library houses approximately 78,000 volumes and 400 periodicals in English and Chinese. For more information, visit **nanjing.jhu.edu/students/library.htm**.

Public Libraries

Baltimore has an excellent system of public libraries. Especially noteworthy in downtown Baltimore is the Enoch Pratt Free Library **www.prattlibrary.org** which features a Maryland collection. The library of the Maryland Historical Society specializes in Maryland history and genealogy. **www.mdhs.org**

The vast collections of the Library of Congress (**www.loc.gov**) and the National Library of Medicine (**www.nlm.nih.gov**) in Washington are also accessible, either through interlibrary loan or on-site visits.

Course Identification

Courses listed in the catalog are those the departments plan to offer, however, not every course is available during a given year. Necessarily, some courses will be canceled and other courses scheduled. The schedules of graduate and undergraduate courses for a given term are published before the end of the preceding term. In the course listings that follow, the credits shown are for one semester only. No credits are listed for graduate (600-level) courses; many departments indicate instead the hours of class time per week.

A code number, indicating the department or program; a course number, indicating level; and sometimes a code letter, indicating area, for purposes of the distribution requirement, identify courses.

Code Numbers

Department and program code numbers for the Schools of Arts and Sciences and Engineering are as follows:

362 Africana Studies
070 Anthropology
375 Arabic
371 Art
290 Behavioral Biology
020 Biology
580 Biomedical Engineering
250 Biophysics
372 Chaplain
540 Chemical and Biomolecular Engineering
030 Chemistry
373 Chinese
560 Civil Engineering
040 Classics
050 Cognitive Science
600 Computer Science
270 Earth and Planetary Sciences
180 Economics
310 East Asian Studies
520 Electrical and Computer Engineering
662 Engineering Management
060 English
370 English as a Second Language
660 Entrepreneurship & Management
061 Film and Media Studies
500 General Engineering
570 Geography and Environmental Engineering
210–215 German and Romance Languages and
　　　Literatures
381 Hindi
100 History
010 History of Art
140 History of Science and Technology
300 Humanities
650 Information Security Institute
360 Interdepartmental
378 Japanese
379 Kiswahili
380 Korean

361 Latin American Studies
510 Materials Science and Engineering
550 Applied Mathematics and Statistics
110 Mathematics
530 Mechanical Engineering
374 Military Science
389 Museum and Society Programs
376 Music
130–134 Near Eastern Studies
080 Neuroscience
670 Nanobiotechnology
382 Persian
150 Philosophy
170–174 Physics and Astronomy
190, 191 Political Science
661 Professional Communication
200 Psychological and Brain Sciences
280 Public Health Studies
195 Public Policy
377 Russian
383 Sanskrit
230 Sociology
225 Theatre Arts and Studies
220 Writing Seminars

Course Numbers

Course numbers have the following significance:
100–299 Undergraduate course, lower-level
300–499 Undergraduate course, upper-level
500–599 Independent study/research/internship
600–799 Course offered for advanced degree programs
800–849 Independent study/research and
　　　dissertation, graduate level

Code Letters

The following code letters are a guide to undergraduate distribution and writing requirements:
(E)　Engineering
(H)　Humanities
(N)　Natural Sciences
(Q)　Quantitative Studies
(S)　Social and Behavioral Sciences
(W)　Writing-Intensive

January Intersession

The Krieger and the Whiting schools set aside approximately three weeks in January for students and faculty to participate in a variety of credit and noncredit courses and activities that enrich the intellectual and social life of the campus. In addition to traditional offerings, courses designed to help students branch out and explore other skills are offered. Alumni and outside experts augment faculty to offer instruction in a diverse array of applied courses and insight into worlds such as finance, communications, and biotechnology. The Office of Student Activities offers informal noncredit subjects ranging from personal enhancement, Zen and the art of listening, through practical skill-building and corporate etiquette, to the performing arts. Participation is voluntary on the part of both faculty and students.

Zanvyl Krieger School of Arts and Sciences

All the undergraduate and graduate programs in Arts and Sciences come under the direction of the dean of the Krieger School of Arts and Sciences. The excellence of these programs has been maintained and enhanced ever since 1876, when Daniel Coit Gilman assembled a Faculty of Philosophy of international distinction. The creative vision of these first professors remains and is reflected in a school that encourages independent research and creative thinking at all levels. The departmental descriptions that follow are notable for the wide range of interdepartmental offerings and the opportunities available for a student to structure a unique field of study in the humanities, natural sciences, quantitative studies, and social and behavioral sciences.

Center for Africana Studies

The Center for Africana Studies (CAS) offers a broad inquiry into the ideas and experiences of African peoples on the continent of Africa, in the Americas, and elsewhere around the globe. It is an interdisciplinary program organized around African American Studies, African Studies, and African Diaspora Studies, its three major sub-fields. Spanning diverse academic disciplines—in humanities, social sciences, and public health—Africana Studies brings together several fields of interdisciplinary scholarship. While these fields possess distinctive intellectual traditions, they offer exciting possibilities for comparative as well as integrative inquiry.

The CAS provides an institutional home for faculty and students interested in critical and comparative study across the three sub-fields as well as specialized study within each sub-field. Through research, course work, and public programs, the CAS seeks to promote fundamental inquiry into the commonalities and contrasts between contemporary and historical experiences of Africans and African Americans, and the place of African Diasporas in both local and global contexts, historically and in the present.

The Faculty

Franklin Knight, Director, Leonard and Helen R. Stulman Professor, Department of History: Caribbean and Latin America.

Pamela Bennett, Assistant Professor, Department of Sociology: African America, racial and ethnic inequality, racial residential segregation, education.

Sara Berry, Professor, Department of History: Africa.

James Calvin, Associate Professor, Carey Business School: business leadership and management practice, global leadership and community transformation.

Nathan Connolly, Assistant Professor, Department of History: the historical role of land in the making of racial categories; the intersection of Jim Crow segregation and capitalism; American liberalism and conservatism as reflections of black class politics; comparative racisms; and black encounters with postmodernism, with an emphasis on the economic and cultural consequences of late 20th-century "diversity" discourse in the United States.

Debra Furr-Holden, Assistant Professor, Department of Mental Health, Bloomberg School of Public Health: community health, African America.

Siba Grovogui, Professor, Department of Political Science: international relations, Africa.

Jane Guyer, Professor, Department of Anthropology: Africa.

Michael Hanchard, Professor, Department of Political Science: comparative politics, Latin American politics, and comparative racial politics.

Floyd W. Hayes III, Coordinator of Programs for Undergraduate Studies, Senior Lecturer, Department of Political Science: African American and African Diaspora.

Pier Larson, Professor, Department of History: Africa and African Diaspora.

Katrina Bell McDonald, Professor, Department of Sociology: African America.

Ben Vinson III, Herbert Baxter Adams Professor, Department of History: African Diaspora, Afro-Latin America.

Affiliated Faculty

Niloofar Haeri, Professor, Department of Anthropology: international relations, Africa.

Richard Jasnow, Professor, Department of Near Eastern Studies: Egyptology.

Michael Johnson, Professor, Department of History: Southern United States.

Philip Morgan, Professor, Department of History: slavery, Atlantic history.

Shani Mott, Postdoctoral Fellow, Department of English: strategic deployments of racial language in American popular culture, with an emphasis on the uses of race in 20th- and 21st-century fiction.

Lester Spence, Assistant Professor, Department of Political Science: black politics, race and politics, urban politics, American political behavior and public opinion.

Ron Walters, Professor. Department of History: 20th-century United States.

Visiting Faculty

Flavia Azeredo, Visiting Assistant Professor, German and Romance Languages and Literatures, and Center for Africana Studies.

Moira Hinderer, Postdoctoral Fellow, Center for Africana Studies, Diaspora Pathways Project Manager: African American history.

Hollis Robbins, Professor, Department of Humanities, Peabody Institute: African American literature.

Undergraduate Major Requirements

Students who choose to major in Africana Studies must complete at least 40 credit hours of course work, including three core courses, one year of foreign language study, and elective courses offered by the center and/or participating departments.

Core courses

Each student will take three core courses, one in each of the sub-fields of Africana Studies—that is, African Studies, African-American Studies, and African Diaspora Studies. Core courses will be offered on a regular basis—either annually or, at a minimum, once every other year. The core will include the following existing courses, plus one introductory course.

> AS 100.120 Slavery: From Africa to America (Larson)
>
> AS 100.121 History of Africa (before 1880) (Berry, Larson)
>
> AS 100.122 History of Africa (since 1880) (Berry, Larson)
>
> AS 362.111 Introduction to Africana Studies (Staff)
>
> AS 362.220 Discourses in African Diaspora (Vinson)

Foreign Language Study

Students must demonstrate competence in an appropriate foreign language, either by examination or by completing one year of language study at the intermediate level. If a student satisfies the language requirement by examination, s/he must take an additional eight credits of elective courses to meet the total requirement of 40 credit hours for the Africana Studies major. Students may elect to study a language spoken in one or more African diasporic communities and/or on the African continent. Relevant languages include, but are not limited to Spanish, French, Portuguese, Arabic, Kiswahili.

Electives

Each student must complete a minimum of 24 additional credit hours, comprised of elective courses offered by participating faculty. The center staff will maintain an updated list of appropriate current course offerings, including courses offered by visiting faculty, postdoctoral fellows, Dean's Teaching Fellows, etc., and assist students in selecting courses to construct a coherent program of study. Participating faculty will also be encouraged to develop courses specifically for Africana Studies, including interdepartmental and/or team-taught courses. Electives should be distributed as follows:

- At least 12 credit hours must be in courses at the 300-level or above.

- Research seminar. Students who wish to do honors in Africana Studies are required to take a two-semester (eight credit) research seminar, in which they will prepare an honors thesis in consultation with a faculty advisor in the student's particular area of interest and the faculty coordinator of the undergraduate research seminar. The research seminar will provide guidance on research design, methodology, and analysis and presentation of findings, and give students an opportunity to discuss one another's projects, share experiences, and receive constructive comments from their peers as well as the faculty coordinator.

In selecting research topics and collecting materials, students are encouraged to explore resources outside those immediately available on campus. With its rich collection of museums and archives, large and historic African-American communities, and growing populations of recent migrants from Africa, the Baltimore-Washington area offers many opportunities for research in Africana Studies. Students who wish to undertake research in Africa or in African American or African diasporic communities beyond the local area will be encouraged to take advantage of summer research grants and/or study abroad opportunities available at Hopkins. The center will work with other departments and programs at Hopkins on behalf of students who wish to combine their research in Africana Studies with work in another field or ongoing program, such as the joint Minority Health Program recently established by the School of Public Health and Morgan State University.

Undergraduate Minor Requirements

Students who wish to minor in Africana Studies must complete a minimum of 24 credits, including two core courses and electives. Three of the electives must be upper-level courses. Foreign language study is not required, but up to eight credits of course work in a foreign language may be counted toward the required electives.

Courses

Africana Studies

362.111 (S) Introduction to Africana Studies
This course is an introduction to the origins and emergence of Black Studies as an academic discipline in the American academy. The course is centered on the social realities of people of African descent living in the United States.
Staff   3 credits

362.220 (H,S,W) Discourses in the African Diaspora
The African Diaspora has emerged as one of the "hot" topics of discussion in contemporary global race relations. The purpose of this course is to engage in a semester-long study into the meaning of the "African Diaspora." Beginning with a brief reflection on some of the theoretical overlays on the topic, the course moves quickly into the heart of the subject matter. The course posts that beyond theoretical discussions there is much to be learned from a close examination of the narrative accounts of individuals who have lived transnationally—who have themselves been actors and agents of the diaspora.
Vinson   2 credits

362.225 Ghana: Diaspora, History, Culture, and Politics
Students enrolled in this study-abroad course will be exposed to core themes related to the modern and historical experiences of Ghana. In addition to traditional academic lectures, readings, and assignments, students will complete a service learning project and will be directly engaged with "active" learning while in the field.
McDonald   2 credits

362.340 (W) Power and Racism
This is an interdisciplinary seminar that examines white supremacy and anti-black racism as a global system of power. Through reading texts in philosophy, history, sociology, politics, and law, this course will focus on trends, developments, and future challenges related to the social relations of racism and power in America and Brazil. Cross-listed with Political Science, History, Sociology, and Philosophy.
Hayes   3 credits

362.357 (W) Black Existential Thought
Black existentialism is a branch of Africana philosophy, which focuses on the philosophical tendencies that arose out of the experience of the African Diaspora. This seminar is a philosophical interrogation into the meaning of the lived experience of being black in the context of an anti-black world through addressing such existential questions as freedom, identity, anguish, dread, responsibility, embodied agency, evil, resentment, liberation, and nihilism. Cross-listed with Humanities, Philosophy, and Political Science.
Hayes   3 credits

Anthropology

070.103 (H,S,W) Africa and the Museum
Guyer   3 credits

070.222 (H,S,W) Africa in the 21st-Century
The present and future of Africa are often projected in apocalyptic terms. We attempt here to understand the ordinary realities of life—family, making a living, community, congregation, governance, and inequality—with special attention to works by African scholars, public figures, writers, and artists.
Guyer   3 credits

070.393 (H,S) Law and Development: Postcolonial Perspectives
What is "development"? How are the interconnections between "structural adjustment" and the "rule of law" currently transforming the space of the postcolonial world? This course explores anthropological critiques of development with a focus on labor, land, and locality. Open to upper-level undergraduates and graduate students only.
Obarrio   3 credits

Economics

180.252 (S) Economics of Discrimination
Morgan   3 credits

German and Romance Languages

210.278 (H) Intermediate/Advanced Portuguese Language
Staff   3.5 credits

211.394 (H,W) Portuguese: Brazilian Culture and Civilization
Bensabat-Ott   3 or 4 credits

213.408 (H) German: The Literature of Blacks and Jews in the 20th-Century
M. Caplan   3 credits

215.456 (H) Spanish: Gauchos, Negros, Gitanos
E. González   3 credits

History

100.109 (H,S) Making America: Slavery and Freedom 1776–1876
Johnson, Morgan   3 credits

100.113 (H,S) Making America: Race, Radicalism, and Reform in America, 1787–1919
Walters, Morgan   3 credits

100.120 (H,S) Slavery from Africa to America
Larson   3 credits

100.121-122 (H,S) History of Africa
Berry, Larson   3 credits

100.243 (H,S) Brazil for Beginners
Russell-Wood   3 credits**100.304 (H,S) New World Slavery, 1500–1800**
Morgan   3 credits

100.338 (H,S,W) Contemporary African Political Economics in Historical Perspective
Berry   3 credits

100.370 (H,S) The U.S. Antislavery Movement
Johnson   3 credits

100.419 (H,S) U.S. Slavery, 1607–1865
Johnson   3 credits

100.429-430 (H,S,W) The History of Colonial Brazil
Russell-Wood   3 credits

100.445 African Fiction as History
Larson   3 credits

100.453 (H,S) Africa and the Atlantic
Larson   3 credits

100.457 (H,S) Abraham Lincoln, Slavery, and the American Civil War
Johnson   3 credits

100.461 (H,S,W) Power, Identity, and the Production of African History
Berry   3 credits

100.463 (H,S) The African Diaspora: The Brazilian Experience
Russell-Wood   3 credits

100.473 The Indian Ocean: Economy, Society, Diaspora
Larson   3 credits

100.485 Children and Disaster in Africa
Larson   3 credits

100.489-490 (H,S) Bondage and Culture: Slavery and Cultural Transformation in the Atlantic
Larson   3 credits

Language Teaching Center

379.151-152 Beginning Kiswahili
Cross-listed with Language Teaching Center.
Kamau   3 credits

379.251-252 (H) Intermediate Kiswahili II
Prerequisite: 379.151-152. Cross-listed with Language Teaching Center.
Kamau   3 credits

Near Eastern Studies

130.135 (H) Ancient Egyptian Civilization
Bryan   3 credits

130.322 (H) Law, Ethics, and Wisdom in Ancient Egypt
Jasnow   3 credits

130.323 (H) History of Ptolemaic and Roman Egypt
Jasnow   3 credits

130.325 (H) Women in Ancient Egypt
Bryan   3 credits

130.326 (H) Egyptian Religion and Mythology
Jasnow   3 credits

130.327 (H) Ancient Egyptian Painting
Bryan   3 credits

130.328 (H) Ancient Egypt within Africa
Bryan   3 credits

130.329 (H) Ancient Egyptian Art
Bryan   3 credits

130.333 (H) Egypt in the Amarna Period
Bryan   3 credits

Political Science

190.214 (S) Introduction to Racial and Ethnic Politics
What do scholars mean when they use concepts of race and ethnicity, and what are the political implications of these concepts in everyday life? One aim of this course is to answer this question. The second aim is to help first-year college students develop familiarity with these concepts and an understanding of how ideas about racial and ethnic difference have impacted the formation of societies, governments, laws, policies, and individuals, even themselves. Comparative in scope, this course will lead students through readings about racial and ethnic relations in countries like Brazil, England, Northern Ireland, and China, often utilizing the United States as a referent. Freshmen only.
Spence   3 credits

190.302 (S) Politics of Black Cultural Productions
Spence   3 credits

190.385 (S) Urban Politics and Policy (AP)
Spence   3 credits

Public Health

280.399 (S) Practicum in Community Health
Students will participate in community-based health services intervention programs, working with community leaders and health interventionists from the schools of Medicine and Public Health. Classroom presentation and paper required. Seniors and juniors only. Permission required.
Goodyear, Bone   3 credits   fall

362.385 (H,Q,S) Community Health Promotion
This course is an introduction to the salient features of community health and community health promotion. Community health promotion is understanding a com-

munity, its health status and evolution, its needs and assets, its resources and activities, and understanding how the community situation might be changed (and health improved) by action on the part of the community and outside experts. The course aims to provide students with learning opportunities that will enable them to be conversant in topics of community health promotion by applying basic conceptual models of community health to local health scenarios. Students will become familiar with resources, agencies, data, and techniques that are involved in a wide array of community health promotion initiatives. Cross-listed with Public Health Studies.
Furr-Holden   4 credits

Sociology

230.112 (W) Freshman Seminar: Race and Education in the U.S.
The goal of this course is to explore issues of race and ethnicity in American education. Through lectures, films, and discussions, students will become familiar with various sociological lenses through which the educational issues facing blacks, Asians, Latinos, and American Indians are analyzed.
Bennett   3 credits

230.208 (S) Contemporary Perspectives in Race Relations
McDonald   3 credits

230.212 (S,W) Race Ethnicity and Education in the United States
Bennett   3 credits

230.309 (S) Segregation and Social Inequality
This course presents an in-depth study of segregation and its relationship to social and economic inequality. Students will explore several forms of sbegregation—residential, school, and occupational segregation. We begin with the history of residential segregation in the United States, its patterns and causes, as well as its social, economic, and demographic consequences. We then explore school segregation, and end with an examination of seg-

regation of men and women in work. Through lectures, readings, discussions, and films, students gain insight into racial, ethnic, and gender inequality across several social, economic, and demographic domains.
Bennett   3 credits

230.313 (S,W) Space, Place, Poverty, and Race: Sociological Perspectives on Neighborhoods and Public Housing
Is a neighborhood just a grouping of individuals living in the same place, or do neighborhoods have collective meanings and impacts on children and families? We will capitalize on research methodologies used to define and describe neighborhoods and their effects on economic and educational outcomes. These include case studies, census data, surveys, quasi/experimental data. Focus is on how research measures neighborhood effects and incorporates community-level processes into models of social causation (e.g., social capital/control, community efficacy, civic engagement). Also examined: patterns in residential mobility, segregation, and preferences within black and white populations; development of housing policy in the U.S. programs to determine how neighborhoods affect issues of social importance. Statistics and public policy background is helpful but not required.
DeLuca   4 credits

230.316 (S,W) The African-American Family
McDonald   3 credits

360.469 (H,S) Issues in Globalization
Cross-listed with Sociology and Political Science.
Grovogui   3 credits

Practicum

362.500 (H,S,W) Africana Studies Research Practicum
This research-intensive course is designed to introduce and familiarize students with basic research techniques for conducting scholarship in Africana Studies, particularly with reference to the African Diaspora and Baltimore.
Vinson   Staff

Anthropology

The Anthropology Department specializes in socio-cultural anthropology: the study of social and cultural forms of human life using ethnographic, historical, and comparative methods. Faculty in our department are engaged in research that addresses topics considered traditional such as the study of ethnicity, language, family and kinship, or medical pluralism, and also new and emergent issues such as those relating to childhood, technological imaginaries, biomedicine, state, violence, and popular economies. In all cases, the acute awareness of shifting contexts in which institutions are embedded and the impact of global, regional, and national politics on social life is built into the methodology and the theory engaged by faculty and students. Faculty in our department have research expertise in the Americas, South Asia, the Middle East, and sub-Saharan Africa. Our research is oriented toward the investigation of a number of cross-cutting themes of trans-regional concern rather than a comprehensive coverage of global cultural areas.

The department's distinctive orientation to anthropology can be characterized in terms of its orientation to non-European anthropological and philosophical traditions, alongside the dominant anthropologies which have been seen as definitive of the discipline in the past. In terms of specific topics, faculty in our department are engaged in research on violence, social suffering and theories of everyday life; the material and moral force of the state; money and value; environments; new kinship; anthropology of religion and secularism; anthropology of medicine; media and visual anthropology; health and well-being; and anthropology of language.

The department offers a B.A. program and a Ph.D. program. The B.A. prepares students either to continue to a higher job or degree in anthropology (and related fields) or to develop anthropological skills and imagination as complementary to pre-professional training, such as medicine, engineering, and international relations.

Undergraduate course work offers an introduction to the basic methodologies and theories of contemporary anthropology through discussion and directed research on these and other topical issues. Student advising helps interested students to develop concentrations, through sequences of complementary courses tailored to their own interests, including electives outside the department. In addition, majors have the option to pursue an honors program.

Undergraduate majors in anthropology are required to do seven courses, two of which are required courses and an additional two must be taken at 300 level or higher, in addition to a language requirement. Students wishing to write an honors thesis are also required to do two additional courses in which they work on their dissertation topics. Minors are required to take six courses. The Logic of Anthropological Enquiry is recommended but not required for the minor.

The core curriculum for majors develops a stepwise sequence from the freshman seminar to the senior honors option. We offer an elective 100-level Freshman Seminar that introduces anthropological approaches to a broad range of contemporary issues. Here, we hope to develop curiosity in anthropology as a way of knowing the world, and to encourage critical student reflection on their own life experiences. Our 100 level introductory course, Invitation to Anthropology, is geared toward freshmen and sophomores. The objective of this course is twofold: to offer anthropological knowledge and analytic skills to a broad range of students, and to prepare potential majors for further training in social theory and fieldwork methods. Following from this introductory course, our 300-level The Logic of Anthropological Inquiry is a requirement for majors. It deepens students' capacity to link theory and method, prepares students to carry out field research, and guides students in the presentation of original research. Building on this foundation, the Junior/Senior Seminar, also required of majors, is a thematic capstone course that demands an extended engagement with classic debates and encourages integrative thinking across the range of anthropology courses taken. By the end of their junior year, majors in anthropology may decide to pursue an honors thesis based on an extended research project. Drawing from their previous course preparation and working closely with a faculty advisor, such students spend one summer conducting field research, one semester conducting secondary literature review, and the final semester writing their honors thesis.

Outside of the core curriculum, both majors and minors may take a wide variety of courses. Thematic courses are highly varied and reflect faculty interests, usually including (in any one year) courses in religion and philosophy; medical, legal, economic and linguistic anthropology; and study of diverse areas of the world. Courses on the state, law and money offer a critical and comparative approach for students aiming toward political, economic and legal careers. Courses in medical anthropology serve pre-med and public health students. Philo-

sophical and theoretical courses are attractive to humanities students. We see teaching and research as integrally linked, and invite undergraduate students to envisage research as they take introductory and advanced courses in anthropology.

The training of graduate students focuses on providing students with a vocabulary and grammar to engage in anthropological reasoning in sociocultural anthropology and with skills in research methods. The department emphasizes training in anthropological theory in relation to new developments in other disciplines within the social sciences; understanding of regions in terms of cross-cutting questions rather than geographical questions alone; and the capability to place a problem within a broad history of anthropology that is engaged through multiple national and regional traditions.

Our faculty brings into the classroom an extraordinary range of personal and professional experiences. We are proud to have one of the most diversified faculties in the discipline worldwide, both in terms of gender and ethnic or national origins. Their collective fieldwork experience spans the world, including the Americas, the Middle East, sub-Saharan Africa, and South Asia.

For more information on our programs of study, the faculty, and current events, please visit our website at **http://anthropology.jhu.edu**.

The Faculty

Emma Cervone, Assistant Professor: race, gender, ethnicity, contemporary indigenous movements in Latin America and development, the process of formation and redefinition of national identities in the Latin American and Southern Italian contexts; Latin America.

Veena Das, Krieger-Eisenhower Professor: history and myth, philosophy and anthropology, violence, social suffering, medical anthropology; South Asia, Europe.

Aaron Goodfellow, Visiting Assistant Professor and Senior Lecturer Associate Director, Program for the Study of Women: the social/cultural meaning of pharmaceuticals, the technology of sexually transmitted disease (std) prevention; the social/cultural meaning of medical interventions, social suffering, kinship, paternity, queer families, sexuality and gender.

Jane Guyer, George Amstrong Kelly Professor (Chair): social and economic anthropology, money and culture, household and gender; West Africa.

Niloofar Haeri, Professor: public dress codes and the regulation of morality, language, and modernity, contemporaneity in non-Western

societies, methodology, gender, Arabic; Iran, Egypt, and the Middle East.

Clara Han, Assistant Professor: medical anthropology; violence, urban poverty, subjectivity, care, and everyday life; Chile, Latin America.

Naveeda Khan, Assistant Professor: anthropology of religion, violence and everyday life, state and urban formations, political affect, Islam, South Asia.

Sidney W. Mintz, Research Professor and Professor Emeritus: economic anthropology, peasant society, food, life history; Latin America, Caribbean.

Juan Obarrio, Assistant Professor: political theory, law and justice, development and value, temporalities; Southern Africa, South America.

Anand Pandian, Assistant Professor: modernity and power, nature and development, ethics and affect, cinema and landscape; South Asia.

Deborah Poole, Professor: visuality and representation; race and ethnicity; violence, liberalism, and the state; law and judicial reform; Latin America (Peru, Mexico).

Joint Appointments

Sara Berry, Professor (History): economic and social change, agrarian history, historical and anthropological methods; Africa.

Lori Leonard, Associate Professor (Health, Behavior and Society): social and economic change; natural resources and extractive industries; transnational governance; gender; health; longitudinal studies; Africa.

Erica Schoenberger, Professor (Geography and Environmental Engineering): economic geography, regional development, environment and society.

Elizabeth D. Tolbert, Assistant Professor (Peabody Conservatory): expressive culture and intercultural aesthetics, performance, gender, ritual, ethnomusicology, music and language; Finland.

Facilities

In addition to the regular departmental colloquium where invited speakers from Hopkins and other campuses around the world present their ongoing research, the department holds one or two special symposia every year, including one organized by graduate students. The department also invites a distinguished scholar each year to present the Sidney W. Mintz Lecture. The purpose of the Mintz lectures is to integrate scholarly and social concerns, focusing on questions of political and economic inequality, racism, gender and ethnic differences from an interdisciplinary perspective. Previous lectures have subsequently been published in Current Anthropology.

The Baltimore-Washington area is unusually rich in library, archival, and museum resources relating to anthropology. In addition to the excellent collection in the Milton S. Eisenhower Library, the William H. Welch Medical Library, and other libraries at Johns Hopkins, major anthropological holdings are available at the Smithsonian Institution, the Library of Congress, and the other specialized libraries and museums in nearby Washington, D.C. Students can use the Smithsonian Institution's ethnological and library collection through a cooperative arrangement.

Financial Aid

Undergraduate majors and non-majors are eligible to apply for a Provost's Undergraduate Research Award to support special research and write-up projects in their senior year.

Graduate fellowships and teaching assistantships are available, and most students admitted receive support. Stipends are currently offered at $20,000 per year plus fellowships that cover tuition. Some additional funds are usually available on a competitive basis for summer field research (including travel grants from the Institute for Global Studies, the Program for the Study of Women, Gender, and Sexuality, and the Program for Latin American Studies), for special language-learning needs, and for dissertation write-up; the award of an Owen Fellowship in Arts and Sciences provides an additional $5,000 per annum for three years on a competitive basis. Write-up students may apply for a Dean's Teaching Fellowship.

Undergraduate Programs

Courses in the department are open to all students in the university, regardless of their choice of majors. Although there are no formal prerequisites, students with no previous courses in Anthropology are encouraged to consider courses at the 100- or 200-level. Freshman seminars are designed to introduce students to different perspectives within anthropology through close examination of a contemporary issue.

Requirements for the B.A. Degree

To fulfill the general requirements for the B.A. degree, students majoring in anthropology must complete a total of 21 credits (7 courses) in Anthropology. These include:

- 070.319 The Logic of Anthropological Inquiry
- 070.317 Junior/Senior Seminar
- Five other courses
  - Two at the 100- or 200-level

- At least three more courses at 300-level or higher, of which one can be a cross-listed course taught outside the department. After consultation with faculty, majors can take an independent study course toward the major. There is also a possibility of doing the anthropology major with a defined concentration, for which students are advised to consult the director of undergraduate studies.

Honors Thesis in Anthropology

Students with at least a 3.5 GPA (major GPA) by their junior year are encouraged to write a senior thesis by registering for a two-semester independent study with a faculty advisor. When there are five or more students who wish to write theses, a three-credit senior thesis seminar will be offered which can replace one of these independent studies.

Minor in Anthropology

A minor in anthropology is available to undergraduate students in any major. Students should discuss their intention to minor in anthropology with the department's undergraduate advisor. Requirements for the minor are:

- One 100-level or 200-level course
- Five other courses at 200-level or above, of which at least three must be at or above the 300-level.

Graduate Programs

Ph.D. in Anthropology

The graduate program in anthropology leads to the Ph.D. degree. By admitting only a few students each year, the Department of Anthropology encourages close working relationships between students and faculty and the opportunity for students to develop their anthropological interests in ways that are uniquely suited to them to become researchers, scholars, and teachers.

Requirements for the Ph.D. Degree

Students will usually spend two to three years in residence, one year or more conducting field research, and a final year completing the dissertation. Requirements include:

- A total of 10 courses to be completed in the first two years, two of which are required courses on theory and method: Pro-Seminar and Anthropological Research Methods. For the sequencing of the required courses, students should consult the detailed guidelines available in the department.
- A student should be able to demonstrate a reading knowledge of at least one foreign language relevant to his/her field of study before completing

the comprehensive exams in the second semester of the second year of study.

• For the comprehensive exams, students are required to write two essays (one conceptual and one related to region or area) and develop a research proposal. The paper on region or area is may be completed by the end of the second year.

• Students are expected to conduct exploratory fieldwork during at least one summer and to discuss their summer fieldwork in a departmental methodology workshop. The requirement must be completed before the qualifying exams that allow students to proceed to their dissertation research. Students are also encouraged to take

the proposal-writing course when offered and to apply for fieldwork grants from external agencies.

For further information about graduate study in anthropology, contact the academic program coordinator in the Department of Anthropology or visit the departmental website at **http://anthropology. jhu.edu**.

Interdisciplinary Ph.D. Degrees
Students can petition the department and the graduate board to create joint Ph.D. courses of study. Current cases include Anthropology/Public Health and Anthropology/Intellectual History (in the Humanities Center)

Undergraduate Courses

As our course offerings change frequently, the most up to date information may be viewed via our website at **http://anthropology.jhu.edu**.

070.103 (H,S,W) Africa and the Museum
Freshman seminar course on African material life, as created, used, collected, displayed, and discussed. Aims to introduce both Africa and its representations in the West.
Guyer   3 credits

070.113 (H,S) Freshmen Seminar
Introduces students to anthropology through ethnographic films and selected readings in anthropology.
Haeri   2 credits

070.132 (H,S,W) Invitation to Anthropology
Introduces students to modes of reasoning in anthropology. How do anthropologists examine such questions as the meaning of family, is writing always linear, is shopping good for society?
Khan   3 credits

070.134 (H,S) Religions of the World: An Introduction
Introduces the religious vocabulary and practices of different religions in the contemporary world.
Staff   3 credits

070.140 (H,S) Undergraduate Seminar: Commodities and Comforts: The Anthropology of Mass and Popular Culture
What tools do anthropologists use to understand the contemporary? How do anthropologists understand the world in which we live and the objects that surround us in daily life? What might anthropologists have to say about Hollywood films, cyber space, shopping malls, fast food, raves, hip-hop, and the 24 hour news media? Through an investigation of anthropological engagements with mass and popular cultural forms, as they are consumed, enacted, or resisted across the globe, students explore

different methodologies and approaches to the study of contemporary cultural forms.
Goodfellow   3 credits

070.150 (H,S,W) Introduction to Modern Religion and Secularism
We often hear about the resurgence of religion within our secular public sphere. We will use ethnographies, histories, films, and social theory to examine the concepts and claims that go into making this statement before we gauge its truth.
Khan   3 credits

070.218 (H,S,W) The Politics of Multiculturalism
Examines the political significance and the appeal of the concept of multiculturalism in a number of countries of Latin American and Oceania in the context of native peoples' struggles for recognition and justice.
Cervone   3 credits

070.219 (H,S) Anthropology and Public Action
Anthropologists have used their expertise in public debates, legal cases, advisory roles and so on, and have studied the "public sphere". Case studies show how anthropological knowledge has been mobilized and how anthropologists have chosen to intervene in public life.
Guyer   3 credits

070.222 (H,S,W) Africa in the 21st Century
Rapid urbanization has created new needs, occupations, entertainments, etc., outside the "formal sector". We use anthropological studies, African literature, film, and the press online to understand making a living, creating social life, imagining futures and struggling in the political domain.
Guyer   3 credits

070.248 (H,S) Medical Anthropology
How can we explore illness as moral experience; the interplay of social processes, biology, and medicine; the social

experiences of death and dying? Explores these questions in ethnographic work, as well as film, medicine, and public health studies
Han   3 credits

070.259 (H,S,W) Gift and Sacrifice
How do gifts become the foundation of society? How does the fetish take control over a person? What is the meaning of the ritual sacrifice of living beings and things? Explores classical and contemporary anthropological explorations of circulation, exchange, of power, dread, and desire
Obarrio   3 credits

070.265 (H,S) Anthropology of Media.
Examines the mediation of contemporary cultural life through technologies such as cinema, television, radio, design, and the Internet, investigating questions of desire, power, identity, and belonging.
Pandian   3 credits

070.285 (H,S) Understanding Aid
Analyzes theories of development that have been guiding international cooperation in developing countries since the late 1940s. Case studies focus on Latin America, the Caribbean, India, and Africa.
Cervone   3 credits

070.291 (H,S) Social Networks and Beyond
What is a network? We all cultivate, take part in, think with, are frustrated by, and utilize networks of all different kinds, but what are they? Can they be located? In what ways do they (not) exist? What counts as participation? We investigate how social scientists and others have approached networks. The goal is to discuss connections and to discover the different agents at work in their making and imagination. Students read literatures touching on the topics of rumor, conspiracy, the internet, kinship, epidemiology, and finance to become aware of how anthropologists conceive of and contribute to the formation of networks.
Goodfellow   3 credits

070.299 (H,S,W) Economies in the Americas
Explores how visual images, including film, photography, and digital media, circulate and acquire meaning. Students will develop fieldwork-based projects that explore the historical and cultural dimensions of visual experience in the Americas.
Poole   3 credits

070.306 (H,S) Healing: Politics and Poetics
Metaphors of health and illness; individual and social. The body in pain and the body politic. Ethnographies of historical memory vis-à-vis medicine, epidemics, sacredness, shamanism, terror, humanitarianism, truth, and reconciliation. Open to senior undergraduates and graduate students.
Obarrio   3 credits

070.309 (H,S) Anthropology of Media
Examines the profound mediation of contemporary human life through technologies like film, television, radio,

mobile phones, iPods, and the Internet, investigating questions of desire, politics, production, and the virtual.
Pandian   3 credits

070.315 (H,S) Advanced Topics in Medical Anthropology
We select a small number of topics for intensive discussions and individual research. Topics may include an examination of health inequities, impact of new technologies on medical practice, and illness as experience.
Das, Han   3 credits

070.317 (H,S,W) Junior/Senior Seminar
Explores the history and practice of anthropology through a consideration of a specific problem, which may change from year to year. Consult the department for the current theme.
Staff   3 credits

070.319 (H,S) The Logic of Anthropological Inquiry
Anthropology combines theory and methods from the sciences and the humanities. We take a close look at those logics, as shown in ethnography as a mode of inquiry and as a genre of writing. Counts as a required course for Anthropology majors but open to all undergraduates.
Guyer   3 credits

070.320 (H,S,W) Film, Fate, and Law: Comparative Perspectives on the Outlaw in Mexican and Indian Films
What fates befall filmic bandits? What do these fates tell us about the ordinary experiences of law and time? Explores these questions through Mexican and Indian films about banditry and crime.
Khan, Poole   3 credits

070.321 (H,S) Prisons and Police
How does incarceration generate sociality? How do prisons and policing figure in anthropological thought and social theory? Explores both the emergence of prisons as forms of punishment and reform as well as sociality, and consider policing in relation to concepts of population as well as neighborhood. It draws from classic topics in anthropology of law, custom, and crime as well as explores contemporary engagements with topics of incarceration and security. It draws widely from ethnography, social and political theory, film, public health studies, and sociological works on incarceration.
Han   3 credits

070.322 (H,S) Anthropology and Fiction
Looking at fiction, poetry, visual montage, and other forms of experimental writing in contemporary anthropology, we will explore ethnography as a creative practice of provoking altered states such as compassion, dream, wonder, and shame.
Pandian   3 credits

070.324 (H,S) The Social History of Languages
The history of languages in terms of their social functions, codification, adaptations for administrative purposes, their use in literature, their dissemination, expansion, or

decline. Examples of languages we will consider in the course are Latin, Arabic, Hebrew, French, and English.
Haeri   3 credits

070.325 (H,S) The Anthropology of Money
The root of evil? The passing "stranger?" The proof of virtue? Money has been accorded many roles and meanings, in exchange and as wealth, across society and history. The course combines ethnographic, comparative, and historical study with research on responses to present conditions.
Guyer   3 credits

070.327 (H,S,W) Poverty's Life: Anthropologies of Health and Economy
Medicine, economics, and ethics have profoundly shaped debates on poverty. Analyzes these debates and tracks the relationships between body, economy, and the everyday. How can anthropological reasoning and methods inform approaches to health and economic scarcity and insecurity?
Han   3 credits

070.338 (H,S) Social History of Languages
The history of languages in terms of their social functions, codification, adaptations for administrative purposes, their use in literature, their dissemination, expansion, or decline. Examples of language we will consider in the course are Latin, Arabic, Hebrew, French, and English.
Haeri   3 credits

070.347 (H,S) Discourse Analysis: "Human Foregatherings and Comminglings"
Are conversations and stories we tell within them amenable to systematic investigation? Examines a variety of approaches to the analysis of conversations, narratives, and oral histories.
Haeri   3 credits

070.351 (H,S,W) Political Life of Gender
Explores the role of gender in the production and contestation of socio-economic inequality and political domination. Examples will be drawn from Latin America and other colonial and post-colonial societies.
Cervone   3 credits

070.354 (H,S) Engendering Life
Explores the role of gender in the production and contestation of socio-economic inequality and political domination. Examples will be drawn from Latin America and other colonial and post-colonial societies.
Cervone   3 credits

070.356 (H,S) Culture and Power in Contemporary Middle East
Provide an in-depth knowledge of selected countries in the Middle East through cultural productions such as film and literature. Particular attention is paid to educational systems and lives of minorities.
Haeri   3 credits

070.368 (H,S,W) Modern South Asia: Political Culture in Pakistan
Pakistan ranks among one of the most politically distressed countries at present. The Pakistani state is considered to be in crisis. Its civil society is considered to be non-existent. Through films, ethnographies, novels, and histories we will see how Pakistanis comment upon their situation. In the process we will see how a political culture endures.
Khan   3 credits

070.369 (H,S,W) Anthropology of the Senses
What role do the senses play in politics? How does historical and ethnographic attention to the three best known human senses, vision, hearing, and smell, help us to think about the emotions found in everyday life, political judgment, and religious practice?
Khan   3 credits

070.373 (H,S,W) Anthropology of Mental Illness
How can we understand mental illness from an anthropological perspective? A study of mental illness brings together a critical analysis of medical and psychiatric discourses, institutions of care, as well as economic inequality. It also challenges us to consider fundamental questions of how to engage with subjectivity and experience. We will work through historical analyses of psychiatric discourse, ethnographic explorations of mental illness and addictions, and social theory on subjectivity and science and technology.
Han   3 credits

070.378 (H,S) Cultural Property and Politics in Latin America
Explores the political uses of culture and the idea of cultural property in Latin American indigenous movements, development policies, and government programs.
Poole   3 credits

070.393 (H,S) Law and Development: Postcolonial Perspectives
What is "development"? How are the interconnections between "structural adjustment" and the "rule of law" currently transforming the space of the postcolonial world? Explores anthropological critiques of development with a focus on labor, land, and locality.
Obarrio   3 credits

070.394 (H,S) The Gift of Justice
Explores various expressions of political imagination and collective action in Latin American urban public spaces. It uses anthropological perspectives to analyze.
Obarrio   3 credits

070.395 (H,S) Anthropology of Clothes
Cross-cultural examination of the reasons for dressing in particular ways. Looks at economic and religious factors, the influence of fashion on our decisions, and conflicts over how we are to appear in public.
Haeri   3 credits

070.396 (H,S) On the Question of Drugs
Explores how drugs—licit and illicit—have shaped understandings of the self, politics, and morality across world regions. Examines anthropological theory on the body, political economy, and affect through a focus on how substances are mediated through the law, economy, medicine, and family. Specific cases will include how discourses of war and terror, and public health discourses shape drug production and experiences of consumption and trafficking; how religious practices and discourses shape bodily experiences of substances as well as addictions; and how pharmaceuticals, clinical reasoning, and the experience of illness interact.
Han   3 credits

070.397 (H,S) Introduction to South Asia
Introduction to the diversity and complexity of modern South Asia: kingship and colonialism; caste and religion; nationalism and violence; cinema and diaspora; politics of development, identity, and the body.
Pandian   3 credits

070.399 (H,S) Back to the Future
What is the imagination of the future within and across cultures? Explore this question by reading among the following topics: memory and monuments; prophecy and divination; social engineering and dystopias; political eschatology and warfare; hope and revolution; cyborg science; finance and future markets; Marxism and avant-gardes; sci-fi and punk.
Obarrio, Khan   3 credits

070.503-504 Independent Study
Individual study projects proposed by a student to a faculty member.
Staff   3 credits

070.505-506 Directed Research
Individual research projects proposed by a student to a faculty member.
Staff   3 credits

070.507-508 Directed Readings
Small group seminars proposed by students to a faculty member.
Staff   3 credits

070.551-552 Internship
Practical workplace experience related to the program, supervised by a faculty member.
Staff   3 credits

070.561-562 Senior Essay
Directed research for selected seniors. See guidelines for Honors Program on page 72.
Staff   3 credits

Graduate Courses

Departmental Colloquium

Reports of research by staff members, advanced students, and invited speakers. All graduate students are expected to attend.

Seminars

Each year several seminars, often co-taught, are offered on special topics that vary from year to year in accordance with student and faculty interest. The following have either been offered recently or are planned for the next two years:

070.604 Modes of Anthropological Inquiry
Examines the intricate connections between the theoretical concerns and the methods of inquiry by tracing changes in relation to selected topics and their corresponding ethnographies.
Das

070.607 On Care and Well-Being
What productive anthropological inquiries would a reflection on care and well-being provoke? Engages these issues through anthropological, historical, and philosophical perspectives. It raises critical questions of how medical institutions and discourses as well as historical and political change transform subjectivity and relationality. Focused reading on texts from Michel Foucault, Georges Canguilhem, Jean-Luc Nancy, Heidegger, and Levinas. We will put these readings in conversation with recent and classic ethnography and historical monographs and essays.
Han

070.613 Advanced Topics in Medical Anthropology
Examines methods and modes of writing in medical ethnography, and will address contemporary debates in the field of medical anthropology theory. Readings will draw from recent ethnographies in medical anthropology and pair these works with social and political theory. Open to advanced undergraduates.
Das, Han

070.614 Anthropological Subjects: On Method
Examines the relationship between method, interpretation, and research design through intensive reading and discussion of selected works in anthropology and history, and students' dissertation research proposals.
Staff

070.616 Proseminar on Anthropological Theory
Close reading of anthropological texts in order to elicit the relation between knowledge and institutions. Will not provide a survey but will select one or two salient concepts and place them within the conceptual and institutional history of various anthropologies.
Staff

070.617 Methods
Teaches how to think about data, evidence, and forms of writing using examples from the literature. Students will be required to use their pre-dissertation research to form good questions for their dissertation research. Open to anthropology graduate students only.
Staff

070.625 The Temporality of Law
Revisits anthropological debates about legal form, customary law, and dispute resolution for insights into how the temporality of law, as both process and expectation, shapes understandings of community, responsibility, and belonging.
Poole

070.637 (Im)possible community
Recent debates on community in continental thought and its relevance for historical and ethnographic studies of political communities. Emphasis is on questions of myth, futurity, labor, expenditure, sacrifice as political concepts. Bataille, Heidegger, Derrida, Nancy, Blanchot, and current political anthropology.
Obarrio

070.638 Modernity of Religion: Belief
How is "belief" rendered an object of study within anthropology and religious studies? What relationships between interiority and exteriority does it signal? How are concerns over dissimulation and deception articulated and contended with? Open to advanced undergraduates.
Khan

070.643 Anthropology's Engagement with Philosophy
Selected texts of anthropologists who have engaged philosophers to see how such categories as "belief," "reason," and "everyday" are illuminated through this engagement.
Das

070.645 Quest for the Ordinary
Key texts to ask both theoretical and methodological questions about the relation between the notions of the ordinary, the everyday, and the domestic.
Das

070.649 Readings in Anthropological Theory and Method
Staff and students will jointly discuss recently published works in major journals.
Staff

070.650 Duplicity and the Law
Examines the idea of law as both process and promise through a reading of classic and contemporary anthropological discussions of law, legal pluralism, custom, and the state.
Poole

070.651 Anthropology of "The Everyday"
"The everyday" as an orienting concept by which to engage social theory and ethnography. We read from among the following: Durkheim, Tarde, Lefebvre, de Certeau, Freud, Nietzsche, Cavell, Brooks, Das, Gilsenan, and Pandalfo.
Khan

070.654 On the Question of Ethics
How are questions of ethics posed in relation to knowledge? Looks at classical and contemporary writings on this issue.
Das

070.655 The Place of Law
Explores the intimate relationship of law to place. What affective force does law gain through its appeal to origins and custom? How does law invoke belonging as place?

070.659 Proposal Writing
Offers a forum for students to discuss research projects, prepare grant proposals, and think further about issues of ethnographic methodology and writing. Open to anthropology graduate students only.
Obarrio

070.663 Semiotics
A close reading of some of the major figures in the history of semiotics. Learn to carry out semiotic analysis on linguistic texts and then examine other kinds of texts available in popular culture.
Haeri

070.667 Encountering Experience
What do we seek in attending to experience? Reading from Hume, Emerson, Dilthey, James, Dewey, Merleau-Ponty, Deleuze, Turner, Jackson, Desjarlais, and others. Examines experience as concept, object, and mode of inquiry. Considering problems of sensation, expression, movement, time, and world, we will query identification of experience as property of the human/subject alone.
Pandian

070.672 The Human and the Inhuman: Conversations between Philosophy and Anthropology
Explores different philosophical and anthropological perspectives on what defines human forms of life and their moving boundaries with the inhuman. Readings include Lévy-Strauss, Diderot, Deleuze, Durkheim, Cavell, Ishiguro, and others.
Das, Marrati

070.684 Genealogy As Method
Notions of genealogy have long been central to anthropological inquiry. Whether seen as a method enabling the development of anthropology into a comparative science, or as critical constructions enabling the conditions of possibility for contemporary social structures to emerge, genealogical methods remain central to the production of anthropological knowledge. Yet, what is often overlooked is what genealogy consists of and what counts as genealogical knowledge. What are anthropologists doing when engaging notions of genealogy? By exploring ethnographic, philosophical, and historical texts, students investigate the place of genealogical methods and their place in the production of knowledge. Scholars whose

work will be explored include W.H.R. Rivers, Malinowski, Levi-Strauss, Fassin, Nietzsche, Foucault, Asad, Strathern, and Povinelli.
Goodfellow

070.686 Ethnography of Emergence
As 'locality' is being currently redefined, these changes in spatial perception make the "contemporary" appear untimely and uncanny. What are the thresholds where the emergent becomes crystallized? Explores unprecedented, sudden eruptions and reconfigurations, considering the ways in which Anthropology's long-cultivated sensibility to singularities, between salvage and prediction, now turns toward novel phenomena in the present. The focus will be on method and theory of ethnographic inquiry. This is a team taught class.
Obarrio

070.688 Anthropology and Fiction
Looking at fiction, poetry, visual montage, and other forms of experimental writing in contemporary anthropology, explores ethnography as a creative practice of provoking altered states such as compassion, dream, wonder, and shame.
Pandian

070.690 Performance in Anthropological theory
Performance theories in language, ritual, and theatre. It will also look at recent applications of performance theory to economics and law and ask if the assumptions underlying notions of performance remain constant across these fields.
Das

Independent Study

Directed reading and writing under the supervision of a faculty member is an important part of the graduate program, beginning in the first year.

The following numbers designate faculty members rather than course content, which will vary from year to year with student and faculty interests.

070.801-802 Dissertation Research
Staff

070.867-868 Directed Reading and Research
Han

070.869-866 Directed Reading and Research
Pandian

070.871-872 Directed Reading and Research
Das

070.873-870 Directed Reading and Research
Goodfellow

070.875-874 Directed Reading and Research
Cervone

070.879-880 Directed Reading and Research
Guyer

070.883-882 Directed Reading and Research
Haeri

070.885-886 Directed Reading and Research
Poole

070.867-892 Directed Reading and Research
Khan

070.893-884 Directed Reading and Research
Obarrio

070.895-896 Directed Reading and Research
Schoenberger

070.897-898 Directed Reading and Research
Berry

Archaeology Undergraduate Major

The major in archaeology is an interdepartmental program that introduces students to archaeological theory, the analysis of archaeological materials, and the results of archaeological research in prehistoric and early historic periods in the Old and New Worlds. Archaeology studies human societies through examination of their material culture (physical remains), considering such issues as human subsistence, interaction with climate and physical environment, patterns of settlement, political and economic organization, and religious activity and thought. The field allows for the study of the entirety of human experience from its beginnings to the present day, in every region of the world and across all social strata.

Students in the major will have the opportunity to study and conduct research on materials stored in The Johns Hopkins Archaeological Museum, which consists of a diverse and extensive assemblage of artifacts from ancient Greece, Rome, Egypt, Mesopotamia, Palestine, and Mesoamerica. Opportunities may also be available to study materials in the Classical, Egyptian, and Near Eastern collections in the Walters Art Museum.

Committee for the Archaeology Major

Glenn Schwartz, Co-Director, Whiting Professor of Archaeology (Near Eastern Studies): Near Eastern archaeology, archaeological method and theory.

H. Alan Shapiro, Co-Director, W. H. Collins Vickers Professor of Archaeology (Classics): Greek and Roman art and archaeology.

Betsy Bryan, Alexander Badawy Chair in Egyptian Art and Archaeology (Near Eastern Studies): Egyptian archaeology and art.

Michael Harrower, Assistant Professor (Near Eastern Studies): archaeology.

Lisa de Leonardis, Austen-Stokes Professor (History of Art): art and archaeology of the ancient Americas.

Matthew Roller, Professor (Classics): Roman material culture and history.

Mark Teaford, Professor (Center for Functional Anatomy and Evolution, School of Medicine): human evolution, fossil hominoids and hominins.

Hérica Valladares, Assistant Professor (Classics): Roman art and archaeology.

Requirements for the B.A. Degree

Requirements for the major include 13 courses (39 credits). These can be selected from a diversity of offerings available from different departments. In addition, students must take a core of three courses consisting of Introduction to Archaeology, World Prehistory, and Archaeological Method and Theory.

1. Core courses: Introduction to Archaeology (130.110); World Prehistory (130.177); and Archaeological Method and Theory (130.354/131.654).

2. Six additional courses in archaeology, both regionally specific and/or methodologically/theoretically advanced (see below).

3. Invitation to Anthropology (070.132)

4. Three additional courses, to be decided in conjunction with the student's advisor, pertinent to the archaeological issues that the student has concentrated on. (For example, a student interested in Greek archaeology could enroll in Greek history or language courses, or a student interested in gender and archaeology could enroll in courses related to gender studies outside of archaeology).

5. Significant archaeological field experience to be determined in consultation with the student's faculty advisor.

Honors Program

Senior archaeology majors have the option of writing an honors thesis under the supervision of a faculty member, which will count for three credits and is outside the requirements of the major. Successful completion of the thesis will result in the conferring of a B.A. with honors.

Courses

Anthropology

070.132 (H,S,W) Invitation to Anthropology
Das   3 credits

Biology

020.207 (N,S) Introduction to Biological Anthropology
Teaford   3 credits

020.365 (N) Introduction to the Human Skeleton
Ruff   3 credits

020.366 (N) Human Evolution
Teaford   3 credits

Classics

040.102 (H) Jews, Greeks and Others in Ancient Israel: Historical and Archaeological Aspects
Staff   3 credits

040.111 (H) Greek Civilization
Staff   3 credits

040.112 (H) Roman Civilization
Staff   3 credits

040.218 (H) Celebration and Performance in the Early Aegean
Anderson   3 credits

040.221 (H) The Archaeology of Early Greece
Anderson   3 credits

040.301 (H) Art and Society in Classical Athens
Shapiro   3 credits

040.320 (H) Myth in Classical Art
Shapiro   3 credits

040.351 (H) Pompeii: Life and Art in a Roman City
Valladares   3 credits

040.359 (H) Making Identities: How Archaeology Constructs People in the Past and Present
Anderson   credits

Graduate courses that may be taken with permission of the instructor

040.609 (H) Sexuality in Egyptian and Roman Art
Valladares and Bryan   3 credits

040.617 (H) Roman Painting: A Survey
Valladares   3 credits

040.659 (H) Archaic Greek Vase-Painting in the Walters Art Museum
Shapiro   3 credits

040.679 (H) Greek Sculpture in the Walters Art Museum
Shapiro   3 credits

040.680 (H) Roman Sculpture in the Walters Art Museum
Staff   3 credits

040.699 (H) Roman Landscapes: Text and Image
Valladares   3 credits

Geography and Environmental Engineering

570.317 (N) Paleoecology
Brush   3 credits

570.406 (H,S,W) Environmental History
Schoenberger   3 credits

570.423 (N) Principles of Geomorphology
Wilcock   4 credits

History

100.470 (H,S) Monuments and Memory in Asian History
Meyer-Fong   3 credits

History of Art

010.105 (H) Ancient Art of the Americas
DeLeonardis   3 credits

010.334 (H) Problems in Ancient American Art
DeLeonardis   3 credits

010.336 (H) Hellenistic Art
3 credits

010.355 (H) Art and Religion in the Roman World
Tucci   3 credits

010.365 (H) Ancient Andean Art
DeLeonardis   3 credits

010.370 (H) Art of Ancient Peru
DeLeonardis   3 credits

010.378 (H) Roman Historical Art
3 credits

010.398 (H) Tombs for the Living
DeLeonardis   3 credits

010.407 (H) Ancient Americas Metallurgy
DeLeonardis   3 credits

010.718 (H) Art and Architecture in Augustan Age
Tucci   2 hours

Near Eastern Studies

130.101 (H) Ancient Near Eastern Civilizations
Schwartz   3 credits

130.102 (H,S) From Neanderthals to the Neolithic
S. McCarter   3 credits

130.110 (H,S) Introduction to Archaeology
Schwartz; S. McCarter   3 credits

130.115 (H,S) Introduction to Near Eastern Archaeology
Schwartz   3 credits

130.135 (H) Ancient Egyptian Civilization
Bryan   3 credits

130.177 (H,S) World Prehistory
Harrower   3 credits

130.316 (H) Ancient City of the Future
Schwartz   3 credits

130.328 (H) Ancient Egypt within Africa
Bryan   3 credits

130.329 (H) Ancient Egyptian Art
Bryan   3 credits

130.351 (H,S) The Emergence of Civilization: A Cross-Cultural Perspective
Schwartz   3 credits

130.353 (H,N) Space Archaeology: An Introduction to Satellite Remote Sensing, GIS, and GPS
Harrower   3 credits

130.354 (H,S) Archaeological Method and Theory
Harrower   3 credits

130.355 (H,N) Geographic Information Systems in Archaeology
Harrower   3 credits

131.800 Independent Readings and Research
(Laboratory seminar on zooarchaeology may be offered by Melinda Zeder, adjunct professor of Near Eastern Studies and curator in the American Museum of Natural History, Smithsonian Institution)

389.341 (H,S) Understanding the Materials and Techniques of Art Objects
Balachandran   3 credits

Graduate courses that may be taken with permission of the instructor:

131.634-635 (H,S) Seminars in Near Eastern Archaeology
Schwartz   3 credits

131.653 (H, N) Space Archaeology: An Introduction to Satellite Remote Sensing, GIS, and GPS.
Harrower   3 credits

131.654 (H,S) Archaeological Method and Theory
Harrower   3 credits

131.655 (H,N) Geographic Information Systems in Archaeology
Harrower   3 credits

133.700-701 (H) Survey of Egyptian Archaeological Sites
Bryan   3 credits

133.720-721 (H) Egyptian Art of the Old through Middle Kingdoms
Bryan   3 credits

133.724-725 (H) Egyptian Art of the Second Intermediate Period and the New Kingdom
Bryan   3 credits

133.730 (H) Egyptian Art of the Third Intermediate and Late Periods
Bryan   3 credits

133.735 (H) Egyptian Art of the Ptolemaic and Roman Periods
Bryan   3 credits

133.750-751 (H) Seminar in Egyptian Art and Archaeology
Bryan   3 credits

Art Workshops

Although the university does not offer a degree program in art, the Homewood Art Workshops provide a studio environment in which undergraduates can pursue their creative interests and earn academic credit in a visual arts program. Courses in drawing and painting develop observational skills and techniques in the beginning student. Courses in photography, cartooning, and design balance studio work with research and critical analysis.

The Faculty

Craig Hankin, Instructor (Director): painting, portraiture, life drawing.

D. S. Bakker, Instructor: aesthetics, visual philosophy, Surrealism.

Phyllis Berger, Instructor (Photography Supervisor): photography, digital imaging, documentary photography.

Thomas Chalkley, Instructor: sequential imagery, political and social satire, popular culture.

Howard Ehrenfeld, Instructor: digital photography.

Barbara Gruber, Instructor: figure painting, *plein air landscape.*

Cara Ober, Instructor: watercolor, mixed media, color theory.

Larcia Premo, Instructor: sculpture, printmaking.

Courses

371.131 Studio Drawing I
This course focuses on developing fundamental drawing skills for the serious student with little or no previous studio experience. Basic concepts of form and composition are taught through exercises based on the book *Drawing on the Right Side of the Brain* and with the aid of still-life setups and live models. Weekly readings and critiques; working sketchbook; final portfolio review. Limit: 15.
Hankin   2 credits   spring/fall

371.133 Painting Workshop I
This course develops fundamental oil painting techniques for the serious student with minimal prior studio experience. Observational skills are taught through the extensive use of still-life setups, with particular attention paid to issues of light, color, and composition. Slide lectures and a museum trip give students an art historical context in which to place their own discoveries as beginning painters. Periodic critiques; final portfolio review. Prerequisite: 371.131 or equivalent. Limit: 12.
Hankin, Gruber   2 credits   spring/fall

371.134 Painting Workshop II
Students who have mastered basic painting skills undertake sustained projects, including figure and *plein air* landscape work. Slide lectures and handouts deepen student appreciation of representational traditions. Advanced techniques, materials, and compositional issues are also investigated. Weekly critiques; final portfolio review. Prerequisite: 371.133 or permission of instructor. Limit: 12.
Gruber   2 credits   fall

371.135 Studio Drawing II
Building on basic drawing skills, this course explores various media, techniques, and compositional elements with special emphasis on portrait and life drawing. A visit to the Baltimore Museum of Art's Print and Drawing Library supplements lectures and enriches the student's understanding of the history of artists' drawings. Weekly critiques; working sketchbook; final portfolio review. Prerequisite: 371.131 or permission of instructor. Limit: 15.
Hankin   2 credits

371.136 Drawing: The Portrait
An intensive look at the traditions and techniques of portrait drawing. Students work from live models in a variety of media and study master portraits by Holbein, Rembrandt, Ingres, Degas, etc. Weekly critiques; working sketchbook; final portfolio review. Prerequisite: 371.131 or permission of instructor. Limit: 15.
Hankin   2 credits

371.139 (H) Still Life/Interior/Landscape
This intermediate drawing class will examine three grand traditions in representational art. We will explore problems in still life that have occupied artists from Chardin to Morandi; in interiors from Vermeer to Giacometti; in landscape from Corot to Diebenkorn. We will also look at where the boundaries between these genres blur and how they overlap. BMA Print & Drawing Library visit. Weekly critiques; working sketchbook; final portfolio review. Prerequisite: 371.131 or permission of instructor. Limit: 15.
Hankin   2 credits

371.140 (H) Cartooning
A history-and-practice overview for students of the liberal arts. The conceptual basis and historical development of cartooning is examined in both artistic and social contexts. Class sessions consist of lecture (slides/handouts), exercises, and ongoing assignments. Topics include visual/narrative analysis, symbol and satire, editorial/political cartoons, character development, and and animation. Basic drawing skills preferred but not required. Midterm exam; final paper/project. Limit: 15.
Chalkley   3 credits   spring

371.149 (H) visualreality/alt.sim
In art, Realism is a simulation of visual reality. But art can also simulate alternative realities, those realities or truths that exist only in daydreams or nightmares. In this class, we will learn to explore and create representations of these additional moments of existence. This will require thinking creatively or "outside the box," a useful skill in any field. Using a variety of media, students are asked to solve problems to which there is no one correct answer.

Weekly discussions and critiques; final project; portfolio review. Prerequisite: Imagination (and some prior studio experience). Limit: 12.

Bakker   3 credits   fall

371.150 Life Drawing

An intermediate drawing course focusing on all aspects of the human form. Beginning with infrastructure (skeletal and muscular systems), we will work directly from the model using a variety of media and techniques to address problems in figurative art from the Renaissance to the present. BMA print and drawing library visit. Weekly critiques; working sketchbook; final portfolio review. Prerequisite: 371.131 or permission of instructor. Limit: 15.

Hankin   2 credits

371.151 (H) Photoshop and the Digital Darkroom

In this course, students use Photoshop software as a tool to produce images from a fine art perspective, working on projects that demand creative thinking while gaining technical expertise. Run as a companion to traditional photography classes, students will make archival prints, have regular critiques, and attend lectures on the history of the manipulated image and its place in culture. Students will look at art movements which inspire digital artists, including 19th-century collage, dada, surrealism, and the zeitgeist of Hollywood films. They will meet with artists who work in this medium as well as visit the BMA to see its growing collection of digital images. Students must have a digital camera. Prior knowledge of Photoshop is not required. Limit 10.

Berger   3 credits   fall

371.152 (H) Introduction to Digital Photography

In this course, students learn to use their digital cameras through a variety of projects that help them develop technical and creative skills. Students explore documentary, landscape, and portrait photography. Critiques and slide lectures of historic photographs, which range from postmortem daguerreotypes to postmodern digital imagery, help students develop a personal vision. Students gain camera proficiency with one-on-one instruction in the field. Basics for print adjustment and output will be covered. Students must have a digital camera with manual aperture and shutter speed. Limit: 10.

Ehrenfeld   3 credits   spring/fall

371.154 Introduction to Watercolor

Watercolor is simultaneously the most accessible of all painting media and the most misunderstood. Through a structured approach of demonstration and experimentation, and also by examining master artists, students will explore a wide range of approaches to watercolor. Technical aspects include painting techniques, properties of transparent and opaque media, color mixing, and types of paper. Students will also learn how to observe interactions of color in nature and to use these color relationships in figurative and abstract works. Painting indoors and out, students will explore subjects of still life, landscape, and portrait in increasing degrees of complexity as the semester progresses. Students will keep a sketchbook journal to record their visual thoughts and to collect and catalog their newly acquired vocabulary of techniques and skills. Limit: 12.

Ober   2 credits   spring

371.155 Introduction to Sculpture

A studio course introducing students to sculptural concepts and methods. Emphasis is on the process of creating. Even the simplest materials can effectively activate space, convey meaning, and elicit emotion when used thoughtfully and imaginatively. Students will learn different methods including additive and reductive techniques, construction, modeling, and mold-making. No prerequisites except a willingness to experiment, make mistakes. and clean up when you are done. Limit: 12.

Premo   2 credits   fall

371.162 (H) Black & White: Digital Darkroom

In this digital course, students explore the black-and-white aesthetic. They develop camera skills on numerous field trips including Ladew Topiary Gardens, the Maryland Zoo & Botanical Gardens, and an optional weekend trip to Cape Henlopen State Park in Delaware. Students meet frequently for critiques and discussions based on historic and contemporary imagery. They will learn to use Photoshop for image adjustment. Techniques such as high dynamic range, duotone, panorama, and infrared will be covered. Students work on a project of their choice and produce a portfolio of ten prints. Digital SLRs are provided. Limit: 10.

Berger   3 credits   spring

371.163 (H) Digital Photography II

In this class, students will have the opportunity to expand the photographic skills learned in Introduction to Digital Photography. Through advanced photographic techniques and exploration of new aesthetic concepts, students will produce a portfolio of high quality prints. Students will be introduced to creative techniques such as flash photography, light painting, professional studio lighting for portraiture and still life, night photography, time-exposure, macro and cameraless photographic experiments. Prerequisite: 371.152. Limit: 10.

Ehrenfeld   3 credits   spring

371.164 Introduction to Printmaking

Working with nontoxic/water-based inks and both an engraving press and hand tools, students will explore several types of print-making. Methods will include intaglio, collograph, and both simple and multiplate relief. As they develop their prints, students can then observe and exploit the strengths that each method has to offer. Drawing and Photoshop skills are helpful but by no means required. Limit: 12.

Premo   2 credits   spring

371.303 (H) Documentary Photography

In this course, students will work on a semester-long photo-documentary project on a subject of their choice. During this process they will explore different genres of documentary photography including the fine art document, photojournalism, social documentary photography, the photo essay, and photography of propaganda. Several field trips will be planned to fuel student projects. Camera experience is a plus, but not a prerequisite. A digital SLR camera will be provided for each student. Limit: 10.

Berger   3 credits   spring

David S. Olton Behavioral Biology Program

The Behavioral Biology Program seeks to establish a greater understanding of the relations of brain and behavior through an interdisciplinary program of study. Students in the David S. Olton Behavioral Biology Program examine the complex interplay between animal behavior, and the processes and mechanisms that underlie behavior. This can encompass a wide range of inquiry, from sociology to molecular biology. One goal of the program is to teach students how to integrate scientific discoveries from the wide array of scientific fields of inquiry that contribute to the study of behavioral biology.

The interdisciplinary characteristics of the Behavioral Biology Program provide an excellent preparation for post-graduate work. For those interested in the health professions, behavioral biology can be integrated into a premedical curriculum that will provide a broad, humanistic perspective. For those who wish to pursue scientific careers in psychopharmacology, behavioral neuroscience, and physiological psychology, the program provides excellent preparation. Students interested in the fields of organismal or integrative biology should consider this major.

Many students ask about the similarities and differences between the Behavioral Biology Program and the major in Neuroscience. Both of these programs are interdepartmental, and a majority of professors teach courses that are listed for both majors. Behavioral Biology majors can explore many aspects of the biology of behavior, including the neural mechanisms of behavior (which obviously overlaps with the neuroscience major), but also biomechanical, evolutionary, ecological, and social aspects of behavior. The Behavioral Biology major also has fairly liberal course requirements which provide students with an opportunity to explore more choices in their liberal arts education. Students majoring in Neuroscience focus directly on the brain and on neural function/mechanisms. Generally speaking, the Systems Neuroscience concentration in the Neuroscience major has the most overlap with Behavioral Biology.

Program and Affiliated Faculty

Gregory F. Ball, Professor (Co-Director): Psychological and Brain Sciences.

Eric Fortune, Associate Professor, (Co-Director): Psychological and Brain Sciences.

Linda Gorman, Teaching Professor: Psychological and Brain Sciences.

Peter Holland, Professor: Psychological and Brain Sciences.

Chris Kraft, Lecturer: Johns Hopkins Center for Marital and Sexual Health, Sexual Behaviors Consultation Unit, Johns Hopkins Medical Institutions.

Undergraduate Program

The core program of the behavioral biology major provides breadth and background in five fundamental areas: (a) physics, chemistry, mathematics; (b) biology; (c) psychology, anthropology, sociology; (d) neuroscience; (e) history of science. In addition, students fulfill the requirements for a natural sciences major. The exact courses to be taken are determined by the student in conjunction with the faculty advisor. Students should note that the university does not permit a double major in an area major and a related discipline. Only courses that fulfill the lower-level distribution requirements (15 H and S credits) may be used to fulfill the requirements of a second major or minor, and the second program must be outside of the natural sciences. Behavioral biology majors wishing to pursue a second major or a minor must first obtain the approval of the co-directors of the program.

Hopkins undergraduates may enter the Behavioral Biology Program at any time, provided all requirements can be completed before graduation. The program co-directors, Dr. Gregory Ball and Dr. Eric Fortune, coordinate undergraduate advising for the program and should be consulted prior to declaring the major. Additional information regarding the Behavioral Biology Program is available through Hope Stein at hope.stein@jhu.edu or 410-516-6196.

Please consult our website for the most recent updates.

Math/Science Requirements for the B.A. Degree

030.101 and 030.105 Introductory Chemistry I and Lab

030.102 Introductory Intermediate Chemistry II and Lab

171.101 (or 171.103) and 173.111 General Physics I and Lab

171.102 (or 171.104) and 173.112 General Physics II and Lab

110.106 (or 110.108) Calculus I

110.107 (or 110.109) Calculus II

020.151 and 020.153 General Biology I and Lab

020.152 and 020.154 General Biology II and Lab

550.111 Statistical Analysis I

550.112 Statistical Analysis II
Students may substitute 550.211 (Probability and Statistics for the Life Sciences) for 550.111 and 550.112.

290.490 Senior Seminar in Behavioral Biology (capstone course)

Core Classes (12 credits)

200.141 Physiological Psychology

200.208 Animal Behavior

020.207 Introduction to Biological Anthropology

080.305 The Nervous System I or 080.250 Neuroscience Lab

- Advanced bio-behavioral sciences courses in two areas (9 credits). Consult major checklist and website for current information.

- Intermediate/Advanced Social/Developmental/ Cognitive Sciences courses (6 credits). Consult major checklist and website for current information at **http://krieger.jhu.edu/behavioralbiology/ courses/index.html**.

- Eighteen credits of humanities and social science courses.

- Twelve credits of humanities, social, quantitative and/or engineering courses (twelve Q or E credits taken for departmental requirements may be used to fulfill the distribution requirement).

- Behavioral Biology Research—while not required by the major, it is highly recommended.

Additional University requirements—please consult your academic advisor.

Courses

290.420 (S) Human Sexual Orientation (elective)
This course examines the historical and current theories of sexual orientation and sexual variation development. Sexual variations encompass sexual behavior that falls outside traditional heterosexual coital sexual activity. This course looks at various types of sexual variations, also known as sexual paraphilias. Sexual paraphilias can include sexual sadism/masochism, fetishism, voyeurism, pedophilia, and exhibitionism. This course examines the biological, psychological, and social contributing factors that influence the development of sexual orientations and variations along with treatment and modification of problematic sexual behaviors.
Kraft   3 credits   fall/spring

290.490 (N) Senior Seminar in Behavioral Biology (required)
This course considers Great Ideas across the scope of Behavioral Biology, and includes discussion of classic and cutting-edge articles in the original literature. Grades are based on student presentations and weekly written reactions to assigned articles. This course serves as a capstone course for senior Behavioral Biology majors.
Holland/Ball   3 credits   fall/spring

360.236 Ecuador and the Galapagos Islands (Winter Intersession, optional)
This course is an introductory field experience tropical biology course held in Ecuador and on the Galapagos Islands. The course concentrates on the flora and fauna of the Amazon rain forest, Ecuador, and the Galapagos Islands. Special attention is given to the consideration of the behavioral adaptations exhibited by various animal taxa. Final grade is based on a field notebook that the student keeps and a final paper due late January. There are no prerequisites other than a valid passport and approval of instructors. Spanish-speaking students are encouraged to apply. No S/U. Students are selected on a competitive basis by the instructors. Application required.
Fortune   3 credits   Intersession

Bioethics Program

The practice of medicine, the development of public health policies, and advances in the biomedical sciences raise fundamental moral and philosophical issues. The bioethics program is designed to provide students with an understanding of these issues, and the background and the conceptual tools to think about them clearly. The program is a collaboration between the Johns Hopkins Berman Institute of Bioethics and the Department of Philosophy, and draws on the resources of both.

The Faculty

Hilary Bok, Associate Professor (Director), Philosophy.

Maria Meritt, Assistant Professor (Bloomberg School of Public Health): bioethics.

Andrew Siegel, Core Faculty, (Berman Institute of Bioethics).

Requirements for the Minor

The requirements for the bioethics minor consist of eight courses. These must include:

- 150.219 Bioethics
- 150.220 Introduction to Moral Philosophy
- Either 020.151 and 020.152 (General Biology I and II) or 020.305 and 020.306 (Biochemistry and Cell Biology) or 580.421-422 (Physiological Foundations for Biomedical Engineering I and II)
- At least two upper-level seminars offered by the bioethics program
- Courses totaling six credits, which can be either upper-level bioethics seminars not counted in fulfillment of the previous requirement, courses cross-listed in the bioethics program, or other courses approved by the program's advisory committee. A list of these courses can be obtained from the program director.

Biology

The Department of Biology offers a broad program of undergraduate, graduate, and postgraduate study in the biological sciences. Included among the areas in which instruction and research opportunities are available are biochemistry and biophysics, cell biology, molecular biology, microbiology, developmental biology, genetics, neuroscience, and immunology.

Research in the department has a strong molecular orientation: a common goal of the research carried out in departmental laboratories is to understand biological phenomena in molecular terms. Both the undergraduate and graduate curricula reflect this orientation. Courses offered by the department employ the basic quantitative approaches of biochemistry, biophysics, and genetics to provide training in molecular biology, broadly defined, with the breadth and opportunities for specialization necessary to prepare students for professional careers in biology and related fields.

In addition to its own graduate program in Cellular, Molecular, Developmental Biology and Biophysics (CMDB Program), the department participates in a collaborative program with the National Institutes of Health. Students in the CMDB Program may also complete their thesis work in specific laboratories in Biophysics, Chemistry, and the Carnegie Institution of Washington Department of Embryology. These programs are described in more detail below.

The Faculty

Karen Beemon, Professor: retroviral RNA processing and transport; avian leukosis virus tumorigenesis.

Maurice J. Bessman, Professor Emeritus, Research Professor: biochemistry and enzymology, synthesis of nucleic acid derivatives, biochemical basis of spontaneous mutations.

Ludwig Brand, Professor: fluorescence studies of protein and membrane dynamics.

Thomas Cebula, Visiting Professor.

Xin Chen, Assistant Professor: genetic and epigenetic mechanisms that regulate germ cell differentiation.

Kyle W. Cunningham, Professor, Co-Director of Graduate Studies: calcium transport and signaling mechanisms in yeast.

Jocelyn DiRuggiero, Associate Research Professor: Genomic diversity, DNA repair mechanisms and environmental stress responses in extremophiles.

Michael Edidin, Professor: membrane organization and dynamics, immunology.

Douglas Fambrough, Professor Emeritus: membrane proteins, targeting, structure, function, and regulation, Na, K-ATPase, Ca-ATPase.

Emily Fisher, Lecturer.

Ernesto Freire, Professor, Henry A. Walters Professor in Biology: structure-based thermodynamics of molecular recognition and function. Novel strategies for drug development.

Samer Hattar, Assistant Professor: light reception for non-image detection: role of rods, cones, and the new photoreceptors (melanopsin-containing retinal ganglion cells).

Edward M. Hedgecock, Professor: developmental genetics of the nervous system of *Caenorhabditis elegans*.

Blake Hill, Associate Professor: protein design, protein folding, and protein-biomolecule interactions.

Vincent J. Hilser, Professor: thermodynamics, protein structure and dynamics, molecular recognition, protein folding.

Robert Horner, Senior Lecturer.

M. Andrew Hoyt, Professor: genetics of chromosome segregation and signal transduction in yeast.

Ru-Chih Huang, William D. McElroy Research Professor: gene regulation and chromosomal structure and function, principles of cancer biology and control of cancer and viral growth.

Rejji Kuruvilla, Assistant Professor: local retrograde signaling by target-derived neurotrophins in neuronal development.

Yuan Chuan Lee, Research Professor: glycoproteins, glycolipids, carbohydrate receptors, and cell-surface substances.

Young-Sam Lee, Assistant Professor: regulation by small metabolites: phosphate signaling pathways.

J. Michael McCaffery, Research Professor.

Richard E. McCarty, Professor Emeritus: structure, mechanism, and regulation of the chloroplast ATP synthase, chloroplast metabolite transport.

Evangelos N. Moudrianakis, Professor: assembly and dynamics of nucleoproteins and chromosomes, bacterial, and chloroplast bioenergetics.

Carolyn Norris, Senior Lecturer.

Rebecca Pearlman, Senior Lecturer.

Peter Privalov, Research Professor: physics of protein structure.

Saul Roseman, Professor Emeritus, Research Professor: functions of cell membranes in cell recognition and sugar transport.

Joel F. Schildbach, Professor and Director of Undergraduate Studies: structural biology of bacterial conjugation.

Robert Schleif, Professor: protein-DNA interactions and regulation of gene activity.

Trina Schroer, Professor: microtubule-based motors, organelle transport.

Richard Shingles, Lecturer.

Howard H. Seliger, Professor Emeritus: bioluminescence and chemiluminescence, estuarine ecology.

Allen Shearn, Professor Emeritus: developmental genetics, imaginal disk development in *Drosophila* studied in lethal and temperature-sensitive mutants.

Mark Van Doren, Associate Professor, and Co-Director of Graduate Studies: gonad development and the formation of sexual dimorphism in the soma and germline.

Beverly R. Wendland, Professor and Chair: endocytic mechanisms and membrane trafficking events.

David Zappulla, Assistant Professor: telomerase RNA-protein enzyme complex and its involvement in chromosome stability, cancer and aging.

Haiqing Zhao, Associate Professor: cellular and molecular mechanisms underlying the development and function of olfactory sensory neurons.

Adjunct Appointments

Jef Boeke, Professor (Medicine).

Alex Bortvin, Assistant Professor: Genetic and epigenetic controls of germ cell development and function in vertebrates.

Donald D. Brown, Professor Emeritus: gene expression in development.

Victor G. Corces, Professor (Emory): control of gene expression, molecular mechanisms of mutagenesis by transposable elements.

Chen-Ming Fan, Professor: molecular and cellular interactions that contribute to vertebrate embryogenesis.

Steven Farber, Associate Professor: Real-time imaging of lipid metabolism in live zebrafish; identification of genes which regulate cholesterol absorption using biochemical and genetic strategies.

Joseph G. Gall, Professor: chromosome structure and functions, nucleic acids in development.

Marnie Halpern, Professor: zebra fish development.

Audrey Huang, Lecturer.

Nicholas Ingolia, Assistant Professor: genome-wide analysis of translation *in vivo*.

Douglas Koshland, Professor (UC-Berkeley): analysis of mitosis in yeast.

Sharon Krag, Professor.

Kenneth Rose, Professor (Medicine).

Christopher Ruff, Professor (Medicine).

George Scangos, Professor.

Allan Spradling, Professor, and Director of Carnegie Institution for Science: molecular genetics of *Drosophila*.

David Weishampel, Professor (Medicine).

Yixian Zheng, Professor: cell division, cell morphogenesis, and cell fate specification.

Joint Appointments

Doug Barrick, Professor (Biophysics).

Gregory Bowman, Assistant Professor (Biophysics).

Richard Cone, Professor (Biophysics).

David E. Draper, Professor (Chemistry).

Karen Fleming, Associate Professor (Biophysics).

Bertrand Garcia-Moreno E., Professor (Biophysics).

Juliette Lecomte, Professor (Biophysics).

Paula Pitha-Rowe, Professor (Medicine).

Robert Siliciano, Professor (Medicine).

Craig A. Townsend, Professor (Chemistry).

Sarah Woodson, Professor (Biophysics).

Undergraduate Programs

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 48.)

The Biology degree is designed to provide students with a thorough grounding in modern biology, with special emphasis on the molecular aspects of the discipline.

All courses required for the biology major must be passed with a grade of C- or better with one exception. The department will accept one passing grade below C- in senior year provided that the average for all formal lecture and laboratory courses is at least 2.0.

Biology majors with a score of 4 or 5 in high school AP Biology are not required to take General Biology I and II.

Core Courses

- **Mathematics:**
  110.106-107 or 110.108-109 Calculus

- **Physics:**
  171.103-104 or 171.101-102 General Physics
  173.111-112 General Physics Lab

- **Chemistry:**
  030.101-102 Introductory Chemistry I and II
  030.105-106 Introductory Chemistry Lab
  030.205-206 Introductory Organic Chemistry I and II
  030.225 Organic Chemistry Lab

- **Biology:**
  020.151-152 General Biology I and II (for the
    class of 2005 and later)
  020.305 Biochemistry
  020.315 Biochemistry Lab
  020.306 Cell Biology
  020.316 Cell Biology Lab
  020.330 Genetics
  020.340 Genetics Lab or 020.373
    Developmental Biology Lab
  020.363 Developmental Biology

Electives

At least three courses totaling eight credits or more
are required, to be selected from the following list
of courses approved by the director of undergradu-
ate studies.

- **Biology**
  020.304 Cellular and Molecular Neuroscience
  020.310/610 Developmental Neurobiology
  020.311 Enzymes and Proteins
  020.312/612 Introduction to the Human Brain
  020.313/623 Neurobiology of Sensation
  020.317/614 Signaling in Development and
    Disease
  020.322 Cellular and Molecular Biology of
    Sensation
  020.324 DNA Microarray Technology
    (Bioinformatics)
  020.325 Introduction to the Protein World
  020.326 Introduction to Glycobiology
  020.327 Molecular Biology of Extremophiles
  020.328 Adopt a Genome: Genomics and
    Sequence Analyses*
  020.329 The Microbial World
  020.331/630 Human Genetics
  020.332 Photosynthesis by Land and Aquatic
    Organisms (Plant Biochemistry)
  020.333 Adaptations of Plants to Their
    Environments
  020.335 Landmarks in Biochemical Research
  020.336 Stem Cell Biology (in Development
    and Disease)
  020.342 Proteins
  020.344 Virology
  020.346 Immunobiology
  020.347 AIDS
  020.349 Microbial Pathogenesis (Epidemics
    and Pandemics)
  020.352 Topics in Virology and Bacteriology
  020.353 Examining Alternative Health
    Strategies
  020.365 Introduction to the Human Skeleton
  020.366 Human Evolution
  020.367 Primate Behavior and Ecology

020.368 Mammalian Evolution
020.370/670 Emerging Strategies and
  Applications in Biomedical Research
020.375 Human Anatomy
020.376/606 Molecular Evolution
020.379 Evolution
020.380 Eukaryotic Molecular Biology
020.383 Molecular Biology of Aging
020.629 Principles of Cancer Biology
020.634 Chromatin and Transcription
020.637 Genomes and Development
020.638 Regulation and Mechanisms of the
  Cell Cycle
020.639 Macromolecular Assemblies in Biology
020.642 Proteins: Structure, Folding, and
  Interaction with Partners
020.646 Biological Spectroscopy
020.651 Retroviruses
020.665 Advanced Biochemistry
020.667 Bioconjugate Techniques
020.668 Advanced Molecular Biology
020.674 Grad Biophysical Chemistry
020.676 Functional Interpretation of
  Biological Structures
020.680 Molecular Basis of Drug Discovery
020.682 Molecular Recognition and Signaling
020.686 Advanced Cell Biology

*Successful completion of this course provides 1.5 credit
hours toward the upper level bio elective requirement for
the BA and BS degrees and 1.5 credit hours toward the
BS research requirement.*

- **Applied Mathematics and Statistics**
  550.310 Probability and Statistics for the
    Physical and Information Sciences
  550.311 Probability and Statistics for the
    Biological and Medical Sciences
  550.420 Introduction to Probability
  550.430 Introduction to Statistics
  550.435 Bioinformatics and Statistical Genetics

- **Biomedical Engineering**
  580.321 Statistical Mechanics and
    Thermodynamics
  580.421 Physiological Foundations for
    Biomedical Engineering I
  580.422 Physiological Foundations for
    Biomedical Engineering II
  580.425 Ionic Channels in Excitable Membranes
  580.427 Calcium Signals in Biological Systems
  580.440 Cell and Tissue Engineering
  580.441 Cellular Engineering
  580.442 Tissue Engineering
  580.474 Molecular and Cellular Imaging

- **Biophysics**
  250.304 Mathematical Approaches to Biological Problems
  250.326 Biological Macromolecules: Structures and Function
  250.332 X-ray Crystallography of Biological Molecules
  250.345 Cellular and Molecular Physiology
  250.351 Reproductive Physiology
  250.353 Computational Biology (Biomolecular Dynamics and Ensembles)
  250.372 Introduction to Biophysical Chemistry
  250.391 Proteins and Nucleic Acids

- **Chemistry**
  030.301 Physical Chemistry I
  030.302 Physical Chemistry II
  030.425 Advanced Mechanistic Organic Chemistry I
  030.426 Advanced Mechanistic Organic Chemistry II
  030.441 Spectroscopic Methods of Organic Structure Determination
  030.451 Spectroscopy
  030.634 Bioorganic Chemistry

- **Chemical and Biomolecular Engineering**
  540.402 Cellular and Molecular Biotechnology of Mammalian Systems
  540.404/604 Therapeutic & Diagnostic Colloids
  540.409 Modeling, Dynamics and Control of Chemical and Biological Systems
  540.431 Biochemical Engineering/ Biotechnology
  540.435 Genome Engineering
  540.437 Applications of Molecular Evolution to Biotechnology
  540.441 Cellular Engineering
  540.459 Biotechnology in Regenerative Medicine
  540.460 Computational and Experimental Design of Biomolecules

- **Computer Science**
  600.403 Computational Genomics: Sequence Modeling

- **Earth and Planetary Sciences**
  270.308 Population and Community Ecology
  270.311 Geobiology
  270.320 The Environment and Your Health (Global Change and Human Health)
  270.325 Oceanography

- **Geography and Environmental Engineering**
  570.303 The Environment and Your Health
  570.309 Microbiology
  570.317 Paleoecology
  570.328 Geography and Ecology of Plants
  570.395 Principles of Estuarine Environment: The Chesapeake Bay
  570.403 Ecology
  570.411 Environmental Microbiology
  570.443 Aquatic Chemistry
  570.450 Molecular Biology for Engineering Applications

- **Neurosciences**
  080.304 Cellular and Molecular Neuroscience
  080.305 The Nervous System I
  080.306 The Nervous System II
  080.310 Communication Between Cells: The Synapse as a Model System
  080.322 Cellular and Molecular Biology of Sensation
  080.330 Brain Injury and Recovery of Function
  080.335 Neuroscience of Pain
  080.340 Neuroplasticity
  080.352 Primate Brain Function
  080.355 Visual System
  080.360 Diseases and Disorders of the Nervous System

- **Physics**
  171.309 Wave Phenomena with Biophysical Applications
  171.310 Biological Physics
  171.319-320 Intermediate General Physics for the Biosciences

- **Psychological and Brain Sciences**
  200.312 Imaging the Human Mind
  200.314 Advanced Statistical Methods
  020.322 Cellular and Molecular Biology of Sensation
  200.329 Brain, Communication and Evolution
  200.344 Behavioral Endocrinology
  200.370 Functional Human Neuroanatomy
  200.376 Psychopharmacology
  200.378 Evolution of Behavior
  200.391 Sex Differences in the Brain, Behavior and Cognition

- **Public Health**
  280.335 The Environment and Your Health

B.S. Degree in Molecular and Cellular Biology
The Biology Department offers a B.S. degree in molecular and cellular biology. The B.S. program is designed to provide a more rigorous preparation for advanced study in the biomedical sciences. The program is tailored not only to students planning to enter Ph.D. programs or obtain employment in the biotechnology industry but also for premedical students.

Requirements

The B.S. degree in molecular and cellular biology requires, in addition to the requirements for the B.A. degree in biology, at least two additional courses totaling five additional credits or more (for a total of at least 13 credits) from the elective list and six credits of research supervised by a faculty member in Biology, Biophysics, or basic science departments in the School of Medicine currently involved in graduate Ph.D. programs. The supervised research will include participation in group meetings and writing a summary of accomplished work at the end of the year. General Biology I and II are not required for the B.S. degree.

B.A./M.S. Degree in Molecular and Cellular Biology

The Biology Department offers a B.A./M.S. (or B.S./M.S. if the student has completed the requirements for the B.S. degree) degree in molecular and cellular biology. The B.A./M.S. degree provides Hopkins biology majors with advanced training in preparation for careers in science and medicine.

Requirements

Students in the B.A./M.S. program must complete all requirements for the B.A. degree. In addition, students enrolled in the combined bachelor's/master's program must complete the following requirements:

- Four additional advanced or specialized courses. At least two of these courses must be at the 600-level or above. Eligible courses fulfilling the advanced course work requirements are listed on the Biology Department website.

- 020.401 and 020.402 Advanced Seminar in Molecular and Cellular Biology (3 credits each). All B.A./M.S. students will participate in this three-credit weekly seminar during their year in the program. The seminar involves student presentations of research and discussion of topics of current interest in the field.

- 020.551, 020.552, and 020.553 Mentored Research Program in Molecular and Cellular Biology. The Mentored Research Program provides B.A./M.S. students with intensive research experience for a full academic year. Students in the program work under the direction of a research mentor on an original research project approved by the Molecular and Cellular Biology (MCB) Program Committee, produce a written report in the form of a thesis, and make a presentation of the work to the Biology Department.

- Final Report and Presentation. The Mentored Research Program culminates in the preparation of a written report of the research project in the form of a thesis. The written report and an oral presentation of the work are evaluated by a Thesis Committee. Passing performance, as judged by the committee, is required for the M.S. degree.

- Teaching Requirement. Teaching is an integral component of the Master's degree. The teaching requirement is generally fulfilled as a teaching assistant for the General Biology and General Biology Laboratory courses for two semesters.

Students admitted to the B.A./M.S. program will be awarded the M.S. degree if they complete the above-described requirements, receive a grade of B or better in all courses during the one year duration of the program, and achieve passing performance on the final written report and oral presentation of the research project completed during the research year as judged by the Thesis Committee.

Admission

Admission to the B.A./M.S. Molecular and Cellular Biology program is selective. Hopkins biology majors and MCB majors who have achieved a mimimum overall grade point average of 3.2, as well as a minimum natural science grade-point average of 3.0, and have had at least two semesters of previous research experience may apply for admission during the junior or senior years. Students with a GPA below the minimum requirement will be considered under special circumstances if a strong commitment to research is demonstrated. Students interested in applying to the Master's program should attend an information session prior to application. Admission decisions are made by the MCB Program Committee, on the basis of (a) the student's academic record, (b) a written proposal for a project to be completed in the Mentored Research Program, (c) letters of support and recommendation, and (d) an interview with the student if required. The committee reserves the right to require interviews for individual students for further clarification of application materials.

Students may matriculate into the program in either the fall or spring semesters. Please consult the Biology Department website for application deadlines and additional information.

Courses fulfilling the advanced course requirements for the B.A./M.S. program

020.304 Cellular and Molecular Neuroscience

020.310/610 Developmental Neurobiology

020.311 Enzymes and Proteins

020.312/612 Introduction to the Human Brain

020.313/623 Neurobiology of Sensation

020.317/614 Signaling in Development and Disease

020.322 Cellular and Molecular Biology of Sensation

020.324 DNA Microarray Technology (Bioinformatics)

020.327 Molecular Biology of Extremophiles

020.328 Adopt a Genome: Genomics and Sequence Analyses

020.329 The Microbial World

020.331/630 Human Genetics

020.332 Photosynthesis by Land and Aquatic Organisms (Plant Biochemistry)

020.333 Adaptations of Plants to Their Environments

020.335 Landmarks in Biochemical Research

020.336 Stem Cell Biology (in Development and Disease)

020.342 Proteins

020.344 Virology

020.346 Immunobiology

020.347 AIDS

020.349 Microbial Pathogenesis (Epidemics and Pandemics)

020.352 Topics in Virology and Bacteriology

020.353 Examining Alternative Health Strategies

020.365 Introduction to the Human Skeleton

020.366 Human Evolution

020.370/670 Emerging Strategies and Applications in Biomedical Research

020.376/606 Molecular Evolution

020.379 Evolution

020.380/650 Eukaryotic Molecular Biology

020.383 Molecular Biology of Aging

020.629 Principles of Cancer Biology

020.634 Chromatin and Transcription

020.637 Genomes and Development

020.638 Regulation and Mechanisms of the Cell Cycle

020.639 Macromolecular Assemblies in Biology

020.646 Biological Spectroscopy

020.651 Retroviruses

020.665 Advanced Biochemistry

020.667 Bioconjugate Techniques

020.668 Advanced Molecular Biology

020.674 Grad Biophysical Chemistry

020.676 Functional Interpretation of Biological Structures

020.680 Molecular Basis of Drug Discovery

020.682 Molecular Recognition and Signaling

020.686 Advanced Cell Biology

020.731 Seminar: Molecular Morphogenesis

020.735 Seminar: Membrane Trafficking

020.738 Seminar: Biological Spectroscopy

020.739 Seminar: Topics in Biochemistry

Honors in Biology

Students earning either a B.A. in Biology or B.S. degree in Cellular and Molecular Biology are eligible to receive their degree with honors.

The B.A. in Biology with Honors requires, in addition to the regular requirements for the B.A. in Biology, a 3.5 GPA for N and Q courses, two semesters of research, presentation of a poster describing the research, and a recommendation from the research sponsor.

The B.S. in Cellular and Molecular Biology with Honors requires, in addition to the regular requirements for the B.S. in Cellular and Molecular Biology, two semesters of research, a 3.5 GPA for N and Q courses, a written report approved by the research sponsor, presentation of a poster describing the research, and recommendation from the research sponsor.

The research requirement must be completed under the direction of a faculty member in a department associated with the Johns Hopkins University or the Johns Hopkins Medical Institutions. If the student's research director is not a member of the Department of Biology, a Biology faculty member must serve as a sponsor and approve the recommendation from the research director.

Departmental Graduate Programs

Requirements for the Ph.D. Degree in Cellular, Molecular, Developmental Biology and Biophysics (CMDB Program)

A program of study leading to the Ph.D. degree is open to students who are candidates for, or who already have, the bachelor's or master's degree in the biological or physical sciences. To be admitted, the applicant should have had either a thorough training in the fundamentals of biology and both organic chemistry and general physics, or a broad training in the physical sciences and mathematics. Special attention is given to the applicant's quality of scholarship and his or her promise as an investigator.

In addition to the general university requirements for an advanced degree (see page 51), doctoral candidates must meet the following departmental requirements:

- Four core courses and four 600- and 700-level electives.

- At least one year of laboratory teaching during the period of graduate residence.

- A high level of achievement in a comprehensive written proposal and oral examination covering proficiency in the field of the student's research interest and various areas of biology and related fields.

- A dissertation based on a program of independent research, a public seminar followed by an oral examination by the thesis committee.

All graduate students are required to complete the four core courses during the first year. In addition, students are required to complete four elective courses before graduation chosen from the list below of 600-level electives and 700-level seminars offered each semester. At least two out of the four courses must be 600-level.

Core Courses:

Fall Semester
   020.668 Advanced Molecular Biology
   020.686 Advanced Cell Biology

Spring Semester
   020.637 Genomics and Development
   020.674 Graduate Biophysical Chemistry

Elective Courses:

   020.606 Molecular Evolution
   020.612 Introduction to the Human Brain
   020.613 Biology Science Writing
   020.615 Communication Between the Cells
   020.620 Stem Cells
   020.629 Principles of Cancer Biology
   020.630 Human Genetics
   020.634 Chromatin and Gene Expression
   020.638 Regulation and Mechanisms of the
       Cell Cycle
   020.643 Virals and Antivirals
   020.646 Biological Spectroscopy
   020.650 Eukaryotic Molecular Biology
   020.679 Advanced Biological Electron
       Microscopy
   020.731 Seminar: Molecular Morphogenesis
   020.735 Seminar: Membrane Trafficking
   020.738 Seminar: Biological Spectroscopy
   020.739 Seminar: Topics in Biochemistry
   250.685 Proteins and Nucleic Acids

   250.689 Physical Chemistry of Biological
       Macromolecules
   250.690 Methods in Molecular Biophysics

Teaching Opportunities

Since most biology Ph.D.'s will teach at some time during their careers, experience in teaching is considered an essential part of the Ph.D. program. The minimum teaching requirement is three contact hours a week for one year in the laboratory sections of undergraduate courses. Further teaching experience is gained through the preparation and presentation of reports in seminars and journal clubs. The department stresses organization of material and clarity of presentation.

Facilities

The lecture rooms, teaching laboratories, and research facilities of the Biology Research Complex (consisting of Seeley G. Mudd Hall and Macaulay Hall) offer a thoroughly modern research facility for molecular biology.

Financial Aid

The department has fellowship funds for the support of graduate students. Awards are granted for tuition and living expenses. Laboratory fees and research expenses are paid by the department.

Carnegie Institution, Department of Science

The Carnegie Institution's Department of Embryology is located on the Homewood campus, close to the Biology research complex. Members of this group hold part-time appointments in the Department of Biology and participate in the training of graduate students. With the approval of both the department and the Carnegie staff, a number of graduate students in biology conduct thesis research in the Carnegie laboratory. The interests of the Carnegie staff include developmental and molecular biology.

Undergraduate Courses

020.104(N) Freshman Seminar: From Genes to DNA and Back
A course consisting of introductory lectures followed by student presentations in the form of seminars. The issues analyzed will be: How did we arrive at the concept of the "gene"? Early experiments that gave substance to this concept? How did we arrive at the "one gene, one enzyme" dogma? What is the chemical nature of the gene"? Is DNA enough for regulated gene expression? Is it "all in our genes"? What is genetic plasticity and epigenetics? What about genomics and proteomics?
Moudrianakis   1.5 credits   fall

020.106(N) Freshman Seminar: Tuberculosis
Mycobacterium tuberculosis is an extremely successful intracellular bacterial pathogen able to manipulate phagocytic cells and its own metabolism to survive within a host. The molecular mechanisms of this survival and resistance to antibiotics will be studied.
Horner   1 credit   fall

020.111(N) Freshman Seminar: The 'Nobels' in Medicine and Chemistry
Key events in our understanding of the life sciences will be traced with the aid of Nobel awards. Freshmen only.
Brand   1 credit   fall

020.113 (N) Freshman Seminar: Microbes in the Media
This seminar discusses scientific issues that are in the news today. Possible topics might include genomics, adaptation and evolution of bacterial pathogens, emergence of anti-biotic resistance, pandemic flu, food safety, bioterrorism, and bioremediation microbial fuel cells, or other biotech-nology topics that could emerge during the semester. Freshmen only.
Cebula   1.5 credits

020.115 (N) Freshman Seminar: Living Off the Sun
This course is a combination of lectures and student pre-sentations that address fundamental principles and also contemporary issues examining the way all forms of life on earth are ultimately dependent on sunlight to satisfy their food and energy requirements. Special emphasis will be on current developments in biotechnologies that utilize microbial populations to supply us with fuels and also to clean up environmental hazards. The course will also consider ways to extract lessons from Nature's suc-cessful designs and harmonious adaptations so that we, in the long run, can utilize them toward a minimization of our negative impact on the environment.
Moudrianakis   1.5 credits   spring

020.125 (H, N) Biology in Film
This course will feature weekly presentations of highly acclaimed Hollywood films. Each film will be hosted by a different member of the Biology faculty who will provide an introduction and discussion of the film. Film topics include early discoveries in the biomedical arena, genetic and infectious diseases, and the potential consequences of human genetic engineering. Students will be expected to attend all classes and complete a questionnaire based on each film.
Staff   1 S/U credit   spring

020.135-136 Phage Hunting
This is an introductory course open to all freshman regardless of intended major. No science background is required. This is the first semester of a year-long research-based project lab course in which students will participate in a nation-wide program in collaboration with under-graduates at other colleges. Students will isolate and characterize novel bacteriophages (viruses that infect bacteria) from the environment using modern molecular biological techniques. The course includes two lab meet-ings per week. Two semester class. Freshmen only.
Fisher, Schildbach   2 credits

020.151 (N) General Biology I
This course begins with an overview of the biosphere, followed by analysis of ecosystem and exploration of ani-mal behavior in the context of ecosystems and evolution. Next, the cellular and molecular basis of life and the ener-getics of organisms are presented as unifying themes. The biochemistry of organic molecules, factors controlling gene expression, cellular metabolism, and advances in biotechnology represent topics of concentration. Mecha-nisms of inheritance and evolution are introduced. This course will also include a series of workshops that will explore current trends in research, experimental design and analysis, and molecular modeling. **Note:** The Friday workshop is a required part of this course.
McCarty, Pearlman, Shingles   4 credits   fall

020.152(N) General Biology II
This course builds on the concepts presented and dis-cussed in General Biology I. The primary foci of this course will be on the diversity of life and on the anat-omy, physiology, and evolution of plants and animals. There will be a special emphasis on human biology. The workshops that were introduced in General Biology I (020.151) will include the use of simulation software, a critique of the primary literature, and an exploration of current trends in medicine.
McCarty, Pearlman, Shingles   4 credits   spring

020.153 (N) General Biology Lab I
This course reinforces the topics covered in General Biology I (020.151). Laboratory exercises explore sub-jects ranging from forest ecology to molecular biology to animal behavior. Students participate in a semester-long project, identifying bacteria using DNA sequencing. Corequisite 020.151. Students who have credit for AP Biology but take General Biology Lab I will lose four AP Biology credits.
Pearlman   1 credit   fall

020.154 (N) General Biology Lab II
This course reinforces the topics covered in General Biology II (020.152). Laboratory exercises explore sub-jects ranging from evolution to anatomy and physiology. Students participate in a project using molecular biology techniques to determine whether specific foods are made from genetically engineered plants. Corequisite: 020.152. Students who have credit for AP Biology but take General Biology Lab II will lose four AP Biology credits.
Pearlman   1 credit   spring

020.161 (N) Biology Workshop I
The workshop covers applications and current trends in Biology, through guest lectures from researchers and hands-on computer programs. Prerequisite: Score of 4 or 5 on AP Biology exam. *(Credit will be awarded for either 020.151 or 020.161, but not both)*
Pearlman   1 credit   fall

020.162 (N) Biology Workshop II
The Biology Workshop covers applications and current trends in biology, through guest lectures from researchers and hands-on computer programs. Prerequisite: Score of 4 or 5 on AP Biology exam. *(Credit will be awarded for either 020.152 or 020.162, but not both)*
Pearlman   1 credit   spring

020.205 (N) Introduction to Biological Molecules
This course presents an overview and introduction to basic biochemistry and molecular biology, especially focusing on medicine and biotechnology. Students will

be involved in lecture, class discussions, group presentations and laboratory exercises. Prerequisite: high school level chemistry and biology.

Shingles, Ketchum   3 credits   summer

020.209 (N) Dinosaurs

This course covers all of the major groups of dinosaurs, from Triceratops to T. Rex and their relatives living today, birds. It will also cover the origins of the group, their near demise 65 million years ago, their behavior, growth, and development, and a history of their study.

Weishampel   3 credits   spring/odd years

020.214 (N) Self-Organizing Patterns in Nature

The manifestations of all biological structures and related functions are the end effect of the formation and maintenance of complex molecular and cellular patterns. These patterns (macromolecules, cellular organelles, cells, and tissues) are assembled from their constituent parts under fundamental rules not too dissimilar to those that govern the formation of snowflakes or the dewdrops on a spider web. This course (lectures and student presentations) attempts to describe these common rules and to explain the formation and function of significant biological assemblies. Prerequisite: 020.305.

Moudrianakis   3 credits   spring/even years

020.296 (N) Foreign Gene Expression in E. coli

This laboratory, offered during intersession, will introduce molecular cloning techniques that allow bacteria to be used to produce a particular gene product. Recombinant plasmids, carrying either a single gene or a fusion protein gene, will be constructed and used to transform competent E. coli, and the gene products isolated. Prerequisite: permission of instructor.

Horner   2 credits   intersession

020.305 (N) Biochemistry

The molecules responsible for the life processes of animals, plants, and microbes will be examined. The structures, biosynthesis, degradation, and interconversion of the major cellular constituents including carbohydrates, lipids, proteins, and nucleic acids will illustrate the similarity of the biomolecules and metabolic processes involved in diverse forms of life. Sophomores, juniors and seniors only. Prerequisite: Chemistry 030.101-102

Hill, Schildbach   4 credits   fall

020.306 (N) Cell Biology

How the molecules of living systems are organized into organelles, cells, tissues, and organisms will be explored, as well as how the activities of all of these are orchestrated and regulated to produce "life"–a phenomenon greater than the sum of its parts. Considerable emphasis is placed on experimental approaches to answering these questions. Topics covered include biological membranes, cytoskeletal elements, cell locomotion, membrane and protein traffic, the nucleus, second messengers, signal transduction, cell growth, the cell cycle, the extracellular matrix, cell contacts and adhesion, intercellular communication, epithelial structure and function, and the cell biology of early development and organ function. Prerequisite: 020.305.

Staff   4 credits   spring

020.307 (N) Enzymes, Metabolism, and Metabolic Disorders

This course will cover basic and advanced concepts in enzymology and metabolic processes while focusing on how these processes contribute to human health and diseases. This course is composed of lectures, discussion sessions, and student presentations.

Y.S. Lee   3 credits   fall

020.311 (N) Enzymes and Proteins

This course will emphasize the structure and function of enzymes and other proteins. It will build on the fundamentals covered in Biochemistry (020.305). Some enzymes will be discussed in detail and some of the experimental methods used to understand mechanisms of action will be explored. Prerequisite: 020.305.

Brand   2 credits   fall

020.312 (N) Intro to the Human Brain

This course explores the outstanding problem of biology: how knowledge is represented in the brain. Relating insights from cognitive psychology and systems neuroscience with formal theories of learning and memory, topics include: (1) anatomical and functional relations of cerebral cortex, basal ganglia, limbic system, thalamus, cerebellum, and spinal cord; (2) cortical anatomy and physiology including laminar/columnar organization, intrinsic cortical circuit, hierarchies of cortical areas; (3) activity-dependent synaptic mechanisms; (4) functional brain imaging; (5) logicist and connectist theories of cognition; and (6) relation of mental representations and natural language.

Hedgecock   3 credits   spring

020.315 (N) Biochemistry Laboratory

This course will reinforce the topics presented in Biochemistry (020.305) through laboratory exercises which use quantitative measurement to study cellular components and processes. Topics include pH, proteins, carbohydrates, lipids, nucleic acids, and enzymes. Prerequisite or corequisite: 020.305.

Horner: 2 credits   fall

020.316 (N) Cell Biology Laboratory

This course will reinforce the topics presented in Cell Biology (020.306) through laboratory exercises which use visible and fluorescence microscopy to study chromosomes, cell organelles, cell surface receptors, contractile proteins, and microfilaments.

Prerequisites: 020.305, 020.315 or corequisite: 020.306.

Horner   2 credits   spring

020.317 (N) Signaling in Development and Disease

An advanced undergraduate seminar on current topics on signal transduction mechanisms underlying neuronal morphology, development, and function. The proper functioning of the nervous system relies on the establishment of precise neuronal circuits through a developmental program including proliferation, neuronal migration, axonal growth and neuronal survival. This course pertains to the extracellular cues and downstream neuronal signaling pathways that coordinate these key events during neuronal development. The course will also cover

the role of aberrant signaling mechanisms in neuronal degeneration and disease.
Kuruvilla   3 credits   fall/odd years

020.322 (N) Cellular and Molecular Biology of Sensation
Leading scientists in sensory biology from the Johns Hopkins community will present the most current knowledge in the cellular and molecular biology of sensation. A lecture and a student presentation of an exemplar manuscript will be presented each week on a different topic of sensory systems. Prerequisites: 020.304, 020.305, 020.306 or 080.305; instructor permission required.
Hattar   3 credits

020.323 (N) Nature at Design: Linking Form to Function
The course begins with an introduction to the theories of optics of photonic and electron microscopies and quickly moves to applied microscopies. The students will be instructed in the methods of biological sample preparation, image acquisition, and processing. This is mainly a laboratory experience. Emphasis is placed on the principles of native sample preservation and on image acquisition through scanning electron microscopies, although other forms of microscopes will also be utilized. The class will be divided into four groups of five students each, and each group will meet twice per week for at least four hours per session. Students who wish, can spend more time with the microscope and image processing.
Moudrianakis   2 credits   intersession

020.325 (N) Introduction to the Protein World
The chemical, physical, and biological aspects of proteins will be considered; their primary, secondary, tertiary, and quaternary structures; evolution of these structures and mechanisms of their formation and functioning.
Privalov   3 credits   spring

020.327 (N) Molecular Biology of Extremophiles
The microbial diversity and molecular adaptation of microorganisms inhabiting extreme environments. Prerequisites: 020.151 and 020.152.
DiRuggiero   3 credits

020.328 (N) Adopt a Genome: Genomics and Sequence Analyses
This genomics course integrates lectures, discussions and independent research. It is designed for students to learn to use available bioinformatics tools for genome and sequence analysis and to put this knowledge into practice by carrying out primary research. Lectures and discussions will cover sequencing strategies and high throughput technologies, metagenomics, current large-scale sequencing projects (i.e. the Human Microbiome) and current issues in genomics. Individual research projects will consist of genome analyses and pathway reconstructions for new microbial genomes in collaboration with the Joint Genome Institue (JGI), the Department of Energy Genomic Center. Successful completion of this course provides 1.5 credit hours toward the upper level bio elective requirement and 1.5 credit hours toward the B.S. research requirement. Prerequisite: 020.330.
DiRuggiero   3 credits

020.329 (N) The Microbial World
This course explores the physiology and genetics of microorganisms within an evolutionary and ecological framework. Concepts in microbiology will be supported by molecular studies of microbial evolution and microbial communities including that of the human microbiome. Prerequisite: 020.305.
DiRuggiero , Fisher   3 credits

020.330 (N) Genetics
Presentation of the principles of heredity and variation, and their application to evolution and development; physico-chemical nature of the gene; problems of recombination; gene action. Suggested prerequisites: 020.305; 020.306. Suggested co-requisite: 020.340.
Hoyt, Cunningham   3 credits   fall

020.331 (N) Human Genetics
This course will examine the growing impact of human genetics on the biological sciences, on law and medicine, and on our understanding of human origins. Topics include structure and evolution of the human genome, genetic and physical mapping of human chromosomes, molecular genetics of inherited diseases, and forensic genetics. Prerequisite: 020.330.
Hedgecock   2 credits   fall/even years

020.332 (N) Photosynthesis by Land and Aquatic Organisms
This course will emphasize plant biochemistry, including fundamental physiological processes of plants, cell structure and function, light capture and photosynthesis, plant growth and development, and the metabolism of minerals and nitrogen. Prerequisites: 020.305, 020.306.
Moudrianakis, Horner   2 credits   spring

020.334 (N) Planets, Life, and the Universe
This multidisciplinary course explores the origins of life, planets' formation, Earth's evolution, extrasolar planets, habitable zones, life in extreme environments, the search for life in the universe, space missions and planetary protection. Prerequisites: three upper-level (300+) courses in sciences (Biophysics, Biology, Chemistry, Physics, Astronomy, Math, or Computer Science).
DiRuggiero, Norman   3 credits

020.340 (N) Genetics Laboratory
This laboratory explores the genetics of living organisms, and students will be required to return to lab on succeeding days to observe and record the results of their experiments. Prerequisites: 020.315, 020.316; prerequisite or corequisite: 020.330.
Norris   2 credits   fall

020.344 (N) Virology
This course will cover basic principles of viral replication and pathogenesis, as well as the host response to viral infection. It will then focus on several viruses of interest, including HIV-1, influenza, Human Papilloma Virus, Hepatitis C, and Ebola Virus.
Beemon, Pitha-Rowe   3 credits   spring/even years

020.346 (N) Immunobiology

A course for upper-level undergraduates that will introduce them to immunochemistry, immunobiology, and clinical immunology. Emphasis is placed on the language, concepts, and experimental methodology of modern immunology and the application of this information to specific human diseases. Prerequisites: 020.305, 020.306; corequisite: 020.330.

Edidin   3 credits   spring

020.347 (N) AIDS

This course will cover the biology of the infectious agent that causes AIDS, the effects of HIV on the immune system, the search for an HIV vaccine, and the pharmacology of the anti-viral agents that are used to suppress HIV infection. Prerequisite: 020.306.

Schroer   3 credits   spring/even years

020.360 (N) Biology of Aging

Our understanding of the biology of aging has been revolutionized with the isolation of mutations that can double lifespan. Why would natural selection have failed to produce such long-lived individuals? In this course we will investigate not only how we age, but also why we age. Each class will begin with a lecture introducing an age-related topic, followed by student presentation and discussion of research papers. Grades will be based upon class participation, quality of presentations, and a final exam. Strong command of cell biology and genetics is recommended. Prerequisite: 020.306

Norris   3 credits   summer

020.363 (N) Developmental Biology

Development of invertebrates, vertebrates, and plants. The course will emphasize the experimental bases for the fundamental concepts of development. Prerequisites: 020.305-306, 020.330.

Van Doren, Chen   3 credits   spring

020.365 (N) Introduction to the Human Skeleton

This course will provide a basic understanding of human skeletal biology, including bone composition and bone growth, recognition of skeletal elements, functional anatomy of different skeletal systems, comparative anatomy.

Ruff   3 credits

020.368 (N) Mammalian Evolution

An introduction to the evolutionary history and diversity of mammals, with emphasis on the first half of the Cenozoic—the beginning of the Age of Mammals. The course will focus primarily on the adaptive radiation of mammals (including our own order primates) that followed the extinction of the dinosaurs, exploring the origins and relationships of the major groups of mammals as well as the anatomical and ecological reasons for their success. Lectures will be supplemented with relevant fossils and recent specimens.

Rose   3 credits   spring/odd years

020.370 (N) Emerging Strategies and Applications in Biomedical Research

In this class, up-to-date primary literature manuscripts related to new discoveries and new strategies that are allowing scientists to make amazing progress in biomedical research will be presented. Examples include labeling neurons with up to 90 different colors to trace their circuitry, evolution studies in glowing bacteria, detecting several viruses on a single chip, and using fiber optics and channel rhodopsin to induce sleep. Students should be interested in reading primary literature research papers and discussing them in class. Prerequisite: 020.305 or 020.306 or 080.305 or 080.306; juniors and seniors only.

Hattar   3 credits   spring

020.373 (N) Developmental Biology Laboratory

The course will include laboratory study of developing vertebrate and invertebrate embryos, analysis of embryogenesis at the molecular, cellular, tissue, and organ levels. Corequisite: 020.363.

Norris   2 credits   spring

020.376 (N) Molecular Evolution

A history of life on earth has been recorded in the DNA of modern organisms. But what information is contained in this record and how can we understand it? This course introduces basic principles of molecular evolution and a wide array of methodologies used to infer and interpret molecular sequence data. Many interesting studies of gene and genome evolution will be covered as examples of this burgeoning area of research.

Cunningham   2 credits   spring/odd years

020.379 (N) Evolution

This course takes a broad look at the impact of natural selection and other evolutionary forces on evolution. Emphasis is placed on what we can learn from genome sequences about the history of life, as well as current evolutionary pressures. Prerequisites: 020.306, 020.330 or permission required.

Norris   3 credits   fall

020.380 (N) Eukaryotic Molecular Biology

The course will present analysis of the structural basis of the genomic content, beginning with the fluctuations of the DNA structure in response to its cellular microenvironment. Next it will deal with the mechanics of its compaction into chromatin and the differentiation of the chromatin structure at the level of the nucleosome via histone polymorphism and modifications; chromatin-based epigenetics; chromosomal territories, chromosomal imprinting, and chromosome inactivation. Next, the lectures will address mechanisms of transcription, the role of transcription factors in initiation, elongation, and termination. It will conclude with analysis of the events of RNA processing and export to the cytoplasm. Paradigms of the role of chromatin differentiation to certain human diseases will be presented. Prerequisite: 020.330.

Beemon, Moudrianakis , Zappulla   3 credits   fall

020.395 (N) Fundamentals of Biological Light Microscopy

Introduction to the principles, practice, and application of light microscopy (LM) to biomedical research. The course will cover light optical theory and instrumentation design, use, and applications. It will afford students hands-on experience in both specimen preparation and microscope operation (including epifluorescence, confocal, and deconvolution light microscopes). Prerequisite: permission of instructor.

McCaffery   2 credits   intersession/even years

020.397 (E,N) Fundamentals of Biological Electron Microscopy

Introduction to the principles, practice, and application of electron microscopy (EM) to biological/cell biological research. The course will cover electron optical theory; instrumentation design, use, and applications; and will afford students hands-on experience in both specimen preparation and electron microscope operation (including both transmission and scanning electron microscopes). Prerequisite: permission of instructor.

McCaffery   2 credits   intersession/odd years

020.401-402 Seminar: Current Progress in Cellular & Molecular Biology and Biophysics

This is a weekly seminar designed for graduate students enrolled in the B.A./M.S. and Ph.D. programs. The seminar involves students presenting research and discussing topics of current interest in the field .

Norris   3 credits
020.401 is offered in the fall
020.402 is offered in the spring

020.420 (N) Build-a-Genome

Must understand fundamentals of DNA structure, DNA electrophoresis and analysis, polymerase chain reaction (PCR) and must be either a) experienced with molecular biology lab work or b) adept at programming with a biological twist. In this combination lecture/laboratory "Synthetic Biology" course students will learn how to make DNA building blocks used in an international project to build the world's first synthetic eukaryotic genome, Saccharomyces cerevisiae v. 2.0. Please study the wiki **www.syntheticyeast.org** for more details about the project. Following a biotechnology boot-camp, students will have 24/7 access to computational and wet-lab resources and will be expected to spend 15-20 hours per week on this course. Advanced students will be expected to contribute to the computational and biotech infrastructure. Successful completion of this course provides three credit hours toward the supervised research requirement for Molecular and Cellular Biology majors, or two credit hours toward the upper level elective requirement for Biology or Molecular and Cellular Biology majors. Prerequisite: permission of instructor.

Boeke, Bader, Ostermeier   4 credits   fall and spring

020.441-442 (N) Mentoring in Biology

This course provides students who have taken General Biology I and II the opportunity to mentor new students in General Biology I and II. Mentors collaborate with faculty on how to lead effective sessions, help students teams complete team assignments, and generally help students understand difficult concepts and principles in biology. Mentors must have a firm command of the topics covered in biology and must meet with both faculty and students through the course of the semester. Prerequisite: permission of instructor, 020.151-152, S/U only.

Pearlman, Shingles   1 credit   fall and spring

020.451 (N) Build-a-Genome Mentor

In addition to producing and sequencing DNA segments like regular B-a-G students, mentors will help prepare and distribute reagents, and maintain a Moddle site to track student reagent use and productivity. Mentors will also be expected to mentor specific students who are learning new techniques for the first time, contribute to the computational and biotech infrastructure associated with Build-a-Genome, and pursue at least one independent research project. Successful completion of this course provides three credit hours toward the supervised research requirement for Molecular and Cellular Biology majors. Prerequisite: permission of instructor.

Boeke, Bader   4 credits   fall and spring

020.501-502 Introduction to Independent Study in Biology

Program of study and reading under the tutelage of a faculty member on those topics not specifically listed in the form of regular courses. Freshmen and Sophomores only. Prerequisite: permission of full-time faculty member in Biology department.

1 to 3 credits based on work equivalent to class-based courses.

020.503-504 Introduction to Research in Biology

Research involves planning and conducting experiments, collection and analysis of data, reporting of results. Usually students are not prepared for research or independent study until their junior year. These courses are offered to accommodate the exceptional freshman or sophomore who has already had extensive laboratory and/or course experience enabling him/her to undertake advanced work. Freshmen and sophomores only. Prerequisite: permission of full-time faculty member in Biology Department.

1 to 3 credits

020.505-506 Internship in Biology

Practical work experiences which have an academic component as certified by a member of the faculty. Prerequisite: consent of advisor.

1 credit, S/U only

020.511-512 Independent Study

Program of study and reading under the tutelage of a faculty member on those topics not specifically listed in the form of regular courses. Juniors and seniors only. Prerequisite: Permission of full-time faculty member in Biology Department.

1 to 3 credits based on work equivalent to class-based courses.

020.513-514 Research Problems

Planning and conducting original laboratory investigations on biological problems, collection and analysis of data, reporting of results. Juniors and seniors only. Prerequisite: Permission of full-time faculty member in Biology Department.

1 to 3 credits

020.551, 020.552, 020.553 Mentored Research Program in Molecular & Cellular Biology

These courses provide B.A./M.S. students with intensive research experience for a full academic year. Students in the program work under the direction of a research mentor on an original research project, produce a written report in the form of a thesis, and make a presentation of the work to the Biology Department.

Graduate Courses

All 600-level courses are open to undergraduates with permission.

020.601 Current Research in Bioscience

Staff   fall

020.606 Molecular Evolution

A history of life on earth has been recorded in the DNA of modern organisms. But what information is contained in this record and how can we understand it? This course introduces basic principles of molecular evolution and a wide array of methodologies used to infer and interpret molecular sequence data. Many interesting studies of gene and genome evolution will be covered as examples of this burgeoning area of research.

Cunningham

020.612 Introduction to the Human Brain

This course explores the outstanding problem of biology: how knowledge is represented in the brain. Relating insights from cognitive psychology and systems neuroscience with formal theories of learning and memory, topics include (1) anatomical and functional relations of cerebral cortex, basal ganglia, limbic system, thalamus, cerebellum, and spinal cord; (2) cortical anatomy and physiology including laminar/columnar organization, intrinsic cortical circuit, hierarchies of cortical areas; (3) activity-dependent synaptic mechanisms; (4) functional brain imaging; (5) logicist and connectist theories of cognition; and (6) relation of mental representations and natural language.

Hedgecock   spring

020.613 Biology Science Writing

Students will learn how to write abstracts and grant proposals, organize scientific manuscripts and thesis dissertations by writing and rewriting about their own research and editing other students' work. Focus will be on structure, substance, accessibility, and clarity of writing.

Huang   spring

020.614 Signaling in Disease and Development

An advanced undergraduate seminar on current topics on signal transduction mechanisms underlying neuronal morphology, development, and function. The proper functioning of the nervous system relies on the establishment of precise neuronal circuits through a developmental program including proliferation, neuronal migration, axonal growth, and neuronal survival. This course pertains to the extracellular cues and downstream neuronal signaling pathways that coordinate these key events during neuronal development. The course will also cover the role of aberrant signaling mechanisms in neuronal degeneration and disease.

Kuruvilla   fall

020.616 Planets, Life, and the Universe

This multidisciplinary course explores the origins of life, planets' formation, Earth's evolution, extrasolar planets, habitable zones, life in extreme environments, the search for life in the Universe, space missions, and planetary protection. Prerequisites: Three upper-level (300+) courses in sciences (Biophysics, Biology, Chemistry, Physics, Astronomy, Math, or Computer Science).

DiRuggiero, Norman   fall

020.620 Stem Cells

This course consists of introductory lectures given by faculty members, followed by student presentations in the form of seminars. The introductory part will cover the basic knowledge about stem cells, such as: What features make cells qualified as stem cells? What are the unique cellular and molecular properties of stem cells? How do stem cells maintain their identities? What are the mechanisms underlying stem cell differentiation and reprogramming? What are the therapeutic applications of stem cells? The student seminar will be based on selected literatures by the faculty. A summary mini-review paper is required for a chosen topic at the end of the semester.

Chen   spring/even years

020.630 Human Genetics

This course will examine the growing impact of human genetics on the biological sciences, on law and medicine, and on our understanding of human origins. Topics include structure and evolution of the human genome, genetic and physical mapping of human chromosomes, molecular genetics of inherited diseases, and forensic genetics.

Hedgecock   fall/even years

020.634 Chromatin and Gene Expression

An advanced course in molecular genetics covering various aspects of gene expression, including the structure of the nucleosome, effects of chromatin on transcription of eukaryotic genes, mechanisms of enhancer function, and the role of nuclear organization on gene expression. The course will consist of lectures as well as presentations of current papers by the students.

Moudrianakis, Beemon   fall/even years

020.637 Genomes and Development

This course covers the genetic analysis of development, model developmental systems, cell determination, organization of tissues and organs, cell motility and recognition, and sexual reproduction.

Van Doren, Spradling, Halpern, Bortvin

3 credits   spring

020.638 Regulation and Mechanisms of the Cell Cycle
The great progress in eukaryotic cell cycle research in the past decade was made possible by a unique synergism between different modern biological approaches (genetic, cell biological, biochemical, and developmental). These approaches will be highlighted in this course. We will cover the mechanisms the cell employs to carry out its duplication cycle, such as DNA replication, mitotic spindle function, and cytokinesis, as well as the regulatory mechanisms that govern these processes. The relationship of cell cycle biology to the cancer problem will receive special attention. Prerequisites: 020.305, 020.306, and 020.330, or the equivalent.
Hoyt   spring/even years

020.640 Epigenetics & Chromosome Dynamics
It has become finally recognized that the primary structure of the DNA is not the sole and absolute determinant of the phenotype of an organism. Much depends on the modulations of the primary information by time and tissue specific enzymatic modifications of this information and the result is the epigenetic information potential within the nucleus. This potential is dynamic; it can be "written and re-written" in the life-trajectory of a cell. We will examine the various process and states of genome epigenetics, from simple genes to whole chromosomes, chromosomal subsets and even the whole nucleus. This graduate level course will consist of few special overview lectures given by the instructors and the rest will be student presentations. The topics will be selected by the faculty, but we will also consider the inclusion of special and timely topics suggested by the students. The duration of each session will be 90 minutes. Upper level undergraduates may register with signature of the instructors. The evaluation of the students for grade assignment will depend on a) the quality of the student's oral presentation; b) the students extent and depth of participation in the discussions of each and every seminar; c) the completion of papers given as homework assignments.
Migeon, Moudrianakis   fall

020.643 Viruses and Anti-Virals
Viral infections are a major health problem for the entire world. The human and economic cost to society is tremendous; however, for many of these diseases no effective cures are available. Viral infections like HIV/AIDS, hepatitis C, herpes, HPV, SARS, avian flu, West Nile virus and dengue not only affect or threaten people in the developing world but also in the most developed regions of the planet. Currently, fewer than 30 antivirals have been approved by the FDA, most of which specifically target HIV/AIDS. This course will discuss current strategies and approaches for the development of new antivirals using a molecular and thermodynamic point of view.
Beemon, Freire   spring

020.644 RNA
A graduate seminar course that will explore RNA from its beginning in the primordial RNA world to its present-day roles in gene regulation in bacteria, mammals, and viruses. Topics will include the early RNA world, riboswitches, ribozymes, evolution of protein synthesis, splicing, telomerase, RNA interference, microRNAs, long non-coding RNAs, viral non-coding RNAs, and RNA therapeutics.
Beemon   spring

020.646 Biological Spectroscopy
This course provides a theoretical background for fluorescence spectroscopy and demonstrates how fluoresence can be used to advantage to address important problems in biochemistry, biophysics, molecular biology, and cell biology.
Brand   2 hours   fall/even years

020.650 Eukaryotic Molecular Biology
The course will present analysis of the structural basis of the genomic content, beginning with the fluctuations of the DNA structure in response to its cellular microenvironment. Next it will deal with the mechanics of its compaction into chromatin and the differentiation of the chromatin structure at the level of the nucleosome via histone polymorphism and modifications; chromatin-based epigenetics; chromosomal territories, chromosomal imprinting and chromosome inactivation. Next, the lectures will address mechanisms of transcription, the role of transcription factors in initiation, elongation, and termination. It will conclude with analysis of the events of RNA processing and export to the cytoplasm. Paradigms of the role of chromatin differentiation to certain human diseases will be presented.
Beemon, Moudrianakis, Zappulla   fall

020.666 Biological Thermodynamics
An in-depth discussion of thermodynamics, statistical thermodynamics, and their applications to the conformational equilibrium and the interactions of biological macromolecules with other macromolecules and small molecular weight ligands.
Freire   fall

020.668 Advanced Molecular Biology
An advanced course in organization and function of eukaryotic and prokaryotic genes, including discussion of techniques to analyze gene structure and transcription. Prerequisite: 020.665.
Schleif   fall

020.674 Graduate Biophysical Chemistry
Students interested in pursuing biophysical research, who have taken undergraduate physical chemistry, may opt to take a two-semester series in Molecular Biophysics (250.689-690). This course will provide an overview of protein and nucleic acid structure, fundamentals of thermodynamics and kinetics, ligand binding, folding and stability of macromolecules, and the principles of biophysical methods such as fluorescence spectroscopy, NMR, and X-ray crystallography. Similar topics are covered in the two-semester series, but with greater emphasis on mathematical and quantitative analysis. Students wishing to pursue this option should consult with faculty.
Woodson, Brand, Hill, Bowman   spring

020.679 Advanced Biological Microscopy
This course builds upon the basic skills and knowledge students acquire in 020.395 and 020.397. The course will

emphasize the integration and use of various light and electron microscopy techniques and their application to various biomedical research related questions; with students participating in the design, implementation, and analysis of their own experiments or experiments pertaining to ongoing research in the Center. Additionally, the course will cover basic theory and applications of nonlinear spectral imaging techniques with special emphasis on coherent Raman spectroscopy. The course will be comprised primarily of a practical hands-on component but will also include applied theory as students will read, analyze, and discuss current journal articles. Prerequisites: 020.395, 020.397, or permission of the instructor.
McCaffery, Wilson   spring/even years

020.684 Fundamentals of Drug Design
The creation and implementation of new approaches to the drug discovery and development process is a very active area of research. Currently, only one compound out of 5,000 that enter preclinical studies becomes a drug. Moreover, the development process is time consuming, lasting more than ten years on average. The rate of failure is extremely high. It has become evident that this field is in urgent need of revolutionary changes. This course will cover drug discovery, with issues ranging from the identification of hits to their optimization as drug candidates. Current as well as novel and proposed approaches aimed at accelerating discovery, potency optimization, selectivity, pharmacokinetics, and other drug properties will be discussed. Graduate students only.
Freire   2 hours   fall

020.686 Advanced Cell Biology
All aspects of cell biology are reviewed and updated in this intensive course through critical evaluation and discussion of the current scientific literature. Topics include protein trafficking, membrane dynamics, cytoskeleton, signal transduction, cell cycle control, extracellular matrix, and the integration of these processes in cells of the immune system. Open to graduate students and advanced undergraduates by permission of the instructor.
Cunningham   3 hours   fall

020.731 Seminar: Critical Thinking in Biology
Halpern, Hill, Zappulla   fall/odd years

020.735 Seminar: Membrane Trafficking
The Membrane Trafficking seminar course consists of several weeks of lectures and discussions led by the professors discussing key background concepts in the field of membrane trafficking. Class meetings during the final weeks of the course are seminars on current topics in membrane trafficking, led by the students. Over the course of the semester, students will learn about the methods and logic of experiment design, model building and hypothesis testing, gain exposure to and skills in reading and summarizing scientific literature, and get experience with preparing and delivering an effective oral presentation.
Wendland/McCaffery   fall/odd years

020.738 Seminar: Biological Spectroscopy
We will discuss important recent and classical papers in biological spectroscopy with an emphasis on steady-state and nanosecond time-resolved fluorescence. Topics will include FRET, fluorescence anisotropy, and single molecule fluorescence. We will discuss photophysics and applications of spectroscopy to studies of proteins, membranes, and nucleic acids.
Brand   spring/even years

020.739 Seminar: Topics in Biochemistry
Minireviews taken from the *Journal of Biological Chemistry*. Students select a topic of their choice from the "Compendium of Minireviews" for the current year and present it to the class for discussion.
Bessman   2 hours   spring

020.753 Methods and Logic in Biology
Staff   fall/odd years

020.801-802 Research on Biological Problems
Independent research for the Ph.D. dissertation.
Staff

020.823-826 Introduction to Biological Research
Training in techniques of biological research in research laboratories. Open to first-year biology graduate students only.
Staff

250.685 Proteins and Nucleic Acids
The structure of proteins, DNA, and RNA and their functions in living systems. Experimental and theoretical approaches to macromolecules, including modeling, simulating, and visualizing three-dimensional structures.
Woodson, Bowman, Lecomte   fall

250.689 Physical Chemistry of Biological Macromolecules
Introduction to the principles, methods, and approaches employed in the study of the energetics of proteins and nucleic acids, with emphasis in understanding the relationship between structure, energy, dynamics, and biological function. Topics include classical, chemical, and statistical thermodynamics, kinetics, theory of ligand binding, and conformational equilibria.
Garcia-Moreno   3 hours   fall

250.690 Methods in Molecular Biophysics
Introduction to the methods employed in the study of energetics, structure, and function of biological macromolecules. Topics include optical spectroscopy, transport methods, NMR, X-ray crystallography. Course emphasizes theoretical understanding and practical knowledge through problem solving and literature discussion. Prerequisites, highly recommended: Proteins and Nucleic Acids (250.685) and Physical Chemistry of Biological Macromolecules (250.689), Calculus (110.108/109), or equivalent course work.
Bowman and Staff   spring

Thomas C. Jenkins Department of Biophysics

The Department of Biophysics offers programs leading to the B.A., M.A., and Ph.D. degrees, for students who wish to develop and integrate their interests in the physical and biological sciences.

Research interests in the Department cover molecular and cellular structure, function, and biology, membrane biology, and biomolecular energetics. The teaching and research activities of the faculty bring its students in contact with biophysical scientists throughout the university. Regardless of their choice of research area, students are exposed to a wide range of problems of biological interest. For more information, see the department Web page at **www.jhu.edu/~biophys**.

The Faculty

Doug Barrick, Professor: energetic and structural basis of Notch signal transduction, protein energetics, repeat protein folding.

Gregory Bowman, Assistant Professor: biophysical and biochemical characterization of chromatin-remodeling proteins; X-ray crystallography.

Richard Cone, Professor: mucosal protective mechanisms, contraception and prevention of sexually transmitted diseases, cellular and molecular mechanics.

Karen G. Fleming, Associate Professor: energetics and folding of membrane proteins.

Bertrand Garcia-Moreno E., Professor (Chair): experimental and computational studies of protein energetics and electrostatics.

Juliette T. J. Lecomte, Professor: Structure and dynamics of proteins in solution; NMR spectroscopy.

George Rose, Krieger-Eisenhower Professor: modeling and simulation of protein folding and protein structure.

Sarah A. Woodson, Professor: folding and assembly of RNA and RNA-protein complexes.

Research/Teaching Faculty

Ana Damjanovic, Associate Research Scientist (part-time): computational studies of protein structure, dynamics and function.

Patrick Fleming, Senior Lecturer: computational studies of protein folding, structure and solvation.

Secondary Appointments

Department of Biology Faculty

Ludwig Brand, Professor: protein structure and function, fluorescence of macromolecules, nanosecond fluorimetry.

Ernesto Freire, Professor: biophysical chemistry, thermodynamics of macromolecular assemblies in membranes protein-lipid interactions, microcalorimetry.

Vincent J. Hilser, Professor: conformational fluctuations in function, disease, and evolution.

Evangelos Moudrianakis, Professor: mechanisms of enzyme action, especially of chloroplast and mitochondrial coupling factors. Human chromosome structure and function, self-assembly of chromosomal components.

Peter Privalov, Professor: physics of protein structure.

Robert Schleif, Professor: protein-DNA interactions and regulation of gene activity.

Beverly Wendland, Professor (Chair): molecular mechanisms of endocytosis in yeast and mammalian cells.

Department of Chemistry Faculty

David E. Draper, Professor: physical biochemistry protein-RNA recognition, structure and function of ribosomal RNAs, translational control of gene expression, RNA structural motifs.

Christopher Falzone, Associate Research Professor: NMR spectroscopy of proteins.

Craig A. Townsend, Professor: organic and bioorganic chemistry, biosynthesis of natural products, stereochemical and mechanistic studies of enzyme action, application of spectroscopic techniques to the solutions of biological problems.

Joint Appointments

Department of Biochemistry and Molecular Biology

P. C. Huang, Professor: organization and regulation of stress inducible genes and their gene products.

Affiliations

There are strong ties with the entire Department of Biophysics and Biophysical Chemistry at the School of Medicine.

L. Mario Amzel, Professor: X-ray diffraction studies of biological macromolecules; enzymes involved in oxidate reductions and phosphorylation; experimental and modeling studies of binding proteins.

Dominique Frueh, Assistant Professor: NMR studies of protein dynamic modulations and conformations in active enzymatic systems.

Albert Lau, Assistant Professor: characterization of receptor-ligand interactions and macromolecular conformational transitions using computational and crystallographic approaches.

Daniel J. Leahy, Professor: X-ray diffraction studies of cell-surface receptors and extracellular matrix components.

Jon Lorsch, Associate Professor: techniques of mechanistic enzymology to study process of translation initiation in eukaryotes.

Jungsan Sohn, Assistant Professor: structure and function of biological stress sensors.

Herschel Wade, Assistant Professor: structural, functional, and energetic treatments of ligand-activated molecular switches.

Cynthia Wolberger, Professor: three-dimensional structure of protein-DNA complexes, X-ray crystallography.

Jie Xiao, Assistant Professor: dynamics of molecular process at single molecule and single cell level.

Research Activities of Primary Faculty

Mucosal Protection and Reproductive Health (Dr. Cone)

The Mucosal Protection Laboratory is developing methods women can use for protection against both pregnancy and sexually transmitted diseases, including AIDS. Basic research projects include investigating the ability of mucosal antibodies and vaginal acidity (lactic acid) to inactivate viral and bacterial pathogens, and how normal vaginal lactobacilli suppress the array of anaerobic bacteria that causes BV (bacterial vaginosis). BV is the most common vaginal infection (one in three women at any given time) and women with this little-recognized infection are at markedly increased risk of sexually transmitted infections, miscarriage, and premature birth. Research and development of microbicides for preventing BV and sexually transmitted diseases is being sponsored by NIH in collaboration with ReProtect, Inc., through a research agreement with Johns Hopkins University. Research on nanoparticles for enhanced delivery of drugs to mucosal surfaces is being done in collaboration with Dr. Justin Hanes, Director of Nanomedicine at the Johns Hopkins School of Medicine.

Macromolecular Energetics (Dr. Garcia-Moreno E.)

One of the most important challenges in molecular biophysics is to understand the relationship between the structure and the function of biological macromolecules. This requires understanding the connection between structure, thermodynamic stability, and dynamics. In our lab we study structure-energy relationship with computational approaches combined with a variety of experimental approaches based on NMR spectroscopy, X-ray crystallography, and equilibrium thermodynamics. The experiments contribute the physical insight needed to guide the development of computational methods for structure-based energy calculations, as well as the data required to benchmark these methods. We focus on studies of protein electrostatics because electrostatic energy is uniquely useful in correlating structure with function in key energy transduction processes in biological systems.

Protein Folding (Dr. Rose)

A globular protein will spontaneously self-assemble its components into a highly organized three-dimensional structure under appropriate physiological conditions in a process called protein folding. Our principal goal is to understand protein folding, using an approach involving simulation, modeling, and analysis. In the classical model of folding, an unfolded protein visits an astronomical number of possible conformations. In contrast, we recently reevaluated this popular model and found that the unfolded state is far less heterogeneous than previously thought. This realization has prompted us to pursue a novel strategy to predict folding.

Biophysics of RNA (Dr. Woodson)

The control of cell growth and type depends on the ability of RNA to fold into complex three-dimensional structures. RNA catalysts are good models for studying the physical principles of RNA folding, and the assembly of protein-RNA complexes such as the ribosome. Changes in RNA three-dimensional structure are monitored by fluorescence spectroscopy, "X-ray footprinting," and neutron scattering. Bacterial and yeast expression systems are used to study intracellular folding of RNA.

Protein Folding, Notch Signaling (Dr. Barrick)

The folding of proteins into their complex native structures is critical for proper function in biological systems. This spontaneous process of self-assembly is directed by physical chemistry, although the rules are not understood. We are using repeat-proteins, linear proteins with simple architectures, to dissect the energy distribution, sequence-stability relationship, and kinetic routes for folding. In addition, we are studying the molecular mechanisms of Notch signaling, a eukaryotic transmembrane signal transduction pathway. The transmission of information across the membranes of cells is essential for cell differentiation and homeostasis; signaling errors result in disease states including cancer. We are focusing on interactions between proteins involved in Notch signaling using modern biophysical methods. Thermodynamics of association and allosteric effects are determined by spec-

troscopic, ultracentrifugation, and calorimetric methods. Atomic structure information is being obtained by NMR spectroscopy. The ultimate goal is to determine the thermodynamic partition function for a signal transduction system and interpret it in terms of atomic structure.

NMR Spectroscopy (Dr. Lecomte)

Many proteins require stable association with an organic compound for proper functioning. One example of such "cofactor" is the heme group, a versatile iron-containing molecule capable of catalyzing a broad range of chemical reactions. The reactivity of the heme group is precisely controlled by interactions with contacting amino acids. Structural fluctuations within the protein are also essential to the fine-tuning of the chemistry. We are studying how the primary structure of cytochromes and hemoglobins codes for heme binding and the motions that facilitate function. The method of choice is nuclear magnetic resonance spectroscopy, which we use to obtain detailed structural and dynamic representations of proteins with and without bound heme. The ultimate goal is to understand the evolution of chemical properties in heme proteins and how to alter them.

Structural and Energetic Principles of Membrane Proteins (Dr. K. Fleming)

Membrane proteins must fold to unique native conformations and must interact in specific ways to form complexes essential for life. Currently, the chemical principles underlying these processes are poorly understood. Thermodynamic and kinetic studies on membrane proteins with diverse folds and oligomeric states are carried out with the goal of discovering the physical basis of stability and specificity for membrane proteins. Our research results in a quantitative understanding of sequence-structure-function relationships that can ultimately be used to describe membrane protein populations in both normal and disease states, to design novel membrane proteins, and to develop therapeutics that modulate membrane protein functions in desirable ways.

Chromatin Remodeling (Dr. Bowman)

Chromatin, the physical packaging of eukaryotic chromosomes, plays a major role in determining the patterns of gene silencing and expression across the genome. Chromatin remodelers are multicomponent protein machines that establish and maintain various chromatin environments through the assembly, movement, and eviction of nucleosomes. At present, the molecular mechanisms by which chromatin remodelers alter chromatin structure are not understood. Our long-term goal is to gain a molecular understanding of the remodeling process and in particular how remodeling is coupled to the transcriptional machinery. Our strategy is to couple structure determination with functional studies to determine how different components of a chromatin remodeler cooperate and interact with the nucleosome substrate.

Facilities

The department shares state-of-the-art equipment for X-ray diffraction analysis, NMR spectroscopy, and numerically intensive computer simulations with other biophysics units within the University. In addition, the department houses a full complement of equipment for molecular biological and biochemical work, and for various kinds of spectroscopy. Also, we have more-specialized equipment, including computer clusters, high-end graphics workstations.

Undergraduate Program

Bachelor of Arts in Biophysics

The undergraduate major in biophysics is intended for the student interested in advanced study of biophysics or the related fields of biochemistry, molecular biology, physiology, pharmacology, and neurobiology. The biophysics major fulfills all premedical requirements. The student majoring in biophysics, with the advice of a member of the department, chooses a program of study that will include foundation courses in biology, chemistry, and physics followed by advanced studies in modern biophysics and research.

For updated information on academic requirements and department events for majors, check the undergraduate website at **www.jhu.edu/~biophys/ undergrads**.

Requirements for the B.A. Degree

(See also General Requirements Departmental Majors, page 48.)

I. Required Courses

- **Chemistry**
  030.101 Introductory Chemistry I (3)*
  030.102 Introductory Chemistry II (3)*
  030.105 Introductory Chemistry Lab I (1)*
  030.106 Introductory Chemistry Lab II (1)
  030.205 Introductory Organic Chemistry I (4)*
  030.206 Introductory Organic Chemistry II (4)*
  030.225 Organic Chemistry Lab (3)*

- **Physics**

  First Year Series Choices

  171.101 General Physics for Physical Science
  Majors I (4)*

  171.102 General Physics for Physical Science
  Majors II (4)*

  or

  171.103 General Physics for Biological Science
  Majors I (4)*

  171.104 General Physics for Biological Science
  Majors II (4)*

  or

  171.105 Introduction to Classical Physics I (4)*
  171.106 Introduction to Classical Physics II (4)*

  Second Year Series choices

  171.201 Special relativity and Waves (4)
  171.202 Modern Physics (4)
  or
  171.309 Wave Phenomena with Biophysical
  Applications (3)
  171.310 Biological Physics (3)

  One Year Physics Lab is Required
  173.111 General Physics Lab I (1)
  173.112 General Physics Lab II (1)

- **Mathematics**
  110.108 Calculus I (4)*
  110.109 Calculus II (4)*

  and one of the following sequences:
  110.201 Linear Algebra (4)
  110.202 Calculus III (4)
  or
  110.211 Honors Multivariable Calculus (4)
  110.212 Honors Linear Algebra (4)
  or
  110.202 Calculus III (4)
  550.291 Linear Algebra and Differential
  Equations (4)

- **Biology**
  020.315 Biochemistry Lab (2)*
  020.306 Cell Biology (4)*

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  * *Denotes science or math courses required for
  premedical students.*

- **Biophysics**
  250.307 Biochemistry (4)*
  250.345 Cellular and Molecular Physiology (3)
  250.372 Intro to Biophysical Chemistry (3)
  250.381 Spectroscopy and Its Applications to
  Biophysical Reactions (3)

250.521 Research Problems in Biophysics I (3)
250.531 Laboratory in Biophysics (3)

and one of the following:

250.265 Introduction to Bioinformatics (3)
250.305 Bioenergetics: Origins, Evolution and
Logic of Living Systems (3)
250.353 Computational Biology (3)
250.383 Molecular Interactions Laboratory (3)
250.391 Proteins and Nucleic Acids (3)
250.401 Advanced Seminar in Structural and
Physical Virology (3)
250.411 Advanced Seminar in Structural
Biology of Chromatin (3)
250.689 Physical Chemistry of Biological
Macromolecules (3)
250.690 Methods in Molecular Biophysics (3)

II. Electives

Two other 300- or higher-level courses in biology,
chemistry, physics, or biophysics, at least two of
which must be chosen from the following:

- **Biophysics**
  250.265 Introduction to Bioinformatics (3)
  250.305 Bioenergetics: Origins, Evolution and
  Logic of Living Systems (3)
  250.351 Reproductive Physiology (2)
  250.353 Computational Biology (3)
  250.383 Molecular Interactions Laboratory (3)
  250.391 Proteins and Nucleic Acids (3)
  250.401 Advanced Seminar in Structural and
  Physical Virology (3)
  250.411 Advanced Seminar in Structural
  Biology of Chromatin (3)
  250.689 Physical Chemistry of Biological
  Macromolecules (3)
  250.690 Methods in Molecular Biophysics (3)

- **Chemistry**
  030.301 Physical Chemistry I (3)
  030.302 Physical Chemistry II (3)

- **Physics**
  171.204 Classical Mechanics II (4)
  171.301 Electromagnetic Theory II (4)
  171.312 Statistical Physics and
  Thermodynamics (4)

- **Biology**
  020.330 Genetics (3)
  020.346 Immunobiology (3)
  020.363 Developmental Biology (3)
  020.380 Eukaryotic Molecular Biology (3)

*Note: Cell Biology Lab is not eligible as an upper
science elective*

- **Computer Science**
  600.226 Data Structures (3)
  600.271 Automata and Computation Theory (3)

- **Chemical and Biomolecular Engineering**
  540.414 Computational Protein Structure
      Prediction and Design

Scheduling conflicts occasionally arise due to schedule changes in the departments of Physics, Biology, and Chemistry. Prospective biophysics majors should consult with the departmental undergraduate advisor to determine how these conflicts have been resolved. A grade of C or higher is mandatory for courses fulfilling departmental degree requirements.

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* Denotes science or math courses required for premedical students.

Sample Program for the B.A. in Biophysics
(visit our website for more up-to-date sample programs)

- **Year 1**

  Fall

030.101 Intro Chemistry I	3
030.105 Intro Chemistry Lab I	1
110.108 Calculus I	4
171.101 General Physics I	4
173.111 General Physics Lab	1
250.131 Topics in Biophysics Res	1
Elective H/S/W	3
Total	17

  Spring

030.102 Intro Chemistry II	3
030.106 Intro Chemistry Lab II	1
110.109 Calculus II	4
171.102 General Physics II	4
173.112 General Physics Lab	1
Elective H/S/W	3
Total	16

- **Year 2**

  Fall

030.205 Intro Organic Chemistry I	4
030.225 Organic Chemistry Lab	3
250.265 Bioinformatics	3
110.202 Calculus III	4
Elective H/S/W	3
Total	17

  Spring

030.206 Intro Organic Chemistry II	4
250.307 Biochemistry	4
110.201 Linear Algebra	4
Elective H/S /W	3
Total	15

- **Year 3**

  Fall

171.309 Wave Phenomena with Biophysical Applications	3
250.345 Cellular & Mol. Physiology	3
250.531 Laboratory In Biophysics	3
020.315 Biochemistry Lab	2
Elective H/S/W	3
Total	14

  Spring

171.310 Biological Physics	4
250.372 Intro to Biophysical Chemistry	3
020.306 Cell Biology	4
250.521 Research Problems I	3
Elective H/S/W	3
Total	17

- **Year 4**

  Fall

250.381 Spectroscopy and its Appl.	3
Upper-level Science Elective I	3
Elective H/S/W	3
Elective H/S/W	3
Total	12

  Spring

Biophysics Major Elective I	3
Upper-level Science Elective II	3
Upper-level Science Elective III	3
Elective H/S/W	3
Elective H/S/W	3
Total	15

Requirements for B.A.: 120 credits, 30 of which have to fulfill distribution requirements (at least 12 W credits and 18 H/S credits; at least 6 H/S credits during each of first two years).

Ete Z. Szüts Undergraduate Research Travel Award
This award, named in honor of a Ph.D. graduate student from this department, will provide funds for up to 80 percent of the transportation costs of undergraduate research students in biophysics to attend a scholarly meeting. Recipients must be sponsored by a member of the departmental faculty who will be at the same meeting.

Biophysics Department Research Award
To honor senior Biophysics Major for excellence in undergraduate research in Biophysics.

Biophysics Department Scholarship Award
To honor senior Biophysics major for outstanding achievements in academics and research in Biophysics.

Honors in Biophysics

To be eligible for departmental honors at graduation, biophysics majors must achieve an overall GPA of 3.5 or better. In addition, a paper based on their mandatory six lab research credits must be submitted and acceptable to the student's research supervisor and research sponsor.

Master's Program

Fifth-Year Master's Degree

Interested undergraduate biophysics majors must apply by January 15 of their senior year to enter a fifth-year master of arts degree program. Those accepted will be enrolled as graduate students.

The following classes are required:
  250.685 Proteins and Nucleic Acids
  250.689 Physical Chemistry of Biological
          Macromolecules
  250.690 Methods in Molecular Biophysics

These courses account for about half the student's time. The remaining effort is spent on a substantial research project. A report related to the research being carried out is also required. See General Information below.

General Information

M.A. student research projects are reviewed along with the Ph.D. student projects during the Semi-Annual Review of Thesis Research 250.673/674. Oral presentations are given along with those of Ph.D. candidates in the same laboratory. M.A. students are encouraged to attend departmental seminars and are included in social and scientific events designed for biophysics graduate students. A completed graduate application, JHU transcript, and a letter of recommendation, preferably from a mentor familiar with the applicant's research, are required. There is no financial aid available for Master of Arts candidates. The M.A. program is open only to undergraduates currently enrolled at Johns Hopkins University.

Doctoral Programs

The Thomas C. Jenkins Department of Biophysics offers two Ph.D. programs. Annual application deadline is January 15.

Program in Molecular Biophysics

The Program in Molecular and Biophysics (PMB), which began in 1990, brings together Johns Hopkins faculty at the Homewood and Medical School campuses. Its goal is to prepare students to deal with interdisciplinary problems in molecular bio-physics and structural biology. For more information, see PMCB Web page at **www.jhu.edu/~pmb**.

Admission

All applicants must have a B.S. or a B.A. degree. Applications from students in any branch of science are welcome; however, we are particularly eager to attract applicants with undergraduate majors in physics, chemistry, mathematics, or relevant areas of engineering. There are no required undergraduate courses. Instead, applications are examined for general strength of scientific background. The Graduate Record Examination, including a subject test, is required.

Please use the Johns Hopkins University online application, selecting biophysics under the School of Arts & Sciences. Supplementary materials (letters of recommendation, GRE scores, statement, etc.) should be sent directly to:

Program in Molecular Biophysics
Johns Hopkins University
101 Jenkins Hall
3400 N. Charles Street
Baltimore, MD 21218

Requirements for the Ph.D.

Programs are developed individually for each student, and due account is taken of previous training.

The following courses are required: 250.689 Physical Chemistry of Biological Macromolecules, 250.690 Methods in Molecular Biophysics, 250.685 Proteins and Nucleic Acids, and, at the School of Medicine 100.705/712 Computer Modeling of Biological Macromolecules/Lab, and 330.709 Organic Mechanisms in Biology. Students have to demonstrate strength in the following four areas: biological sciences, chemistry, mathematics, and physics. Typically, incoming students already have strength in at least two of these areas from undergraduate training. Deficiencies will be remedied through additional course work or self-study. Students must pass a proficiency exam in biological sciences at the end of their first year. In the mathematics and physics areas, students will be required to have calculus through the study of several variables, and one year of calculus-based physics, respectively. In the chemistry area, students are required to have basic chemistry, organic chemistry, and physical chemistry. In biological sciences, students are required to have knowledge of biochemistry and cell and molecular biology.

Additional academic requirements include completion of three 12-week laboratory rotations, a one-hour seminar on a current topic of biophysical research, and passing the Graduate Board Oral Preliminary Examination, to be given near the end of the second year.

Completion of an original investigation and presentation of a dissertation are required. The dissertation must be accepted by the program and be considered worthy of publication by the referees. Students must then pass an oral examination on their dissertation and related topics.

The Program in Cell, Molecular Developmental Biology and Biophysics

The Program in Cell, Molecular Developmental Biology and Biophysics (CMDB) gives students a strong background in modern biology and physical biochemistry. This combination prepares students to study complex biological phenomena using quantitative physical methods. The training faculty reside in the T. C. Jenkins Department of Biophysics, the Biology Department, and the Carnegie Institutions Department of Embryology, all located on the Johns Hopkins Homewood campus. Students take core graduate courses in cell, molecular, and developmental biology, and in biophysics, and complete four eight-week rotations their first year. Other requirements include the Graduate Board Oral Preliminary Examination, given before the end of the second year, and successful defense of the dissertation.

For more information about CMDB, please check its website (**www.jhu.edu/emdb**). Interested applicants can apply online via the program website or by U. S. mail to:

Ms. Joan Miller (joan@jhu.edu)
Graduate Admissions Coordinator
CMDB Program
Department of Biology
Johns Hopkins University
3400 N. Charles Street
Baltimore, MD 21218
410-516-5502

Financial Aid

Two National Institutes of Health training grants currently provide stipend and tuition support: one is for students who enroll in PMB and the other is for those who enter CMDB. Students supported by these training grants must be U.S. citizens or permanent residents. In addition, several research assistantships funded by grants and contracts awarded to faculty by outside agencies may be available to qualified students. University fellowships providing remission of tuition are also available. Graduate students in biophysics are eligible for and encouraged to apply for various nationally administered fellowships, such as National Science Foundation fellowships. Information on these and other support mechanisms can be obtained through the fellowship advisor at the applicant's college or from the National Research Council, Attn: Fellowships, 1000 Thomas Jefferson St., Washington, DC 20007.

It is anticipated that financial support covering normal living costs and tuition will be made available to accepted students. Support for foreign students is extremely limited.

Undergraduate Courses

Introductory

250.106/300/306 (N) Introduction to Biomedical Research and Careers I, II, III
Seminar series designed for those interested in or curious about a career in biological sciences and medicine. A novel format combining lectures with talk show interviews gives students a broad view of different research problems, experimental approaches, and practical applications, as well as career paths. The emphasis is on the excitement of scientific explorations, rather than an abundance of technical facts and figures. 250.106 is for freshmen and non-science majors; 250.300 is for sophomore, junior, and senior science majors; 250.306 is for those who have already taken 250.106 or 250.300.
P-C Huang, Staff   1 credit

250.131 (N) Topics in Biophysics Research
Discussion and project-oriented course in which students are introduced to contemporary areas of research in biophysics. Open to freshmen and sophomores only.

K. Fleming, Cone   1 credit

250.205 (N) Computing for the Life Sciences
Designed to teach computer literacy for life science applications. Students will learn to work in UNIX environment, writing shell scripts, and mastering use of powerful UNIX commands (e.g. grep, awk, sed), writing code in Python, using PyMol for molecular graphics, and working with numerical computing statistical packages such as Mathematica, Matlab or R. Brief lectures with extensive hands-on computer laboratories. Course offered spring 2012 and 2013 and possible each semester thereafter.
Staff   3 credits

250.253 (N) Protein Biochemistry and Engineering Laboratory
Entry-level project laboratory. Students use protein engineering techniques to try and modify existing proteins to endow them with new structural or physical properties. Also, introduction to standard biochemistry laboratory

practice and protein science, including experiments n site-directed mutagenesis, protein purification and characterization of structure and stability. Taught in spring semester.

Staff   3 credits

250.265 (N) Introduction to Bioinformatics

Algorithms and databases for biological information. A mostly computer lab course covering basic programming; algorithms for comparison of sequence, protein structure and gene expression; protein structure prediction and an introduction to major databases. Students complete a genomics database project and will give presentations on the ethics of using genomic information. No programming experience necessary. Preference to Biophysics majors. Instructor permission required.

P. Fleming   3 credits

Intermediate

250.300 (N) Introduction to Biomedical Research and Careers II

(See 250.106)

250.305 (N) Bioenergetics: Origins, Evolution, and Logic of Living Systems

The defining characteristic of living systems is their ability to perform energy transduction. No man-made energy-conversion machine is as efficient as those found in biological systems. This course examines the structural, physical and cellular basis of biological energy transduction, with emphasis on how the fundamental requirement for energy transduction dictates the logic reflected in the organization, evolution and possibly even the origins of biological systems. Implications for design of synthetic organisms and artificial energy transducing machines will be discussed. Prerequisites: Organic Chemistry (030.205); Biochemistry (250.307) and ideally some physical chemistry. Taught only in Spring Semester of odd-numbered years.

Garcia-Moreno   3 credits

250.306 (N) Introduction to Biomedical Research and Careers III

(See 250.106)

250.307 (N) Biochemistry

Designed to constitute a foundation for advanced courses in biophysics and other quantitative biological disciplines. Topics include chemical, physical and energetic principles of biochemistry; biomolecular structure, assembly, and function; and regulation and integration of metabolism. Emphasis on interrelatedness of all aspects of biomolecules and metabolism, with a quantitative approach to problems in biological sciences. Lecture and computer laboratories. Prerequisite: Organic Chemistry (030.205).

P. Fleming   4 credits   spring

250.345(N) Cellular and Molecular Physiology

How cells and molecules function as parts of whole organisms. Topics include speeds of diffusion, motor proteins, and animal motility; bacterial size, shape and chemotaxis;

sensory and neuronal mechanisms; osmosis; mucosal protective mechanisms; cellular and organismic circulation and respiration. Prerequisite: Biochemistry (250.307) or Biochemistry (020.305).

Cone   3 credits

250.351 (N) Reproductive Physiology

This team-taught lecture course focuses on reproductive physiology and on the biochemical and molecular regulation of the female and male reproductive tracts. Topics include the hypothalamus and pituitary, peptide and steroid hormone action, epididymis and male accessory sex organs, female reproductive tract, menstrual cycle, ovulation and gamete transport, fertilization and fertility enhancement, sexually transmitted diseases, and male and female contraceptive methods. Introductory lectures on each topic will be followed by research-oriented lectures and readings from current literature. Prerequisite: Biochemistry (250.307) or Biochemistry (020.305).

Zirkin, Cone, Staff   2 credits

250.353 (N) Computational Biology

Designed to make you think differently about molecules. A mostly computer lab course that introduces several computational approaches to the study of biological macromolecules. The concepts of molecular ensembles and probability distributions addressed in this course have application to all aspects of science. No programming experience is required. Preference to Biophysics majors. Prerequisites: Biochemistry (250.307) or Biochemistry (020.305); Organic Chemistry 030.101-201. Instructor permission required.

P. Fleming   3 credits

250.372 (N) Introduction to Biophysical Chemistry

Course provides working understanding of physical chemistry of the cell, emphasizing problem solving. Topics include classical and statistical thermodynamics, thermodynamics of folding of proteins and nucleic acids folding, ligand binding thermodynamics, cooperativity and anti-cooperativity, allosteric models, lattice statistics, helix-coil transition, polymer theory, and kinetics of biological reactions. Students use mathematical analysis software for data fitting and numerical simulation. Prerequisite: calculus, organic chemistry, and introductory physics.

Barrick   3 credits

250.381 (N) Spectroscopy and its Application in Biophysical Reactions

Continues Biophysical Chemistry (250.372). fundamentals of quantum mechanics underlying various spectroscopies (absorbance, circular dichroism, fluorescence, NMR); application to characterization of enzymes and nucleic acids.

Lecomte   3 credits

250.383 Molecular Interactions Laboratory

Molecular interactions are key to biological processes. This advanced course combines lecture and laboratory format to introduce biophysical methods for measuring molecular interactions. Experiments are discovery based, and students measure protein folding and binding reactions using circular diachronic and fluorescence

spectroscopy, analytical ultracentrifugation, and calorimetric. Also, there are several units on protein crystallography methods. Emphasize problem solving and data analysis. Basic UNIX helpful. Prerequisites: Biochemistry (250.307) or Biochemistry (202.305) and Biochemistry Laboratory (020.315). Introduction to Biophysical Chemistry (250.372) and either Introduction to Bioinformatics (250.265) or Computational Biology (250.353) are recommended and are helpful.

K. Fleming   3 credits

250.391 (N) Proteins and Nucleic Acids

Basic computing for biological applications. First two weeks are introduction to programming through Python. Balance of course focuses on structure of proteins, DNA and RNA and their functions in living systems. Advanced lectures and discussions based on readings from scientific literature. Also listed as graduate course 250.685. Prerequisites: Biochemistry (020.305); Introduction to Biophysical Chemistry (250.372).

Bowman, Woodson   3 credits

250.401 (N) Advanced Seminar in Structural and Physical Virology

Physical basis of virus structures and structural basis of viral cycles and infectivity. Discussion topics are meant to illustrate fundamental contributions from biophysics and quantitative and physical approaches to the study of complex biological systems. Prerequisites: Organic Chemistry (030.205); Biochemistry (250.307) and ideally some physical chemistry.

Garcia-Moreno   3 credits   spring semester
even numbered years

250.411 (N) Advanced Seminar in Structural Biology of Chromatin

Focus is on structural and physical aspects of nucleosomes/DNA, histone-modifying enzymes, centromeres/telomeres, DNA damage responses, and transcription. Topics are meant to illustrate how the structural and chemical aspects of how proteins and nucleic acids are studied to understand contemporary biological questions. Biochemistry (250.307) or Biochemistry (020.305) and Intro to Biophys Chem (250.372) helpful.

Bowman   3 credits

250.519-520 Independent Study of Biophysics

Admission with permission of faculty member who is to supervise the study.

Staff   up to 3 credits per semester

250.521-522-523 Research Problems in Biophysics

Original laboratory investigations in biophysics. Registration with consent of faculty member who is to supervise work.

Staff   up to 3 credits per semester

250.531 Laboratory in Biophysics

Introduction to independent research in biophysics, with emphasis on basic laboratory techniques. Individual course of study to be arranged with faculty mentor. Permission required from faculty sponsor.

Staff   up to 3 credits per semester

250.574 Intersession Research

250.597 Summer Research
Staff

Graduate Courses

250.601-602 Biophysics Seminar

Students and invited speakers present current topics in the field.

Cone, Staff

250.631-632 Laboratory Research in Biophysics

Research training in biophysics. Prerequisite: consent of instructor.

Staff

250.640-641 Seminar on Mucosal Protection I & II

Graduate level seminar on physiology, immunology, and epidemiology of mucosal protection.

Cone

250.644 Graduate Biophysical Chemistry

Review of classical and statistical thermodynamics, protein and nucleic acid structure, ligand binding, and enzyme kinetics. Biophysical methods such as fluorescence, NMR spectroscopy, and X-ray crystallography will also be discussed. Prerequisite: Biochemistry (020.305) and Advanced Molecular Biology (020.668) or equivalent. Co-listed as 020.674.

Brand, Woodson, Bowman, Staff

250.673-674 Semi-Annual Review of Thesis Research

Once each term, advanced graduate students make a 10-minute presentation of their thesis work to the departmental faculty. The presentation is followed by a half-hour discussion.

Bowman, Staff

250.685 Proteins and Nucleic Acids

Basic computing for biological applications, with introduction to programming through Python. The structure of proteins, DNA and RNA and their functions in living systems. Students required to participate in discussions based on readings from primary scientific literature. Also listed as undergraduate course 250.391. Prerequisite: undergraduate biochemistry and physical chemistry, or permission of instructor.

Bowman, Woodson

250.689 Physical Chemistry of Biological Macromolecules

Introduction to the principles, methods, and approaches employed in the study of the energetics of proteins and nucleic acids, with emphasis in understanding the relationship between structure, energy, dynamics, and biological function. Topics include classical, chemical, and statistical thermodynamics, kinetics, theory of ligand binding, and conformational equilibria.

Garcia-Moreno

250.690 Methods in Molecular Biophysics
Introduction to the methods employed to the study of energetics, structure, and function of biological macromolecules. Topics include optical spectroscopy, transport methods, NMR, X-ray crystallography. Course emphasizes theoretical understanding and practical knowledge through problem solving and literature discussion. Prerequisites, highly recommended: Proteins and Nucleic Acids (250.685) and Physical Chemistry of Biological Macromolecules (250.689), Calculus (110.108/109), or equivalent course work.
Bowman, staff

250.801-802 Dissertation Research
Staff

Chemistry

The Department of Chemistry, in conjunction with other departments of the university, offers a broad education and the opportunity to do research in chemistry and related fields. The great diversity of the field of chemistry, ranging between physics and biology, is reflected in the research interests of the faculty. Undergraduate chemistry majors usually go on to graduate study in chemistry, chemical engineering, biology, oceanography, geochemistry, biophysics, environmental sciences, or medicine, while others enter the chemical industry. The Ph.D. in chemistry leads to professional careers in colleges and universities, research institutes, industry, and government laboratories.

The Faculty

Kit H. Bowen, E. Emmet Reid Professor: experimental chemical physics—photoelectron spectroscopy of negative ions, structure and dynamics of gas phase, weakly bound molecular clusters.

Arthur Bragg, Assistant Professor: experimental physical chemistry—chemical dynamics and charge/energy transfer in condensed-phase systems, ultrafast spectroscopy.

Paul J. Dagdigian, Arthur D. Chambers Professor: experimental chemical physics—dynamics of gas-phase chemical reactions, collisional energy transfer, molecular electronic spectroscopy, laser-induced fluorescence and ionization.

David E. Draper, Vernon Kriebel Professor: physical biochemistry—RNA folding, RNA-ligand interactions, NMR of protein and RNA, translational control of gene expression.

D. Howard Fairbrother, Professor: physical chemistry—the structure of chemically protective surfaces, chemistry of adhesives, environmental surface chemistry.

David Goldberg, Professor: inorganic and bioinorganic chemistry—structure/function relationships in heme proteins, artificial enzyme design, biomimetic molybdenum and tungsten coordination compounds, redox active ligands, synthesis of tetrapyrrolic macrocycles (phthalocyanine and porphyrin-based systems) for small-molecule activation and materials applications.

Marc M. Greenberg, Professor: organic and bioorganic chemistry—application of chemical, biochemical, and biological techniques to studies on DNA damage and repair, independent generation and study of reactive intermediates, development and application of methods for modified oligonucleotide synthesis, design of mechanistically inspired enzyme inhibitors radiosensitizing agents, and sensors.

Kenneth D. Karlin, Ira Remsen Professor: inorganic and bioinorganic chemistry—synthetically derived structural, spectroscopic and functional models for copper and iron proteins, copper-dioxygen reversible binding and metal-mediated substrate oxidation, O_2-reduction with copper cluster compounds, porphyrin-iron and copper chemistry relevant to heme-copper oxidases, metal-catalyzed ester and amide hydrolysis, metal complex protein and DNA interactions.

Thomas Lectka, Professor: organic chemistry—the design and synthesis of theoretically interesting nonnatural products with applications in bioorganic and physical organic chemistry, materials science and supramolecular chemistry, novel approaches to asymmetric catalysis, theoretical organic chemistry.

Tyrel McQueen, Assistant Professor: solid state inorganic chemistry—electronically and magnetically active materials—condensed matter physics.

Gerald Meyer, Bernard N. Baker Professor: inorganic chemistry—photochemistry and electrochemistry of metal complexes and inorganic solids, light-induced electron and energy transfer, materials science, artificial photosynthesis.

Douglas Poland, Professor: theoretical chemistry—statistical mechanics, kinetics of cooperative biological and physical-chemical phenomena, use of moments to calculate energy and ligand-binding distributions, models for the persistence exponent of DNA.

Gary H. Posner, Jean and Norman Scowe Professor: organic, medicinal, and organometallic chemistry—new synthetic methods, asymmetric synthesis of natural products having pharmacological (e.g., anti-tumor, contraceptive, antimalarial) activity, chemical carcinogenesis, and cancer chemotherapy and chemoprotection.

Justine P. Roth, Associate Professor: inorganic chemistry and enzymology—rational design of redox catalysts, selective bond activation/oxidation by enzymes and transition metal complexes, synthetic systems for light to chemical energy transduction.

Harris J. Silverstone, Professor: theoretical chemistry—development of mathematical techniques for applying quantum mechanics to chemical problems, high-order perturbation theory, semiclassical methods, divergent

expansions, photoionization, LoSurdo-Stark effect, magnetic resonance spectral simulation, hyperasymptotics.

Joel R. Tolman, Associate Professor: biophysical chemistry—protein-protein interactions, protein dynamics and structure, NMR methodology.

John P. Toscano, Professor (Chair): organic chemistry—photochemistry and photobiology, time-resolved IR spectroscopy, structure/reactivity relationships for reactive intermediates, the design of phototriggered nitric oxide-releasing drugs for applications in medicine, the chemistry and biology of nitroxyl (HNO).

John D. Tovar, Assistant Professor: organic chemistry —organic electronics, conjugated and conducting polymers, electrochemistry, nanostructured materials, polymer chemistry bioinspired self— assembly, and supramolecular chemistry.

Craig A. Townsend, Alsoph H. Corwin Professor:— organic and bioorganic chemistry—biosynthesis and chemistry of natural products, stereo-chemical and mechanistic studies of enzyme action, small molecule/DNA interactions, application of spectroscopic techniques to the solution of biological problems.

David R. Yarkony, D. Mead Johnson Professor: theoretical chemistry—electronic structure theory, multi-configuration self-consistent-field methods, excited state chemistry, electronic energy transfer in chemical reactions, spin-forbidden processes, and electronically nonadiabatic processes.

Research Professors

Christopher Falzone, Associate Research Professor: organic chemistry.

Adjunct, Emeritus, and Joint Appointments

David Gracias, Assistant Professor (Chemical and Biomolecular Engineering).

John W. Gryder, Professor Emeritus.

Blake Hill, Associate Professor (Biology).

Howard E. Katz, Professor (Materials Science and Engineering).

Walter S. Koski, Professor Emeritus.

Albert S. Mildvan, Professor Emeritus (Biological Chemistry, School of Medicine).

Brown L. Murr, Professor Emeritus.

Alex Nickon, Vernon Krieble Professor Emeritus.

Lawrence M. Principe, Professor (joint appointment in History of Science and Technology).

Dean W. Robinson, Professor Emeritus.

Michael (Seungju) Yu, Associate Professor (Materials Science and Engineering).

Lecturers

Jane Greco, Senior Lecturer.
Louise Pasternack, Senior Lecturer.
Tina Trapane, Senior Lecturer.

Facilities

The department is well-equipped with instrumentation, both shared and in individual faculty research laboratories, to perform modern chemical research. The Departmental Instrumentation Facility houses the following pieces of major instrumentation:

- Bruker Avance 400 MHz FT-NMR spectrometers (2), one located in the Instrumentation Facility in Remsen Hall and the other on the first floor of the new chemistry building.
- Bruker Avance 300 MHz FT-NMR spectrometer.
- Varian Mercury 200 MHz FT-NMR spectrometer (located in the undergraduate instructional laboratory).
- VG70S magnetic sector mass spectrometer, with EI, and CI ionization.
- VG70SE magnetic sector mass spectrometer, with FAB ionization.
- Finnigan LCQ ion trap mass spectrometer with electrospray ionization (APCI available as an option) and Thermo Finnigan Surveyor HPLC.
- Finnigan LCQ Duo ion trap mass spectrometer with electrospray ionization (for inorganic and organometallic use).
- Bruker Autoflex III Maldi-ToF-Tof Mass spectrometer with Maldi ionization and collision cell.
- Shimadzu GC17A/QP5050A GC-MS with EI ionization.
- Bruker EMX EPR spectrometer equipped with a liquid helium cryostat and variable temperature controller.
- Bruker Vector 33 FT-IR spectrophotometer.
- Jasco P-1010 polarimeter.
- Jasco circular dichroism spectrophotometer.
- Xcalibur3 X-ray diffractometer with CCD area detector (located on the second floor of the new chemistry building).
- Protein Technologies Symphony Quartet Peptide Synthesizer.

NMR spectrometers suitable for studies of biological macromolecules are located in the Biomolecular NMR Center, located in an underground facility in front of the new chemistry building. The instruments include 500, 600, and 800 MHz FT-NMR spectrometers.

A variety of different mass spectral techniques are available in the recently overhauled Mass Spec-

trometry Facility. High-resolution mass spectra of submitted samples are obtained on a service basis by a staff member using two magnetic sector instruments equipped with EI, CI, and FAB ionization methods. MALDI-TOF, GC/MS, and electrospray instruments are also available and operated by students and researchers following training by the facility staff.

The newly established X-ray Diffractometer Facility is operated by a staff member. The instrument is suitable for detailed molecular-level structural characterization of new organic or inorganic compounds.

The department has recently established an in-house peptide synthesis facility. This facility is equipped with a four-channel peptide synthesizer from Protein Technologies, an Agilent HPLC equipped with both a diode array and a fluorescence detector, and a lyophilizer.

The department shares with the Physics and Astronomy Department the use of the Physical Sciences Machine Shop, located in the Bloomberg Center. Electronics construction and repair is handled by a staff member in the Departmental Instrumentation Facility.

Undergraduate Programs

Programs for undergraduate majors can be tailored to individual interests so that a major in chemistry is excellent preparation not only for further work in chemistry, but also for any field that rests on a chemical foundation. It is a good choice for a premedical student interested in medical research.

Requirements for the B.A. Degree
(See also General Requirements for Departmental Majors, page 48.)

Core Courses:
  030.101-102 Introductory Chemistry I, II
  030.105-106 Introductory Chemistry Lab I, II
  030.205-206 Intro Organic Chemistry I, II
  030.225 Organic Chemistry Lab
  030.228 Intermediate Organic Chemistry Lab
  030.301-302 Physical Chemistry I, II
  030.305-306 Physical Chemistry
       Instrumentation Lab I, II
  030.356 Advanced Inorganic Lab

Outside Courses:
Outside courses required for both of the sample programs are
  171.101-102 General Physics or 171.103-104
  173.111-112 General Physics Lab
  Differential and integral calculus, preferably
       110.108-109 Calculus I, II

Advanced Elective Courses:
  Six credits of advanced chemistry beyond
       030.305-306.

Nine additional credits composed of advanced chemistry, science electives at the 300-level or higher approved by a Department of Chemistry advisor, and/or mathematics beyond Calculus II.

None of the advanced course requirements may be fulfilled with research. Although a student may take more than 12 credits of independent research, only 12 may count toward the 120 required credits.

Lecture and laboratory courses should be taken in sequence. In particular, 030.228 Intermediate Organic Chemistry Lab must be taken before 030.356 Advanced Inorganic Lab.

To allow maximum flexibility in choosing electives, students should complete both physics and organic chemistry by the end of the sophomore year. 030.449 Chemistry of Inorganic Compounds and 020.305 Biochemistry are required for an American Chemical Society accredited degree.

Sample Program A
A typical program might include the following sequence of courses:

- **Freshman/Fall Term**
  030.101 Introductory Chemistry I
  030.105 Introductory Chemistry Lab I
  Calculus

- **Freshman/Spring Term**
  030.102 Introductory Chemistry II
  030.106 Introductory Chemistry Lab II
  Calculus

- **Sophomore/Fall Term**
  030.205 Introductory Organic Chemistry I
  030.225 Organic Chemistry Lab
  171.101 *or* 171.103 General Physics
  173.111 General Physics Lab

- **Sophomore/Spring Term**
  030.206 Introductory Organic Chemistry II
  030.228 Intermediate Organic Chemistry Lab
  171.102 *or* 171.104 General Physics
  173.112 General Physics Lab

- **Junior/Fall Term**
  030.301 Physical Chemistry I
  030.305 Physical Chemistry Lab I
  Electives

- **Junior/Spring Term**
  030.302 Physical Chemistry II
  030.306 Physical Chemistry Lab II
  Electives

- **Senior/Fall Term**
  030.356 Advanced Inorganic Lab
  Electives

- **Senior/Spring Term**
  Electives

Sample Program B
A premedical student majoring in chemistry might take the following sequence of courses:

- **Freshman/Fall Term**
  030.101 Introductory Chemistry I
  030.105 Introductory Chemistry Lab I
  Calculus

- **Freshman/Spring Term**
  030.102 Introductory Chemistry II
  030.106 Introductory Chemistry Lab II
  Calculus

- **Sophomore/Fall Term**
  030.205 Introductory Organic Chemistry I
  030.225 Organic Chemistry Lab
  171.101 *or* 171.103 General Physics
  173.111 General Physics Lab

- **Sophomore/Spring Term**
  030.206 Introductory Organic Chemistry II
  030.228 Intermediate Organic Chemistry Lab
  171.102 *or* 171.104 General Physics
  173.112 General Physics Lab

- **Junior/Fall Term**
  020.305 Biochemistry
  020.315 Biochemistry Lab
  Electives

- **Junior/Spring Term**
  020.306 Cell Biology
  020.316 Cell Biology Lab
  Electives

- **Senior/Fall Term**
  030.301 Physical Chemistry I
  030.305 Physical Chemistry Lab I
  Electives

- **Senior/Spring Term**
  030.302 Physical Chemistry II
  030.306 Physical Chemistry Lab II
  030.356 Advanced Inorganic Lab
  Electives

Honors in Chemistry
Each year, the Chemistry faculty will award honors in Chemistry to graduating seniors with a major in chemistry who have achieved an outstanding academic record in science and chemistry, or who have completed a distinguished research project carried out under the supervision of a faculty member in the Department of Chemistry. To carry out an honors research project, formal application to the department advising coordinator (currently Professor Poland) must be made by the beginning of the senior year, submitting a transcript and a letter of sponsorship by the faculty member under whom a research project will be carried out. A written thesis based on one year of research must be submitted to the faculty advisor.

Graduate Programs

Each student's background and interests determine the course of study. The normal program leads to the Ph.D. degree. A student is not usually accepted for a terminal M.A. degree.

Requirements for the M.A. and Ph.D. Degrees
Normally, the minimum course requirement for both the M.A. and the Ph.D. degrees is eight one-semester graduate courses in chemistry and related sciences. Exceptionally well-prepared students may ask for a reduction of these requirements.

Requirements for the Ph.D. degree include a research dissertation worthy of publication, and a knowledge of chemistry and related material as demonstrated in an oral examination. Each student must teach for at least one year.

Requirements for the M.A. degree, in addition to completion of formal course work and research, include a satisfactory performance on an oral examination.

Financial Aid and Admissions
Fellowships, research appointments, and teaching assistantships are available for graduate students. There are no fixed admission requirements. Undergraduate majors in chemistry, biology, earth sciences, mathematics, or physics may apply, as well as well-qualified individuals who will have received a B.A. degree.

For further information about graduate study in chemistry visit the Chemistry Department website at **www.chemistry.jhu.edu**.

Undergraduate Courses

030.101 (N) Introductory Chemistry I

An introduction to the fundamental principles of chemistry. The main topics to be covered are atomic and molecular structure at the level of dot structures and VSEPR geometries, the periodic table, stoichiometry and the balancing of chemical equations, the gas laws, the law of mass action and chemical equilibrium, acids and bases, and elementary chemical thermodynamics. Corequisite: 030.105.

Staff   3 credits   fall

030.102 (N) Introductory Chemistry II

A continuation of 030.101 with an emphasis on chemical kinetics and chemical bonding. Topics will include the energy levels and wave functions for the particle-in-a-box and the hydrogen atom and approximate wavefunctions for molecules including an introduction to hybrid orbitals. Prerequisite: 030.101.

Staff   3 credits   spring

030.105-106 (N) Introductory Chemistry Laboratory

Laboratory in the fundamental methods of chemistry with related calculations. Corequisites: 030.101-102. Prerequisite: 030.105 is prerequisite for 030.106.

Pasternack   1 credit   fall and spring

030.205 (N) Introductory Organic Chemistry I

The fundamental chemistry of the compound of carbon. Material is organized according to functional groups. The synthesis and characterization of organic compounds, as well as the mechanisms of their reactions are emphasized. Valence bond and molecular orbital theories are used to correlate the properties and geometries of organic molecules. The basic chemistry of carbon compounds serves as the foundation for biochemistry. Prerequisites: 030.101-102, 030.105-106.

Staff   4 credits   fall

030.206 (N) Introductory Organic Chemistry II

A continuation of 030.205. Prerequisite: 030.205.

Staff   4 credits   spring

030.225 (N) Organic Chemistry Laboratory

Techniques for the organic chemistry laboratory including methods of purification, isolation, synthesis, and analysis. Prerequisites: 030.101-102, 030.105. Corequisite: 030.205 or 030.104. Chemistry majors should take this course in the fall semester.

Greco   3 credits   fall and spring

030.228 Intermediate Organic Chemistry Laboratory

Laboratory skills acquired in the introductory organic chemistry laboratory will be further developed for the synthesis, isolation, purification, and identification of organic compounds. Spectroscopic techniques and their applications will be emphasized. Prerequisite: 030.225.

Staff   3 credits   spring

030.301 (N) Physical Chemistry I

The laws of thermodynamics, their statistical foundation, and application to chemical phenomena. Prerequisites: general physics, general chemistry, and calculus (two semesters recommended).

Staff   3 credits   fall

030.302 (N) Physical Chemistry II

An introduction to quantum mechanics and its application to simple problems for which classical mechanics fails. Topics include the harmonic oscillator, the hydrogen atom, very approximate treatments of atoms and molecules, and the theoretical basis for spectroscopy. Prerequisite: 030.301. Recommended: 110.302 Differential Equations.

Staff   3 credits   spring

030.305-306 (N) Physical Chemistry Instrumentation Laboratory I, II

This course is designed to illustrate the principles of physical chemistry and to introduce the student to techniques and instruments used in modern chemical research. Chemistry majors are expected to take this sequence of courses, rather than 030.307. Pre- or corequisites: 030.301-302.

Fairbrother, Tolman   3 credits   fall and spring

030.307 (N) Physical Chemistry Instrumentation Laboratory III

This is a one-semester course which selects experiments that are most relevant to chemical engineering. Prerequisites: 030.301-302 or equivalent.

Trapane   3 credits   fall

030.308 (N) Elementary Computational Chemistry

This course introduces the student to the use of computers to address questions in chemistry. Basic notions of self consistent field and density functional theory will be introduced. Molecular wave functions (orbitals) for molecules of increasing complexity, starting from simple diatomic molecules and increasing to molecules of biological relevance, will be determined. Visualization tools will be used to understand the nature of chemical bonding and molecular interactions. Ligand field interactions will be quantified. Chemical reactions will be described using rigorously computed reaction paths. Equilibrium and transition state structures will be determined and analyzed. Molecular vibrations will be computed, analyzed and visualized. Infrared spectra will be simulated. The effects of solvents will be considered. NMR chemical shifts will be studied. Prerequisite: 030.205-206

Yarkony   3 credits   spring

030.345 (N) Chemical Applications of Group Theory

The theory of the representations of finite and continuous groups will be applied to problems in chemistry.

Yarkony   3 credits   spring

030.356 (N) Advanced Inorganic Laboratory
Laboratory designed to illustrate the principles and practice of inorganic chemistry through the synthesis and characterization of transition metal and organometallic compounds. Methods used include vacuum and inert atmosphere techniques. Instrumental approaches and modern spectroscopic techniques are applied to the characterization of compounds generated. Prerequisite: 030.225. Corequisite: 030.449.
Roth   3 credits   fall

030.402 (N) Experimental Methods in Physical Chemistry
This course introduces the student to experimental methodologies used in gas phase physical chemistry. Topics to be covered include vacuum technology, charged particle optics, lasers, mass spectrometry, data acquisition, detectors, measurement of temperature and pressure, and design and fabrication of scientific apparatus. These topics will be tied together with examples of specific experimental studies.
Bowen   3 credits   spring

030.441 (N) Spectroscopic Methods of Organic Structure Determination
The course provides fundamental theoretical background for and emphasizes practical application of ultraviolet/visible and infrared spectroscopy, proton and carbon-13 nuclear magnetic resonance and mass spectrometry to the structure proof of organic compounds.
Tovar   3 credits   fall

030.442 (N) Organometallic Chemistry
An introduction to organometallic chemistry beginning with structure, bonding, and reactivity and continuing into applications to fine chemical synthesis and catalysis. Pre- or corequisite: 030.449 or equivalent.
Staff   3 credits   spring

030.445 (N,Q) Applied Mathematics
Numerical methods useful in physical sciences will be developed. Topics include linear algebra, differential equations, quadrature and function approximation. Knowledge of a programming language is required.
Yarkony   3 credits   not offered yearly

030.446 (N) Mathematica as a Tool for Chemists
A systematic, hands-on introduction to Mathematica. Covers Mathematica's basic "language", analytic and numerical calculations, data manipulation, graphical representation, interactivity, programming, and document production. Prerequiste: Calculus (including power series).
Silverstone   3 credits   spring

030.449 (N) Chemistry of Inorganic Compounds
The physical and chemical properties of inorganic, coordination, and organometallic compounds are discussed in terms of molecular orbital, ligand field, and crystal field theories. Emphasis is placed on the structure and reactivity of these inorganic compounds. Other topics to be discussed include magnetic properties, electronic spectra, magnetic resonance spectra, and reaction kinetics.
Staff   3 credits   spring

030.451 (N) Spectroscopy
The spectroscopy and structure of molecules starting from rotational, vibrational, and electronic spectra of diatomic molecules and extending to polyatomic molecules as time permits. Prerequisites: 030.301-302 or equivalent.
Dagdigian   3 credits   fall

030.452 (N) Materials and Surface Characterization
The chemistry associated with surfaces and interfaces as well as a molecular level understanding of their essential roles in many technological fields. The first half of this course addresses various analytical techniques used to study surfaces including X-ray, photoelectron spectroscopy, and scanning tunneling microscopy. The second half of this course uses a number of case studies to illustrate the application of surface analytical techniques in contemporary research.
Fairbrother   3 credits   fall

030.453 (N) Intermediate Quantum Chemistry
The principles of quantum mechanics are developed and applied to chemical problems. Prerequisites: 030.301-302 or equivalent.
Silverstone   3 credits   fall

030.466 (N) Physical and Analytical Methods
This course surveys a number of commonly used spectroscopic and analytical techniques with the objective of showing how each method works and what kinds of information can be obtained. The course reviews basic theory and instrumentation underlying each method along with a review of data reduction and error analysis. Illustrative examples are presented from a range of disciplines. Prerequisite: 030.302 or equivalent.
Meyer   3 credits   not offered yearly

030.501-502 Independent Research in Physical Chemistry I
Research under the direction of members of the physical chemistry faculty.
Staff   1-3 credits

030.503-504 Independent Research in Inorganic Chemistry I
Research under the direction of members of the inorganic chemistry faculty.
Staff   1-3 credits

030.505-506 Independent Research in Organic Chemistry I
Research under the direction of members of the organic chemistry faculty.
Staff   1-3 credits

030.507-508 Independent Research in Biochemistry I
Research under the direction of members of the biochemistry faculty.
Staff   1-3 credits

030.509-510 Independent Research in Biochemistry II
Research under the direction of members of the biochemistry faculty. Prerequisites: 030.507-508 and permission of instructor.
Staff   1-3 credits

030.512 Independent Research in Materials Chemistry I
Research under the direction of the materials chemistry faculty.
Staff   1-3 credits

030.521-522 Independent Research in Inorganic Chemistry II
Research under the direction of the inorganic chemistry faculty. Prerequisites: 030.503-504 and permission of instructor.
Staff   1-3 credits

030.523-524 Independent Research in Physical Chemistry II
Research under the direction of the physical chemistry faculty. Prerequisites: 030.501-502 and permission of instructor.
Staff   1-3 credits

030.525-526 Independent Research in Organic Chemistry II
Research under the direction of the organic chemistry faculty. Prerequisites: 030.505-506 and permission of instructor.
Staff   1-3 credits

Graduate Courses

Advanced graduate courses are open to qualified undergraduate students. Not all 600-level courses are offered every year.

030.601 Statistical Mechanics
An introduction to the statistical mechanics of cooperative phenomena using lattice gases and polymers as the main models. Topics to be covered will include phase transitions and critical phenomena, scaling laws, and the use of statistical mechanics to describe time dependent phenomena. Prerequisite: 030.301.
Poland   3 hours   not offered yearly

030.610 Chemical Kinetics
The molecular mechanism of elementary physical and chemical rate processes will be studied. Topics such as elastic scattering, collisional vibrational and rotational energy transfer, chemically reactive collisions, and the theory of unimolecular decay will be covered. Pre- or co-requisite: one year of quantum mechanics.
Bowen   3 hours   fall

030.611 Electron Transfer Processes
Electron transfer processes are distinguished by their ubiquity and essential roles in many physical, chemical, and biological processes. Rates of electron transfer in cytochromes and semiconductors span over 20 orders of magnitude. Therefore, it is important to understand the factors which underlie this large rate variation. This course is concerned primarily with this issue. Electron transfer theories will be developed from a historical point of view. Basic concepts and terminology will be discussed

as well as the spectroscopic and electrochemical techniques useful for quantitating electron transfer processes. The final third of this course will highlight recent electron transfer studies in biology, the solid state, and solution. Prerequisite: 030.356 or permission of instructor.
Meyer   3 hours   not offered yearly

030.612 Nucleic Acids Chemistry
A survey of the physical properties of DNA and RNA. Areas to be explored include conformations of secondary and tertiary structures, polyelectrolyte properties, folding and unfolding reactions, and recognition by small molecules and proteins. Prerequisite: 030.301 or its equivalent.
Draper   3 hours   spring

030.613-614 Chemistry–Biology Interface Program Forum
Chemistry–Biology Interface (CBI) program students and faculty will meet weekly in a forum that will host presentations from CBI faculty and students as well as invited guest speakers. These meetings will serve as a valuable opportunity for students to develop presentation skills and interact with CBI students and faculty. Enrollment is required for first- and second-year CBI students, and is recommended for advanced-year graduate students.
Greenberg   1 hour   fall and spring

030.615 Topics in Biological Inorganic Chemistry
This course is concerned with the chemistry of metals in biological systems. Major emphasis is placed on metalloproteins in which a transition metal is known to occupy the active site of the protein. Chemical approaches to modeling bioinorganic systems also are discussed. The lectures illustrate how chemical, spectroscopic, and structural methods have been used to understand the structure and function of metals in biology. Prerequisites: 030.301-302 or the equivalent; some background in biochemistry or inorganic chemistry is helpful but not required.
Goldberg   3 hours   fall

030.617 Special Topics in Inorganic Chemistry
Topics from the recent primary literature in inorganic chemistry will be discussed, via instructor lectures and presentations by the graduate-undergraduate students enrolled in the course. The topics covered may range from bioinorganic to organometallic to solid-state inorganic chemistry. Prerequisite: 030.449 or equivalent.
Karlin   3 hours   spring

030.619 Chemical Biology I
Parts I and II constitute the core course of the Chemistry-Biology Interface (CBI) Program. An introduction to the structure, synthesis, reactivity, and function of biological macromolecules (proteins, nucleic acids, carbohydrates, and lipids) will be provided using the principles of organic and inorganic chemistry. Discussion will incorporate a broad survey of molecular recognition and mechanistic considerations, and introduce the tools of molecular and cellular biology that are utilized in research at the interface of chemistry with biology and medicine. Prerequisite: 030.206 or equivalent.
Townsend   3 hours   fall

030.620 Chemical Biology II
Beginning at the surface of cells, chemical events of protein-protein, protein-nucleic acid and carbohydrate recognition will be discussed proceeding to mechanisms of cell signaling and controls of metabolism in cells. The roles of metals in cellular homeostasis and oxidative stress, gene activation, control of the cell cycle, protein modification and engineering by rational and selection methods, and biotechnological tools as combinatorial chemistry, the use of arrays, biomaterials, proteomics, and informatics will be discussed. Prerequisite: Chemical Biology I or permission from instructor.
Townsend   3 hours   spring

030.621-622 Seminar on the Chemical Literature
Seminars are presented by advanced graduate students on topics from current chemical journals. First-year graduate students are expected to attend this course for credit. Undergraduate students may take the course on a satisfactory/unsatisfactory basis.
Staff   1 hour   fall and spring

030.625 Advanced Mechanistic Organic Chemistry I
The course covers the application of techniques in physical chemistry to the study of organic reaction mechanisms. Topics include chemical bonding and structure, stereochemistry, conformational effects, molecular orbital theory, methods to determine reaction mechanisms, reactive intermediates, and photochemistry. Prerequisites: 030.205-206.
Greenberg   3 hours   fall

030.626 Advanced Mechanistic Organic Chemistry II
This course covers advanced organic reactions and their mechanisms. Emphasis is given both to methods of postulating mechanisms for rationalizing reaction results and to the use of mechanistic thinking for designing reactions and reagents. This course is intended to be taken in sequence with 030.425. Prerequisites: 030.205-206.
Tovar   3 hours   spring

030.634 Topics in Bioorganic Chemistry
Each year, topics in modern bioorganic chemistry will be treated in depth, drawing from the current literature as a primary resource. Topics will include natural products chemistry, biosynthetic reaction mechanisms, and drug design. Methods of synthesis, combinatorial synthesis, and genetics will be described throughout. Carbohydrates, lipids, polyketides, polypeptides, terpenes, and alkaloids are some of the molecule classes to be examined. Prerequisites: Chemical Biology I or two semesters of organic chemistry and one of biochemistry.
Townsend   3 hours   not offered yearly

030.635 Methods in Nuclear Magnetic Resonance
This course will introduce the necessary theoretical background required for an appreciation of modern techniques in magnetic resonance. The concepts developed will be extended into the context of current applications, with an emphasis on the practical aspects of solution-state NMR studies of macromolecules. Prerequisite: 030.302.
Tolman   3 hours   fall

030.676 Green Chemistry: An Inorganic Perspective
The course will provide background into green chemistry and the minimization of hazardous materials associated with chemical practices. Emphasis will be placed on recent literature on green inorganic chemistry.
Karlin   3 hours   not offered yearly

030.677 Advanced Organic Synthesis I
The reactions and principles involved in the synthesis of simple and complex organic compounds. Discussion of famous natural product syntheses and practice in developing rational designs for organic syntheses. Problems in the design of syntheses and in the use of chemical literature.
Posner   3 hours   fall

030.678 Advanced Organic Synthesis II
An advanced discussion of organic stereochemistry and its application to problems in asymmetric reactions and catalysis will be presented. Emphasis will be placed on the latest reports in the literature, especially with respect to the development of new catalytic, asymmetric processes. Prerequisite: 030.677.
Lectka   3 hours   spring

030.679 Advanced Asymmetric Synthesis
The asymmetric synthesis of organic molecules using stoichimetric and catalytic methodology will be addressed, from the historical development of chiral auxiliaries to cutting-edge asymmetric catalysts. Prerequisite: 030.677.
Lectka   3 hours   not offered yearly

030.682 Organic Chemistry of Nucleic Acids
Nucleic acids (DNA/RNA) are essential molecules for all living beings. Studies on their structure, synthesis, chemical properties, and noncovalent interactions with other molecules are critical for understanding their role in biological processes. More recently, these molecules have been used as therapeutic and diagnostic agents. This course focuses on the structure, reactivity, and molecular recognition of these molecules. The topic will be approached from the perspective of organic chemistry, but biochemical and biological concepts will be included (and explained).
Greenberg   3 hours   not offered yearly

030.688 Physical Inorganic Methods
This course provides fundamental examples of the kinds of information that can be obtained by applications of methods to inorganic chemistry. Topics to be covered include symmetry, group theory, spectroscopy, magnetism, and ionization methods. The course assumes some background in basic molecular orbital theory. Pre- or corequisite: 030.449 or equivalent.
Meyer   3 hours   not offered yearly

030.690 Intermediate Computational Chemistry
Modern computational chemistry is an invaluable partner to laboratory-based methods in understanding and predicting molecular structure, properties, spectra, and energetics as well as chemical reactivity. The modern computational arsenal includes electron density-based methods, density functional theory (DFT) and time dependent DFT (TDDFT), as well as wave function-based

methods, including self-consistent field (SCF) theory, multiconfiguration SCF (MCSCF) theory, many body perturbation theory (MBPT), coupled cluster-based methods and the method of configuration interaction (CI). Techniques based on molecular mechanics are also available. Both ground and electronically excited states will be considered as will states of distinct spin-multiplicities. The student will learn the ideas behind the computational methods and will understand the strengths and weaknesses and range of applicability of these techniques. The course will provide, indeed will emphasize, the opportunity for hands-on experience in using modern computational tools to solve practical problems in molecular structure and chemical reactivity.

Yarkony   3 hours   spring

030.691 Solid State Chemistry
Survey of the principles of the structure and properties of non-molecular solids. Basic crystallography, including space group symmetry and structure determination by X-ray, neutron, and electron diffraction is covered, as are fundamental concepts of bonding in solids. Topics include lattice dynamics, electronic band structure, mag-netism, and strongly correlated electron behavior, and their relationship to observed materials properties such as superconductivity, thermoelectricity, and optical prop-erties. Cross-listed with Physics and Astronomy.

McQueen   3 hours   fall

030.693 Methods in Time-Resolved Spectroscopy
In this course we will survey common time-resolved spec-troscopic methods used to interrogate the dynamic and static properties of chemical systems. We will explore theoretical treatments, both of key molecular processes (e.g. radiative and non-radiative transitions, solvation, coherence dephasing) and the spectroscopic tools used to interrogate them. Furthermore, we will survey the technical developments that are now allowing us to capture events that occur on ever faster timescales (cur-rently down to the attosecond regime), and across the electromagnetic spectrum (from X-rays to Terahertz). Prerequiste: Undergraduate physical chemistry (I and II). Previous or concurrent concentrated study of Quan-tum Mechanics (graduate level or from a physics course) would be helpful, but not strictly required.

Bragg   3 hours   fall

Classics

The discipline of Classics has played a central role in the teaching and research missions of Johns Hopkins University from the time of its foundation. Basil Lanneau Gildersleeve, a professor of Greek, was the first professor appointed by the board of trustees, and thus became the very first faculty member (aside from the founding president, Daniel Coit Gilman) in the University. Gildersleeve and his colleagues organized the first modern departments of Greek and Latin—departments with an innovative structure based on the German seminar system, which encouraged a fusion of teaching and research. This "seminar" was in time widely adopted by other North American universities, and to this day remains at the core of the research university.

Today, the Classics Department seeks to maintain and enhance its tradition of leadership and innovation. Members of the current faculty are highly interdisciplinary, combining philological, historical, iconographical, and comparative methods in the study of the cultures, broadly conceived, of ancient Greece and Rome. The undergraduate and the graduate programs, leading to B.A., M.A., and Ph.D. degrees, reflect these emphases. Requiring rigorous study of the ancient languages and literatures, ancient history, and Greek and Roman art and archaeology, these programs aim to produce broad, versatile scholars who have a holistic view of the ancient cultures and of the evidence by which those cultures are comprehended.

The Faculty

Secondary appointments in parentheses.

Silvia Montiglio, Basil L. Gildersleeve Professor of Classics: Greek literature and culture; the ancient novel and narrative; philosophy.

Matthew Roller, Professor and Chair: Latin literature, Roman social and cultural history, Roman material culture, Graeco-Roman philosophy.

H. Alan Shapiro, W. H. Collins Vickers Professor of Archaeology (History of Art): Greek and Roman art and archaeology, Greek mythology and religion. (Graduate Advisor)

Hérica N. Valladares, Assistant Professor: Roman art and archaeology, Latin poetry, Ovid in the Renaissance, 18th-century reception of antiquity. (Director of Undergraduate Studies)

Dimitrios Yatromanolakis, Associate Professor (Anthropology, Humanities Center): Greek literature, Greek social and cultural history, theory and anthropology of Greek music, papyrology, epigraphy, performance cultures of Greece and Rome.

Emeriti

Marcel Detienne, Basil L. Gildersleeve Professor Emeritus: Greek, social history, cultural history, mythology, anthropology and classics.

Georg Luck, Professor Emeritus: Latin literature, textual criticism, ancient magic.

Joint Appointments

Primary appointments in parentheses.

Richard Bett, Professor (Philosophy): ancient philosophy, ethics.

Christopher Celenza, Professor (German and Romance Languages and Literatures): Renaissance Latin literature, literary culture, palaeology.

Pier Luigi Tucci, Assistant Professor (History of Art): Roman art and architecture.

Part-Time and Visiting Faculty

Emily Anderson, Lecturer: Aegean Bronze Age art and archaeology, material culture, sociocultural interaction, identity, glyptic.

Michael Sullivan, Visiting Assistant Professor: Greek and Roman literature.

Facilities

The department's main scholarly resource is the Milton S. Eisenhower Library, which has broad and deep holdings in the various fields of classical antiquity. The department also has a significant collection of Greek, Roman, and Etruscan antiquities, housed in the Johns Hopkins Archaeological Museum (shared with Near Eastern Studies). Additionally, the department enjoys close ties with several local and regional institutions whose missions include the study of the ancient world: the Walters Art Museum, with its world-class collection of antiquities and manuscripts; the Baltimore Museum of Art, with its Roman mosaics; and the Center for Hellenic Studies in Washington, D.C. Finally, the department is a member of the American School of Classical Studies at Athens, the American Academy in Rome, and the Intercollegiate Center for Classical Studies at Rome.

Undergraduate Programs

The department offers undergraduate courses in Greek and Latin languages and literatures, ancient history, classical art and archaeology, Greek and Roman civilizations, history of sexuality and gender, ancient philosophy, mythology, and anthropological approaches to the classics. These courses are open to all students in the university, regardless of their academic year or major field of interest.

Requirements for the B.A. Degree

The B.A. program in classics is highly flexible, accommodating a variety of interests in and approaches to the ancient world. Twelve courses (36 credits) are required for a major in classics. All majors take a minimum of four language courses (Greek and/or Latin), two of which must be at the 200-(interm ediate) level or above. Majors must also take at least four courses in ancient history or art history. The other four courses are chosen from among the department's offerings, in consultation with the director of undergraduate studies (DUS) in the Classics Department, so as to build an intellectually substantial and coherent curriculum that fits the student's interests. Possible areas of emphasis include language and literature, ancient philosophy, art and archaeology, and ancient history. Certain courses taken in other departments may count toward the major, with the approval of the DUS. Advanced undergraduates may participate in graduate seminars, with the approval of the DUS and the professor. The major also requires a reading knowledge (i.e., second-year proficiency) in French or German or Italian.

Students intending to pursue graduate study in classics will need to do substantially more work in Greek and Latin than what the major minimally requires: most graduate programs expect successful applicants to have studied one language for at least three years and the other for at least two. Therefore, students interested in graduate work should be engaged in a language-intensive curriculum by the end of the sophomore year.

The Classics Department awards each year the Evangelia Davos Prize to the classics major or minor whose work in Greek studies is outstanding.

Honors Program in Classics

Under this program senior classics majors have the opportunity to write an honors thesis in close consultation with a faculty member. This work of guided research and writing counts for three credits and is outside the requirements of the major. This program awards a B.A. with honors.

Study Abroad

The Department of Classics is a member of the Intercollegiate Center for Classical Studies in Rome and can provide information on other year-long, semester-long, or summer programs in Greece and Italy (e.g., the College Year in Athens and the summer session of the American School of Classical Studies at Athens). Interested students, especially classics majors and minors, are encouraged to consider these options for studying overseas.

Minor in Classics

The requirements for the minor in classics are extremely flexible: six courses (18 credits) from among the department's offerings. These courses are selected, in consultation with the DUS, to meet the needs and interests of the student. Minors may wish to pursue the study of one ancient language, or create a curriculum that meshes with their other academic pursuits. Interested students should consult the DUS.

B.A./M.A. Degree

Students interested in the B.A./M.A. program are expected to declare their interest by the spring semester of their junior year and will be admitted on the basis of outstanding performance in previous Classics courses. In their senior year, they are to devise a program that would best prepare them to do advanced work in their final year, in particular addressing any weakness in one or the other classical language. The student is to complete the requirements for the B.A. in his or her fourth year, and the M.A. requirements in the fifth year. However, the B.A. and M.A. degrees are conferred concurrently at the end of the M.A. year. For the M.A. the following additional work is required:

- Four semesters (12 credits) of Latin and/or Greek, six credits of which must be above the intermediate level (Latin 040.207, Greek 040.205)

- Two graduate seminars in the Classics Department

- A thesis of 20,000 to 25,000 words representing original research. The thesis will be supervised by a member of the Classics Department faculty and graded by the supervisor and a second reader from Classics or an outside department.

Graduate Programs

Requirements for the M.A. Degree

Note: Students are not admitted for the M.A. as a terminal degree, but only for the Ph.D.

- Six seminars and translation examinations in Greek and Latin

- A reading knowledge of German, French, or Italian. Student will demonstrate this knowledge by passing the departmental examination in one of the three languages.

Requirements for the Ph.D. Degree

To receive a Ph.D. in classics from Johns Hopkins University, students must complete successfully a range of seminar work and examinations, and then write a substantial dissertation. The Graduate Program in Classics is designed to be completed in five

years, of which the first three are dedicated to seminar work and examinations, and the last two to the dissertation. Assuming satisfactory progress toward the Ph.D., all students admitted to the program receive five years of living expenses and tuition remission, in order to make it possible to complete the program in a timely manner. This support takes the form of a fellowship for the first two years, and teaching for at least two of the remaining years. The department is also able to offer teaching opportunities in the summer, as well as funded summer travel for program-related purposes. All students, upon reaching dissertation level, are encouraged to apply for outside funding to spend a year abroad. If outside funding is obtained, the Johns Hopkins

fellowship may be held in reserve for an additional year. A detailed outline of the Ph.D. program, including a prospectus of all seminars and exams, can be found on the Classics Department website (http://classics.jhu.edu).

Application information may be obtained from Professor Matthew B. Roller, Chair, Department of Classics, The Johns Hopkins University, 113 Gilman Hall, 3400 North Charles Street, Baltimore, MD 21218. Telephone: 410-516-7556; Fax: 410-516-4848; email: classics@jhu.edu. The application deadline is on or about January 15. For the precise date, please refer to the Graduate Admissions website (http://grad.jhu.edu).

Undergraduate Courses

A student may not take a more advanced course when he/she has earned a D or D+ in a prerequisite course, including first-semester freshman courses.

Languages

040.105-106 Elementary Ancient Greek
This course provides a comprehensive and intensive introduction to the study of ancient Greek. During the first semester, focus is on morphology and vocabulary; emphasis in the second semester is on syntax and reading. Credit is given only upon completion of a year's work. Course may not be taken satisfactory/unsatisfactory.
Staff   4 credits

040.107-108 Elementary Latin
This course provides a comprehensive and intensive introduction to the study of Latin for new students as well as a systematic review for those students with a background in Latin. Emphasis during the first semester is on morphology and vocabulary; during the second semester, the focus is on syntax and reading. Credit is given only upon completion of a year's work. Course may not be taken satisfactory/unsatisfactory.
Staff   3.5 credits

040.205-206 (H) Intermediate Ancient Greek
Reading ability in classical Greek is developed through a study of various authors, primarily Plato (fall) and Homer (spring). Prerequisites: 040.105-106 or equivalent.
Staff   3 credits

040.207-208 (H) Intermediate Latin
Although emphasis is still placed on the development of rapid comprehension, readings and discussions introduce the student to the study of Latin literature, principally through texts of Cicero (fall) and Vergil (spring). Prerequisites: 040.107-108 or equivalent.
Staff   3 credits

040.305-306 (H) Advanced Ancient Greek
Reading of prose or verse authors, depending on the needs of students.
Staff   3 credits

040.307-308 (H) Advanced Latin
A major goal of these courses remains to increase proficiency and improve comprehension of the Latin language. Hence, they involve intensive reading of Latin texts, with the usual attention to matters of grammar, idiom, translation, etc. Increasingly, however, these courses present Latin texts as cultural artifacts providing a means of access to the culture(s) that produced them. Therefore these courses also involve substantial reading of secondary materials, and significant class time is devoted to the discussion of the literary, historical, and social issues that the texts raise. Specific offerings vary year by year. Prerequisites: 040.207-208 or equivalent.
Staff   3 credits

Classical Civilization, History, Culture, Art

040.104 (H) The Roman Republic: History, Culture, and Afterlife
This introductory level course examines the history, society, and culture of the Roman state in the Republican period (509-31 BCE), during which it expanded from a small city-state to a Mediterranean empire. We will also consider the Republic's importance for the later phase of Western society, notably the American and French revolutions. All readings in English.
Roller   3 credits

040.111 (H) Greek Civilization
This course examines the historical, political, and cultural development of the ancient Greek world from Minoan civilization to Hellenistic times.
Staff   3 credits

040.112 (H) Roman Civilization
This course examines important social, political, and cultural developments in the ancient Roman world, primarily through a study of literary texts, from Rome's beginnings as a small city-state to the high empire.
Staff   3 credits

040.113-114 (H) Introduction to Greek Culture
Staff   3 credits

040.117-118 (H) Introduction to Roman Culture
Staff   3 credits

040.119 (H) The World of Pompeii
This course will focus on the history and archaeology of Pompeii. Close attention will also be paid to the reception of Pompeian materials in European and American Culture. Cross-listed with History of Art.
Valladares   3 credits

040.121 (H) Greek Mythology
Greek myths fascinate us as adventurous narratives, yet they are also enigmatic and require interpretation. This course combines the pleasure of reading stories with the concern for their understanding. Readings in ancient and modern texts.
Staff   3 credits

040.126 (H) Religion, Music, and Society in Ancient Greek Culture
Who were the ancient Greeks? What do they mean to us? And how can we "read" their civilization? An interdisciplinary exploration of ancient Greek culture from Mycenaean Greece and "Homer" to Alexander the Great as seen through literature, social and cultural history, music, and art. Emphasis will be placed on social imaginary, religion, and philosophy; on fundamental institutions such as the city-state, democratic discourses, festivals, and symposia; on myth and ritual; and on ancient music and society.
Yatromanolakis   3 credits

040.129 (H) Drinking Parties, Homoeroticism, and Gender Politics
How is eroticism conceived of in ancient Greek societies? How was homoeroticism and homosocial desire imagined and defined in diverse sociopolitical contexts? How were gender and social and erotic intercourse represented in different cultural discourses—visual, philosophical, and literary? This course explores aspects of eroticism, ritual, philosophy, and politics in ancient Greece and other traditional cultures. Related films will be incorporated.
Yatromanolakis   3 credits

040.132 (H) The Uses of Myth in Classical Greece and Rome
How did the Greeks and Romans approach mythology? Through reading ancient authors we consider how myths function in literature; by looking at ancient art we examine the visual forms these tales received.
Valladares   3 credits

040.213 Food and Dining in the Ancient World
This course examines the diet and dining practices of the Graeco-Roman world. Ancient texts, images, and archaeological remains are the primary objects of study, along with modern scholarship and comparative materials from other cultures.
Roller   3 credits

040.218 (H) Celebration and Performance in the Early Aegean
Surviving imagery suggests that persons in Minoan and Mycenaean societies engaged in various celebratory performances, including processions, feasts, and ecstatic dance. This course explores archaeological evidence of such celebrations, focusing on sociocultural roles, bodily experience, and interpretive challenges.
Anderson   3 credits

040.301 (H) Art and Society in Classical Athens
The course studies Athens from the Persian Wars to the Peloponnesian War (490-404 B.C.) using primary texts and archaeological remains.
Shapiro   3 credits

040.313 (H) Mythology and Its Interpretations
Staff   3 credits

040.320 (H) Myth in Classical Art
The course traces the representation of the principal gods and heroes of Greek myth in the visual arts (sculpture and vase-painting) of Greece, as well as later reflections in Roman painting.
Shapiro   3 credits

040.330 (H) The Age of Perikles
A survey of Athens in the High Classical period, focusing on primary sources read in translation (Thucydides, Plutarch) and archaeological evidence.
Shapiro   3 credits

040.348 (H) The World of Homer
The course will explore in depth the two epics, *Iliad* and *Odyssey*, as well as other early Greek poetry, in its historical, archaeological, and cultural setting.
Shapiro   3 credits

040.349 (H) The Morality of Wealth: Ancient Texts and Modern Questions
What is the moral purpose of wealth? What values should drive economic decisions? Explore such questions by examining ancient Greek, Roman, and Early Christian sources in light of modern ethics. Prerequisite: Knowledge of Latin or Greek useful but not required.
Staff   3 credits

040.351 (H) Pompeii: Life and Art in a Roman City
This course will introduce students to scholarship in the city of Pompeii. We will study key houses and monuments, approaching them from an interdisciplinary lens. Prerequisite: Background in classics and/or art history.
Valladares   3 credits

040.360 (H) The Archaeology of Daily Life
This course will examine objects of daily life from the Greco-Roman world in the Johns Hopkins University Archaeological Museum. Students will collaborate on an online catalogue, featuring their research. Limited to juniors and seniors from Classics, History of Art, Archaeology, and Museums and Society. Others with permission of instructor only. Cross-listed with History of Art, Near Eastern Studies, and Museums and Society.
Valladares   3 credits

040.368 (H) The Authority of Ruins: Antiquarianism in Italy, 1690-1890
This seminar will focus on the transformation of antiquarianism in Italy after the discovery of Herculaneum and Pompeii. Students will work primarily with rare books from the collections at JHU. Cross-listed with History of Art and Museum and Society.
Valladares   3 credits

040.501-502 Independent Study

Cross-Listed: Undergraduate Level

Center for Language Education

383.111 Beginning Sanskrit
Saini   3 credits

German and Romance Languages and Literatures

211.414 (H) Body as Vehicle: Antonin Artaud and the French 20th Century Approach to Theatrical Performance
Staff   3 credits

214.352 (H) Writing and Wonder: Books, Libraries, and Discovery (1350–1550)
Celenza, Stephens   3 credits

History of Art

010.355 (H) Art and Religion in the Roman World
Tucci   3 credits

Interdepartmental

360.133 (H,W) Great Books at Hopkins
Staff   3 credits

Near Eastern Studies

130.308 (H) Pleasure in Ancient Mesopotamia
Delnero   3 credits

130.311 (H,W) Gilgamesh: The World's First Epic Hero
Delnero   3 credits

130.354 (H,S) Archaeological Method and Theory
Harrower   3 credits

130.355 (H,N) Geographic Information Systems in Archaeology
Harrower   3 credits

Philosophy

150.201 (H) Introduction to Greek Philosophy
Bett   3 credits

150.401 (H,W) Greek Philosophy: Plato and his Predecessors
Bett   3 credits

150.402 (H) Greek Philosophy: Aristotle
Bett   3 credits

Graduate Courses

This is a listing of seminars offered in recent years. Some are offered regularly; others have been offered just once.

040.603 Classical Vase-Painting in the Walters Art Museum
The seminar will focus on recent approaches in the study of Athenian and South Italian red-figure vase-painting, ca. 480-323 B.C., with special reference to examples in the Walters Art Museum. Cross-listed with History of Art.
Shapiro

040.604 Latin Epic
Intensive reading of selections of Vergil's *Aeneid*, Ovid's *Metamorphoses*, and Statius' *Thebaid*; also, examination of key scholarly debates surrounding these texts and the epic genre in general.
Roller, Valladares

040.610 The Art of Description: Ekphrasis in Greece and Rome
The seminar will examine in detail representative examples of ekphrasis in Greek and Latin poetry along with relevant works of art from all periods of Antiquity. Cross-listed with History of Art.
Shapiro, Valladares

040.611 Classical and Hellenistic Sculpture in the Walters Art Museum
This seminar will explore the functions, genres, and iconography of sculpture in the 5th to 1st centuries BCE on the basis of Greek originals in the Walters collections. Cross-listed with History of Art.
Shapiro

040.612 Ancient Greek Prose Composition
Translating modern English prose into ancient Greek. Emphasis on the Attic dialect.
Yatromanolakis

040.615 Ovid's Metamorphoses
In this seminar, we will study Ovid's *Metamorphoses*, paying special attention to the text's generic playfulness and the author's poetics of illusion. We will also survey recent critical trends in Ovidian studies.
Valladares

040.617 Roman Painting: A Survey
This course will offer a survey of established approaches to Roman painting and challenge students to develop their own methodological lens for analyzing this material.
Valladares

040.621 Proseminar to Classical Archaeology
Graduate level introduction to methods of research in the material culture of Greece and Rome. Cross-listed with History of Art.
Shapiro

040.624 Hero or Villain? Odysseus in Greek Literature and Culture
We shall read Greek literary and philosophical texts dealing with the figure of Odysseus, to see how he was regarded as a moral type.
Montiglio

040.626 Athenian Festivals
The seminar will explore the major Athenian festivals of the Archaic and Classical periods through a combination of archaeological, iconographical, and epigraphical evidence. Cross-listed with History of Art.
Shapiro

040.627 Sanctuaries of Athens and Attika
The seminar will explore the history and topography of the major Attic sanctuaries, with a focus on the dedications in their religious and archaeological context. Cross-listed with History of Art.
Shapiro

040.629 Representing Tiberius
Tiberius was a quite different figure from his predecessor, Augustus—almost an "anti-princeps." This seminar involves intensive Latin reading in the major sources for Tiberius' life and career (Suetonius, Tacitus, Velleius, various epigraphic texts) as we investigate the evolving understanding of the emperor's socialpolitical role.
Roller

040.632 Latin Prose: Style, Word Order, Composition
Close study of the structuration of Latin prose. We will read and analyze selections of various prose authors, observing word order and colon construction; we will also practice composing Latin prose in various styles.
Roller

040.633 Intensive Survey of Archaic and Classical Greek Poetry: Texts and Historical/Archaeological Contexts
An intensive survey of ancient Greek poetic texts (including complex fragmentary texts), which emphasize reading for comprehension and speed. Archaeological sources and sociocultural institutions that provide a context for texts will be explored.
Yatromanolakis

040.634 Latin Verse Satire: A Genre in Search of an Occasion
This seminar examines the "distinctively Roman" genre of verse satire and associated problems of form, content, and occasion. Substantial readings in Latin from the genre's major authors: Lucilius, Horace, Persius, and Juvenal.
Roller

040.639 Propertius
In this seminar, we will read Propertius' four books of elegiac poetry and survey recent scholarship on this author. Special attention will be paid to textual criticism, literary theory and reception.
Valladares

040.640 The Ancient Greek Novel
The Ancient Greek Novels are romantic love stories, with a beautiful heroine and a handsome hero. Excerpts from a sample of novels will be read in Greek and the entire corpus in English. Graduate students only. Knowledge of ancient Greek is required.
Montiglio

040.642 Greek Vases in the Johns Hopkins Archaeological Collection
The seminar will update the scholarship on selected vases in the collection published since the 1984 catalog and generate detailed labels to accompany the new installation. Cross-listed with History of Art.
Shapiro

040.643 How to Persuade a Roman Emperor
This seminar examines texts addressed directly to emperors, texts that seek to form, guide, persuade, or provide models for them. The principal readings are Seneca's De Clementia and Pliny the Younger's Panegyricus.
Roller

040.659 Archaic Greek Vase-Painting in the Walters Art Museum
The seminar explores the various regional ceramic workshops of the seventh to sixth centuries, focusing on selected examples in the Walters Art Museum collection. Cross-listed with History of Art.
Shapiro

040.663 Heroes and Hero Cult in Greece
This seminar explores the origins of hero cult in Greece and the evolution of the heroic image in Greek art. Cross-listed with History of Art.
Shapiro

040.665 Survey of Greek Literature
An intensive survey of Greek poetic and prose texts, which emphasizes reading for comprehension and speed. Texts range from Homer to Lucian.
Staff

040.668 The Authority of Ruins: Antiquarianism in Italy, 1690–1890
This seminar will focus on the transformation of antiquarianism In Italy after the discovery of Herculaneum and Pompeii. Students will work primarily with rare books from the collections at JHU. Cross-listed with History of Art.
Valladares

040.679 Greek Sculpture in the Walters Art Museum
An advanced survey of Greek sculpture of the seventh to fourth centuries B.C.; student projects on representative examples in the Walters collection. Cross-listed with History of Art.
Shapiro

040.681 Performance Cultures of Archaic and Classical Greece: Poetic Genres and Social Institutions
By focusing on a wide range of texts (literary and theoretical) and images, this seminar examines diverse social and cultural contexts of performance in archaic and classical Greece, such as the symposium, choruses of young women, and religious festivals. The seminar also investigates ways in which performance culture interacts with social imagination. "Genres" to be studied include archaic and classical lyric, elegy and iamb, tragedy, comedy, and satyr-play. Anthropological perspectives will be explored throughout.
Yatromanolakis

040.687 Proseminar in Classical Philology
An overview of research areas and tools in Classics, beginning with library resources and databases and moving on to such topics as epigraphy, textual transmission, papyrology, and various forms of critical theory.
Staff

Reading Seminars

These seminars are intended to train the graduate students of the Classics Department in direct and critical work on primary sources. With the consent of the instructor, they are open to graduate and undergraduate students from other departments who are proficient in Greek and Latin.

040.702 Reading Ancient Greek Poetry
Prerequisite: Greek.
Yatromanolakis

040.704 Reading Archaic Greek Literature
Prerequisite: Greek.
Staff

040.705-706 Reading Ancient Greek Prose
Prerequisite: Greek.
Staff

040.707 Reading Latin Prose
Prerequisite: Latin.
Staff

040.709 Intensive Latin Reading
Prerequisite: Latin.
Roller

040.710 Reading Latin Poetry
Prerequisite: Latin.
Staff

040.712 Reading Greek Philosophy
A seminar devoted to close reading and analysis of fragments of the pre-Socratics in the original Greek. Prerequisite: At least two years of Greek or permission of the instructor. Cross-listed with Philosophy.
Bett

Independent Study

040.801-802 Independent Study
Staff

040.811 Directed Readings in Classics
Staff

Cross-Listed: Graduate Level

German and Romance Languages and Literatures

214.681 Representing the Ancient Italian Past in the Renaissance
Stephens

214.761 Reading and Writing In Pre-Modern Europe
Celenza

214.771 Literature, Philosophy, and Christianity: Gianfrancesco Pico della Mirandola (1469–1553)
Stephens

History of Art

010.717 Alternative Histories through Art and Archaeology: from Archaic to Late Antique Rome
Tucci

010.718 Art and Archaeology in the Augustan Age
Tucci

Cognitive Science

Cognitive science is the study of the human mind and brain, focusing on how the mind represents and manipulates knowledge and how mental representations and processes are realized in the brain. Conceiving of the mind as an abstract computing device instantiated in the brain, cognitive scientists endeavor to understand the mental computations underlying cognitive functioning and how these computations are implemented by neural tissue. Cognitive science has emerged at the interface of several disciplines. Central among these are cognitive psychology, linguistics, and portions of computer science and artificial intelligence; other important components derive from work in the neurosciences, philosophy, and anthropology. This diverse ancestry has brought into cognitive science several different perspectives and methodologies. Cognitive scientists endeavor to unite such varieties of perspectives around the central goal of characterizing the structure of human intellectual functioning. It is this common object of inquiry that integrates traditionally separate disciplines into the unified field of cognitive science.

Programs in cognitive science at Johns Hopkins University reflect the interdisciplinary nature of the subject, requiring the student to approach the study of the mind/brain from several different investigative perspectives. The programs in cognitive science draw on courses offered by several other departments as well.

The Faculty

Luigi Burzio, Professor Emeritus: theoretical phonology, morphology, and syntax, Romance linguistics.

Barbara Landau, Dick and Lydia Todd Faculty Development Professor (Chair): language acquisition, cognitive development, spatial representation, and acquisition of the lexicon.

Géraldine Legendre, Professor: syntax, optimality theory, Romance and Balkan morphology and syntax, acquisition of syntax.

Michael McCloskey, Professor: cognitive neuropsychology, vision, spatial and lexical representation, foundations of cognitive science.

Akira Omaki, Assistant Professor: psycholinguistics, first language acquisition, second language acquisition, syntax.

Soojin Park, Assistant Professor: cognitive neuropsychology, vision, scene perception and memory, spatial navigation, functional neuroimaging.

Brenda Rapp, Professor: cognitive neuropsychology, spelling, spoken language production, spatial frames of reference, reading and neural bases of recovery of function.

Kyle Rawlins, Assistant Professor: formal semantics, pragmatics, syntax and interfaces, lexical representation, mathematical linguistics, computational models of meaning and communication.

Paul Smolensky, Krieger-Eisenhower Professor of Cognitive Science: grammatical theory and neural networks; optimality theory: phonology, learnability, computation, syntax.

Colin Wilson, Associate Professor: theoretical phonology: constraint interaction, targeted constraints, learnability; experimental phonology: artificial grammar learning, substantive bias; computational cognitive science: finite state, maximum entropy, and Bayesian methods.

Joint/Adjunct Appointments

Dana Boatman, Associate Professor (Neurology and Otolaryngology, Medicine): speech perception, auditory processing disorders, auditory neurophysiology.

John Desmond, Associate Professor of Neurology, Division of Cognitive Neuroscience: neuroimaging, transcranial magnetic stimulation methods to investigate neural correlates of behavior.

Howard Egeth, Professor (Psychological and Brain Sciences): perception, attention.

Jason Eisner, Associate Professor (Computer Science): computational linguistics (syntax and phonology), natural language processing, statistical machine learning.

Lisa Feigenson, Associate Professor (Psychological and Brain Sciences): cognitive development, object and number representation in infants and young children.

Barry Gordon, Therapeutic Cognitive Neuroscience Professor (Neurology, Medicine): cognitive neurology, cognitive neuroscience, language, aphasia, memory, amnesia and memory disorders, autism, computational models of cognition, and cognitive disorders.

Steven Gross, Associate Professor (Department of Philosophy): philosophy of language, philosophy of mind, metaphysics.

Justin Halberda, Associate Professor (Psychological and Brain Sciences): cognitive development, reasoning and word learning, attention, symbolic and connectionist modeling.

Argye Hillis-Trupe, Professor (Neurology, Medicine): language impairments in acute stroke, hemi-spatial neglect after stroke, relationship between cognitive impairments and regions of hypoperfused brain.

Guy McKhann, Professor (Neurology and Neuroscience, Medicine): neurological and cognitive changes after cardiac surgery.

Maureen Stone, Adjunct Professor (Director, Vocal Tract Visualization Lab, Department of Oral and Craniofacial Biological Sciences, Department of Orthodontics, University of Maryland Dental School): speech science, phonetics, vocal tract and tongue kinesiology, measurement and modeling.

Steven Yantis, Professor (Psychological and Brain Sciences): visual perception, attention, and functional neuroimaging.

Facilities

The department is located in Krieger Hall. Laboratory and office space is provided for graduate students. The department's research facilities are provided by the following laboratories: Language and Cognition Lab (Landau); Language Acquisition Lab (Legendre); Cognitive Neuroscience Lab (McCloskey); Language Processing and Development Lab (Omaki); Visual Cognitive Neuroscience Lab (Park); CogNeuro Lab (Rapp); Semantics Lab (Rawlins); Computational Linguistics Lab (Smolensky); Phonetics/Phonology Lab (Wilson); Integrated Experimental/Theoretical Grammar Research (IGERT) Lab and Library. Department members also conduct research in the F.M. Kirby Center for Functional Brain Imaging at the Kennedy Krieger Institute and in other laboratories at Johns Hopkins Medicine.

Undergraduate Programs

The required courses are divided into five general areas, as described below. The program is structured so as to ensure some exposure to each of the five areas. In addition, it provides in-depth training in two focal areas chosen by the student. Majors in cognitive science thus acquire a broad perspective which will enable them to situate particular research disciplines within the overall study of the mind/brain.

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors)

- 050.101 Cognition
- Three courses from each of two focal areas the student chooses from among the five areas of concentration listed at the end of this section.

At least one course in each area must be at the 300-600 level, not including research, readings, or practica.

- One course at any level from each of the three non-focal areas.
- Three additional courses at the 300-600 level, chosen from any of the five areas of concentration or from other offerings in the Department of Cognitive Science.

Students may use three credits of research to satisfy one of these course requirements.

- Either math option (A or B):
- A. Any two of the following:
  - 110.106 or 108 Calculus I
  - 110.107 or 109 Calculus II
  - 550.171 Discrete Mathematics
  - 110.201 or 550.291 Linear Algebra
  - 150.118 Introduction to Formal Logic
  - 150.218 Introduction to Symbolic Logic
  - 050.370 Formal Methods in Cognitive Science: Language
  - 050.371 Formal Methods in Cognitive Science: Inference
  - 050.372 Formal Methods in Cognitive Science: Neural Networks
- B. Statistics Sequence (All three courses are required for completion of the statistics sequence. If Area A, Cognitive Psychology and Neuropsychology, is a focal area, the statistics sequence is required, and should be completed by the end of the sophomore year if possible.)
  - 550.111-112 Statistical Analysis
  - 200.207 Laboratory in Analysis of Psychological Data
- One modern foreign language at the intermediate level, or two modern foreign languages at the elementary level.

All courses taken to fulfill major requirements must be passed with a grade of C or better.

Up to 12 credits taken for departmental requirements may be used to fulfill university distribution requirements. See the Undergraduate Academic Manual.

Areas of Concentration

A. Cognitive Psychology/Neuropsychology

B. Linguistics

C. Computational Approaches to Cognition

D. Philosophy of Mind

E. Neuroscience

Courses offered by the Cognitive Science Department, and also courses offered by other departments (e.g., Psychological and Brain Sciences, Philosophy, Computer Science), may be used to satisfy the requirements for these areas of concentration. A list of the specific courses that satisfy the requirements for each area is maintained on the Cognitive Science Department website. However, please note that courses change over time, and some courses are not offered every year. The Director of Undergraduate Studies can answer questions about which courses qualify for each area of concentration.

Minor in Linguistics

A minor in linguistics is available to undergraduates majoring in any department, except for cognitive science majors who choose linguistics as one of their focal areas. Students intending to minor in linguistics should declare their intention, preferably by the beginning of junior year.

The requirements for the minor are:

- One foreign language through the intermediate level or two foreign languages through the elementary level.
- Six courses in linguistics from those listed under Area B. Of these, four must be at the 300-level or above, excluding research and reading courses.

Graduate Programs

Requirements for Admission

A program of study leading to the Ph.D. degree is open to students with a bachelor's or master's degree in cognitive science or one of the several areas that contribute to it. Prospective graduate students would be well advised to take courses in cognitive psychology, linguistics, and computer science. Some preparation in the foundations of contemporary neuroscience is also an asset, as is training in the philosophical issues surrounding the study of mind

and consciousness. However, there are no fixed prerequisites (in the form of specific required courses) for admission to graduate studies. The Department of Cognitive Science invites inquiries from students who are prepared in any of the related fields and who are interested in extending their work to the broader study of the mind/brain.

Requirements for the Ph.D. Degree

Doctoral candidates will be expected to meet the following specific requirements:

- Approximately 8 to 10 courses, selected in conjunction with the student's advisory committee, to achieve depth in a chosen research area.
- A selection of courses to ensure breadth of training across cognitive science: two each in the areas of psychology, computation, and linguistics, and one each in philosophy and cognitive neuroscience.
- Two courses focused on integration across the sub-areas of cognitive science.
- Two research papers, each employing a different research methodology within cognitive science, e.g., theoretical linguistics and psychology.
- Experience serving as a teaching assistant.
- A dissertation proposal detailing a significant research project and the methods to be used; a Ph.D. dissertation presenting an original contribution to some area(s) of cognitive science, in a format approaching publication standards; a dissertation defense.

(For a precise and up-to-date statement of the requirements, see information on the Ph.D. program at **www.cogsci.jhu.edu**).

Financial Aid for Graduate Students

The department provides competitive levels of funding covering tuition and living expenses. Research expenses, including some support for travel to present papers at scholarly meetings, are also provided.

Undergraduate Courses

Introductory Courses

050.101 (N,S) Cognition

Introductory course exploring the study of human mental processes within the field of cognitive science. Drawing upon cognitive psychology, cognitive neuropsychology, cognitive neuroscience, linguistics, and artificial intelligence, the course examines theory, methods, and major findings in work on vision, reasoning, and language. No prerequisites.
Wilson   3 credits

050.102 (N,S) Language and Mind

Introductory course dealing with theory, methods, and current research topics in the study of language as a component of the mind. What it is to "know" a language; components of linguistic knowledge (phonetics, phonology, morphology, syntax, semantics) and the course of language acquisition. How linguistic knowledge is put to use: language and the brain, linguistic processing in various domains, relation between human and computer processing of language. Comparison of normal spoken

language with signed language and other communication systems. Grading is based on homework and written examinations. No prerequisites. Cross-listed with Neuroscience and Psychological and Brain Sciences.
TBA   3 credits

050.105 (N,S) Introduction to Cognitive Neuropsychology
When the brain is damaged or fails to develop normally, even the most basic cognitive abilities (such as the ability to understand words, or perceive objects) may be disrupted, often in remarkable ways. This course explores a wide range of cognitive deficits, focusing on what these deficits can tell us about how the normal brain works. Topics include brain anatomy and causes of brain damage, reading and spelling deficits, unilateral spatial neglect, hemispheric disconnection, cortical plasticity, and visual perception of location and orientation. Students read primary sources: journal articles that report deficits and discuss their implications. Cross-listed with Neuroscience.
McCloskey   3 credits

050.107 (N,S) Language and Advertising
Advertising pervades our culture; interactions with advertising are an unavoidable fact of modern life. This class uses tools from linguistics and cognitive science to analyze these interactions, and understand the impact of advertising on its viewers. A central theme is to treat ads as communicative acts, and explore the consequences—what can theories of communication (from linguistics, psychology, and philosophy) tell us about ads? How do ads use central features of human cognition to accomplish their aims? Do ads manipulate, and if so, how successfully? The theories of communication we explore include Gricean pragmatics, theories of speech acts, linguistic theories of presuppositions, and more. Students will collect, analyze, and discuss advertisements in all mediums. No prerequisites.
Rawlins   3 credits

050.112 (N,S,W) Nature, Nurture, and Cognition
Using both seminal and contemporary readings as a foundation, this seminar explores how genetics and experience interact to influence thinking, understanding the underlying cognitive processes (both human and otherwise). In so doing, we will discuss how innate determination of various components of cognition ultimately influence human nature. Open to freshmen only.
Landau   3 credits

050.203 (N,S) Cognitive Neuroscience: Exploring the Living Brain
This course surveys theory and research concerning how mental processes are carried out by the human brain. Currently a wide range of methods for probing the functioning brain is yielding insights into the nature of the relation between mental and neural events. Emphasis will be placed on developing an understanding of both the physiological bases of the techniques and the issues involved in relating measures of brain activity to cognitive functioning. Methods surveyed include electrophysi-

ological recording techniques such as EEG, ERP, single/multiple unit recording and MEG; functional imaging techniques such as PET and fMRI; and methods that involve lesioning or disrupting neural activity such as WADA, cortical stimulation, animal lesion studies, and the study of brain-damaged individuals. No prerequisites. Co-listed with 080.203 in Neuroscience.
Rapp   3 credits

050.204 (N,S) Visual Cognition
Vision is central to our daily interactions with the world: we can effortlessly navigate through a city, comprehend fast movie trailers, and find a friend in a crowd. While we take the visual experience for granted, visual perception involves a series of complicated cognitive processes beyond just opening our eyes. The goal of this course is to provide an introduction to visual cognition, including existing theoretical frameworks and recent research findings. We will explore questions such as: How do we see the stable world when our eyes are constantly moving? What is the relationship between seeing and knowing? Do infants see the world the same way as adults do? What are the neural mechanisms underlying visual perception? No prerequisites.
Park   3 credits

050.206 (N,S) Bilingualism
Do children get confused when they grow up exposed to more than one language? Is it possible to forget one's native language? Are the first and second language processed in different areas of the brain? How does brain damage impact the different languages of a polyglot? Does knowing a second language affect non-linguistic cognitive processing? This course will address questions such as these through an exploration of mental and neural processes underlying bilingual and multilingual language processing. No prerequisites.
Yarmolinskaya   3 credits

050.208 (N,S) Language Acquisition
What do infants under 10 months of age know about the sound patterns of their native language? When an adult points to a dog and speaks an unfamiliar word, how does a child know whether the word means Fido, toy poodle, dog, animal, white, or small? Why do children start to make mistakes like *goed* and *seed* after a period of using only *went* and *saw*? How do young children learn their language's syntax, i.e., its rules of word order, agreement, and so on? What is the role of genetically programmed knowledge of the regularities common to all languages, as opposed to experience with a specific language? Questions such as these are addressed, drawing on insights from psychological experiments, linguistic theory, and computational models. No prerequisites.
Landau, Legendre   3 credits

050.240 (N,S) The World of Language
This hands-on course exposes students to the fascinating variety—and uniformity—to be found among the world's 6,000 languages through group lectures on a variety of topics as well as actual linguistic fieldwork conducted in small groups with a native speaker of a language unknown

to the participants. This course is a good preparation for upper-division linguistics courses. No prerequisites.
Legendre   3 credits

Intermediate and Advanced Courses

050.303 (N,S) Mind, Brain, and Beauty
(also 050.603/upper-level)
What underlies our aesthetic response to art, music, and other facets of human experience? Do identifiable properties of objects and events evoke consistent aesthetic responses, or is beauty mostly in the eye of the beholder? Examining such questions from cognitive science, neuroscience, and philosophical perspectives, this course explores relevant research and theory in the visual, auditory, and tactile domains. Several researchers will discuss their ongoing studies with the class, and students will also have the opportunity to participate in demonstration experiments that illustrate phenomena under discussion. Prerequisites: One or more courses in one of these: Cognitive Science, Neuroscience, Philosophy, or Psychology —or permission of instructor. Cross-listed with Philosophy, Neuroscience, and Psychological and Brain Sciences Same as 050.603.
McCloskey   3 credits

050.311 (N,S,W) The Literate Mind and Brain
This course surveys current cognitive theories of our ability to comprehend (read) and produce (spell) written language. Additional topics include the neural substrates of written language and written language acquisition. Emphasis is placed on evidence from cognitive neuropsychology and cognitive psychology. The course typically includes a multi-week lab component during which individuals with acquired written language deficits (dyslexia/dysgraphia) are actively studied by students enrolled in the class; students are responsible for planning the testing sessions, preparation of testing materials, data scoring and analysis, etc. Prerequisite: 050.101, 050.102, or 050.105 or permission of instructor. Cross-listed with Neuroscience.
Rapp   3 credits

050.314 (H,N) Classic Papers in Language Learning
(also 050.614/upper-level)
Classic and current issues in language acquisition focusing on enduring questions and issues—how different scientific disciplines and theorists and experimentalists have addressed these issues. Prerequisite: Permission, junior or senior standing, cognitive science or psychological and brain sciences major.
Landau   3 credits

050.315 (N,S) Cognitive Neuropsychology of Visual Perception: The Malfunctioning Visual Brain
When we think about our ability to see, we tend to think about our eyes, but in fact vision happens mostly in the brain. This course explores the remarkable perceptual deficits that occur when the visual regions of the brain are damaged or fail to develop normally, focusing on what these perceptual malfunctions tell us about normal visual perception. Topics include visual system anatomy and physiology; functional specialization in the lower visual system as revealed by cerebral achromatopsia (color blindness resulting from brain damage) and akinetopsia (impaired motion perception); cortical plasticity in the visual system; spatial deficits in perception and action; and the implications of high-level visual deficits, including prosopagnosia (impaired face recognition), Charles Bonnet syndrome (complex visual hallucinations in blind areas of the visual field), blindsight (accurate responding to visual stimuli despite apparent inability to see them), and Anton's syndrome (denial of blindness). Prerequisite: 050.101 or 050.105 or 050.203 or 080.203 or permission of instructor. Cross-listed with Neuroscience.
McCloskey   3 credits

050.316 (N,S) Morpho-Phonology
(also 050.616/upper-level)
This course addresses the interaction of principles of sound-structure: Phonology, with principles of word formation: Morphology, and examines the hypothesis that morphology too consists of a set of relations that are enforced in parallel, just like the constraints of the phonology. It devotes special attention to the role of representational distance in both sub-domains, reviewing evidence that a proper characterization of distance is key to understanding important phenomena in both areas, like neutralization of segmental contrasts and syncretism in inflectional paradigms. Prerequisites: One introductory phonology course and some familiarity with optimality theory.
Wilson   3 credits

050.317 (N,S) Semantics I
(also 050.617/upper-level)
This course is an introduction to the study of meaning in natural language. We address both the conceptual and empirical issues that a semantic theory must grapple with, as well as some of the formal machinery that has been developed to deal with such problems. After discussing foundational questions, we turn to formal semantics and pragmatics, as well as their interfaces with syntax and the lexicon. Specific topics covered include conversational implicature; pre-supposition, type-driven composition, quantification and scope, lexical aspect, argument structure, and the nature of lexical representations of meaning. Prerequisite: 050.101 or 050.240 or 050.107 or permission of instructor.
Rawlins   3 credits

050.318 (N,S) Practicum in Language Disorders
This course provides the opportunity to learn about adult aphasias, language disorders which are one of the most common consequences of stroke. You will receive training in supportive communication techniques and work as a communication partner with an individual with aphasia for two hours per week. Three class meetings for orientation and reading assignments will be held on campus; training and practicum will be conducted at a local aphasia support center. Transportation required. Prerequisites: Students with a junior or senior status. Students must have taken and earned an A or above in 080.203 or 050.203 or 050.105 or 050.311. A minimum major GPA of

3.5 is required. Please see additional instructions on the Neuroscience Department website at http://krieger.jhu.edu/neuroscience/.
Rapp   1 credit

050.320 (N,S) Syntax I
(also 050.620/upper-level)
Introduces the basic methods and means of analysis used in contemporary syntax investigations, practicing with data from different languages. Prerequisites: 050.102, 050.240, or permission of instructor.
Legendre   3 credits

050.321 (N,S) Syntax II
(also 050.621/upper-level)
Building on 050.320, this course addresses and compares conceptions of syntactic theory that have emerged in the 1980s and 1990s. Discussion focuses on both the substantive and formal properties of the fundamental principles of syntactic theory, as well as the cross-linguistic evidence that has motivated them. When possible, connections will be made to other areas of linguistic inquiry such as processing, acquisition, and computation. The particular choice of topics and conceptions will vary from year to year but may include (1) the contrast between the Principles and Parameters view where syntactic theory is composed of a set of inviolable principles whose form admits a certain amount of cross-linguistic variation, and the Optimality Theory view where the principles are invariant though violable, and cross-linguistic variation is determined by the relative importance of satisfying the various principles; (2) the role of structure building operations in grammar, and the differences between characterizations of well-formedness in terms of sequences of derivational steps and representational well-formedness requirements. Prerequisite: 050.320 or permission of instructor.
Legendre, Rawlins   3 credits

050.322 (N,S) Semantics II
(also 050.622/upper-level)
This course extends the material in 050.317 to cover advanced but central topics in semantic and pragmatic theory, focusing on intensional semantics (especially possible world semantics and situation semantics). Empirical domains of interest in this class include modality, tense, grammatical aspect, conditionals, attitude and speech reports, questions, and free choice phenomena. Three core theoretical issues addressed in this class are the nature of a compositional account of the above intensional phenomena, the representations of possibilities involved, and the role of the syntax/ semantics/pragmatics interface in such an account. Prerequisites: 050.317 or permission of instructor.
Rawlins   3 credits

050.325 (N,S) Phonology I
(also 050.625/upper-level)
An introduction to the basic principles underlying the mental representation and manipulation of language sounds and their relation to human perception and vocal articulation: how units of sound are both decomposable into elementary features and combined to form larger structures like syllables and words. The role of rules and constraints in a formal theory of phonological competence and in accounting for the range of variation among the world's languages. Prerequisite: Previous experience with one other language-related course is desirable but not obligatory.
Wilson   3 credits

050.326 (N,S,W) Foundations of Cognitive Science
(also 050.626/upper-level)
This course explores general issues and methodologies in cognitive science through the reading of classic works (from Plato and Kant through Skinner and Turing) and recent research articles to begin construction of a coherent picture of many seemingly divergent perspectives on the mind/brain. Recent brain-based computational models serve to focus discussion. Prerequisite: at least one course at the 300-level or higher in cognitive science, computer science, neuroscience, philosophy, or psychology. Cross-listed with Neuroscience.
Smolensky   3 credits

050.327 (N,S) Phonology II
(also 050.627/upper-level)
This course extends the material covered in 050.325 with more advanced topics in morphology, phonology, and phonetics, varying from year to year. Sample topics include stress systems and metrical phonology, tone and auto-segmental phonology, reduplication and prosodic morphology, non-concatenative morphology, constraints and optimality theory, feature geometry, articulatory phonology, and phonetics/phonology interface. Prerequisite: 050.325 or permission.
Wilson   3 credits

050.329 (N,S) Advanced Phonological Analysis
(also 050.629/upper-level)
Intended as third semester of the phonology sequence. Sources will include research articles as well as textbooks. Potential topics include the following—Assimilation: tone systems, vowel harmony, and auto-segmental phonology; Dissimilation: the Obligatory Contour Principle; Prosodic morphology: reduplication, templatic morphology; Stress: metrical theory; Opacity: rule ordering vs. constraint ranking; Issues in optimality theory: alignment constraints; Inventory typology and local conjunction, lexical stratification; the Phonetics/Phonology interface. Prerequisites: 050.326/626, 050.327/627 highly recommended.
Wilson, Smolensky   3 credits

050.332 (N,S) Developmental Cognitive Neuroscience
(also 050.632/upper-level)
This seminar provides an in-depth examination of the current literature on cognitive development in the context of developmental cognitive neuroscience. We will consider several domains of inquiry, including visual perception and attention; knowledge of objects, faces, and space; and language learning. For each of these, we will consider issues such as the nature of knowledge representation in the developing brain; the kinds of developmental changes that occur; the effects of different kinds

of experience, including those presented by genetic deficits, environmental deprivation, and brain damage; the developmental time course within which such damage or difference can affect cognitive development. Prerequisite: one of the following: Introduction to Developmental Psychology, Introduction to Cognition, Introduction to Cognitive Neuropsychology, Introduction to Cognitive Development, or permission of instructor. Cross-listed with Neuroscience.

Landau   3 credits

050.333 (N,S) Psycholinguistics
(also 050.633/upper-level)

This course provides a broad survey of current research on language processing in adult native speakers and language learners. Topics include speech perception, word recognition, and sentence production and comprehension. We will discuss the nature of representations that are being constructed in real-time language use, as well as how the mental procedures for constructing linguistic representations could be studied by various behavioral and physiological measures. Prerequisite: 050.102 or 050.240 or permission.

Omaki   3 credits

050.334 (N,S) Computational Models of Cognition
(also 050.634/upper-level)

Introduction to connectionist, symbolic, and statistical techniques used in computational modeling of language, learning, and reasoning. Students will implement models, but no extensive programming background will be assumed. Prerequisite: 100-level course in Cognitive Science or permission.

TBA   3 credits

050.336 (N,S) Topics in Cognitive Neuroscience
(also 050.636/upper-level)

This course discusses classic to cutting-edge research topics in the field of cognitive neuroscience. The course will explore research with various functional neuroimaging methods such as fMRI, EEG, and TMS, etc. Topics will vary with special focus on topics in perception, attention, and memory.

Park   3 credits

050.339 (N,S) Cognitive Development
(also 050.639/upper-level)

This is a survey course in developmental psychology, designed for individuals with some basic background in psychology or cognitive science, but little or none in development. The course is strongly theoretically oriented, with emphasis on issues of nature, nurture, and development. We will consider theoretical issues in developmental psychology as well as relevant empirical evidence. The principal focus will be early development, i.e., from conception through middle childhood. The course is organized topically, covering biological and prenatal development, perceptual and cognitive development, the nature and development of intelligence, and language learning. No prerequisites. Cross-listed with Psychological and Brain Sciences and Neuroscience.

Landau   3 credits

050.356 (N,S) Special Topics in Cognitive Development
(also 050.656/upper-level)

Advanced seminar on tools/background for developmental theorist/researchers. Readings cover human cognitive development, other species, computational modeling, and theoretical-philosophical underpinnings. Intense round-table debate, heavy reading, graduate and advanced undergraduates. Prerequisite: junior or senior status for undergraduates. Co-listed with Psychological and Brain Sciences.

Landau   3 credits

050.358 (N,S) Language and Thought
(also 050.658/upper-level)

Have you ever wondered about the relationships between language and thought? Philosophers, linguists, psychologists, and cognitive scientists have too, and this course will survey the current thinking on this matter. Does language develop from an undifferentiated system of cognition or is it "special," developing independently from other systems of knowledge? Do certain aspects of knowledge require language for their development and use? Once acquired, does one's native language affect the form in which we think? Classical papers such as those by Whorf and Sapir, more recent philosophical papers by people such as Fodor and Dennett, and recent empirical work by linguists and psychologists on the relationship between language and thinking in development and in adults will be covered. Discussions will focus on the theoretically possible relationships between language and thought and the empirical data that speak to these. Limit 20 juniors and seniors only—others by permission. Majors in cognitive science, psychology, and philosophy are welcome but course is open to all majors. No prerequisites. Cross-listed with Psychological and Brain Sciences.

Landau   3 credits

050.364 (N,S) Advanced Topics in Cognitive Neuropsychology
(also 050.664/upper-level)

Seminar in which students will read, critique, and present research articles on topics currently attracting attention and/or controversy in cognitive neuropsychology. Prerequisite: one or more of 050.105, 050.203, 050.311, 050.315, 080.203.

McCloskey, Rapp   3 credits

050.370 (N,Q) Formal Methods in Cognitive Science: Language
(also 050.670/upper-level)

This course will be devoted to the study of formal systems that have proven useful in the cognitive science of language. We will discuss a wide range of mathematical structures and techniques and demonstrate their applications in theories of grammatical competence and performance. A major goal of this course is bringing students to a point where they can evaluate the strengths and weaknesses of existing formal theories of cognitive capacities, as well as profitably engage in such formalization, constructing precise and coherent definitions and rigorous proofs.

Rawlins   3 credits

050.371 (N,Q) Formal Methods in Cognitive Science: Inference
(also 050.671/upper-level)
This course introduces techniques for computational modeling of aspects of human cognition, including perception, categorization, and induction. Possible topics include maximum likelihood and Bayesian inference, structured statistical models (including hierarchical and graphical models), nonparametric models. The course emphasizes the close connections among data analysis, theory development, and modeling, with examples drawn from language and vision. No prerequisites.
Wilson   3 credits

050.372 (N,Q) Formal Methods in Cognitive Science: Neural Networks
(also 050.672/upper-level)
Introduction to continuous mathematics for cognitive science, with applications to biological and cognitive network models: real and complex numbers, differential and integral multi-variable calculus, linear algebra, dynamical systems, numerical optimization. Prerequisite: Calculus I.
Smolensky   4 credits

050.480 (N,S) Learning Theory
(also 050.680/upper-level)
Recently, statistical learning has played a leading role in informing the empiricist/nativist and connectionist/symbolic debates. But just what is "statistical learning" and what's new about it? This course presents theories of statistical learning, such as Bayesian models, causal networks, information-theoretic models (e.g., minimum description length and maximum entropy formalisms). These methods have caused revolutions in machine vision and natural language processing. During the course, these methods will be compared with other numerical learning methods such as connectionist networks, and with non-numerical learning theories such as Gold's classic learnability theory and its probabilistic extension to PAC (probably approximately correct) learning theory. This recent work has fundamental implications for the ancient problem of induction. Prerequisites: With instructor permission, this course is open to upperclass undergraduates concentrating in computation.
Smolensky   3 credits

Independent Study

The following courses must be individually arranged between a student and a particular professor.

Fall Semester Offerings/Independent Study

050.501 Readings in Cognitive Science/Freshmen

050.503 Research in Cognitive Science/Freshmen

050.505 Readings in Cognitive Science/Sophomores

050.507 Research in Cognitive Science/Sophomores

050.509 Cognitive Science Internship

050.511 Readings in Cognitive Science/Juniors

050.513 Research in Cognitive Science/Juniors

050.515 Readings in Cognitive Science/Seniors

050.517 Research in Cognitive Science/Seniors

Spring Semester Offerings/Independent Study

050.502 Readings in Cognitive Science/Freshmen

050.504 Research in Cognitive Science/Freshmen

050.506 Readings in Cognitive Science/Sophomores

050.508 Research in Cognitive Science/Sophomores

050.510 Undergraduate Internship

050.512 Readings in Cognitive Science/Juniors

050.514 Research in Cognitive Science/Juniors

050.516 Readings in Cognitive Science/Seniors

050.518 Research in Cognitive Science/Seniors

Other Independent Study Offerings

050.570 Independent Study

050.572 Research–Intersession

050.597 Summer Independent Study

050.599 Summer Independent Research

Graduate Courses
Advanced undergraduates may take 600-level courses with permission of the instructor.

Topical Seminars

050.602 Topics in Cognitive Neuropsychology
The analysis of cognitive disorders consequent to brain damage provides crucial constraints for theories of the structure of cognitive mechanisms and brain-cognition relationships. Current developments in various domains of cognitive neuropsychology are reviewed. Topics vary from year to year and include disorders of language production and comprehension, disorders of reading and writing, and disorders of attention, perception, and memory.
McCloskey, Rapp   2 hours

050.603 Mind, Brain, and Beauty
(co-taught with 050.303, see description)
McCloskey   3 hours

050.612 Introduction to Linguistics for Non-Cognitive Science Students
This course is primarily intended for engineering students of language and speech processing.
Staff   2 hours

050.614 Classic Papers in Language Learning
(co-taught with 050.314, see description)
Landau   3 hours

050.616 Morpho-Phonology
(co-taught with 050.316, see description)
Wilson   3 hours

050.617 Semantics I
(co-taught with 050.317, see description)
Rawlins   3 hours

050.620 Syntax I
(co-taught with 050.320, see description)
Legendre   3 hours

050.621 Syntax II
(co-taught with 050.321, see description)
 Legendre, Rawlins   3 hours

050.622 Semantics II
(co-taught with 050.322, see description)
Rawlins   3 hours

050.625 Phonology I
(co-taught with 050.325, see description)
Wilson   3 hours

050.626 Foundations of Cognitive Science
(co-taught with 050.326, see description)
Smolensky   3 hours

050.627 Phonology II
(co-taught with 050.327, see description)
Wilson   3 hours

050.629 Advanced Phonological Analysis
(co-taught with 050.329, see description)
Wilson, Smolensky   3 hours

050.630 Topics in Language Processing
This course examines current models of human language processing. Subject matter may include experimental studies of sentence processing (e.g., parsing, co-reference processing, grammatical agreement); lexical recognition/production; and the role of grammatical knowledge, discourse structure, and real-world information in processing. Prerequisite: 050.333 or equivalent or permission of instructor.
Omaki   3 hours

050.632 Developmental Cognitive Neuroscience
(co-taught with 050.332, see description)
Cross-listed with Neuroscience.
Landau   3 hours

050.633 Psycholinguistics
(co-taught with 050.333, see description)
Omaki   3 hours

050.634 Computational Models of Cognition
(co-taught with 050.334, see description)
TBA   3 hours

050.636 Topics in Cognitive Neuroscience
(co-taught with 050.336, see description)
Park   3 hours

050.639 Cognitive Development
(co-taught with 050.339, see description)
Cross-listed with Psychological and Brain Sciences and Neuroscience.
Landau   3 hours

050.656 Special Topics in Cognitive Development
(co-taught with 050.356, see description)
Co-listed with Psychological and Brain Sciences.
Landau   3 hours

050.658 Language and Thought
(co-taught with 050.358, see description)
Cross-listed with Psychological and Brain Sciences.
Landau   3 hours

050.664 Advanced Topics in Cognitive Neuropsychology
(co-taught with 050.364, see description)
McCloskey, Rapp   3 hours

050.666 Information Extraction from Speech and Text
Introduction to statistical methods of speech recognition (automatic transcription of speech) and understanding. The course is a natural continuation of 600.465 but is independent of it. Topics include elementary information theory, hidden Markov models, efficient hypothesis search methods, statistical decision trees, the estimation-maximization (EM) algorithm, maximum entropy estimation, finite state transducers, context-free grammars, parsing, and the Baum, CYK, and Viterbi algorithms. Weekly assignments and several programming projects. Prerequisites: 550.310 or equivalent, expertise in C or C++ programming. Cross-listed with Electrical and Computer Engineering and Computer Science.
Khudanpur   3 hours

050.670 Formal Methods in Cognitive Science: Language
(co-taught with 050.370, see description)
Rawlins   3 hours

050.671 Formal Methods in Cognitive Science: Inference
(co-taught with 050.371, see description)
Wilson, Smolensky   3 hours

050.672 Formal Methods in Cognitive Science: Neural Networks
(co-taught with 050.372, see description)
Smolensky   4 hours

050.680 Learning Theory
(co-taught with 050.480, see description)
Smolensky   3 hours

Research Seminars

(permission required)

050.800 Directed Readings
Guided independent readings in special fields of cognitive science.
Staff

050.801 Research Seminar in Cognitive Neuropsychology
Participants in this graduate seminar will read and discuss current research articles in cognitive neuropsychology of vision or language, and present their own research.
Rapp, McCloskey   2 hours

050.802 Research Seminar in Cognitive Processes
Current issues and ongoing research on human cognition are discussed.
McCloskey, Rapp   2 hours

050.811 Research Seminar in Language and Cognition
A specialized research seminar for individuals researching language acquisition, cognitive development, and the interface between language and cognition. Students must actively carry out empirical or theoretical research in these areas.
Landau   2 hours

050.817 Research Seminar in Semantics
A critical analysis of current issues and debates in natural language semantics. Discussion of on going research.
Rawlins   2 hours

050.818 Research Seminar in Language Development
Participants in this graduate seminar will read and discuss current research articles in language development and present their own research.
Legendre, Omaki   2 hours

050.821 Research Seminar in Grammatical Structure
Topics in phonological, morphological, syntactic, and/or semantic theory. Discussion of the current literature and specifically of the relevance of linguistic results for the study of the mind.
Staff   2 hours

050.822 Research Seminar in Syntax
A critical analysis of current issues and debates in theoretical syntax. Discussion of on going research.
Legendre, Omaki, Rawlins   2 hours

050.823 Research Seminar in Phonology
Classic and contemporary readings from the phonology literature on topics of interest to seminar participants. Prerequisite: 050.627 or permission.
Smolensky, Wilson   2 hours

050.824 Research Seminar in Lexical Representation
A critical review of evidence bearing on the question of how words are represented and stored in the mind.
Wilson   2 hours

050.825 Research Seminar in Optimality Theory
Legendre, Smolensky, Wilson   2 hours

050.826 Research Seminar in Formal Approaches to Cognitive Science
Readings and research presentations on varying topics in mathematics, computation, and formal linguistics with bearing on cognitive science.
Smolensky, Wilson, Rawlins   2 hours

050.827 Research Seminar in Language Acquisition
Focus is on current research in acquisition of syntax.
Legendre, Omaki   2 hours

050.828 Research Seminar in Cognitive Neuroscience of Vision
This seminar will read on going and recent papers on the cognitive neuroscience research of vision.
Park   2 hours

050.829 Research Seminar on Formal Theory in Cognitive Science
In this seminar we will: read some literature addressing theory in cognitive science; attempt to formulate a theory of theory in cognitive science; discuss common misconceptions about theory in cognitive science; analyze, formalize, and axiomatize theory in the literature, focusing on the link between theory and empirical data; work together to develop explicitly the theory behind students' research; discuss the proper treatment of theory in an empirical article in cognitive science. The example domain areas within cognitive science that we consider will be chosen to reflect participants' interests. Permission required.
Smolensky   2 hours

050.830 Topics in Cognitive Science
Staff   2 hours

050.832 Research in Language Processes
Current topics in human language processing, with discussion of recent developments in theory and experimental study.
Omaki   2 hours

050.835 Research Seminar in Experimental and Processing Linguistics
Readings and research addressing the application of experimental methods to core questions of grammatical theory and the application of grammatical theory to questions of language processing.
Legendre, Omaki, Rawlins, Smolensky, Wilson   2 hours

050.839 Research in Cognitive Science
Staff   2 hours

050.849 Teaching Practicum
Staff   2 hours

050.850 Departmental Seminar
Staff   2 hours

050.860 Professional Seminar in Cognitive Science
Addresses professional issues such as research ethics, success on the job market and in an academic career, teaching and mentoring, and differing professional standards in the sub-disciplines of cognitive science.
Staff   2 hours

Morton K. Blaustein Department of Earth and Planetary Sciences

The Department of Earth and Planetary Sciences offers programs of study and research in a wide range of disciplines including the atmosphere, biosphere, oceans, geochemistry, geology and geophysics, and planets. The undergraduate program in Earth and Planetary Sciences is flexible and lets the student, in consultation with a faculty advisor, devise a program that is challenging, individual, and rigorous. The graduate program develops skills in research through independent investigation under the general guidance of one or more members of the faculty, backed up by relevant course work. The department gives particular emphasis to the integration of experimental investigation, theoretical calculation, and quantitative field observations.

The Department also offers an interdepartmental undergraduate program in Global Environmental Change and Sustainability. This program introduces students to the science of the Earth and its living and nonliving systems as well as how humans interact with Earth and its natural systems and how humans can use a variety of tools, such as policy, communication, individual and societal behavior change, and law to harm or help those systems. Students are exposed to theory, research, and the practical applications of both throughout their course work.

The Faculty

John M. Ferry, Professor: metamorphic geology.

Anand Gnanadesikan, Associate Professor: biogeochemical oceanography.

Thomas W. N. Haine, Professor: physical oceanography.

Naomi Levin, Assistant Professor: sedimentary geology, stable isotope ecology.

Bruce D. Marsh, Professor: igneous petrology and geophysics.

Peter L. Olson, Professor: geophysical fluid dynamics.

Benjamin H. Passey, Assistant Professor: geochemistry, paleoecology, paleoclimate.

Darrell F. Strobel, Professor: planetary atmospheres and astrophysics.

Dimitri Sverjensky, Professor: molecular surface geochemistry and environmental geochemistry.

David R. Veblen, Professor: crystallography.

Darryn W. Waugh, Morton K. Blaustein Professor (Chair): atmospheric dynamics.

Benjamin Zaitchik, Assistant Professor: climate dynamics, surface hydrology.

Research/Teaching Faculty

Albert Arking, Principal Research Scientist: atmospheric sciences.

Linda Hinnov, Associate Research Professor: quantitative stratigraphy and paleoclimatology.

Sakiko Olsen, Senior Lecturer: metamorphic petrology.

Richard Stolarski, Research Professor: atmospheric chemistry.

Katalin Szlavecz, Associate Research Professor: soil ecology.

Joint Appointments

Olivier Barnouin, Assistant Research Professor: Applied Physics Laboratory.

Robert A. Dalrymple, Professor, Civil Engineering.

Carlos E. Del Castillo, Assistant Research Professor: Applied Physics Laboratory.

Kevin J. Hemker, Professor, Mechanical Engineering.

Cindy L. Parker, Assistant Professor: Environmental Health Sciences.

James Roberts, Assistant Research Professor: Applied Physics Laboratory.

Nathaniel Winstead, Assistant Research Professor: Applied Physics Laboratory.

Emeritus Appointments

George W. Fisher, Professor Emeritus: global earth systems and religious ethics.

Lawrence A. Hardie, Professor Emeritus: geology, geochemistry and sedimentation.

Facilities

The Department of Earth and Planetary Sciences is housed in Olin Hall, a modern building dedicated to the Earth sciences, nestled on a wooded knoll on the western edge of campus. Its facilities include state-of-the-art instrumentation, a departmental library, and modern computer equipment. There are laboratories for crystallography, evolutionary biology/ecology, stable isotope geochemistry, materials science, and fluid and solid mechanics. Olin Hall also contains equipment for modern petrographic work (including a computer-controlled image analysis system), darkroom facilities, and a laboratory for sectioning rocks. There is also a substantial collection of rocks, minerals, and fossils. Facilities are available for a wide spectrum of

fluid mechanical experiments, including thermal convection and solidification.

A JEOL 8600 electron microprobe in Olin Hall is available to all members of the department. Crystallographic facilities include a modern specimen preparation laboratory for transmission electron microscopy and single-crystal X-ray diffraction studies. The transmission electron microscopy laboratory houses state-of-the-art instruments capable of both high-resolution imaging at the atomic scale and microanalysis at the nanometer scale.

The department contains several computer laboratories containing clusters of workstations and personal computers, together with printers and scanners. These computers are used for numerical simulations, graphics applications, data manipulation, and word processing.

Field studies and excursions form an integral part of the program of instruction and research in geology and are closely integrated with the laboratory and course work. Situated at the fall line between the Coastal Plain and the Piedmont and only an hour's ride from the Blue Ridge and Appalachians, Baltimore is an excellent location for a department with a field-oriented program in geology. The department has a permanent field station for geological research, Camp Singewald, in the Bear Pond Mountains of Washington County, Maryland, and a vehicle for field use.

Supporting facilities on campus include the Milton S. Eisenhower Library, the Space Telescope Science Institute, and the Homewood High-Performance Computing Center. In addition, the JHU Applied Physics Laboratory, the facilities of the Smithsonian Institution and the Geophysical Laboratory and the Department of Terrestrial Magnetism of the Carnegie Institution of Washington are available by special arrangement for students qualified to use them. For students whose research requires substantial computation, special arrangements can be made to use the supercomputers at the NASA Goddard Space Flight Center and the National Center for Atmospheric Research.

Undergraduate Programs

The Department of Earth and Planetary Sciences offers programs of study for majors, joint majors, and minors in Earth and Planetary sciences (EPS) and in Global Environmental Change and Sustainability (GECS). The EPS major focuses on the study of the physical, chemical, and biological processes that shape the Earth and the other planets. It is designed primarily for scientists who wish to have careers researching the science of the Earth and planets, although it is also suitable for students plan-

ning careers in the health professions. The GECS major is an interdepartmental program introducing students to the science of the Earth and its living and nonliving systems, as well as how humans interact with Earth and its natural systems, and how humans can use a variety of tools, such as policy, communication, individual and societal behavior change, and law to harm or help those systems.

Earth and Planetary Sciences (EPS) Major

The EPS major is for undergraduates interested in the study of the physical, chemical, and biological processes that shape the Earth and the other planets, drawing on the disciplines of geology, geochemistry, hydrology, ecology, geobiology, oceanography, and atmospheric science.

The student can design a specific plan of appropriate courses in consultation with the coordinator for undergraduate programs in the department. Depending on the student's background, it may be appropriate initially to take a freshman seminar or 100-level course designed for the non-major. Those who wish to be majors may proceed directly to courses at the 200- and, in many cases, the 300-level. Our courses provide a broad educational base in the Earth and planetary, and the environmental earth sciences, and enable exploration of a set of electives at the 300-level, depending on the area of interest.

Undergraduates majoring in the department must satisfy the general university requirements for the B.A. degree (see General Requirements for Departmental Majors, page 48). In addition, students are required to take the following courses:

The department requires a total of 9 credits at the 100- or 200-levels and a total of 12 credits at the 300-level within the Department. Courses should be selected to reflect an Earth and Planetary Sciences emphasis and should include the following:

270.108 Oceans and Atmospheres
270.220 Dynamic Earth
270.221 Dynamic Earth Laboratory

In addition the following courses outside the Department of Earth and Planetary Sciences are required:

030.101 Introductory Chemistry
and either
110.106-107 Calculus I and II for the biological and social sciences *or*
110.108-109 Calculus I and II for the physical sciences and engineering
and either
171.101-102 General Physics for physical science majors *or*
171.103-104 General Physics for biological science majors

In order to satisfy the university distribution requirements, and to enrich the educational background of the majors, the department strongly recommends taking some of the courses listed below.

500.200 Computing for Engineers and Scientists

500.211 Technical Communication

500.212 Effective Oral Presentations

550.291 Linear Algebra and Differential Equations or an equivalent course

570.108 Environmental Engineering

570.109 Environment and Society: Toward Sustainability

570.239 Current and Emerging Environmental Issues

600.107 Intro to Programming in Java

600.109 Intro to Programming in C/C++

Honors in EPS Major

To receive honors in Earth and Planetary Sciences, you must have met the following criteria:

• Have taken a challenging set of courses during the four years of study.

• Have a GPA in your major requirements of a 3.5 or higher.

• Complete a senior thesis at a level judged to be sufficiently high by the faculty of the Department of Earth and Planetary Sciences.

• Present the results of the thesis orally in the Department of Earth and Planetary Sciences.

To notify us that you are eligible for honors you must:

1. Obtain an honors checklist by either downloading it from **www.advising.jhu.edu** or by picking one up in the Office of Academic Advising.

2. Complete the checklist after February 1 of your senior year and take it to Dr. Dimitri A. Sverjensky.

3. Return the signed checklist to the Office of Academic Advising by April 1. You do not need to make an appointment to return the checklist, but it must be signed by the correct representative from your department or it will not be processed.

Minor in EPS

The Earth and Planetary Sciences minor is for science undergraduates interested in applying their major discipline to Earth's environment through geology, geochemistry, ecology, geobiology, oceanography, and atmospheric science. Students are expected to have at least 16 credits in (N), (Q), or (E) courses. Students will take 12 credits in the department, at least six of which are at the 300-level.

Global Environmental Change and Sustainability (GECS) Major

The major in GECS is an interdepartmental program introducing students to the science of the Earth and its living and nonliving systems, as well as how humans interact with Earth and its natural systems, and how humans can use a variety of tools, such as policy, communication, individual and societal behavior change, and law to harm or help those systems. Students will be exposed to theory, research, and the practical applications of both throughout their course work. Requirements for the major will include a total of 23 courses (78 credits) if the Science Track is chosen and 24 courses (75 credits) for the Social Science Track. Because this is inherently an interdisciplinary major, students in the GECS major are exempt from the University's distribution requirements.

All GECS major students must complete 12 "core" courses listed in Table 1 below. Additionally, students will choose either the "Science Track" or the "Social Science Track" to determine the additional course requirements. The additional course requirements for the Science Track include the core courses listed in Table 2 below, 2 additional upper-level courses from Table 3 (Major Electives in Earth and Environmental Science), and 4 courses from Table 4 (Major Electives in Social Sciences), 2 of which must be upper-level. The additional course requirements for the Social Science Track consist of 2 courses from Table 3 (Major Electives in Earth and Environmental Science), at least 1 of which must be upper-level, and 10 courses from Table 4 (Major Electives in Social Sciences), at least 6 of which must be upper level.

All GECS major students must also complete a senior capstone experience in conjunction with the program Director and relevant faculty. The capstone could consist of a research or internship-type project and will be a demonstration of integration and synthesis of knowledge and skills obtained during the 4 year program. Majors will be encouraged to begin planning their senior project during their junior year and will be required to submit a proposal by the end of September of their senior year. Subsequent milestones will be designated throughout the senior year to ensure that all majors are making satisfactory progress on their projects. All majors will make an oral presentation about their senior project to involved faculty, advisors, and parents at the end of their senior year.

Honors in GECS Major

To receive honors in GECS, you must have met the following criteria:

• Have a GPA of a 3.5 or higher.

• Complete an honor's thesis as part of their capstone project.

To notify us that you are eligible for honors you must:

1 Obtain an honors checklist by either downloading it from **www.advising.jhu.edu** or by picking one up in the Office of Academic Advising.
2 Complete the checklist after February 1 of your senior year and take it to Dr. Cindy Parker.
3. Return the signed checklist to the Office of Academic Advising by April 1. You do not need to make an appointment to return the checklist, but it must be signed by the correct representative from your department or it will not be processed.

Minor in GECS

The GECS minor consists of seven courses. All minors are required to take two core courses: Intro to Global Environmental Change provides the necessary content about the science of the Earth and its environments and Intro to Sustainability covers a thorough overview of the interactions between humans and the Earth's systems and how those interactions could become sustainable. Students then have a choice of one of three other science courses that further explore a subset of interactions of humans with Earth's living and nonliving systems, depending on the student's area of interest. Students must choose two more courses from the list of Earth and Environmental Science Electives (Table 2) and two more courses from the list of Social Science Electives (Table 3). At least one course from each elective list must be upper level. A total of five Earth and Environmental Science courses provide the science basis of the minor, which is then rounded out with two relevant Social Science courses. Because students will be acquiring the methodological tools of their major discipline, this curriculum removes the science methodology required in the GECS major, while keeping the most important core content.

Table 1: Required Core Courses for all GECS Majors:
270.103 Introduction to Global Environmental Change
270.107 Introduction to Sustainability
030.101 + 030.105 Chemistry I + lab
110.106 or 108 Calculus I
180.102 Microeconomics
270.501 Capstone Seminar for GECS Majors

Choose 1
550.111 Statistical Analysis I
280.345 Introduction to Biostatistics
230.205 Introduction to Social Statistics

Choose 2
190.102 Intro Comparative Politics
190.209 Contemporary International Politics
190.211 Intro to Political Economy
190.213 International Politics

Choose 2
270.308 Population and Community Ecology
270.360 Climate: Science & Policy
270.320 The Environment & Your Health

Choose 1
200.101 Introduction to Psychology
200.133 Introduction to Social Psychology
230.101 Introductory Sociology
230.150 Issues in International Development

Table 2: Science Track Core Courses
110.107 or .109 Calculus II
030.102 & .106 Chemistry II & lab
270.307 Geoscience Modeling

Choose 2
171.101/103 & .111 Physics I & lab
171.102/104 & .112 Physics II & lab
020.151 & .153 Biology I & lab
020.152 & .154 Biology II & lab

Table 3: GECS Electives in Earth and Environmental Science
270.104 History of the Earth and Its Biota
270.108 Oceans and Atmospheres
270.220 The Dynamic Earth: An Introduction to Geology
270.308 Population and Community Ecology
270.315 Natural Catastrophes
270.320 Environment and Your Health
270.332 Soil Ecology
270.360 Climate Change: Science and Policy
270.369 Geochemistry of Earth and Environment
270.377 Climates of the Past
270.307 Geoscience Modeling
360.236 Ecuador and Galapagos Islands
420.633 Introduction to GIS
570.108 Introduction to Environmental Engineering
570.239 Current/Emerging Environmental Issues
570.328 Geography and Ecology of Plants
570.353 Hydrology

570.395 Principles of Estuarine Environment: The Chesapeake Bay
570.411 Environmental Microbiology
570.424 Air Pollution
570.443 Aquatic Chemistry

Table 4: GECS Electives in Social Sciences (2009–2010)**

070.132 Invitation to Anthropology
070.219 Anthropology and Public Action
070.327 Poverty's Life: Anthropologies of Health and Economy
140.302 Rise of Modern Science
140.360 Changes in the Land: Science, Technology, and the Ameri En Environment
180.101 Elements of Macroeconomics
180.215 Game Theory and the Social Sciences
180.227 Economic Development
180.231 Comparative Economic Systems
180.241 International Trade
180.252 Economics of Discrimination
180.266 Financial Markets and Institutions
180.280 Population Economics
180.301 Microeconomic Theory
180.302 Macroeconomic Theory
180.311 Intro to Economics of Uncertainty
180.365 Public Finance
190.101 Introduction to Comparative Politics
190.209 Contemporary International Politics
190.211 Introduction to Political Economy
190.213 International Politics
190.304 Introduction to Public Policy
190.309 Politics and Policy Design
190.316 An Introduction to Globalization
190.323 Introduction to International Law
190.363 Politics of International Development
190.411 Environment and Development in the Third World
195.477-478 Introduction to Urban Policy: Seminar
200.133 Introduction to Social Psychology
200.205 Behavior Modification
200.343 Motivation
220.146 Introduction to Science Writing
230.101 Introductory Sociology
230.150 Issues in International Development
230.213 Social Theory
230.306 Economic Sociology
230.313 Space, Place, Poverty, and Race: Sociological Perspectives on Neighborhoods and Public Housing
230.335 Political Sociology
230.342 Gender and International Development
230.349 Globalization and Social Movements
230.391 Theories of International Development

420.614 Environmental Policymaking
420.656 Environment Impact Assessment and Decision Methods
570.109 Environment and Society: Toward Sustainability
570.334 Engineering Microeconomics
570.404 Political Ecology
570.406 Environmental History
570.427 Natural Resources, Society and the Environment

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**The list of acceptable Social Science Electives will be reviewed and updated annually by the Director, with guidance from the Advisory Committee. Courses no longer taught will be removed and new courses will be added. Relevant courses not included in the elective list may be able to be substituted for an elective with approval of the Director. Students wishing to make such a substitution should submit a substitution request in writing via email to the Director explaining the justification for the substitution and include the syllabus from the proposed course. To be relevant, a course does not need to specifically mention or discuss environmental or sustainability issues. A course can be relevant by providing knowledge of an area (e.g. game theory, which is important for understanding the nature of international treaties) that is useful for understanding global change and sustainability issues.

Graduate Programs

Requirements for Admission

Applicants must submit transcripts, Graduate Record Examination scores (aptitude exam only), and supporting letters to show their ability to do advanced study. The applicant should have his/her GRE scores, verbal and quantitative aptitude, sent to the department before the January 15 deadline for filing applications for admission.

The department expects applicants for advanced degrees to have completed undergraduate training in the basic sciences and mathematics. Normally this includes mathematics through at least integral calculus and a year's course each in physics, chemistry, and biology. Further undergraduate study in one or more of these subjects or in mathematics is highly desirable for all programs in the Earth sciences; additional mathematics is essential for geophysics, atmospheric sciences, and dynamical oceanography. Extensive undergraduate work in Earth sciences is not a requirement for admission. If students lack formal training in this area or have deficiencies in the other related sciences, they may be admitted but will have to allow additional time in the graduate program to make up for deficiencies in their preparation.

Requirements for Advanced Degrees

Candidates for the Ph.D. must take courses and meet requirements specified by their advisory committee; must pass a comprehensive examination before a departmental committee and an oral examination administered by the Graduate Board of the university; and must submit an acceptable dissertation involving significant original research. A minimum of two consecutive terms registered as a full-time student is required.

The department rarely accepts candidates for the M.A. degree alone, but Ph.D. students can, with the consent of their advisors, complete a program that will qualify them for the M.A. degree at the end of the second year. Candidates for this degree must pass a comprehensive examination before a departmental committee, and must satisfy the residency requirement specified above for the Ph.D. degree. A student's advisor may require an essay demonstrating research capability.

For further information about graduate study in the Earth and planetary sciences contact the Chair, Department of Earth and Planetary Sciences.

Fields of Graduate Study and Research

The department offers numerous graduate fields: sedimentology, geochemistry and petrology, mineralogy and crystallography, paleobiology, solid Earth geophysics, oceanography, atmospheric sciences, and planetary astrophysics. Descriptions of these fields and their various programs are given below.

Petrology

Modern research in petrology requires a flexible approach combining thermodynamics, solution chemistry, experimental petrology, and careful field observation. The department offers a broad range of courses that provide a thorough background in these areas and a detailed review of research to date. In addition to the facilities available on campus, those at the Geophysical Laboratory and the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, the Smithsonian Institution, the University of Maryland, and the U.S. Geological Survey in Reston are available to students and faculty through a cooperative arrangement.

The program in mineral igneous-petrology is concerned with the chemistry and physics of the origin and evolution of magma. All aspects of the generation, extraction, ascension, cooling, kinetics of crystallization, convection, differentiation, eruption, and flow are considered in detail. The results of high temperature melting experiments as well as detailed chemical analysis are applied to these problems. A nontraditional approach to petrological problems is emphasized through an analytical treatment of volcanological field work. Students are encouraged to take thermodynamics, fluid mechanics, and heat transfer, in addition to Igneous Petrology 270.690, Principles of Earth and Planetary Sciences 270.395, Physics of Magma 270.652, and Geophysical Petrology Seminar 270.604.

The program in metamorphic petrology emphasizes studies of petrogenesis involving field work, chemical, and stable isotope analysis of rocks and minerals, fluid inclusion studies, interpretation of textures and structures, laboratory phase equilibrium studies, and computer modeling of metamorphic processes. Analytical data from mineral assemblages are rigorously interpreted within the framework of chemical thermodynamics and transport theory. All chemical aspects of metamorphism are of concern, including mineral-fluid reactions and reaction mechanisms; the role of heat-rock vs. fluid-rock interaction in driving metamorphism; the scale and mechanism of fluid-rock interaction; major and minor element mobility; pressure-temperature paths followed by rocks during metamorphism; and the interplay between metamorphism and deformation.

Mineralogy and Crystallography

An understanding of crystal structure and the subsolidus behavior of minerals is fundamental to the interpretation of many geological phenomena. The program in mineralogy and crystallography stresses the application of crystallographic theory and experimental approaches to petrologically, environmentally, and geophysically relevant mineral systems.

Research in crystal chemistry utilizes X-ray techniques but more strongly emphasizes the application of high-resolution transmission electron microscopy, electron diffraction, and analytical transmission electron microscopy. The electron microscopy laboratory in the Department of Earth and Planetary Sciences is used to investigate the defects and mechanisms of solid-state reactions in minerals, mechanisms of crystal growth, the structures of fine-grained and disordered geological materials, the chemical and structural variations in synthetic run products and the structures of grain boundaries in rocks.

Geochemistry

The program in molecular surface geochemistry emphasizes fundamental research in how the Earth's environment changes because of interactions between natural waters, minerals and rocks,

and living organisms. It emphasizes understanding of the chemical reactions at water-electrolyte-mineral-biomolecule interfaces. Students are encouraged to undertake quantitative studies integrating field, laboratory, and theoretical methods that permit a predictive approach to a wide variety of geochemical and biogeochemical processes including weathering and soil formation, life in the oceans, the migration of toxic species in the environment, the binding of medical implants in the human body, and the role of mineral surface reactions in the origin of life. Collaborative research possibilities are available through joint projects with the geobiology program in the department, and at the Geophysical Laboratory of the Carnegie Institution of Washington.

The program in stable isotope geochemistry focuses on development and application of geochemical tools that allow for reconstruction and understanding of phenomena such as climate, ecology, biogeochemical cycling, tectonics, sedimentation, and metamorphism. Group members work on questions ranging from paleoenvironments of human evolution, history of the Tibetan Plateau and East Asian monsoons, global expansion of savanna grasslands, niche partitioning among fossil mammals, and temperatures of dolomite formation. Students may pursue their own research interests, and are encouraged to become proficient in all aspects of the science, including instrumentation and laboratory methods, fieldwork, theory, and modeling.

Sedimentology Systems

The teaching and research program in sedimentary systems is dedicated to understanding interactions between sediments, organisms, climate and tectonics in the Earth's past. This program combines sedimentology, paleontology, geochronology, and geochemistry to study Earth history from sedimentary archives. Field and laboratory observations are equally essential to this kind of research, and students are expected to become proficient in both. Through course work and research students should develop literacy in a combination of disciplines, which may include but are not limited to stratigraphy, geochemistry, paleontology, ecology, geomorphology, geochronology, soil science, and meteorology. Interdisciplinary interactions are encouraged within the Earth and Planetary Science department and with members of other departments at Hopkins, such as the Department of Geography and Environmental Engineering in the School of Engineering and the Center for Functional Anatomy and Evolution in the Medical School.

Geobiology and Paleoclimatology

Research emphases within this discipline include soil ecology, soil formation, biohydrology, plant-soil-animal interactions, biogeochemical cycling, paleoecology, and paleoclimatology. Methods of stable isotope geochemistry are used to investigate changes in the cycling of C, H, N, and O through Earth history. Students are invited to participate in ongoing collaborations with the Baltimore Ecosystem Study (Long-Term Ecological Research Site), Smithsonian Environmental Research Center, or to design an original research project under the advisement of our faculty. Instrumentation in the Department of Earth and Planetary Sciences includes stable isotope mass spectrometry, scanning electron microscopy, microprobe and transmission electron microscopy; fieldwork is ongoing at several international sites.

All Ph.D. students are expected to have a background of physics, chemistry, calculus, general biology, and sedimentary geology. Deficiencies can be made up in the first semesters at Hopkins. Students take a core program of statistics, Earth history, stable isotope geochemistry, and ecology. In conjunction with the Department of Geography and Environmental Engineering, Earth and Planetary Sciences offers course work opportunities in Aquatic Chemistry, Plant and Animal Ecology, Geobiology, Analytical Environmental Chemistry, and Sedimentary Geochemistry.

Oceans, Atmospheres, and Climate Dynamics

The oceans, atmospheres, and climate dynamics program focuses on the study of physical processes in the oceans and atmosphere, the interaction between the ocean, atmosphere and land surface, and their role in climate. The philosophy underlying the department's program is a rigorous and thorough background in the physics of fluids and radiation, and their applications to climate and environmental problems, applied mathematics, laboratory experiments, and observations. Problems in radiative transfer and the dynamics of atmospheres and oceans are attacked by theory, laboratory or numerical experiments, and field observations. Johns Hopkins is a member of the University Corporation for Atmospheric Research.

The best preparation for graduate study in this program is an undergraduate degree in physics, applied mathematics, mechanical engineering, or another parent science such as chemistry or geology/geophysics. Prior course work in fluid dynamics, while highly desirable, is not mandatory to pursue graduate study in this area. It is essential to have a broad background in the parent sciences,

specialization in one of them, and at least three years of undergraduate mathematics.

Research in physical oceanography focuses on the processes that maintain the global ocean circulation and the oceans' role in climate and global biogeochemical cycling. In particular, attention is on the role of waves, eddies, and small-scale mixing in controlling the oceans' part in Earth's heat balance. We also study advection, stirring, and mixing processes in the interior ocean and their roles in dispersing atmospheric trace gases and nutrients.

Research in atmospheric dynamics focuses on large-scale dynamics, the transport of trace constituents, and understanding the composition of the global atmosphere (e.g., distributions of stratospheric ozone and tropospheric water vapor). Current interests include stratospheric vortex dynamics, troposphere-stratosphere couplings, transport and mixing processes, and global modeling of chemical constituents.

Research on climate and radiation includes study of the global climate system and its response to radiative forcing due to changes in green-house gases and solar luminosity, the feedback effects of water vapor and clouds, and the radiative and hydrological effects of aerosols. These studies involve global and regional scale modeling, and the analysis and interpretation of satellite observations.

Research on climate also includes studies on the interplay between atmospheric variability and surface processes, including hydrological states and fluxes, human modification of the landscape, and ecosystem activities. This research employs satellite image analysis, numerical modeling, and field observation to build a process-based understanding of the ways in which climate shapes landscape and vice versa. Particular emphasis is devoted to the impact of climate variability on fresh water resources.

A new program of research, combining physical oceanography and atmospheric science, focuses on the role of ocean-atmosphere interactions in the climate of the North Atlantic region. The task is to isolate and understand the predictable mechanisms that govern mid-latitude climate oscillations lasting several years.

A new program of research in global biogeochemical cycling, focuses on applying and developing large-scale computational models that can be combined with observations remotely sensed data to characterize cycling of key elements (including carbon, nitrogen and oxygen) in the earth system. Opportunities exist to link this work to the observational geochemistry work done in the department as well as to stimulate key periods and transitions in Earth History.

Solid Earth Geophysics

Solid Earth geophysics is the study of our planet's interior. Our overarching goals are to understand the formation, structure, composition, and dynamics of the Earth as a whole, and their relationship to geological and surface environmental processes today, in the past, and in the future.

Modern geophysics requires an integrated approach that combines geology, solid and fluid mechanics, seismology, gravity, magnetism, and planetology. Students following the geophysics program are therefore encouraged to take advanced mathematics (including numerical modeling), classical physics, solid and fluid mechanics, as well as a broad range of EPS course work that includes geology, geochemistry, geophysics, and planetary science.

Some examples of broad-based geophysics research topics in EPS include study of Earth's magnetic field, the surface expression of Earth's "geodynamo," which is powered by fluid flow in the Earth's metallic core. Similarly, earthquakes arise from tectonic forces that are ultimately produced by large-scale motions of the Earth's rocky interior, which moves at rates of a few cm per year. Much of earth's surface topography, the presence of Earth's ocean basins, and several physical and geochemical aspects of Earth's surface environment, are a direct consequence of plate tectonics, which governs the internal dynamics of our planet. Volcanism and magma dynamics are other examples of fundamental processes that shape the Earth and its environment, a study that integrates geology, solid and fluid mechanics, and geochemistry.

Professors Olson and Marsh specialize in study of Earth's interior and its influence on the surface environment, and Professor Strobel specializes in the study of the other planets, with emphasis on their atmospheres and magnetospheres.

Planetary Atmospheres/Astrophysics

The program in planetary astrophysics emphasizes the study of planetary atmospheres and magnetospheres. A broad range of fundamental problems in atmospheric chemistry, dynamics, physics, and radiation pertinent to the atmospheres of the giant planets and their satellites is addressed with the goal to understand the global structure of composition, pressure, temperature, and winds. The study of magnetospheric plasma interactions with extended satellite atmospheres is focused on the energy balance, ionospheric structure, and radiative output of their upper atmospheres, and the mass loading rates of the parent planets' magnetospheres. The atmospheres and magnetospheres of the planets

are investigated with the aid of theoretical models and the analysis and interpretation of data acquired by ground-based, Hubble Space Telescope, and satellite observations. Professor Strobel is an interdisciplinary scientist on the Cassini/Huygens Mission. An in-depth study of the Saturnian system is being conducted with the Cassini spacecraft and Huygens Probe. He is also a co-investigator on the New Horizons Pluto Kuiper-belt mission, which was successfully launched on January 19, 2006, and will arrive at Pluto in July 2015, after flying by Jupiter during February 2007 and performing observations of the Jovian system.

This research program is closely coordinated with the astrophysics program in the Department of Physics and Astronomy. Students are encouraged to take courses in astrophysics, chemistry, physics, and applied mathematics to gain the comprehensive background necessary for interdisciplinary research. The best undergraduate preparation is a broad background in physics, applied mathematics, and physical chemistry with a minimum of three years of course work in two of these fields. Advanced undergraduate courses

in classical mechanics, fluid mechanics, electricity and magnetism, thermodynamics, and quantum mechanics are strongly recommended. The facilities of the Center for Astrophysical Sciences and the Space Telescope Science Institute are available for thesis research.

Financial Aid

The university makes available to the department a number of Gilman Fellowships, which provide for complete payment of tuition, together with Johns Hopkins' fellowships and graduate assistantships that carry a nine-month stipend. Graduate assistantships cannot require more than 10 hours a week of service to the department, and all recipients of financial aid carry a full program of study. In addition, a number of special and endowed fellowships pay as much or more. In many areas of study, summer support is also available.

Applications for admission to graduate study and financial aid (including all supporting documents and GRE scores) should be submitted to the department before January 15.

Undergraduate Courses

Courses listed as prerequisites serve to indicate the degree of proficiency that is expected. They need not have been taken at Johns Hopkins.

270.102 (N) Freshman Seminar: Conversation with the Earth
A discussion of current topics on Earth's origin, evolution, and habitability. Topics will include extinction of life from meteorite impact, global warming, ozone depletion, volcanism, ice ages, and catastrophic floods, among others. Section 1 (270.102-01) is for 2 credits for normal participation. Section 2 (270.102-02) is for 3 credits and has the requirement of a term paper.
Marsh, and other faculty

270.103 (N) Introduction to Global Environmental Change
The structure, composition, and dynamics of the Earth and how we learn about them. Sea floor spreading, continental drift, mountain building, earthquakes, volcanoes, and other internal processes. Surface processes including weathering, erosion, sedimentation, and the record of climate change. No prerequisites.
Waugh, Passey   3 credits

270.104 (N) History of the Earth and Its Biota
The history of the earth and life as understood through the geologic record. The evolution and extinction of

major life forms will be examined from the perspective of interactions among the solid earth, ocean, atmosphere, and biosphere.
Hinnov   3 credits

270.106 Freshman Seminar: Special Topics
Focused study of an important problem in the Earth sciences. Topics vary, but emphasis is given toward examination of journal readings via class discussions.
Staff   1 credit

270.107 (N) Introduction to Sustainability
Will introduce interactions between global environment and humans, discuss meaning of sustainability, and introduce use of tools to attain sustainability such as policy, law, communication, marketing, research, advocacy, and international treaties.
Parker   3 credits

270.108 (N) Oceans and Atmospheres
A broad survey of the oceans and atmospheres, and their role in the environment and climate. Subjects include ocean circulation, weather systems, hurricanes and tornadoes, El Nino, climate change, ozone depletion, and marine ecosystems.
Haine, Waugh   3 credits

270.110 (N) Freshman Seminar: Sustainable and Non-Sustainable Resources
An introduction to the important resources involved in the origin and production of oil, natural gas, coal, cement, metals and geothermal fluids.
Sverjensky   1 credit

270.113 (N) Freshman Seminar: Environmental Poisons
An exploration of the occurrence and potential effects of poisons in the environment, from naturally occurring ones such as arsenic to those that may be introduced by mankind such as nuclear waste.
Sverjensky   1 credit

270.114 (N) A Guided Tour of the Planets
An introduction to planetary science and planetary exploration primarily for nonscience majors. A survey of concepts from astronomy, chemistry, geology, and physics applied to the study of the solar system. No prerequisites.
Marsh, Strobel   3 credits

270.205 (N) Introduction to Geographic Information Systems and Geospatial Analysis
This course provides a broad introduction to the principles and practice of Geographic Information Systems (GIS) and related tools of Geospatial Analysis. Topics will include history of GIS, GIS data structures, data acquisition and merging, database management, spatial analysis, and GIS applications. In addition, students will get hands-on experience working with GIS software.
Staff   3 credits

270.220 (N) The Dynamic Earth: An Introduction to Geology
An introduction to the basic concepts of geology. Topics include Earth's internal structure; plate tectonics; geologic time; minerals and rocks; erosion and deposition by oceans, rivers, wind, and glaciers; sedimentary environments; volcanism and plutonism; metamorphism; faults and folds; earthquakes and seismology; geomagnetism. Pre- or corequisites: 030.101 or 171.101-102; 270.221 is corequisite for Earth and planetary science majors, optional for others.
Veblen, Ferry   3 credits   3 hours lecture

270.221 (N) The Dynamic Earth Laboratory
Laboratory exercises to illustrate the concepts developed in 270.220. Corequisite: 270.220.
Staff   1 credit   2 hours lab

270.222 (N) Earth Materials
An introduction to the properties, occurrence, and origin of the basic constituents of the Earth, including minerals and rocks. Introductory training in the recognition of minerals and rocks, in the laboratory and the field.
Veblen, Ferry   4 credits   3 hours lecture, 3 hours lab

270.301 (N) Geochemical Thermodynamics
Principles of chemical thermodynamics. Concept of and criteria for equilibrium. Properties of real fluids and solids. Applications to geologic processes. Prerequisite: 270.222 or 270.341.
Ferry   3 credits   3 hours

270.302 (N) Aqueous Geochemistry
Thermodynamic basis for calculation of equilibria involving minerals and aqueous species at both low and high temperatures and pressures. Theoretical calculation of surface geochemical processes including adsorption and dissolution kinetics. Prerequisite: 270.369.
Sverjensky   4.5 credits   3 hours lecture, 2 hours lab

270.303 (N) Geodynamics
Study of the basic principles that control deformation of Earth's crust and mantle. Elastic, viscoelastic, and viscous deformation are described using examples of Earth dynamics from tectonics, uplift, mantle convection, faulting, etc. Prerequisite: 171.101.
Staff   3 credits

270.304 (N) Igneous and Metamorphic Petrology
Description and origin of igneous and metamorphic rocks. Classification and occurrence. Application of fundamental principles of physics and chemistry to the study of petrogenesis. The control of plate tectonics on rock-forming processes. Corequisite: 270.306. Prerequisites: 270.341-342.
Ferry   3 credits   3 hours lecture

270.305 (N) Energy Resources in the Modern World
This in-depth survey will inform students on the non-renewable and renewable energy resources of the world and the future prospects. Topics include petroleum, natural gas, coal, nuclear, hydroelectric, geothermal, solar, wind, biomass, and ocean energy. Global production, distribution, usage, and impacts of these resources will be discussed. Prerequisite: 270.103, 270.107 or 270.220.
Hinnov   3 credits

270.306 (N) Igneous and Metamorphic Petrology Laboratory
Examination of igneous and metamorphic rocks in hand specimen and thin section. Principles and practice in optical mineralogy. Common mineral associations and textures. Rock suites from several classic localities in North America. Corequisite: 270.304.
Ferry   1 credit   3 hours lecture

270.307 (N,Q) Geoscience Modeling
An introduction to modern ways to interpret observations in the context of a conceptual model. Topics include model building, hypothesis testing, and inverse methods. Practical examples from geophysics, engineering, and medical physics will be featured.
Haine   4 credits

270.308 (N) Population and Community Ecology
This course explores the distribution and abundance of organisms and their interactions. Topics include dynamics and regulation of populations, population interactions (competition, predation, mutualism, parasitism, herbivory), biodiversity, organization of equilibrium and non-

equilibrium communities, energy flow and nutrient cycles in ecosystems. Field trip included. Prerequisite: 270.103 or permission of instructor.

Szlavecz   3 credits

270.310 (N) Global Environmental Change and Sustainability Seminar

By using guest speakers and published literature, students will investigate sustainability topics in greater depth, taking turns presenting relevant papers and leading a focused discussion about the topic.

Parker   3 credits

270.311 (N) Geobiology

A survey of the interactions between geological and biological processes at and near the Earth's surface, covering topics such as biogeochemistry and nutrient cycles, soil chemistry, biomarkers, archives of paleobiology, and the evolution of life, with an emphasis on terrestrial systems.

Levin   3 credits

270.313 (N) Isotope Geochemistry

Principles of equilibrium and kinetic isotope fractionation in fluid, solid and heterogeneous systems. Stable isotopes in the biosphere, hydrosphere and atmosphere. Reconstruction of past climatic and ecological settings. Stable isotopes in igneous and metamorphic systems. Introduction to radiogenic isotopes, geochronology, thermochronology, cosmogenic istotopes and "clumped" isotopes.

Passey   3 credits

270.315 (N) Natural Catastrophes

A survey of naturally occurring catastrophic phenomena, with emphasis on the underlying physical processes. Topics include hurricanes, tornadoes, lightning, earthquakes, tsunamis, landslides, and volcanic eruptions and climate change. Intended for students in science and engineering.

Olson   3 credits

270.318/618 (N) Remote Sensing of the Environment

This course is an introduction to the use of remote sensing technology to study Earth's physical and biochemical processes. Topics covered include remote sensing of the atmosphere, land and oceans, as well as remote sensing as a tool for policy makers.

Del Castillo, Zaitchik   3 credits

270.322 (N) GECS Fieldwork in Ecuador

Course will provide theory and hands-on practice of environmental science and social science fieldwork.

Parker   4 credits

270.325 Introductory Oceanography

This class is an introduction to a wide range of physical, chemical, and biological phenomena in the world's oceans. Underlying basic principles are exposed wherever possible. Topics covered include seawater, waves, tides, ocean circulation, chemical oceanography, biogeochemical ocean processes, and remote sensing of the oceans.

Gnanadesikan   3 credits

270.327 (N) Introduction to Seismology

A study of the structure and constitution of Earth's interior using observations of seismic waves. Topics include propagation, reflection, and refraction of elastic waves, ray theory, dispersion of surface waves, seismicity, plate tectonics, Earth structure and composition. Corequisite: 270.329. Prerequisites: calculus and basic physics.

Olson   3 credits

270.329 (N) Introduction to Seismology Laboratory

Laboratory exercises on the interpretation of seismograms. Corequisite: 270.327.

Olson   1 credit   one 3 hour lab

270.332/607 (N) Soil Ecology

This course introduces basic aspects of cycles and flows in the soil ecosystem, and provides students with an overview of the higher groups of soil organisms, focusing on their identification characters and ecological roles. The course is intended for upper-level undergraduates or graduate students who are interested in soils and soil ecology. The course provides basic laboratory and field surveying skills in the discipline. Prerequisites: Population and Community Ecology, Geobiology, or instructor's permission. Laboratory and field surveying methods are also covered.

Szlavecz   3 credits

270.335 (N) Planets, Life, and the Universe

This multidisciplinary course explores the origins of life, planets' formation, Earth's evolution, extrasolar planets, habitable zones, life in extreme environments, the search for life in the Universe, space missions, and planetary protection.

Levin   3 credits

270.340 (N) Nature of the Solid Planets

The overall origin and evolution of the terrestrial-like planets in the solar system is discussed and analyzed. As a starting point the detailed structure and dynamics of Earth is presented from the perspectives of seismology, gravity, geomagnetism, and volcanism. Extensions are also made to the origin, structure, and present state of the moons of Jupiter and Saturn and other icy bodies. Prerequisites: A firm working knowledge of calculus, through differential equations, physics, and chemistry is required as well as some grounding in Earth and/or Planetary Sciences.

Marsh   3 credits

270.341 (N) Crystallography and the Structure of Inorganic Solids

An introduction to the principles of crystallography, diffraction, and the structures of inorganic crystals. Materials covered include important rock-forming minerals, metals, alloys, semiconductors, superconductors, ceramics, catalysts, and other technologically important materials. Corequisite: 270.343. Prerequisite for Earth science majors: 270.342.

Veblen   3 credits   3 hours lecture

270.342 (N) Mineralogy Laboratory

Exercises in the chemistry and identification of minerals in hand specimen. This laboratory is designed for undergraduate majors in the Earth sciences. Corequisite: 270.341.

Veblen   1 credit   2 hours lab

270.343 (N) Crystallography Laboratory

Exercises in crystallography, crystal chemistry, and X-ray diffraction. Extensive use is made of crystal structure models. This laboratory is designed for students already familiar with minerals in hand specimen or not majoring in Earth sciences. Corequisite: 270.341.

Veblen   1 credit   2 hours lab

270.350 (N) Sedimentary Geology

Introduction to sedimentary processes and sedimentary rocks. Focus is placed on linking physical observations to earth surface processes. Fundamental tools for interpreting the sedimentary rock record, such as depositional models, geochronology, and chemostratigraphy are reviewed. Weekend field trips. Graduate and advanced undergraduate level. Prerequisites: Dynamic Earth or consent of instructor.

Levin   3 credits

270.355 Introductory Atmospheric Science

An introduction to all aspects of atmospheric science. The course will include discussions of observations together with theories and simple models of the key dynamical, radiative, and chemical processes. Topics covered include global atmospheric circulation, air pollution, and climate change. This course is especially for third- and fourth-year undergraduates and graduate students in science and engineering. Prerequisites: 030.101, 110.108-109, 171.101-102.

Waugh   3 credits

270.360 (N) Climate Change: Science and Policy

This course will investigate the policy and scientific debate over global warming. It will review the current state of scientific knowledge about climate change, examine the potential impacts and implications of climate change, explore our options for responding to climate change, and discuss the present political debate over global warming.

Waugh   3 credits

270.369 (N) Geochemistry of the Earth & Environment

An introduction to all aspects of geochemistry: theoretical, experimental, and observational, including the application of geochemistry to issues such as the migration of toxic metals and nuclear waste.

Sverjensky   3 credits   1 hour lab

270.377 (N) Climates of the Past

Earth's climate history through study of forcing mechanisms, climate proxies, and paleoclimate modeling. Presentation of climate-sensitive archives will be followed by discussion of geochemical principles, climates through time, recent advances and emerging problems. For upper-level undergraduate and graduate students in the natural sciences. Prerequisite: 270.220 or instructors' permission.

Hinnov, Levin, Passey   3 credits

270.378/640 (N) Present and Future Climate

Intended for majors who are interested in the science that underlies the current debate on global warming. The focus is on recent observations, and one can glean from model simulations. Prerequisites: Calculus I and II (110.108-109) and General Physics (171.101-102).

Arking, Waugh, Zaitchik   3 credits

270.395 (N) Planetary Physics and Chemistry

The fundamental principles governing the dynamic processes within and around the planets are treated in some detail. Core equations are developed and used to analyze nebula condensation, planetary accretion, convection in mantles and atmospheres, radiative and conductive heat transport, seismic waves, hurricanes, volcanism, and meteorite impacts, among others. Emphasis is on fundamentals and problem solving. Prerequisites: Calculus II, 030.101, 171.101-102 or 103-104 or 105-106.

Marsh, Strobel   3 credits

270.400 Intersession Independent Study

An independent course of study may be pursued under the direction of an advisor on those topics not specifically listed in the form of regular courses.

270.405 (N) Modeling the Hydrological Cycle

Survey of modeling techniques for hydrological monitoring, analysis and prediction, including applied exercises with commonly used models. Topics include the terrestrial water balance, rivers and floods, groundwater, atmospheric transport, and precipitation processes. Focus is on numerical methods applicable at the large watershed to global scale.

Zaitchik   3 credits

270.407 (N) Seminar in Planetary Sciences

Staff   1 credit

270.415 (N) Climate Change Discussions

Discussion of current topics in climate change science.

Zaitchik

270.422 (N) Geochemistry of Ore Deposits

This course explores the geologic processes and economic factors that result in the development of commercial concentrations of non-energy mineral resources. The course will discuss a broad spectrum of ore deposits, ranging from the formation of placer-type Au deposits at Rand, society's largest source of Au, to the genetic link between subduction zone dehydration, porphyry-type Cu, Au, Mo, W, Bi, Sn deposits and shallow-level epithermal Au, Ag deposits. Emphasis will be placed on the physicochemical differences between deposit types and the geochemical causes of ore deposit diversity. The course will examine the relationship between element suites (e.g., Platinum group elements: copper, silver, gold), their position in the periodic table and the reasons they are found together in nature. Related topics to be discussed include importance of mineral resources to the global economy, mineral exploration and evaluation, and mineral extrac-

tion and processing. Reading material for the course will be selected from academic journals.
Staff   3 credits

270.425 (N) Earth and Planetary Fluids
Introductory course on the properties, flow, and transport characteristics of fluids throughout the Earth and planets. Topics covered include constitutive relationships, fluid rheology, hydrostatics, dimensional analysis, low Reynolds number flow, porous media, waves, stratified and rotating fluids, plus heat, mass and tracer transport. Illustrative examples and problems are drawn from the atmosphere, ocean, crust, mantle, and core of the Earth and other planets. Open to graduate and advanced undergraduate students.
Waugh   3 credits

270.495-496 (N,W) Senior Thesis
Preparation of a substantial thesis based upon independent student research, supervised by at least one faculty member in Earth and Planetary Sciences. Open to senior departmental majors only. Required for departmental honors.
Staff   4 credits per semester

270.501-502 Independent Study
An independent course of study may be pursued under the direction of an advisor on those topics not specifically listed in the form of regular courses.

270.507-508 Internship

Graduate Courses

270.601 Fluids Seminar
Graduate discussion group ranging over all aspects of fluids in Earth and planetary sciences.
Haine   1 hour

270.603 Geochemistry Seminar
A variety of topics of current interest involving mineral-fluid interactions will be reviewed. Prerequisite: permission of instructor.
Sverjensky   2 hours

270.604 Geophysical Petrology Seminar
Discussion of present research topics in geophysics and igneous petrology. With consent of instructor.
Marsh   1 hour

270.605-606 EPS Colloquium
A weekly seminar series in which graduate students present their latest research results and attend departmental seminars. This course is required for all graduate students in the Department of Earth and Planetary Sciences.
Wright   2 hours

270.608 Seminar in Atmospheric Sciences
Discussion of current research topics in atmospheric science.
Waugh   1 hour

270.609-610 Special Topics in Earth and Planetary Sciences
Reading courses on particular topics in this area can be arranged after consultation with an individual faculty member.
Staff

270.613 Metamorphic Petrology Seminar
Discussion of recent research topics in metamorphic petrology and geochemistry.
Ferry   1 hour

270.614 Atmospheric and Oceanic Vortices
The fundamental dynamics of vortices in rapidly rotating, stratified fluids is discussed and used to examine the structure and dynamics of vortices occurring in the Earth's atmosphere and oceans and in the atmospheres of the outer planets.
Waugh   2 hours

270.618 (N) Remote Sensing of the Environment
This course is an introduction to the use of remote sensing technology to study Earth's physical and biochemical processes. Topics covered include remote sensing of the atmosphere, land and oceans, as well as remote sensing as a tool for policy makers.
Del Castillo, Zaitchik   3 hours

270.621 Transmission Electron Microscopy: Practice and Applications
A lab and lecture course covering the practical aspects of transmission electron microscopy. Electron diffraction, image formation, and analytical techniques are explained, and students are given an opportunity to gain hands-on microscopy experience. The detailed theory for these experiments is developed in 270.622.
Hemker, Veblen   1 hour lecture, 4 hours lab

270.622 Transmission Electron Microscopy: Theory and Understanding
This course, which follows and complements 270.621, introduces the student to more detailed aspects of kinematical and dynamical theories of electron diffraction. Theory of conventional TEM imaging, phase-contrast imaging (high-resolution electron microscopy), X-ray and energy-loss analytical TEM, and computer-based image simulation are included.
Veblen, Hemker   3 hours lecture, occasional lab work

270.623 Planetary Atmospheres
Fundamental concepts and basic principles of chemistry and physics applied to the study of planetary atmospheres. Vertical structure of planetary atmospheres. Atmospheric radiation, thermodynamics and transport. Principles of photochemistry. Planetary spectroscopy and remote sensing. Upper atmospheres and ionospheres. Evolution and stability of planetary atmospheres. Prerequisite: Undergraduate major in physics or physical chemistry or equivalent.
Strobel   3 hours

270.625 Seminar in Biogeochemistry
In-depth exploration of emerging topics in biogeochemistry, including themes relevant to the evolution of Earth's

biogeochemical cycles, global change, paleoecology, and paleoclimate.

Passey   1 hour

270.626 Ocean General Circulation

The aim of this course is to achieve conceptual understanding of the large scale low frequency ocean general circulation. The role of the ocean circulation in earth's climate is emphasized throughout.

Haine

270.627 Seminar in Soil Ecology

Discussion of current research topics in soil ecology and biogeochemistry. Prerequisite: Soil Ecology (270.332) or permission required.

Szlavecz

270.633 Advanced Topics in Isotopic Geochemistry

In-depth exploration of selected systems in stable isotope geochemistry, and examination of the physical basis of stable isotope fractionation. Topics vary annually.

Passey   1 credit

270.635 Crystal Chemistry and Behavior of Rock-Forming Minerals

A detailed exploration of the crystal structures and subsolidus behavior of the major rock-forming mineral groups. Prerequisite: a basic understanding of crystallography and diffraction.

Veblen   3 hours

270.640 (N) Present and Future Climate

Intended for majors who are interested in the science that underlies the current debate on global warming. The focus is on recent observations, and one can glean from model simulations. Prerequisites: Calculus I and II (110.108-109) and General Physics (171.101-102).

Arking, Waugh, Zaitchik   3 hours

270.641 Inorganic Solids: Structure, Properties, Chemistry, Applications, and Crystallography

An exploration of the structures of inorganic solids, including the chemical elements, minerals, alloys, ceramics, catalysts, and other important materials. A brief but rigorous introduction to crystallography. Laboratory exercises include extensive work with structure models, symmetry, and one field trip.

Veblen   3 hours class, 3 hours lab

270.642 Surface Geochemistry

An overview of theoretical models of adsorption at the solid-aqueous solution interface. Surface chemistry of oxides and silicates in electrolyte solutions. Surface complexation of metals. Prediction of adsorption on surfaces.

Sverjensky   3 hours

270.644 Physics of Climate Variability

This course is an advanced-level review of the ways in which climate varies on time scales of seasons to decades, including El Nino, the Pacific Decadal Oscillation, the Indian Ocean Dipole Mode, the North Atlantic Oscillation, and others. Topics covered will include, depending on the class' interest: (1) methods for isolating climate modes; (2) key dynamic and thermodynamic processes involved in causing such fluctuations, including atmospheric and oceanic wave propagation, air-sea interaction and changes in the thermohaline circulation; (3) impacts of climate modes on biogeochemical cycling, including some that are used by paleoclimatologists to reconstruct past variability. Geophysical understanding and links to fundamental mechanisms are emphasized. Format will consist of a mix of lectures and paper discussions.

Gnanadesikan, Levin   3 hours

270.647 Earth's Interior

Mechanical processes in Earth's core and mantle with applications to plate tectonics, the thermal and chemical evolution of Earth, and generation of Earth's magnetic field. Topics vary yearly.

Olson   3 hours

270.651 Planetary Geophysics

The application of continuum physics to the large-scale processes governing the evolution of Earth's crust and mantle. Topics include elasticity and flexure, creep deformation, conductive and convective heat transfer, fault mechanics and flow in porous media. Prerequisite: 270.321.

Olson   3 hours

270.652 Physics of Magma

The principles of viscous fluid flow, heat conduction and convection are treated in reference to all aspects of the mechanics of magma. Emphasis is placed on understanding petrologic processes as observed in rocks and rock sequences.

Marsh   3 hours

270.653 Earth and Planetary Fluids II

A sequel to 270.425 concentrating on planetary-scale atmospheric and oceanic circulation. Physical understanding of the underlying fluid dynamics will be emphasized.

Haine, Waugh   3 hours

270.659 Seminar in Oceanography

Haine   2 hours

270.661 Planetary Fluid Dynamics

This is a self-contained one-semester course in the applications of basic fluid dynamics concepts to the study of planetary atmospheres. Topics include equations of motion on a rotating planet, the Boussinesq approximation, conservation properties, hydrodynamic instability, convection, turbulence and planetary boundary layers, quasi-geostrophic theory, baroclinic instability, general circulation, and linear wave propagation. Prerequisite: 270.646 or equivalent highly desirable.

Strobel   3 hours

270.662 Seminar in Planetary Science

Major problems of current interest in planetary science are critically discussed in depth. Prerequisite: permission of instructor.

Strobel   1–3 hours

270.681 Advanced Metamorphic Petrology

The interpretation of metamorphic processes based on mineral assemblages, mineral chemistry, chemical thermodynamics, transport theory, experimental petrology, and field studies. Geothermometry and geobarometry; mineral reactions and reaction mechanisms; heat transfer and fluid transfer; element and isotope mobility; thermal models for orogenic belts. Prerequisites: 270.301 and 270.304 or equivalents. Corequisite: 270.682.

Ferry   3 hours

270.682 Advanced Metamorphic Petrology Laboratory

Laboratory studies of metamorphic rocks in thin section. Application of theory and experiment to individual rock samples. Prerequisites: 270.301 and 270.304 or equivalents. Corequisite: 270.681.

Ferry   3 hours

270.690 Igneous Petrology

Properties, occurrence, and origin of the major types of igneous rock. Generation, emplacement, and crystallization of magmas. Prerequisite: 270.306 or permission of instructor. Corequisite: 270.692.

Marsh   3 hours

270.692 Igneous Petrology Laboratory

Experimental crystallization of rocks; fluid mechanical experiments, and computer simulation of movement and crystallization magma. Corequisite: 270.690.

Marsh   3 hours

270.807-808 Research

Independent research for the Ph.D. dissertation.
Staff

Courses by Category

Introductory

270.102 Freshman Seminar: Conversation with the Earth
270.103 Introduction to Global Environmental Change
270.104 History of the Earth and Its Biota
270.108 Oceans and Atmospheres
270.114 A Guided Tour of the Planets
270.220 The Dynamic Earth: An Introduction to Geology
270.221 The Dynamic Earth Laboratory
270.222 Earth Materials General
270.307 Geoscience Modeling
270.308 Population and Community Ecology
270.315 Natural Catastrophes
270.360 Climate Change: Science and Policy
270.400 Intersession Independent Study
270.404 Environmental Seminar
270.495-496 Senior Thesis
270.507-508 Independent Study
270.601 Fluids Seminar
270.605-606 Journal Club

270.609-610 Special Topics in Earth and Planetary Sciences
270.807-808 Research

Solid Earth Geophysics

270.327 Introduction to Seismology
270.329 Introduction to Seismology Laboratory
270.395 Planetary Physics & Chemistry
270.604 Geophysical Petrology Seminar
270.646 Geophysical Fluid Dynamics
270.647 Earth's Interior
270.651 Planetary Geophysics
270.652 Physics of Magma
270.653 Fluid Dynamics of Earth and Planets II

Mineralogy, Petrology, and Geochemistry

270.301 Geochemical Thermodynamics
270.302 Aqueous Geochemistry
270.304 Igneous and Metamorphic Petrology
270.305 Geophysical Petrology Seminar
270.306 Igneous and Metamorphic Petrology Laboratory
270.341 Crystallography and the Structure of Inorganic Solids
270.342 Mineralogy Laboratory
270.343 Crystallography Laboratory
270.369 Geochemistry of the Earth & Environment
270.422 Geochemistry of Ore Deposits
270.603 Geochemistry Seminar
270.613 Metamorphic Petrology Seminar
270.621 Transmission Electron Microscopy: Practice and Applications
270.622 Transmission Electron Microscopy: Theory and Understanding
270.635 Crystal Chemistry and Behavior of Rock Forming Minerals
270.641 Inorganic Solids: Structure, Properties, Chemistry, Applications, and Crystallography
270.642 Surface Geochemistry
270.681 Advanced Metamorphic Petrology
270.682 Advanced Metamorphic Petrology Laboratory
270.690 Igneous Petrology
270.692 Igneous Petrology Laboratory

Oceans and Atmospheres

270.307 Geoscience Modeling
270.355 Introductory Atmospheric Science
270.401 Introduction to Physical Oceanography
270.402 Introduction to Dynamical Oceanography
270.601 Fluids Seminar
270.608 Seminar in Atmospheric Sciences
270.614 Atmospheric and Ocean Vortices
270.644 Physics of Climate Variability
270.646 Geophysical Fluid Dynamics
270.647 Mechanics of the Earth's Interior

270.652 Physics of Magma
270.653 Fluid Dynamics of Earth and Planets II
270.659 Seminar in Oceanography
270.661 Planetary Fluid Dynamics

Paleobiology, Paleoclimatology, Ecology

270.308 Population and Community Ecology
270.332 Soil Ecology
270.377 Climates of the Past

Earth and Planetary Atmospheres

270.355 Introductory Atmospheric Science
270.608 Seminar in Atmospheric Sciences

270.614 Atmospheric and Oceanic Vortices
270.623 Planetary Atmospheres
270.661 Planetary Fluid Dynamics
270.662 Seminar in Planetary Science

Sedimentology

270.350 Sedimentary Environments

Geomorphology and Surficial Geology

Students interested in this general area should consult the courses listed in the Department of Geography and Environmental Engineering (see page 511).

East Asian Studies

The East Asian Studies major is interdisciplinary and interdepartmental. Its primary purpose is to introduce undergraduates to the knowledge, language skills, and research methods they will need to enter various academic and professional paths relating to China, Japan, and Korea. Majors in East Asian studies engage in intensive Chinese, Japanese and/or Korean language study through the Center for Language Education and work with faculty on such topics as China in the global economy, nationalism in East Asia, Korean identity and culture, modern Japanese history and politics, Chinese urban history, and women in East Asia. Students are encouraged to pursue original research projects in East Asia with the support of intersession and summer travel grants, stipends for conference presentations, a senior thesis honors option, and seminars that bring together research scholars, faculty, graduate students and undergraduates in a manner that is distinctly Hopkins. Alumni of the program are making their mark around the world in business and finance, academia, law, international development, medicine and public health, engineering, media, public service and the arts.

The Committee on East Asian Studies

Joel Andreas, Associate Professor (Sociology): sociology of China.

Erin Chung, Assistant Professor (Political Science): politics of Japan and Korea.

Marta Hanson, Assistant Professor (History of Medicine): history of Chinese medicine.

Ho-Fung Hung, Associate Professor (Sociology): sociology of China.

Tobie Meyer-Fong, Associate Professor (History): history of China.

William T. Rowe, Professor (History): history of China and East Asia.

Kellee S. Tsai, Vice Dean for Humanities, Social Sciences and Graduate Programs and Professor (Political Science): politics of China.

Associated Faculty

Rebecca M. Brown, Visiting Associate Professor (History of Art and Political Science): art and politics of East, Southeast, and South Asia.

Victoria Cass, Visiting Associate Professor (Humanities Center): Chinese literature.

Aiguo Chen, Lecturer (Center for Language Education): Chinese.

Yuki Johnson, Teaching Professor and Director (Center for Language Education): Japanese.

Choonwon Kang, Lecturer (Center for Language Education): Korean.

Satoko Katagiri, Lecturer (Center for Language Education): Japanese.

Bavo Lievens, Visiting Lecturer (History): Buddhism, Chinese thought.

Liman Lievens, Lecturer (Center for Language Education): Chinese.

Lu Li, Lecturer (Center for Language Education): Chinese.

Makiko Nakao, Lecturer (Center for Language Education): Japanese.

Sharlyn Moon Rhee, Visiting Assistant Professor (Humanities Center): Korean literature.

Han Ye, Lecturer (Center for Language Education): Chinese.

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 48.) The curriculum of the East Asian Studies major consists of a balanced mixture of language and area studies. A major must fulfill the following requirements:

- Complete at least six semesters of an East Asian language or languages. At least one language must be completed at the third year level or higher. Language competency acquired prior to enrollment at Hopkins will not satisfy this requirement.

- Complete eight other East Asian Studies courses including at least one of the following: 100.131 History of East Asia or 100.347 Early Modern China or 100.348 20th Century China. Two of these eight courses may be comparative courses or advanced language courses listed in the JHU catalog beyond the six required language courses.

- Honors in East Asian Studies may be earned by maintaining a GPA of 3.7 in the major and writing a senior honors thesis by taking the year-long seminar, 360.431-432 Senior Thesis Seminar: East Asian Studies.

- All courses required for the major must be passed with a grade of C- or higher; none may be taken satisfactory/unsatisfactory.

- Transfer credit policy: Up to six classes may be transferred from study abroad programs or other schools upon approval of the major advisor.

Courses

Language

373.111-112 First-Year Heritage Chinese
Staff   3 credits

373.115-116 First-Year Chinese
Staff   4.5 credits

373.211-212 (H) Second-Year Heritage Chinese
Staff   3 credits

373.215-216 (H) Second-Year Chinese
Staff   4.5 credits

373.315-316 (H) Third-Year Chinese
Staff   3 credits

373.415-416 (H) Fourth-Year Chinese
Staff   3 credits

373.452 (H) Topics in Chinese Media
Staff   3 credits

378.115-116 First-Year Japanese
Staff   4 credits

378.215-216 (H) Second-Year Japanese
Staff   4 credits

378.315-316 (H) Third-Year Japanese
Staff   3 credits

378.415-416 (H) Fourth-Year Japanese
Staff   3 credits

380.101-102 (H) First-Year Korean
Kang   3 credits

380.201-202 (H) Second-Year Korean
Kang   3 credits

380.301-302 (H) Third-Year Korean
Kang   3 credits

East Asian Studies

010.146 (H, S) East Asian Art: Pottery to Propaganda
Brown   3 credits

010. 353 (H,S,W) Key Moments in East Asian Politics & Visual Culture
Brown   3 credits

100.131 (H,S,W) History of East Asia
Rowe   3 credits

100.208 (H,S) China: Neolithic to Song
Meyer-Fong   3 credits

100.219 (H,S,W) The Chinese Cultural Revolution
Meyer-Fong   3 credits

100.329 (H,S,W) Chinese Thought
Lievens   3 credits

100.330 (H,S) National Identity in 20th-Century China and Japan
Meyer-Fong   3 credits

100.347 (H,S,W) Early Modern China
Rowe   3 credits

100.348 (H,S,W) Twentieth-Century China
Rowe   3 credits

100.356 (H,S,W) The Buddhist Experience
Lievens   3 credits

100.422 (H,S,W) Society and Social Change in Eighteenth-Century China
Rowe   3 credits

100.437 (H,S,W) Late Imperial China: History and Fantasy
Meyer-Fong   3 credits

100.470 (H,S) Monuments and Memory in Asian History
Meyer-Fong   3 credits

100.478 (H,S) Colloquium: Problems in Chinese Agrarian History
Rowe   3 credits

100.479 (H,S,W) Colloquium: Problems in Chinese Urban History
Rowe   3 credits

100.482 (H,S,W) Colloquium: Historiography of Modern China
Rowe   3 credits

140.346 (H,S) History of Chinese Medicine
Hanson   3 credits

190.315 (S,W) Asian-American Politics
Chung   3 credits

190.320 (S,W) Politics of East Asia
Chung   3 credits

190.330 (S) Japanese Politics
Chung   3 credits

190.341 (S,W) Korean Politics
Chung   3 credits

190.348 (S) Domestic Politics of Contemporary China
Tsai   3 credits

190.434 (S,W) Advanced Topics in Contemporary Chinese Politics
Tsai   3 credits

230.321 (S,W) Revolution, Reform, and Social Inequality in China
Andreas   3 credits

230.415 (S,W) Social Problems in Contemporary China
Andreas   3 credits

360.431-432 Senior Thesis Seminar: East Asian Studies
Staff   3 credits

Economics

The Department of Economics offers programs designed to improve the understanding of important economic problems and to provide the tools needed for the critical analysis of these problems and for dealing with them in practice.

On the undergraduate level, the department provides both for those who want to become professional economists and for those interested in a specialty related to economics, such as business, law, government, history, health care management, or environmental engineering. Still other students are simply interested in improving their understanding of society or making informed assessments of economic policies as citizens or making wise decisions about personal finances.

On the graduate level, the department provides advanced training for students preparing for careers as professional economists. The program encompasses such fields as macroeconomics, microeconomic theory, econometrics, labor economics, international economics, industrial organization, economic development, and public finance, with an emphasis on the application of economic theory and quantitative methods. Because of the small number of graduate students admitted, they can work closely with faculty in graduate courses and seminars, and have easy and informal access to faculty members.

The Faculty

Laurence M. Ball, Professor: macroeconomics.

Christopher Carroll, Professor: macroeconomics.

Carl F. Christ, Professor Emeritus: macroeconomics, econometrics.

Gregory Duffee, Carl Christ Professor: finance.

Hulya Eraslan, Associate Professor: political economics, game theory, corporate finance.

Jon Faust, Louis J. Maccini Professor (Director, Center for Financial Economics): econometrics, macroeconomics, financial economics.

Caroline Fohlin, Research Professor: financial economics, economic history.

Mark Gersovitz, Professor: development economics, public finance.

Bruce W. Hamilton, Professor Emeritus: applied microeconomics.

Joseph Harrington, Professor (Chair): industrial organization, game theory, formal political theory.

Yingyao Hu, Associate Professor: econometrics, applied microeconomics.

Olivier Jeanne, Professor: international macroeconomics.

Przemek Jeziorski, Assistant Professor: industrial organization, applied econometrics, microeconomic theory.

Edi Karni, Scott and Barbara Black Professor: economics of uncertainty and information, microeconomic theory, decision theory.

M. Ali Khan, Abram G. Hutzler Professor: mathematical economics, microeconomic theory, intellectual history.

Elena Krasnokutskaya, Assistant Professor: industrial organization, applied microeconomics, applied econometrics.

Louis J. Maccini, Professor: macroeconomics, applied econometrics.

Robert A. Moffitt, Krieger-Eisenhower Professor: labor economics, applied econometrics, public finance, population economics.

Stephen H. Shore, Assistant Professor: labor economics, applied econometrics, financial economics.

Richard Spady, Research Professor: econometrics, industrial organization.

Tiemen Woutersen, Assistant Professor: econometrics, labor economics, financial economics.

Jonathan Wright, Professor: time series econometrics, empirical macroeconomics, finance.

H. Peyton Young, Research Professor and Scott and Barbara Black Professor Emeritus: game theory, evolutionary economics, microeconomic theory.

Fellows
Robert Barbera
Barclay Knapp

Lecturers
Barbara Morgan, Senior Lecturer: economics of discrimination, comparative economic systems.

Joint Appointments
David Bishai, Associate Professor (Bloomberg School of Public Health): health economics.

Joshua Epstein, Professor (School of Medicine): mathematical and computational modeling of social dynamics.

Kevin Frick, Associate Professor (Bloomberg School of Public Health): health economics.

Steve H. Hanke, Professor (Geography and Environmental Engineering): applied micro- and macroeconomics and finance.

Pravin Krishna, Professor (SAIS): international trade, political economy, development.

Mitsukuni Nishida, Assistant Professor (Carey Business School): industrial organization.

Catherine Norman, Assistant Professor (Geography and Environmental Engineering): environmental economics.

Undergraduate Programs

The introductory course 180.101-102 Elements of Economics is open to all students. Courses at the 200-level have Elements of Economics (180.101 and 180.102) as prerequisites.

The Microeconomic and Macroeconomic Theory (180.301 and 180.302) courses have 180.101 and 180.102 as well as Differential Calculus (110.106 or equivalent) as prerequisites. All 300-level courses above 301 and 302 have Microeconomic and/or Macroeconomic Theory (180.301, 180.302) as prerequisites (or, with permission of the instructor, corequisites), as well as Elements of Economics and Calculus. Some 300-level courses have additional prerequisites; see individual course listings. Independent study is available, subject to the consent of the department and of the faculty member with whom the student wants to work.

Subject to the consent of the instructor, graduate courses at the 600-level are open to qualified undergraduates. They receive 1.5 undergraduate credits per class hour. The 600-level courses for which advanced undergraduates are most likely to be qualified are 180.601 and 180.603, Microeconomic and Macroeconomic Theory.

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 48.)

To receive the B.A. degree with a major in economics, the student must do satisfactory work in the following courses, or work judged at least equivalent by the department.

- Economics Core (5 courses):
  180.101-102 Elements of Macro- and Micro-economics
  180.301-302 Micro- and Macroeconomic Theory
  180.334 Econometrics
- Economics Electives (5 courses):
  The five electives must be regular courses, not internships, independent study courses, or Intersession courses. At least two of the five electives must be at the 300-level. A minimum grade of C- is required for any course to be applied to meeting requirements for the major, including courses taken first semester freshman year.

Except for 180.301-302, 180.334, and 180.591-592, the department does not necessarily offer all 200-500-level courses every year. Students should plan their programs accordingly, in consultation with faculty.

- Mathematics:
  At least one term of differential calculus
- Statistics:
  550.111 Statistical Analysis or the equivalent

Note: The above courses in mathematics and statistics may be used for part of the general requirements for the B.A. degree with a departmental major. Statistical Analysis (550.111) or equivalent is a prerequisite for Econometrics. For the economics major 180.101 and/or 180.102 may be taken in the JHU summer program. ALL OTHER economics courses for the major must be regular courses offered during the academic year within the Department of Economics, except for other courses approved by the department's director of undergraduate studies. (Qualifying courses that are part of a study-abroad program will generally be approved.) The Senior Honors Thesis sequence (180.591-592) cannot be used to satisfy any of the requirements for the major.

Course Scheduling

Students who may want to major in economics should take 180.101-102 Elements of Economics, 110.106 Differential Calculus, and 550.111 Statistical Analysis during their freshman or sophomore year. Those who try to take them later are likely to run into serious schedule conflicts in the junior and senior years because of the need to fulfill the prerequisites for advanced courses.

Economics students interested in an accelerated program for the B.A. or in early admission to graduate study, or both, will find it helpful to take 180.101-102 and 110.106 in their freshman year. They should consult with faculty at an early stage.

Students planning graduate study in economics will find it useful to take 110.201 Linear Algebra, 110.202 Advanced Calculus, 550.311-312 Probability and Statistics, and related work in other social sciences, history, mathematics, operations research, and computer programming.

Honors Program in Economics

Departmental honors are awarded to those students who satisfy the following requirements:

- All economics courses applied to the major have been taken in the department.
- 180.591-592 Economics Senior Thesis. The thesis may not be counted as one of the five economics electives.
- A grade point average of at least 3.5 for all economics courses.

- A grade point average of at least 3.5 for 180.301-302 and the senior thesis.

Minor in Economics

Students with a major in another department may be awarded a minor in economics with satisfactory work in the following courses:

- Elements of Economics (2 courses): 180.101-102 Elements of Macro- and Microeconomics.

- Economics Electives (4 courses): The four courses must be regular courses at the 200- or 300-level, not internships, independent study courses, or Intersession courses.

No substitution of courses in other departments for economics electives may be made. A minimum grade of C- is required for an economics course to be applied to meeting the requirements of the minor. Courses from study abroad can count only if they are approved by the department's director of undergraduate studies.

Center for Financial Economics (CFE)

Founded in 2008 and housed in the Economics Department in the Krieger School of Arts and Sciences at Johns Hopkins, the Center for Financial Economics blends the study of finance and economics, providing in-depth training and cutting-edge research in both. The dual research and teaching missions of the Center are premised on the belief that a deep understanding of modern economies requires an integrated treatment of finance and the broader economic forces driving economic progress. The recent financial crisis vividly illustrates the vital need for improved understanding of these issues on the part of practitioners, policymakers, and academics.

The CFE offers an undergraduate minor, producing expertise in finance within the context of a top-notch liberal arts education. The minor will equip students with a thorough foundation in the workings of financial markets and their role in the broader economy, providing a foundation for careers in finance, business, academics, and government. The Center is working toward offering a financial economics major and a Ph.D. in financial economics.

The Minor in Financial Economics

The main objective of the minor is to provide students with training in the conceptual framework, guiding concepts, and technical tools of modern finance. The broader goal is to provide insights into the large and the small—the macro and micro—of how this framework helps us understand the workings of the economy. The minor in financial

economics includes four required courses and two elective courses chosen from the list below.

Required Courses

180.101 (S) Elements of Macroeconomics
180.102 (S) Elements of Microeconomics
180.366 (S) Corporate Finance
180.367 (S) Investments and Portfolio Management

Elective Courses

180.242 International Monetary Economics
180.261 Monetary Analysis
180.266 Financial Markets and Institutions
180.311-312 Economics of Uncertainty
180.336 The Art and Science of Economic Forecasting
180.337 Financial Econometrics
180.362 Financial Intermediation
180.369 Research in Economics of Financial Markets
180.370 Financial Market Microstructure
180.373 Corporate Restructuring

The minor is open to all majors. One cannot take both the economics and financial economics minor. For economics majors, there is a restriction on double-counting: the two elective courses counting toward the minor cannot also count toward the economics major.

Graduate Programs

Requirements for Admission

The department's admission requirements are flexible. The admission of each applicant is by the department as a whole and rests upon his/her academic record, recommendations of instructors, and other pertinent information.

To apply for admission, an applicant must submit an official transcript of all academic work beyond secondary school and at least two letters of recommendation from previous instructors. Prospective applicants in the U.S. must submit scores from the Graduate Record Examination, and those outside the U.S. should do so if at all possible. Foreign applicants must also satisfy the department that they are fluent in English by a TOEFL score of at least 600.

Students should have a broad background in the arts and sciences and, in particular, a knowledge of economic theory and institutions, statistical inference, and mathematics through at least differential calculus. A knowledge of integral calculus and linear algebra would also be helpful.

Requirements for the M.A. Degree

The department does not admit students from outside Johns Hopkins University who intend to work only for an M.A. However, it does offer this degree as an intermediate step toward the Ph.D. or as a final degree to some of those who do not complete their doctoral work.

Beyond the general university requirements, the department requires for the master's degree either two years of satisfactory graduate course work or one year of satisfactory graduate course work and an acceptable master's essay.

Requirements for the Ph.D. Degree

The departmental requirements for the doctor's degree include the following:

- Basic course work in economic theory, mathematical methods of economics, and econometrics, and additional work in specialized branches of economics depending on his/her previous training and special interests. Candidates may take relevant work in related departments, such as History, Mathematics, Mathematical Sciences, Political Science, Sociology, Anthropology, and Public Health.

- The comprehensive examination. Administered by the department, this consists of two written examinations designed to test the candidate's grasp of micro- and macroeconomics, and a research paper. The written examinations are usually taken at the beginning of the third term, and the research paper is submitted during the fourth term.

- A dissertation. This should be an original investigation worthy of publication, prepared under the supervision of one or more members of the faculty. The candidate must submit the dissertation in final typed form at least three weeks before the date of the Graduate Board Oral Examination. The committee that administers the examination includes a majority of faculty from outside the department.

Financial Aid

The department offers a variety of forms of financial support to graduate students enrolled in the Ph.D. program. Students may receive full or partial tuition fellowships, which may be accompanied by cash stipends or teaching assistantships. In the 2011–2012 academic year, full stipends or assistantships will carry an award of approximately $17,500 per year. The T. Rowe Price Fellowship, established by the T. Rowe Price Associates Foundation to honor the memory of Mr. Price, is awarded to an entering graduate student each year. It covers tuition and pays an annual stipend of $20,000 for three years and a teaching assistantship thereafter. At the same time, it is possible that the department will be able to offer one or more of the university's Owen Fellowships to its outstanding graduate applicants. This fellowship consists of a stipend of $23,500 toward the student's first three years. Although aid is provided on a yearly basis subject to the availability of financial support from the university, it is the department's policy to continue aid for at least four and usually five years, provided the student is making satisfactory progress.

Finally, several summer dissertation fellowships are awarded on a competitive basis to students who have successfully completed their second year of study.

Carl Christ Fellowship

In the academic year 1989–90, the department established the Carl Christ Fellowship fund to honor one of its faculty members for his distinguished service and achievements. The proceeds of the fund are used to support outstanding graduate students at the dissertation stage of their research.

For further information about graduate study in economics, contact the director of graduate admissions, Department of Economics.

Undergraduate Courses

The department plans to offer every course in this list at least once during the academic years 2011–2012 and 2012–2013. However, the indicated instructor(s) of a scheduled course may be changed without notice, and a scheduled course may be canceled if the enrollment is too small, or for other reasons.

180.101 (S) Elements of Macroeconomics

An introduction to the economic system and economic analysis, with emphasis on total national income and output, employment, the price level and inflation, money, the government budget, the national debt, and interest rates. The role of public policy. Applications of economic analysis to government and personal decisions. Prerequisite: basic facility with graphs and algebra.

Maccini, Ball   3 credits   fall

180.102 (S) Elements of Microeconomics

An introduction to the economic system and economic analysis, with emphasis on demand and supply, relative prices, the allocation of resources, and the distribution of goods and services; theory of consumer behavior, theory of the firm, and competition and monopoly, including the application of microeconomic analysis to contemporary problems. Prerequisite: basic facility with graphs and algebra.

Hamilton   3 credits   spring

180.215 (S) Game Theory and the Social Sciences
Game theory is one of the few mathematical tools developed for the purpose of understanding social phenomena. This course provides an introduction to game theory with an emphasis on applications. Applications in economics, political science, business, military science, history, biology, theology, and recreation are covered. No prior knowledge of game theory is presumed and the required mathematical background is minimal (high school algebra and one term of calculus are sufficient).
Harrington   3 credits

180.227-228 (S) Economic Development
A review of the historical experience in presently developed economies, models of development, planning techniques, and development policies. The course is aimed at identifying major economic questions relevant to less developed economies and to showing how economic analysis can be used further to understand the obstacles to development and to formulate appropriate policies. Prerequisites: 180.101-102.
Gersovitz   3 credits

180.241 (S) International Trade
Theory of comparative advantage and the international division of labor: the determinants and pattern of trade, factor price equalization, factor mobility, gains from trade and distribution of income, and theory and practice of tariffs and other trade restrictions. Prerequisites: 180.101-102.
Staff   3 credits

180.242 (S) International Monetary Economics
Balance of payments, foreign exchange markets, adjustments in the balance of payments, the international monetary system, plans for reform, fixed and flexible exchange rates. Prerequisites: 180.101-102.
Jeanne   3 credits

180.252 (S) Economics of Discrimination
This course examines labor market discrimination in the United States, particularly focusing on women and African Americans. There are several objectives: to apply economic theory to the labor market; to examine empirical evidence on earnings and employment outcomes, and to evaluate supply-side explanations for these outcomes; to consider alternative economic theories of discrimination; and to assess the impact of public policies to combat discrimination. Guest speakers will include lawyers and other practitioners in the field. The course will reinforce skills relevant to all fields of applied economics, including critical evaluation of the theoretical and empirical literature, and the reasoned application of statistical techniques. Prerequisite: 180.102 or equivalent.
Morgan   3 credits

180.261 (S) Monetary Analysis
Analysis of money, banking, and government debt, with emphasis on coherent models with microeconomic foundations. Topics include barter and commodity money, monetary institutions in historical perspective, international monetary systems; portfolio theory, liquidity, financial intermediation, bank risk, central banking; debts and deficits, savings and investment, the temptation of infla-

tion. The course aims at providing students with the means to analyze monetary questions and institutions. Prerequisites: 180.101-102.
Ball   3 credits

180.266 (S) Financial Markets and Institutions
Understanding design and functioning of financial markets and institutions, connecting theoretical foundations and real-world applications and cases. Basic principles of asymmetric information problems, management of risk. Money, bond, and equity markets; investment banking, security brokers, and venture capital firms; structure, competition, and regulation of commercial banks. Importance of electronic technology on financial systems. Prerequisites: 180.101-102.
Faust   3 credits

180.289 (S) Economics of Health
Application of economic concepts and analysis to the health services system. Review of empirical studies of demand for health services, behavior of providers, and relationship of health services to population health levels. Discussion of current policy issues relating to financing and resource allocation. Prerequisite: 180.102.
Bishai   3 credits

180.301 (S,W) Microeconomic Theory
An introduction to the modern theory of allocation of resources, starting with the theories of the individual consumer and producer, and proceeding to analysis of systems of interacting individuals, first in the theory of exchange, then to systems which include production as well. Prerequisites: 180.101-102 (can be taken concurrently with 180.101) and Differential Calculus 110.106, or permission of instructor.
Shore   4.5 credits

180.302 (S) Macroeconomic Theory
The course provides a treatment of macroeconomic theory including a static analysis of the determination of output, employment, the price level, the rate of interest, and a dynamic analysis of growth, inflation, and business cycles. In addition, the use and effectiveness of monetary and fiscal policy to bring about full employment, price stability, and steady economic growth will be discussed. Prerequisites: 180.101-102 (can be taken concurrently with 180.102) and Differential Calculus 110.106, or permission of instructor.
Ball, Maccini   4.5 credits

180.303 (S) The Global Finance Crisis
The course will first review the main causes of the crisis in financial regulation, monetary policy, as well as global financial imbalances. The prospects for economic recovery and the current challenges to fiscal and monetary policies will then be discussed. The third part of the course will focus on the long-run implications of the crisis for economic policy. The course will rely on mathematical modeling of key microeconomic and macroeconomic aspects of the crisis, in particular in the areas of banking and monetary policy. Prerequisites: 180.301-302.
Jeanne   3 credits

180.310 (S,W) Economics of Antitrust
This course explores the economic rationale for, and consequences of, antitrust laws. In addition to economic analysis, we will study landmark antitrust cases. Prerequisite: 180.301.
Hamilton   3 credits

180.334 (S,Q) Econometrics
Introduction to the methods of estimation in economic research. The first part of the course develops the primary method employed in economic research, the method of least squares. This is followed by an investigation of the performance of the method in a variety of important situations. The development of a way to handle many of the situations in which ordinary least squares is not useful, the method of instrumental variables, concludes the course. Prerequisite: Statistical Analysis 550.111, or permission of instructor. Pre- or corequisite: 180.301-302.
Hu, Woutersen   3 credits

180.335 (S) Topics in Econometrics
This undergraduate course introduces students to advanced topics in econometrics, with an emphasis on the modeling and estimation methods used in mircoeconomic applications. We will cover methods for handling discrete variable and limited dependent variables (useful, for example, in the analysis of the demand for differentiated products), maximum likelihood estimators, flexible semi-parametric and non-parametric methods. The later part of the course will look at the use of these methods in evaluating effects of the social programs. As part of the course the students will learn to write programs in Matlab (or R language which is available to users at no cost). The problems sets will be used on datasets that come of different areas of economic research.
Krasnokutskaya   3 credits

180.336 (S) The Art and Science of Economic Forecasting
Will sketch out a strategy for anticipating economic turning points. Business cycle basics, monetary policy/financial market/real economy interactions will be reviewed. Long-term growth issues will be explored. Prerequisites: 180.101-102, 180.302 or permission of instructor.
Barbera   3 credits

180.337 (S,Q) Financial Econometrics
This course introduces financial models and the necessary techniques to estimate and test these models, e.g., ARCH, GARCH, integrated volatility models, efficient market hypothesis, as well as risk management models. Prerequisites: 180.334, 180.367. 550.420 recommended.
Woutersen   3 credits

180.351 (S) Labor Economics
The economics of the determination of earnings and the allocation of labor. The theory of labor supply and labor demand will be developed and then applied to questions of income distribution, unions, government intervention in the labor market, and discrimination. If time allows, the relation between unemployment and inflation will be discussed. Prerequisite: 180.301 or permission of instructor.
Morgan   3 credits

180.355 (S) Economics of Poverty and Inequality
This course covers the theories and evidence developed by economists for the analysis of income inequality and poverty. The first half of the course discusses economic theories of inequality as well as motivations for why society should care about inequality and poverty, and also covers concepts and detailed statistical measures. The second half of the course considers theories and evidence for different explanations: human capital, intergenerational transmission, neighborhoods, family structure, and discrimination. Solutions and government policies to reduce inequality and poverty are discussed. The prerequisite for the course is Microeconomic Theory (180.301). Knowledge of statistical analysis up to the level of simple regression is also helpful.
Moffitt   3 credits

180.365 (S) Public Economics
Examines competing views of the appropriate role of government in the economy and its actual role, including analysis of the principal taxes and expenditure programs, with a particular emphasis on Social Security and other social insurance programs. Prerequisite: 180.301.
Staff   3 credits

180.366 (S) Corporate Finance
A theoretically-oriented introduction to the financial management of a corporation. Explains how firms decide whether to invest in a project, how they fund their investments, and how they control financial risks. Prerequisite: 180.301.
Duffee   3 credits

180.367 (S) Investments and Portfolio Management
Investment securities and their markets, especially the stock market. The relation between expected return and risk. The determination of security prices. Financial portfolio selection. The assessment of the performance of managed portfolios. Prerequisites: 180.301 and Statistical Analysis 550.111.
Wright   3 credits

180.368 (S) Managerial Economics and Business Strategy
Seminar on quantitative concepts, decision making, and strategy in business organizations. Overall context is "value"—how it is measured and maximized long term. Microeconomic theory of the firm, competitive analysis, corporate finance. Prerequisites: 180.301, 550.111, and either 180.367 or 551.302 or permission of instructor.
Knapp   3 credits

180.369 (S) Research in Economics of Financial Markets
Focus is heavily on theoretical foundations from economics: contracting, moral hazard, adverse selection, other information-related issues, connections between real and financial variables. Prerequisite: 180.301. Recommended: 180.334, 180.367.
Fohlin   3 credits

180.370 Financial Market Microstructure
How financial markets work in theory and practice. Role of organization and regulation in asset price formation. We examine market liquidity, transactions costs, volatil-

ity, and trading profits. Some emphasis on behavioral finance. Prerequisite: 180.301.

Fohlin   3 credits

180.371 (S) Industrial Organization

Investigation of firm behavior in markets characterized by imperfect competition. Imperfect competition lies in between monopoly and perfect competition and characterizes most major industries in modern capitalist economies. Central issues to be covered in the course include what determines the intensity of competition? What determines the extent of entry and exit? How is it that some firms consistently dominate their industries? Prerequisite: 180.301 or permission of instructor.

Krasnokutskaya   3 credits

180.373 Corporate Restructuring

The objective of this course is to familiarize students with financial, legal and strategic issues associated with the corporate restructuring process. Main focus of the course is on the restructuring of financially distressed firms. The course surveys a variety of restructuring methods (out-of-court workouts, exchange offers, prepackaged bankruptcies, Chapter 11 bankruptcies, insolvency practices in other countries) available to troubled firms. A small portion of this course is concerned with restructuring employee contracts and equity claims (equity carve-outs, spin-offs, tracking stock). Prerequisite: 180.366.

Eraslan   3 credits

180.376 (S) Economics of the Internet

180.390 (S) Health Economics and Developing Countries

Benefits of good health and its costs. Health demand and supply in poor countries. Welfare economics of Public Health.

Gersovitz   3 credits

180.393 (S) Economics of Africa

Discussion of the economic experience of post-colonial Africa emphasizing topics rather than a historical narrative: agriculture, manufacturing, trade, population, education, health, public finances among others. Students are responsible for a research paper, topic choice and paper development in close consultation with the instructor, students to give a class presentation on paper findings. Course qualifies as writing intensive for the writing requirement. Prerequisite: 180.228 or permission of the instructor.

Gersovitz   3 credits

180.501-502 (S) Independent Study

Independent work on selected topics may be arranged by agreement between a student, a faculty member, and the department.

Staff   3 credits

180.521 (S) Research in Economics

Students enrolled in this fall-semester course will do preliminary work on the Senior Honors Thesis. The tasks are to find an area of research, begin working with a thesis advisor, and develop a thesis topic and research plan for the thesis itself. By the end of fall semester the student and advisor should be able to make a firm determination as to the feasibility of the proposed thesis. **Note:** It is in the nature of research that some topics ultimately prove to be infeasible. With that in mind, it is possible to enroll in, and receive credit for, Research in Economics without subsequently enrolling in 180.522 Senior Honors Thesis. Prerequisites: Senior Standing, 180.334 (may be waived by the thesis advisor, depending upon the topic. (This course cannot be counted as one of the five elective courses required for the major of economics).

Fohlin   2 credits

180.522 (S) Senior Honors Thesis

This course is a continuation of 180.521 Research in Economics. Under the supervision of the thesis advisor, students will complete the Senior Honors Thesis. **Caution:** Many research ideas that appear to be promising do not work out. It is possible to start a Senior Honors Thesis which in the end proves to be infeasible. **Be Sure** that you have enough credits to graduate without 180.522. Also be sure to have a serious progress discussion with your thesis advisor before the spring-semester drop deadline. Prerequisites: Senior Standing, 180.521, 180.334 (may be waived by the thesis advisor, depending upon the topic). (This course cannot be counted as one of the five elective courses required for the major in economics).

Fohlin   3 credits

180.591 (S) Research in Economics

Students enrolled in this fall-semester course will do preliminary work on the senior honors thesis. The tasks are to find an area of research, begin working with a thesis advisor, and develop a thesis topic and research plan for the thesis itself. By the end of fall semester the student and advisor should be able to make a firm determination as to the feasibility of the proposed thesis. **Note**: It is in the nature of research that some topics ultimately prove to be infeasible. With that in mind, it is possible to enroll in, and receive credit for, Research in Economics without subsequently enrolling in 180.592 Senior Honors Thesis. Prerequisites: senior standing, 180.334 (may be waived by the thesis advisor, depending upon the topic). (This course cannot be counted as one of the five elective courses required for the major in economics).

Staff   2 credits

180.592 Senior Honors Thesis

This course is a continuation of 180.591 Research in Economics. Under the supervision of the thesis advisor, students will complete the senior honors thesis. **Caution**: Many research ideas that appear to be promising do not work out. It is possible to start a senior honors thesis which in the end proves to be infeasible. **Be Sure** that you have enough credits to graduate without 180.592. Also be sure to have a serious progress discussion with your thesis advisor before the spring-semester drop deadline. Prerequisites: senior standing, 180.591, 180.334 (may be waived by the thesis advisor, depending upon the topic). (Cannot be counted as one of the five elective courses required for the major in economics).

Staff   3 credits

180.599 Independent Study in Economics
Independent work on selected topics may be arranged by agreement between a student, a faculty member, and the department.
Staff   up to 3 credits

Cross-Listed

360.328 Applied Economics Internship
Course given in conjunction with private business and financial institutions, governmental entities, and economic research institutes in the Baltimore-Washington metropolitan area. Requirements include 120 hours of internship time and a research paper on an applied economics topic. Permission of instructor required. Satisfactory/Unsatisfactory. This course does not count as one of the five electives for the economics major or one of the four electives for the minor.
Hanke   3 credits

Graduate Courses

180.601-602 Microeconomic Theory
First term: a systematic presentation of microeconomic theory in both its partial equilibrium and general equilibrium aspects. Topics covered include preferences and utility, exchange, production, theory of the firm, capital and interest, competition and monopoly, stability of equilibrium, and welfare economics. Second term: a more intensive discussion of selected topics, emphasizing recent contributions. Permission of instructor needed for non-doctoral students.
Hamilton, Khan   3 hours (601), 2 hours (602)

180.603-604 Macroeconomic Theory
First term: a comprehensive treatment of macroeconomic theory, including static analysis of aggregate output employment, the rate of interest, and the price level; aggregative theory of investment, consumption, demand and supply of money; empirical work on aggregative relationships. Second term: the macrodynamic theory of growth, cycles, unemployment and inflation, and selected subjects. Permission of instructor needed for non-doctoral students.
Maccini, Carroll   3 hours

180.605-606 Advanced Macroeconomics
Topics of recent research in macroeconomics. Content will vary from year to year. Likely topics include implicit contract theory, search theory and unemployment, disequilibrium macroeconomic models, monetary policy and the control of inflation, contract-based rational expectations models, imperfect competition in macrodynamic models, business cycle models, empirical tests of rational expectations models, theories of investment behavior, and debt neutrality. Prerequisites: 180.603-604.
Ball, Carroll   2 hours

180.607 Macroeconometrics I
The course is an attempt to provide a framework for discussing the techniques that are used in macroeconometric analysis. Generally the bias that it has is one of looking at these from the perspective of someone analyzing macroeconomic data for policy analysis. Consequently, many of the applications considered are drawn from the type of research conducted in central banks and finance ministries. Its emphasis is therefore upon the issues raised by the analysis of time series of macroeconomic data. Today there is an emerging literature that looks at micro-economic data as well as conducting cross-country studies. We will tend to ignore that material as the methods used in such research are essentially those of micro-econometrics, although sometimes with adjustments made to reflect the nature of macro-economic time series. Prerequisites: 180.633-634.
Faust   2 hours

180.608 Macroeconometrics II
This course will cover a range of topics in the time series econometrics and empirical macroeconomics and finance that arise in current research. This course should be taken by people with an interest in either empirical macro or empirical finance and is likely to be helpful to a graduate student with time-series empirical interests, especially in searching for a dissertations topic. Prerequisites: 180.601, 180.602, 180.603, 180.604 and 180.607 or permission from the instructor.
Wright   2 hours

180.611 Economics of Uncertainty
A review of the theory of decision making under uncertainty and its applications to problems of optimal insurance, portfolio selection, savings decisions and optimal search. Alternative approaches to decision making under uncertainty will be surveyed. Attitudes toward risk will be characterized and the issues of measurement and comparability of these attitudes discussed, both in the univariate and multivariate cases; applications are given. The theory of optimal search is developed with emphasis on its usefulness for the study of labor markets and unemployment. Prerequisites: 180.601 and 180.603 or permission of instructor.
Karni   2 hours

180.614 Mathematical Economics
The course traces the extent to which modern economic theory, particularly as it pertains to pure competition in market and non-market games under the rationality postulate, is grounded in the language of probability and measure theory. Special attention will be paid to the formal expression of ideas such as economic and numerical negligibility, on the one hand, and diffuseness and condi-tional independence of information, on the other hand. Toward this end, the course will develop rigorous formulations of basic ideas of (conceptual rather than computational) probability—spaces of events, random variables and their means, marginal and joint densities, stochastic independence, derivatives of probabilities—and apply them to large anonymous and non-anonymous games as well as to finite-agent games with private information.
Khan   2 hours

180.615 Mathematical Methods in Economics
A course in mathematics for economists not planning to work in quantitative areas, or for those whose mathematics background is weak. The emphasis is on optimization theory; also included are topics in advanced calculus and linear algebra. Prerequisites: 180.301-302 or permission of instructor.
Karni   2 hours

180.616 Mathematical Methods in Economics
A continuation of 180.615, this course focuses on dynamic aspects of optimization models. Techniques of dynamic programming and the calculus of variations are also developed. Prerequisite: 180.615 or permission of instructor.
Khan, Carroll   2 hours

180.617 Multi-Agent Numerical Agent
The course covers a set of numerical methods that facilitate computation and estimation of equilibrium outcomes in economic environments. The emphasis is put on dynamic models and their applications in multi-agent settings. The course includes basis topics in numerical analysis (example: optimization, integration, differential equations, and projection methods), as well as advanced applications such as: dynamic programs in discrete and continuous time, approximate dynamic programing, dynamic games, and approximations of Markov perfect dynamics.

180.618 Game Theory and Economic Behavior
This course is an introduction to cooperative and non-cooperative games. Its focus is noncooperative game theory with applications in economics. Topics include foundations of solution concepts, refinements of Nash equilibrium, repeated games, games with incomplete information, differential games, and experimental testing of hypotheses. Prerequisite: 180.601.
Eraslan   2 hours

180.628 Development Policies and Project Evaluation
Trade relations between developed and developing countries, trade policies in developed countries, policies by developing countries, project evaluation, and foreign investment. Corequisites: 180.601, 180.603.
Gersovitz   3 hours

180.633 Econometrics
Mathematical models of economic behavior and the use of statistical methods for testing economic theories and estimating economic parameters. Subject matter will vary from year to year; statistical methods, such as linear regression, multivariate analysis, and identification, estimation and testing in simultaneous equation models, are stressed. Prerequisites: 180.301-302, statistical inference, and differential calculus (including partial derivatives and matrix algebra), or permission of instructor.
Hu   2 hours

180.636 Statistical Inference
Theory and applications of statistical inference. Topics include probability and sampling, distribution theory, estimation, hypothesis testing, and simple regression analysis. Statistical applications will be drawn from economics. Prerequisites: differential calculus and linear algebra. Limited to graduate students in economics except by permission of the chair.
Wright   2 hours

180.637 Microeconometrics I
This course covers the major econometric techniques that are used in applied work in microeconomics. These include limited dependent variables and selection models; treatment-effect models; duration models and panel data models. Prerequisites: 180.633-634 or equivalent.
Woutersen   2 hours

180.638 Microeconometrics II
This course introduces techniques that are used in applied research in microeconomics. Focus is on a particular class of models, namely discrete choice models. Well-known models in this class are the logit and probit models. Models that have better properties involve high-dimensional integrals, and this leads us to a discussion of simulation estimation. Finally, dynamic decision models for forward-looking agents who face irreversible decisions are introduced. As an application some models in economic demography are considered. Prerequisites: 180.601-602.
Hu   2 hours

180.641 International Trade
The pure theory of trade. Theories of comparative advantage, factor price equalization, trade and welfare, tariffs, trade and factor movements. Corequisites: 180.601, 180.603.
Krishna   2 hours

180.642 International Monetary Economics
A link between the balance of payments and asset accumulation/decumulation, microeconomics of international finance, and open-economy macroeconomics. The section on open-economy macroeconomics covers approaches to balance-of-payments adjustments, theories of exchange rate determination, and monetary, fiscal, and exchange-market policies under fixed and flexible rate regimes. Corequisites: 180.601, 180.603.
Jeanne   2 hours

180.651-652 Labor Economics
First term: theories of the allocation of time and supply of labor, human capital, demand for labor, market equilibrium, and income distribution. As time allows, other topics, such as unemployment, unions, and compensating differences are discussed. Second term: current topics in labor economics. The content will vary from year to year. Likely areas include nature vs. nurture in the determination of earnings, the function(s) of unions, the question of the existence of dual labor markets, and internal markets with specific human capital. Prerequisite: 180.601. Corequisite for 652: 180.633-634.
Moffitt   2 hours

180.654 Empirical Methods in Risk & Uncertainty
This doctoral course will provide tools and methods to test the models and measure the parameters of interest

in the microeconomics of decision-making under uncertainty. Prerequisites: 180.101-102, 180.334.

Shore   2 hours

180.661 Monetary Analysis

Study of various recent models of money and its interaction with the government budget constraint and real economic variables. Topics include overlapping generations models (with applications to hyperinflations, open-market operations, commodity money); turnpike models of spatial separation; cash-in-advance constraint; liquidity constraint; search-theoretic view of money. Prerequisites: 180.601, 180.604, 180.615-616.

Staff   2 hours

180.662 Empirical Asset Pricing

Students learn some of the key features of asset-price behavior. They also study how researchers test theory, focusing on the advantages and disadvantages of these research designs. The intuition behind practical econometric tools is developed and applied to asset-pricing questions. Prerequisites: 180.604, 180.633, 180.636 or permission of instructor.

Duffee   2 hours

180.671-672 Industrial Organization

First term: An investigation of firm behavior in imperfectly competitive industries from a game-theoretic perspective. Firm decision making with respect to price and quantity, entry and exit, and investment are explored. Both static and dynamic theories are presented to address questions related to the intensity of competition and the creation and maintenance of market dominance. The course is largely, though not exclusively, theoretical in content. Though no background in game theory is required, students are encouraged to take 180.618 or some other game theory course concurrently. Second term: The emphasis in this course is on empirical analysis of firm behavior. The first part of the course focuses on models of the internal organization of the firm. The second part considers empirical analysis of firm behavior in markets, with an emphasis on the new industrial economics. Prerequisite: 180.601.

Harrington, Kranokutskaya   2 hours

180.690 Advanced Econometrics in Empirical Economics GMM, Empirical Likelihood, and their Generalizations.

GMM (the Generalized Method of Moments) finds wide application in both micro and macro because of its asymptotic validity and efficiency in the absence of arbitrary parametric assumptions. Empirical Likelihood (EL) and its recently developed generalizations offer alternative methods which subsume GMM and offer practical improvement and theoretical insights. This course covers both topics with an emphasis on practical implementation of EL methods. Prerequisites: one course at the graduate level in econometrics or statistics, or permission of the instructor.

Spady

180.694 Applied Microeconomics Seminar

Staff   2 hours

180.695 Microeconomics Workshop

Staff   2 hours

180.696 Macroeconomics Workshop

Staff   2 hours

180.697 Trade and Development Workshop

Duffee   2 hours

180.698 Research and Teaching Practicums

The purpose of the Ph.D. program in economics is to train students to teach and to do research in economics. This course is for graduate students in the Ph.D. program in economics to obtain graduate credit for work off campus that provides training and the development of skills in teaching and/or research. Before the practicum is begun, the graduate student must identify a sponsoring faculty member or seek permission from the student's faculty advisor. The faculty member or advisor must sign a form that certifies that graduate credit will be granted, verifies the nature of the work to be performed by the student, and explains how the practicum helps to fulfill a degree requirement. Once completed, the sponsoring faculty member or advisor submits a grade of pass or fail for the student. The course may be used for curricular practical training.

English

The Department of English offers separate under-graduate and graduate programs, each designed to suit the needs of its particular student body. The undergraduate program, in the context of university requirements and elective courses, provides the basis for a liberal education and prepares students for graduate work or professional schools, such as medicine and law, as well as professional teaching and literary scholarship. The graduate program prepares advanced students for professional teaching careers in English literature.

The Faculty

Amanda Anderson, Caroline Donovan Professor of English Literature: Victorian literature, critical theory.

Sharon Cameron, William R. Kenan Jr. Professor of English: American literature.

Andrew Daniel, Assistant Professor: early modern literature, critical theory, aesthetics.

Frances Ferguson, Professor, Mary Elizabeth Garrett Chair in Arts and Sciences: literature, aesthetic theory, and moral/legal philosophy in the 18th and early 19th centuries.

Allen Grossman, Andrew W. Mellon Professor Emeritus of the Humanities: poetry and poetics.

Richard Halpern, Sir William Osler Professor of English: Renaissance literature, Shakespeare, science and literature, critical theory.

Jared Hickman, Assistant Professor: American literature, intellectual and cultural history of Atlantic (anti) slavery, religion and radical politics, critical race studies.

Douglas Mao, Professor (Chair): British, Irish, and U.S. poetry and fiction since 1860; interdisciplinary study of modernism.

Christopher Nealon, Associate Professor: American literature, aesthetic theory, poetry and poetics, the history of sexuality.

Ronald Paulson, William D. and Robin Mayer Professor Emeritus of the Humanities: 17th- and 18th-century literature and Romantics.

Jesse Rosenthal, Assistant Professor: American literature, aesthetic theory, poetry and poetics, the history of sexuality.

Eric Sundquist, Andrew W. Mellon Professor of the Humanities: American literature and culture, including African American and Jewish American; literature of the Holocaust.

Mark Thompson, Associate Professor: 19th- and 20th-century African-American literature, 20th-century German Idealism, French philosophy and aesthetics, theory.

Larzer Ziff, Research Professor, Caroline Donovan Professor Emeritus of English Literature: American literature.

Joint Appointments

Neil Hertz, Professor Emeritus (Humanities): Romantic literature and critical theory.

John T. Irwin, Professor (Writing Seminars): American literature.

Lecturers

Williams Evans, Senior Lecturer: Expository Writing Program.

Patricia Kain, Senior Lecturer and Director: Expository Writing Program.

Sarah Manekin, Lecturer: Expository Writing Program.

Elena Marx, Lecturer: Expository Writing Program.

Anne-Elizabeth Murdy Brodsky, Lecturer: Expository Writing Program.

George Oppel, Lecturer: Expository Writing Program.

Facilities

Besides the Sheridan Libraries, Hopkins students have easy access to the 12 million volumes and innumerable historical manuscripts of the Library of Congress, as well as the library at Dumbarton Oaks, the Folger Library, the Freer Library, the library of the National Gallery, and many other specialized public collections. Students learn about advances in research and criticism and confer with leading American and European scholars and critics through participation in the activities of the Tudor and Stuart Club, the ELH Colloquium, and the department's other programming.

Undergraduate Program

Courses in the department are open to all qualified students in the university. Selected 100-level courses (e.g. 060.107) may be used to satisfy the distribution requirement for the humanities (H).

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 48.)

While completing the general requirements for the B.A. degree, the student who plans to major in English should include the following courses in his/her program:

• Two courses outside the Department of English of a general introductory nature in the humanities and/or social sciences are required, such as Philosophy 150.111, History 100.101-102, or Political Science 190.101 or 190.280.

• One year of any classical language or modern spoken language at the intermediate level.

• Ten semester courses in the Department of English. These must include (a) Introduction to Literary Study (060.107), which must be taken no later than the sophomore year, b) no fewer than two and no more than four lecture (200-level) courses, c), advanced work (300-level seminars, generally) for the remainder. Three of the 10 required semester courses must be concerned with literature before 1800, and at least one of those must be a 300-level course. Only courses listed under the Department of English rubric (including courses taught in the Arts and Sciences Summer School Program that are devised and staffed by the department) may be counted toward the major. This excludes Advanced Academic Programs and literature courses in other departments that are not cross-listed with English. The department does allow credit for courses taken abroad, up to two courses for the major, subject to the approval of the director of undergraduate studies. A maximum of two courses from other departments but cross-listed with English may be counted toward the major.

• Students who plan to enter graduate school should study a second foreign language.

• The department will not accept a grade of D or D+ in a required course, including a course taken by a first-semester freshman.

All students, whether their goals are professional or not, should choose courses in consultation with their major advisor to suit their individual needs and satisfy departmental requirements. Students who have not yet been assigned to a major advisor may discuss departmental requirements and curriculum planning with the director of undergraduate studies.

Honors in English

Departmental honors are awarded to undergraduate English majors who achieve a cumulative average of 3.6 or higher for all English courses taken to satisfy the major requirements. For more information about Honors in English, visit **http://web.jhu.edu/english/undergrad.html** or contact the director of undergraduate studies in English.

Senior Essay Option

Majors with a cumulative G.P.A. of 3.8 in English courses by the end of the fall semester of their junior year may apply to write a senior essay in the fall of their senior year. For further information and deadlines, visit **http://english.jhu.edu/essay.html**.

English Minor

Students who wish to graduate with a minor in English must take Introduction to Literary Study (060.107), generally within one year of declaring the minor. Six additional English courses are required, of which at least two and no more than three must be lecture (200-level) courses. At least one of the six courses must be a pre-1800 course.

Graduate Program

The Department of English offers advanced programs and guided research leading to the Ph.D. degree in English and American literature in the following major literary fields: the Renaissance, the 18th century, the Romantic period, the Victorian period, American literature, and 20th-century literature.

The department accepts only full-time students working toward the Ph.D.; there is no autonomous M.A. program. Because of its small size and the close association between faculty and students, the department is able to offer an intensive program leading to the Ph.D. in five years.

Requirements for the Ph.D. Degree

Students are required to enroll in three graduate courses in each of the semesters of their first year of study and two in each of the semesters of their second year. By the end of the third year, students will have completed 10 graduate seminars, an oral examination in two fields, and examinations in one or two foreign languages. Fourth-year students will receive dissertation fellowships.

Teaching experience is regarded as an important part of the graduate program, and graduate students are required to teach in the department's literature and expository writing courses during their second, third, and fifth years at Hopkins.

For further information about graduate study, contact the graduate coordinator at the Department of English.

Undergraduate Courses

Introductory Courses

Two of the Expository Writing courses (060.113-114) introduce students of all majors to the concepts and strategies of academic argument.

060.100 (H,W) Introduction to Expository Writing
This course is designed to help less experienced writers succeed with the demands of college writing. Students work closely with instructors on how to read and summarize texts, how to analyze texts, and how to organize their thinking in clearly written essays. Emphasis is on analysis and the skills that analysis depends upon. *Freshmen only.* Limit: 10.
Evans, Kain, Staff   3 credits

060.107 (H,W) Introduction to Literary Studies
This limited-enrollment seminar is designed for freshmen and upperclassmen who want training in critical reading and writing. Required for major.
Staff   3 credits

060.113-114 (H,W) Expository Writing
This course teaches students the concepts and strategies of academic argument. Students learn to analyze sources, to develop their thinking with evidence, and to use analysis to write clear and persuasive arguments. Each section focuses on its own intellectually stimulating topic or theme, but the central subject in all sections is using analysis to create arguments. *No seniors.* Limit: 15. For individual course descriptions, see **http://web.jhu .edu/ewp**.
Kain, Staff   3 credits

060.125 (H,W) 19th Century American Experimental Writing
Cameron   3 credits

060.146 (H,W) Detective Fiction
Rosenthal   3 credits

060.159 (H) American Nightmares: Highsmith, Dick, Burroughs
Daniel   3 credits

060.201 (H) The 19th-Century British Novel
Anderson   3 credits

060.207 (H) Shakespeare
Daniel , Halpern   3 credits (Pre 1800 course)

060.211 (H) British Literature I
Staff   3 credits

060.212 (H) British Literature II
Staff   3 credits

060.215 (H,W) Advanced Expository Writing
Designed for juniors and seniors with experience in using analysis to make clear and persuasive arguments, but open to any students who have taken Expository Writing (060.113/114), this course focuses on the advanced skills of argument. Students learn the various methods of evaluating arguments—to draw inferences from the evidence, to analyze reasoning, and to examine assumptions—as they structure their own complex arguments.. Limit: 12.
Evans, Kain, Staff   3 credits

060.220 (H) The Study of American Literature
Selected authors in American literature.
Staff   3 credits

060.226 (H) African American Literature to 1914
Thompson   3 credits

060.250 (H) A Survey of 18th Century and Romantic Literature
Ferguson   3 credits (Pre 1800 course)

060.255 (H) Russian Novel
Cameron   3 credits

060.290 (H) Literary Theory
Staff   3 credits

Advanced Courses

Each of the following courses meets three hours weekly.

060.302 (H, W) Forms of Early Modern Drama
Daniel   3 credits (Pre 1800 course)

060.305 (H,W) Ancient Tragedy, Modern Thought
Halpern   3 credits (Pre 1800 course)

060.307 (H,W) Training in Writing Consultation
Limit: 15
Staff   1 credit

060.315 (H,W) 17th-Century Literature
Halpern   3 credits (Pre 1800 course)

060.316 (H,W) Milton in Debate
Daniel   3 credits (Pre 1800 course)

060.336 (H,W) Victorian Literature
Staff   3 credits

060.337 (H,W) James Joyce
Mao   3 credits

060.341 (H,W) Freud, Nietzsche, Marx
Halpern   3 credits

060.342 (H,W) Lyric Poetry from Skelton to Marvell
Daniel   3 credits (Pre-1800 course)

060.346 (H,W) Major British Authors
Staff   3 credits

060.347 (H,W) American Bibles
Hickman   3 credits

060.351 (H,W) The Cosmic Race: Cosmopolitanism and Theories of American Culture
Hickman   3 credits

060.352 (H,W) Whitman, Frost, Stevens
Cameron   3 credits

060.363 (H,W) Henry James
Cameron   3 credits

060.367 (H,W) Edwards, Emerson, Thoreau
Cameron   3 credits

060.368 (H,W) The Bloomsbury Group
Mao   3 credits

060.371 (H,W) Major American Authors
Staff   3 credits

060.372 (H,W) Melville, Poe, Hawthorne
Cameron   3 credits

060.374 (H,W) Topics in Modern Literature
Staff   3 credits

060.381 (H,W) American Poetry After World War I
Nealon   3 credits

060.398-399 Directed Research
Staff   3 credits

060.501-502 Independent Study
Individual study projects proposed by a student to any member of the department. Prerequisite: six hours of English beyond the introductory courses, with grades of A or B, and permission of instructor.

060.505-506 Internship
Staff   3 credits

060.509 Senior Essay
Staff   3 credits

Graduate Courses

060.601-602 Victorian Literature
Staff   3 hours

060.607 Reading and Writing in the Romantic Era
Ferguson   3 hours

060.610 What Is Baroque?
Halpern   3 hours

060.615 Shakespeare
Halpern   3 hours

060.619 Spenser and Ethics
Halpern   3 hours

060.624 The Body, Space, and Modernity in 19th Century Fiction
Thompson   3 hours

060.628 Literature of the Holocaust
Sundquist   3 hours

060.634 Richardson's *Clarissa*
Ferguson   3 hours

060.642 Theory and Practice of Education in the Late 18th and Early 19th Centuries
Ferguson   3 hours

060.646 History of Reading and Practical Criticism
Ferguson   3 hours

060.648 George Eliot
Anderson   3 hours

060.651 19th Century Realism: Theory and Practice
Anderson   3 hours

060.655 Gender and Modernity
Anderson   3 hours

060.659 Reading Early Modern Affect [From Humor to Passion]
Daniel   3 hours

060.661 Ralph Ellison and His Circle
Sundquist   3 hours

060.662 Edwards, Emerson, Thoreau
Cameron   3 hours

060.665-666 American Poetry
Cameron   3 hours

060.670 Henry James
Cameron   3 hours

060.671-672 Modern Poetry
Staff   3 hours

060.671 Tragedy and the Philosophy of Action
Halpern   3 hours

060.672 James Joyce
Mao   3 hours

060.673 Migrant Modernism
Mao   3 hours

060.675 The Political Topography of the 19th-Century Novel
Anderson   3 hours

060.677 Poetry as Genre, Poetry as Text
Nealon   3 hours

060.678 Melville, Poe, Hawthorne
Cameron   3 hours

060.681 Literary Theory
Staff   3 hours

060.691 Modernism and the Place of Utopia
Mao   3 hours

060.713 Readings in Psychoanalytic Theory
Halpern   3 hours

060.716 Marxist Aesthetics
Halpern   3 hours

060.800 Independent Study

060.893-894 Individual Work

060.895-896 The Journal Club
All graduate students of the department convene with the faculty to hear and discuss a dissertation chapter by an advanced graduate student who is on the job market.

Environmental Science and Engineering

Environmental problems are among the most urgent facing our society. In order to manage Earth's environment effectively, we must understand the processes that shape Earth's surface, control the chemistry of our air and water, and produce the resources on which we depend. Solutions to environmental problems require contributions from a range of disciplines, from engineering to geology to economics and public policy, and from physics to biology and chemistry. Those with a strong background in supporting disciplines, as well as an ability to understand the different facets of environmental issues, will be best positioned to successfully address these problems.

The Department of Earth and Planetary Sciences (EPS) and the Department of Geography and Environmental Engineering (DOGEE) offer two majors and four minors in the areas of environmental science and engineering, providing opportunities for students from a wide range of backgrounds and interests.

Majors

The Global Environmental Change and Sustainability (GECS) major is an interdepartmental program hosted in EPS for students interested in the science and policy issues related to global environmental issues and sustainability. It introduces students to the science of the Earth and its living and nonliving systems as well as how humans interact with Earth and its natural systems and how humans can use a variety of tools, such as policy, communication, individual and societal behavior change, and law to harm or help those systems.

The Environmental Engineering major (DOGEE) is for undergraduates interested in an engineering degree. The major combines a core program in mathematics, science, and engineering with concentrations in environmental management and economics, environmental engineering science, environmental transport, and environmental health engineering.

Minors

The GECS minor will provide the core Earth and Environmental Sciences content that students majoring in other disciplines would need to have a basic understanding of the science of the Earth and interactions between Earth's living and nonliving systems. By pairing the core science requirements with relevant Social Science content, the minor should allow students to acquire the knowledge base they need. By applying the content and methodology from their major discipline to what they learn in the GECS minor, students will be better prepared to live, work, and study in our changing world. This minor will be especially beneficial for students pursuing majors in Economics, Chemistry, Political Science, Biology, or Sociology.

The Environmental Sciences minor (DOGEE) is for undergraduates majoring in other science or engineering disciplines who wish a scientific introduction to the physical, chemical, and biological processes that control natural environments or to the application of engineering solutions to environmental problems.

The Environmental Engineering minor (DOGEE) offers undergraduate students majoring in engineering disciplines the opportunity to incorporate environmental engineering into their educational programs.

The minor in Engineering for Sustainable Development (DOGEE) offers undergraduates majoring in an engineering discipline the opportunity to learn about sustainability options and issues particular to either a certain region of the world or in a public health medium. Please contact Dr. Erica Schoenberger (ericas@jhu.edu) for more information on this minor.

Detailed descriptions of the above programs are given under Earth and Planetary Sciences (Krieger School of Arts and Sciences) and under Geography and Environmental Engineering (Whiting School of Engineering).

Film and Media Studies

Film and Media Studies is an undergraduate program incorporating courses in film history, aesthetics, and theory; theory and practice in television, popular culture, and new media; and all aspects of 16mm film and digital video production, including courses in screenwriting and animation, and narrative, documentary, and experimental film. Our mission is to give our students comprehensive preparation in film and media, enabling them to realize their scholarly and professional goals by offering excellent instruction in small classes, intensive hands-on experience, and individual mentoring. In addition, we encourage students to take a broad range of courses in the arts and humanities, in the belief that their creativity will be informed by a deep knowledge of history, the arts, and culture. Upon graduation, many of our students pursue careers in some aspect of film or media, or plan to attend graduate film school before entering the profession. Others pursue careers in a wide variety of professions, including music or drama, journalism, entertainment law, or business.

Director

Jean McGarry, Professor (Writing Seminars): Literature, Fiction Writing.

Associate Director

Linda DeLibero (Film and Media Studies): film history and criticism, American cinema.

The Faculty

Lucy Bucknell, Senior Lecturer (Film and Media Studies): film genres, screenwriting, American film.

Mark Lapadula, Lecturer (The Writing Seminars): screenwriting.

Richard A. Macksey, Professor Emeritus (Humanities Center, Writing Seminars, History of Science, Medicine, and Technology): film studies, critical theory.

John Mann, Senior Lecturer (Film and Media Studies): film production, documentary film theory.

Anne Eakin Moss, Visitng Assistant Professor (The Humanities Center): Soviet and Russian cinema, film theory.

Matthew Porterfield, Lecturer: film production, screenwriting.

Suzanne Roos, Lecturer (German and Romance Languages and Literatures): French cinema, cultural theory.

Robert Roper, Visiting Associate Professor (Film and Media Studies): screenwriting.

Meredith Ward, Lecturer: film theory, media studies.

Karen Yasinsky, Lecturer: visual arts, animation, photography.

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 48.)

The major in film and media studies is designed to enable students to understand the history of film and media forms, to think critically about them, and to gain hands-on experience in how they are made.

Majors often participate in the Hopkins Film Society, including the planning and organization of regular film series and the Hopkins Film Festival; HopkinsCinematics, our student-run film blog; and *Frame of Reference*, our journal of film and media. Students are encouraged to pursue a variety of internship opportunities in the film and media industries.

The following courses are required for completion of the film and media studies major:

- Thirty credits to be taken outside humanistic studies in the areas of social and behavioral sciences, quantitative studies, natural science, or engineering science.

- Introduction to Cinema I and II (061.140, 061.141).

- One of two introductory production/visual theory courses: Introduction to Visual Language (061.145) or Introduction to Film Production (061.150).

- At least two of the following courses: Film Genres (061.244); Introduction to Film Theory (061.245); any of several Special Topics in Film and Media (061.220-45).

- An area of emphasis comprised of three related courses outside the program, ideally in an area that can be brought to bear on the study of film or media in significant ways. Such clusters could be imagined, for instance, as focusing on other media and art forms (for example, photography, writing, the visual arts, literature, theater); cross-disciplinary topics or sets of problems (for example, the urban environment, violence and pornography, censorship, copyright and industry regulation, concepts of the public sphere, or globalization); or subfields within area studies (for example, Women and Gender, African-American, or Jewish Studies) and traditional disciplines, such as history, anthropology, philosophy, or political science. Students develop emphasis in

consultation with the Associate Director of Film and Media Studies.

- Seven courses at the 300- or 400-level.
- One 500-level course, either an internship or an independent study.
- Two semesters of a foreign language at the elements level or one at the intermediate level.

Film and Media Studies Minor

Students may develop a minor from seven courses in film and media studies. These must include:

- One semester of Introduction to Cinema, 1892-1941, or Introduction to Cinema, 1941-present.

Two of the following:

- Introduction to Visual Language (061.145)
- Film Genres (061.244)
- Introduction to Film Theory (061.245)
- Special Topics in Film and Media (061.220, 061.246, 061.255)
- Four 300-level coures, excluding production courses

Courses

Please refer to the departmental course listings for more information regarding the following courses.

Film and Media Studies

061.140 (H,W) Introduction to Cinema, 1892–1941
Staff   3 credits   lab fee $40

061.141 (H,W) Introduction to Cinema, 1941–present
Staff   3 credits   lab fee $40

061.145 (H) Introduction to Visual Language
Yasinsky   3 credits   lab fee $40

061.150 (H) Introduction to Film Production
Mann/Porterfield   3 credits   lab fee $100

061.151 (H) Introduction to Animation
Yasinsky   3 credits

061.230 (H) Intermediate Film Production
Mann/Porterfield   3 credits   lab fee $100

061.244 (H,W) Film Genres
Bucknell   3 credits   lab fee $40

061.245 (H) Introduction to Film Theory
Ward/Roos   3 credits   lab fee $40

061.246 (H,W) Special Topics in Film and Media
Staff   3 credits   lab fee $40

061.301 (H) Advanced Film Production
Mann/Porterfield   3 credits   lab fee $100

061.306 (H) Advanced Animation
Yasinsky   3 credits   lab fee $100

061.308 (H) Experimental Video
Yasinsky   3 credits   lab fee $40

061.309 (H) Film and Haiku
Mann   lab fee $100

061.312 (H,W) Writing the Screenplay
Roper   3 credits

061.313 (H,W) Story and Character Design for the Screenplay
Bucknell   3 credits   lab fee $40

061.315 (H,W) Screenwriting by Genre
Bucknell   3 credits   lab fee $40

061.320 (H,W) Silent Masterpieces
Staff   3 credits   lab fee $40

061.323 (H) Masculinities
Bucknell   3 credits   lab fee $40

061.324 (H) The Decadent Black and White
Roper   3 credits   lab fee $40

061.328 (H,W) Gangster Films
Bucknell   3 credits   lab fee $40

061.334 (H,W) Technology in Hollywood Film
Bucknell   3 credits   lab fee $40

061.337 (H,W) Films of the Fifties
Bucknell   3 credits   lab fee $40

061.338 (H) Russian Cinema from Avant-Garde to Socialist Realism
Moss   3 credits   lab fee $40

061.345 (H) Primitive Film
Mann   3 credits   lab fee $100

061.346 (H) Drawing Animation
Yasinsky   3 credits   lab fee $40

061.347 (H) Writing with Light
Staff   3 credits   lab fee $100

061.348 (H) Narrative Productions
Porterfield   3 credits   lab fee $40

061.350 (H) Practicum in Online Media/Journalism
Livingston   3 credits   lab fee $40

061.352 (H) Media Workshop: Theory and Practice
Porterfield, Ward   3 credits

061.353 (H) Documentary Film Production: Cities and Fields
Mann   3 credits

061.361 (H,W) Documentary Film Theory: The Work of Documentary in the Age of Reality Reproduction
Mann   3 credits   lab fee $40

061.362 (H,W) American and European Experimental Film
Mann   3 credits   lab fee $40

061.364 (H,W) Hitchcock and Film Theory
DeLibero   3 credits   lab fee $40

061.365 (H) The New Hollywood: American Films of the Seventies
DeLibero   3 credits   lab fee $40

061.367 (H) Bresson and Ophuls: Two Masters of Form
Roos   3 credits   lab fee $40

061.390 (H) The Actor in Hollywood
DeLibero   3 credits

061.401 (H) Dance for the Camera
Mann   3 credits   lab fee $100

061.402 (H, W) Critical Approaches to Contemporary Film
DeLibero   3 credits

061.412 (H,W) Kubrick and His Critics
DeLibero   3 credits   lab fee $40

061.413 (H) Lost and Found Film
Mann   3 credits   lab fee $40

061.420 (H) The French New Wave
Roos   3 credits   lab fee $40

061.440-441 (H) Senior Project in Film Production
Mann   3 credits

061.442-443 (H) Senior Project in Digital Video Production
Staff   3 credits   lab fee $100

061.501-502 Independent Study in Film and Media Studies
Staff

061.503-504 Independent Study in Film Production
Mann   lab fee $100

061.505-506 Internship in Film and Media
DeLibero   S/U

German and Romance Languages and Literatures

211.409 (H) La Nouvelle Vague
Roos   3 credits

211.411 (H) Introduction au Cinéma Français
Roos   3 credits   lab fee $40

The Humanities Center

300.349 (H) The Cinema of Andrei Tarkovsky
Moss   3 credits

300.366 (H,W) Avant-Garde Cinema
Moss   3 credits

The Writing Seminars

220.336 (H,W) Art of the Screenplay
Lapadula   3 credits

The Department of German and Romance Languages and Literatures

The Department of German and Romance Languages and Literatures offers graduate and undergraduate courses in the languages, literatures, and cultures of France, Germany, Italy, Portugal, Latin America, and Spain. The language program includes a wide range of courses from introductory through conversation and composition to civilization. The literature program treats all periods of literature from both historical and critical-theoretical perspectives. These courses emphasize the close reading of texts and modern theories of literary criticism, particularly those based on contemporary philosophy, psychoanalysis, anthropology, and linguistics. In addition, an active program of visiting professors and lecturers complements the core program offered by the faculty-in-residence.

The Faculty

Nadia Altschul, Assistant Professor: Spanish medieval literature.

Bruce Anderson, Lecturer: French Language and Culture.

Wilda Anderson, Professor: French Enlightenment literature, science and literature.

Flavia Azeredo, Lecturer: Portuguese Language.

Mary M. Bensabat-Ott, Portuguese Language Director, Senior Lecturer: Brazilian culture.

Andrew Marc Caplan, Assistant Professor: Tandetnik Professor of Yiddish Literature, Language, and Culture.

Beatrice Caplan, Lecturer: Yiddish Language and Culture.

Sara Castro-Klarén, Professor: Latin-American literature, colonial studies, contemporary novel.

Christopher Celenza, Professor: Italian literature, Director, Charles Singleton Center for the Study of Pre-Modern Europe.

James Coleman, Visiting Assistant Professor: Italian literature.

Kristin Cook-Gailloud, French Language Director, Lecturer: French.

William Egginton, Andrew W Mellon Professor in the Humanities: Spanish and Latin American literatures (Chair).

Pier Massimo Forni, Professor: Italian literature and culture.

Paula Gefaell Borrás, Lecturer: Spanish Language.

Eduardo González, Professor: Latin American literature, film and media studies.

Claude Guillemard, Senior Lecturer: French.

Veronika Jicinska, Lecturer: German Language.

Andrea Krauss, Assistant Professor: German.

Deborah McGee Mifflin, German Language Director, Associate Teaching Professor.

Aranzazu Moreno Hubbard, Lecturer and Coordinator advanced-levels Spanish Language.

Jacques Neefs, Professor: genetic criticism, 19th- and 20th-century literature, theory of the novel.

Stephen G. Nichols, James M. Beall Professor Emeritus of French and Research Professor: medieval language, literature, and culture, interrelation of literature with history, philosophy, and art history.

Katrin Pahl, Assistant Professor: German.

Maria del Rosario Ramos, Lecturer and Coordinator of Advanced Spanish.

Suzanne Roos, High Intermediate French Course Coordinator, Senior Lecturer, MLN Managing Editor: French cinema and theory.

Elena Russo, Professor: interrelations of Enlightenment philosophy and literature.

Tiphaine Samoyault, Professor: French Literature.

Loreto Sánchez-Serrano, Spanish Language Director, CALL Specialist, Associate Teaching Professor.

Harry Sieber, Professor: Renaissance and Baroque literature of Spain.

Walter Stephens, Charles S. Singleton Professor of Italian: medieval and Renaissance literature and its relation to philosophy and theology.

Elisabeth Strowick, Associate Professor: German.

Rochelle Tobias, Professor: German.

Michelle Tracy, Spanish Elements Course Coordinator, Lecturer.

Sue Waterman, Lecturer: research methods.

Bernadette Wegenstein, Research Professor: media theorist; Director: Center for Advanced Media Studies.

Barry Weingarten, Intermediate Spanish Course Coordinator, Senior Lecturer.

Heidi Wheeler, Vice Coordinator of German Language Instruction, Senior Lecturer.

April Wuensch, Senior Lecturer: French.

Alessandro Zannirato, Italian Language Director, Associate Teaching Professor.

Joint Appointments

Eckart Förster, Professor of Philosophy.

Richard Kagan, Professor of History.

Todd Shepard, Associate Professor of History.

Susan Weiss, Professor of Musicology.

Associates

Alain Boureau, Professor (École des Hautes Etudes en Sciences Sociales): medieval intellectual history.

Bernard Cerquiglini, Professor (Université de Paris VII): philosophy of language, linguistics, and history of language.

Jacqueline Cerquiglini-Toulet, Professor (Université de Paris IV): medieval literature.

Roger Chartier, Professor (École des Hautes Etudes en Sciences Sociales): history of the book and print culture in early modern Europe.

Hent deVries, Professor (Humanities Center): modern European thought, history and critique of metaphysics, philosophies of religion, political theologies, concepts of violence, literature and temporality.

Claude Imbert, Professor (École Normale Supérieure, d'Ulm): logic, philosophy, philosophy of language, interrelation of literature and philosophy.

Peter Jelavich, Professor (History): modern European cultural and intellectual history.

Recent and Current Visiting Faculty

Jack Abecassis, Professor (Pomona College)

Leonard Barkan, Professor (Princeton)

Rip Cohen, Professor (Universidade Nova de Lisboa)

Danièle Cohn, Professor: French literature (École Normale Superieure)

Robert Davidson, Associate Professor (University of Toronto)

Wolfram Groddeck, Professor (University of Basel)

Uwe Hebekus, Professor (University of Konstanz)

Daniel Heller-Roazen, Professor (Princeton)

Giuseppe Mazzotta, Professor (Yale)

Christophe Menke, Professor (Universität Potsdam)

Claude Mouchard, Professor Emeritus (University of Paris 8 Vincennes-Saint-Denis).

Lydie Moudileno, Professor (University of Pennsylvania)

François Noudelmann, Professor (Université Paris VIII)

Brian Reilly, Assistant Professor

Thomas Schestag

Jacob Vance, Assistant Professor (Emory University)

Klaus Weimar, Professor (University of Zürich)

Sergio Zatti, Professor (University of Pisa)

Faculty Emeriti

Lieselotte E. Kurth, Professor Emerita.

Paul Olson, Professor Emeritus.

Facilities

The Milton S. Eisenhower Library has collections that provide an ample basis for advanced research in the German and Romance languages and literatures. With the Peabody Library of The Johns Hopkins University in Baltimore and the Library of Congress and other libraries in nearby Washington, a variety of excellent research resources are available to students and faculty.

Undergraduate Programs

Overview

A major in the department prepares students for teaching language at the elementary level or for graduate work leading to advanced degrees in French, German, Italian, Latin American, Portuguese, or Spanish studies, or in comparative literature. It also provides excellent background for work in fields such as philosophy, history, international affairs, business, law, or medicine. Opportunities are available to study abroad. Students are encouraged to take advantage of these opportunities.

Requirements for the B.A.

Currently, the B.A. is offered in French, German, Italian, Romance Languages, or Spanish. A candidate for the B.A. in the Department of German and Romance Languages and Literatures should have a good command of the spoken language of his or her specialization, and a general familiarity with the literature written in that language. The major requires *a minimum of 24 hours (or eight courses) beyond the first two years of language instruction.* The department also recommends that majors take courses in other literatures, history, philosophy, and anthropology. A grade of D is not acceptable in any course counted for the major.

The student who has had four years of German or a Romance language in high school or two years of German or a Romance language in college normally begins the major with Conversation and Composition (provided they have results commensurate with that level on the placement test) and (where offered) the undergraduate survey of literature. It is recommended that any student majoring in German or a Romance language spend at least one semester of junior year taking university courses in the country of study. Credit transfer is arranged by the student in consultation with the chair or Director of Undergraduate Study and/or the relevant undergraduate language coordinator, and the Office of Academic Advising. In the senior year, a major may be permitted to take courses in the department at the graduate level.

A minor in German or one of the Romance languages is available to undergraduate students in any major. Like the major, the minor allows students to develop competence in German or a Romance language while receiving grounding in the culture and literature of that language. Five or six courses in the department beyond the first two years of language study are required for the minor (see below for details).

French

The Major

Requirements consist of successful completion (a grade of C or higher) of language courses through 210.301-302 Advanced French I and II or equivalent placement; 212.333-334 Introduction à la littérature française I and II; a combination of at least five courses from the 211.300-400 and 212.300-400 series in French cultural studies and literature (taught in French), of which at least three must be from the 212.xxx offerings; 210.417 Eloquent French and 212.429 Senior Thesis Preparation, which are to be taken in the fall semester of the senior year and 212.430, the Senior Seminar, to be taken in the spring of the senior year. Summer language courses in elementary and intermediate Romance languages must be taken at Johns Hopkins Arts and Sciences Summer programs.

Please note that the final authority concerning the structure of the French major rests with the French section of GRLL. Besides fulfilling the generic requirements on the French major checklist from Academic Advising, students must choose their literature courses in consultation with their major advisor to ensure coherent and adequate coverage of the corpus of French cultural and literary works. The decision as to which courses may count for a particular student's major is the responsibility of the student's French major advisor or, in his or her absence, that of the DUS of French. Honors in French will be granted to students whose course work for the French major is completed at a GPA of 3.7 or higher.

Note about courses taken in study abroad programs:

Please note that as of the class of 2013, a maximum of 2 courses in the upper-level culture or literature fields can count toward the minimum requirements for the major. Other courses can count only as additional transfer credits or as the equivalent of either Introduction à la littérature I or II. Three courses must be taken in the department, at least two of which are upper-level literature courses beyond Introduction à la littérature I & II. Any course that a student wishes to substitute for a JHU course must be pre-approved by the student's French advisor or the DUS of French before departure for the study abroad program and re-approved by their French advisor or the French DUS upon return to JHU and upon submission of ALL materials from the course. As courses for which students pre-approve are often not offered once the student enrolls in France, students must keep in contact with their French advisor or the DUS of French during the initial weeks of their stay to ensure pre-approval for their final program. For further information about study abroad credits, please see the study abroad page on the GRLL website (http://grll.jhu.edu/french/study-abroad).

Minor in French Literature

Requirements consist of seven courses beyond 210.201-202 (Intermediate French) or 210.203-204 (High Intermediate French). These courses must include two semesters of 210.301-302 (Advanced French I and II), and both semesters of 212.333-334 (Introduction à la littérature française I and II). In consultation with either the DUS or a student's chosen French minor advisor, students must choose at least two courses in the 212.300-400 series and one more, which may be from the 212. 300-400 series, the 211.300-400 series, or 210.417 Eloquent French. A grade of "C" or better must be earned in required courses, which may not be taken S/U. Minor requirements can be used to meet the University distribution requirements. Please see the GRLL department website study abroad page for restrictions concerning counting study abroad courses for minor credit.

Minor in French Cultural Studies

Minor in French Cultural Studies requirements consist of six courses beyond 210.201-202 (Intermediate French) or 210.203- 204 (High Intermediate French), and must include two semesters of 210.301-302 (Advanced French I and II), one semester of 211.401-402 (La France Contemporaine), two additional courses from the 211.3xx-4xx series and/or 212.3xx-4xx series and either 210.428 Eloquent French or 210.415 Real French. A grade of "C" or better must be earned in required courses, which may not be taken S/U. Minor requirements can be used to meet the University distribution requirements. Please see the GRLL department website study abroad page for restrictions concerning counting study abroad courses for minor credit.

French Government Diplomas in Business, Legal, or Scientific French

Students who desire an official diploma from the Chambre de Commerce et d'Industrie de Paris certifying their competence in business French (le français des affaires), legal French (le français juridique), or scientific French (le français des professions scientifiques et techniques) can take one or more of the appropriate course sequences leading to the official examination for certification.

German

The Major

Students majoring in German must become reasonably proficient in the language and acquire a good knowledge of German literature and some familiarity with the culture and history of the West. Twenty-seven credits (nine courses) are required for the major, beyond 210.161-162 Elementary German and also beyond two semesters of second-year courses (210.261-262). The required Advanced German sequence (210.361-362) counts toward the major. The department strongly advises its majors to gain a knowledge of a second foreign language, either ancient or modern.

Minor

Students minoring in German will need 18 credits in German language and literature beyond the second-year of language instruction (210.261-262). Students who plan to minor in German should declare their intention before the beginning of their junior year.

B.A./M.A. Degree

The department offers highly qualified students the option to complete a combined degree in five years. To receive the B.A./M.A. degree, the student must complete advanced courses in German literature and pass the departmental written and oral master's examinations. Students interested in this option should make an appointment with the director of undergraduate studies no later than the spring of their junior year to discuss the options available to them.

Honors Program

The Department of German offers an Honors Program for highly qualified undergraduates. Students must have a minimum GPA of 3.5 to qualify for the program. Students will work on a project in German literature and thought under the guidance of a faculty advisor. The program is completed by a senior essay more comprehensive in scope than a seminar paper. Students interested in the honors program should meet with the director of undergraduate studies no later than the spring semester of their junior year to discuss the requirements and outline the research project to be conducted the following year.

Italian

The Major

Requirements consist of successful completion of language courses through 210.251-252 Intermediate Italian or equivalent placement; and eight courses from the 211.300-400 Italian Civilization series and 212.200-400 Italian literature series. Two courses in Italian films or film-making, Italian history, or art history are acceptable toward the minimum eight semester courses. Two independent studies are acceptable toward the requirements, but they must be taken after a third-year literature course. It is possible to include among the courses required for the major no more than two courses of Italian literature in translation, with the understanding that substantial readings in these courses are done in the original language.

The Minor

Requirements consist of successful completion of language courses through 210.251-252 Intermediate Italian or equivalent placement. Six courses beyond the first two years of language instruction must include 210.351-352 (Advanced Italian Conversation and Composition I and II). At least three of these six courses must be in Italian. No more than one independent study is permitted to count for the minor. The independent study must be taken after a third-year literature course and have the approval of the sponsor and written consent from the director of undergraduate studies.

Portuguese

The study of Portuguese gives you access to the diverse cultural and literary worlds of Brazil, Portugal and the Portuguese-speaking African and Asian countries. In fact, Portuguese is the third most spoken European language, and the most widely spoken language in South America. Today, there are more than 200 million native Portuguese speakers throughout the world from Angola to Brazil and from Portugal to the distant island nation of East Timor in the Pacific. The Portuguese program in the Department of German and Romance Languages and Literatures offers not only the three levels of language training, but also a growing number of courses on literature as well as the culture and civilization of Brazil.

Romance Languages Major

Students may complete a Romance language major in one of two configurations: by specializing in two of the Romance languages offered by the department, or by majoring in two Romance languages and minoring in a third.

The options are configured as follows:

Dual Language Options

Satisfy two languages as described below:

French

210.301-302 Advanced French I and II
212.333 Intro La Lit Française I *or*
212.334 Intro La Lit Française II
Three upper-level courses plus senior thesis or indpendent study

Spanish

210.311-312 Advanced Spanish I and II
215.231 Intro to Spanish Literature
Three upper-level courses plus independent study

Italian

Six upper-level courses (beyond Intermediate 210.252) plus independent study

Three Language Options:

Language I:

If French: Advanced French I and II
If Spanish: Advanced I and II
If Italian: competency through Intermediate II

Three Upper-Level Courses

If French: Intro La Lit Francaise I or II plus two additional upper-level courses
If Spanish: Intro to Spanish Literature plus two additional upper-level courses
If Italian: five upper-level courses

Language II:

If French: Advanced French I and II
If Spanish: Advanced I and II
If Italian: compentency through Intermediate II

Three Upper-Level Courses

If French: Intro La Lit Francaise I or II plus two additional upper-level courses
If Spanish: Intro to Spanish Literature plus two additional upper-level courses
If Italian: five upper-level courses

Language III:

If French: Advanced French I and II
If Spanish: Advanced I and II

If Italian: competency through Intermediate I
If Portuguese: Advanced Portuguese I and II

Two Upper-Level Courses

If French: Intro La Lit Française I or II plus one additional upper-level course
If Spanish: Intro to Spanish Literature plus one additional upper-level course
If Italian: four upper-level courses
If Portuguese: Brazilian Culture and Civilization plus Contemporary Latin American Novel and Short Story

Spanish

The Major

Requirements consist of successful completion, with a grade of B or better, of language courses through 210.212 Intermediate Spanish II or 210.213 Advanced Intermediate Spanish, or equivalent placement; 210.311 Advanced Spanish I; 210.312 Advanced Spanish II; 211.380 Modern Latin American Culture and/or 211.390 Modern Spanish Culture; 215.231 Introduction to Literature in Spanish; a combination of five courses from the 215.200-400 series, distributed between the cultures and literatures of Latin America and Spain. One of the five courses may be from another department such as Anthropology, History, Political Science, and so forth as long as it is on Latin America or Spain; 210.411 Spanish Translation for the Professions or 210.413 Curso de Perfeccionamiento may also count as one of these required courses. Students placing out of Advanced Spanish will take instead a 215.xxx literature or culture course. Native speakers should consult with the Spanish major advisor. It is strongly recommended that majors spend one semester abroad and/or attend summer or intersession programs. Currently, the department offers a fall program in Madrid, Spain, as well as the Argentina and Peru summer programs organized by the Program in Latin American Studies. Students are expected to consult with the Director of Undergraduate Studies, their department advisor, and the Office of Study Abroad prior to studying abroad.

The Minors

The minors in Spanish language and cultures will consist of six courses beyond the 210.212 Intermediate Spanish II level as explained below in the description of the two possible tracks a student may follow. It is also recommended that Spanish minors study abroad for a semester, a summer, or an intersession. With the approval of the Director of the Spanish Language Program, only two Spanish language courses taken abroad (in programs

other than Johns Hopkins programs) or at another accredited institution may be applied toward the minor, and only one additional Spanish language course will be approved for credit (but this course will not count toward the minor). Students may choose one of these two specialized minors: Spanish for the Professions or Spanish Language and Hispanic Cultures.

Spanish for the Professions

Students must complete six courses beyond 210.212 Intermediate Spanish II that must include the following: 210.311 Advanced Spanish I and 210.312 Advanced Spanish II or 210.317 Advanced Spanish Composition; one of the following three courses: 210.313 Medical Spanish, 210.314 Business Spanish, or 210.315 Legal Spanish; plus 210.411 Spanish Translation for the Professions; and 210.412 Spanish Language Practicum. The sixth course may be selected from 210.413 Curso de Perfeccionamiento or 211.380 Modern Latin American Culture or 211.390 Modern Spanish Culture or any course from the 215.200-400 Spanish Literature series. Students placing out of 210.311 Advanced Spanish I should take instead a 215.xxx literature class. This minor is not open to native speakers.

Spanish Language and Hispanic Cultures

Students must complete six courses beyond 210.212 Intermediate Spanish II that must include the following: 210.311 Advanced Spanish I and 210.312 Advanced Spanish II or 210.317 Advanced Spanish Composition; 215.231 Introduction to Literature in Spanish; and three additional courses to be chosen from 210.413 Curso de Perfeccionamiento or 211.380 Modern Latin American Culture or 211.390 Modern Spanish Culture or any course from the 215.200-400 Spanish literature series (at least one of them must be from the 300-400 level). Students placing out of 210.311 Advanced Spanish I should take instead a 215.xxx literature class. Native speakers should consult with the Spanish minor advisor.

Study Abroad in Madrid, Spain

The Department offers the following courses as part of the study abroad program in Madrid, Spain (Universidad Carlos 3):

215.340 Modern Spanish Literature

This course covers some representative Spanish literary works of the twentieth century, and is divided into four sections: pre-Civil War texts (1900–1939), post-Civil War texts (1939–1975), the literature of the Transition (1975–1982), and contemporary literature (1982–2008). Ramón de Valle-Inclán, Miguel de Unamuno, Federico García Lorca, Antonio Buero Vallejo and Adelaida Gar-

cía Morales are some of the authors whose work will be studied. Three exams and a short research paper in addition to class attendance and participation are required.

215.342 Twentieth-century Latin American Literature

The object of this course is to familiarize students with representative literary works of authors such as Horacio Quiroga, Juan Rulfo, Ernesto Sábato, Jorge Luis Borges, Pablo Neruda and Garbriel García Márques, among others. Discussions of literary historical tendencies, esthetic conceptions and narrative techniques will be based on close reading of assigned works. Two exams and two papers in addition to class attendance and participation are required.

215.412 Spanish Theater

This course will cover the development of the history of Spanish theater: authors, esthetic tendencies and historical and cultural contexts. From the early period, the reading of Calderón de la Barca's *La vida es sueño* introduces the student to Golden Age Spanish Theater, which will be discussed in the context of the *corales de comedias,* Spanish society and culture. The emphasis of the course, however, is placed on more recent Spanish theatrical works by authors such as Ramón de Valle-Inclán, Alfonso Sastre, Sanchis Sinisterra and Alonso de Santos. A short essay is required on the Golden Age section of the course; a second (voluntary) paper will analyze Valle Inclán's *Luces de bohemia.* There will be a final exam. Attendance and participation are required.

215.305 Spanish Art

Spanish Art covers architecture and art from earliest times. The course is divided into three sections: architecture and urbanism in Spain from antiquity to the twentieth century, Spanish painting from Mannerism to the nineteenth century, and contemporary painting and sculpture. Visits to various museums in Madrid—The Prado, Reina Sofía, Sorolla—are included and required. Class assignments, attendance, demonstrated interest and class participation count heavily toward the final grade. There is also a final exam.

211.290 Modern Spanish Culture

Spanish culture will be studied in its historical and social contexts between 1931 and 1982. Movies, textbooks, popular music, photography, posters, literary works and cen-sorship and the Movida Madrileña will constitute the material studied before and after Franco's dictatorship. Visits to museums (Reina Sofía) and monuments (Valle de los caídos) are an integral part of the course. A final paper and exam are required, as is class attendance and participation.

Graduate Programs

Overview

In addition to general university requirements for the Ph.D., the following regulations apply to graduate students in the Department of German and Romance Languages and Literatures.

To be accepted into the Ph.D. program, students must demonstrate by an exceptionally strong academic record that they are capable of advanced study in literature. They will choose French, German, Italian, Latin American, or Spanish literature as the major field of interest. The student will normally take three years of graduate courses and devote the fourth year to study and research in the country on which the student's study concentrates. The well-prepared student can expect to receive the Ph.D. after five years of study. The graduate program in German and Romance Languages and Literatures emphasizes work in three complementary areas: literary history, close textual analysis (including *explication de texte*), and theory of interpretation. By way of preparing students in a variety of critical schools, the faculty and the visiting professors offer training in the different disciplines pertaining to critical theory, including philosophy, theory of language, psychoanalytic theory, intellectual history, and cultural anthropology.

In addition to the major language, the Ph.D. candidate must demonstrate proficiency in one or two other languages besides English, depending on the specialization. (See below for further information.)

A dissertation proposal, presented to the Department Seminar, is required before official admittance to candidacy for the Ph.D.

Requirements for the M.A. degree

The department does not accept applications for the M.A. degree as a terminal degree. However, an M.A. is available to Ph.D. students in other departments who complete eight graduate seminars in the Department.

French

For students who choose to specialize in an early modern period (medieval, Renaissance, or 17th century), proficiency in Latin is required by the end of the third semester. Students may also choose a minor field: another Romance literature, modern criticism, comparative literature, medieval studies, or some other field connected with the student's major field.

German

In addition to fulfilling the general university requirements for advanced degrees, candidates for the M.A. must demonstrate fluency in spoken German, be able to write German reasonably well, have a good knowledge of the history of German language and literature, be familiar with the general cultural background, and have read extensively in German literature, particularly in the periods after 1700. During their first two years at Hopkins,

candidates for the M.A. degree must pass a series of three topical examinations. After the M.A., two major qualifying papers are required under the supervision of two advisors, chosen by the candidate, before work on the dissertation can be undertaken.

Latin American

In addition to the major language, the student must demonstrate proficiency in French and in one other foreign language. The student must take a minimum of four semesters of graduate courses. After this period, normally in the third year, the student will take four field examinations which, if completed successfully, will lead to candidacy for the Ph.D.

Italian

In addition to the major language, the student must demonstrate proficiency in French and in one other foreign language. The student must take a minimum of five semesters of graduate courses. After this period, normally in the third year, the student will take examinations which, if completed successfully, will lead to candidacy for the Ph.D.

Portuguese

There is currently no formal Ph.D. program in Portuguese. Interested applicants should contact the chair or vice chair of the department for details.

Spanish

In addition to the major language, the student must demonstrate proficiency in French and in one other foreign language. The student must take a minimum of five semesters of graduate courses. After this period, normally in the third year, the student will take four field examinations which, if completed successfully, will lead to candidacy for the Ph.D.

Graduate Study Abroad

The Department of German and Romance Languages makes graduate study and research abroad one of the hallmarks of its graduate programs. The opportunity of working closely with some of the most eminent figures in one's field in Europe or Latin America is not a dream but a reality in our programs. Students usually go abroad in their third or fourth year, when they are ready to begin researching their thesis. Eminent scholars from abroad routinely work with our students, often serving as co-directors for their thesis in association with their Hopkins advisor. German and Romance Languages

and Literatures graduate students do not have to teach in a foreign university when they go abroad; they take courses and engage in research for their thesis. The department has fellowships at the Ecole Normale Supérieure (rue d'Ulm) in Paris. In addition, the University of Geneva offers a fellowship each year. Exchange programs with the University of Hamburg, the Humboldt University, and the University of Münster offer the opportunity for graduate students to study in Germany. In addition, a special agreement with the University of Konstanz offers the possibility of spending up to a year in the Graduiertenkolleg and the regular programs at Konstanz; students are encouraged to work with faculty of both institutions. Research fellowships also exist for Spain, Latin America, and Italy.

Financial Aid

The department has a number of fellowships for graduate students. Awards include university fellowships, which carry stipends and teaching fellowships currently set at $20,000 per academic year for teaching one section of an undergraduate language course each semester, in addition to remission of tuition fees. Each year, one entering graduate student in Italian receives a Charles S. Singleton fellowship, which provides full tuition, fees, and stipend, in lieu of a Gilman teaching fellowship. All graduate students are expected to do four years of apprentice teaching of elementary and intermediate level undergraduate courses as part of their professional preparation. The amount of classroom teaching required is usually three to four hours a week. Students are admitted for five years, fully funded, subject to annual review to assure satisfactory progress. In addition, stipends (equivalent to that year's teaching fellowship) are available for study abroad during the third or fourth year.

Fourth-year graduate students may also compete for Dean's Teaching Fellowships, which provide opportunities for the design and teaching of undergraduate courses in literature, cultural studies, or intellectual history.

Graduate students conducting research in Italian studies compete each year for two Charles S. Singleton Travel Grants for study in Italy. This program is administered by the department and is open to graduate students from other departments.

Application Procedures

Prospective graduate students may visit the departmental website at **http://grll.jhu.edu** for further information on programs and faculty. All questions regarding the programs offered by the department should be emailed to grll@jhu.edu. Prospective students are encouraged to apply online through the secure Graduate Admissions website (**https://app.applyyourself.com/?id=jhu-grad**).

Undergraduate Courses

Please note that all language courses are numbered with the prefix 210. All civilization courses are numbered with the prefix 211. All literature courses are numbered with a prefix of 212(French), 213(German), 214 (Italian) or 215(Spanish).

Language and Civilization

French

Final placement in all language courses will be determined either by Webcape (web-based placement examination), to be taken in the computer lab during orientation week and in the department office at other times, or by the previous completion of a French class at Hopkins.

210.101-102 French Elements
The elements, or beginning, French program provides a multifaceted approach to teaching language and culture to the novice French student. From the first day, the students are "immersed" in a linguistically rich environment with French as the primary language of the classroom.
The emphasis of the course is on aural-oral proficiency without neglecting the other basic skills of grammar structure, phonetics, reading, and writing. Year course; both semesters must be completed with passing grades to receive credit. May not be taken on a satisfactory/unsatisfactory basis. Prerequisite: no previous knowledge of French, or appropriate score on Webcape.
Guillemard   4 credits

210.103 Learner Managed French Elements I
This intensive, three-week course is only offered during Intersession for 3 credits and letter grade. It is not intended for true beginners but for students with some French background who will join the regular French Elements II course in the spring: it offers a fast-paced review of the fall semester of French Elements. Major online component supplements in-class instruction. Students must be self-motivated and know how to work independently. bMust complete the year by taking French Elements II 210.102 in order to receive credit. Pre-requisite: score below 270 on Webcape (mandatory online placement test)
Guillemard   3 Credits

210.201-202 (H) Intermediate French
A two-semester course conducted entirely in French, this course develops skills in speaking, listening comprehension, reading, and writing through multimedia material. Extensive study of films and readings from French-speaking countries. Prerequisites: 210.101-102 or 210.103-104 or appropriate score on Webcape exam.
Roos   3 credits

210.203-204 (H) High Intermediate French
A two-semester intermediate course offering a systematic review of language structures, conducted exclusively in French. This course is for students who can express themselves more fluently in both their written and oral work and can analyze more difficult texts than in Intermediate French. Students will study authentic texts, including film "text," and focus on their written and oral skills. This is a reading- and writing-intensive course. Prerequisites: grade of A in 210.101-102, or appropriate score on Webcape exam. Credit will not be given if previously enrolled in 210.201-202 or the equivalent.
Wuensch   3 credits

210.205 (H) Introduction to Phonetics
Designed for intermediate-advanced students seeking to improve their French pronunciation through intensive oral practice, this course will also explore the different accents of France and the Francophone world.
Staff   3 credits

210.301-302 (H,W)) Advanced Writing and Speaking in French I, II
This very interactive third-year language course proposes, in the shape of animated class discussions, to 1) read fictional and non fictional texts through the French explication de textes approach 2) review and develop grammar and conjugation skills 3) learn an array of new vocabulary as well as idiomatic expressions used in everyday speech. Focus will be placed on improving language skills through an individualized review of grammar and vocabulary.
Cook-Gailloud   3 credits

210.405 (H) French Teaching in Public School
Offers advanced students an opportunity to participate in the partnership between JHU and a neighboring elementary school: they will teach French to young students twice a week. Weekly meetings will help prepare the off-site sessions and analyze social and pedagogical issues. Student will keep a journal of their experience and submit a final report. Discussions and writing entirely in French. Prereqs: at least one semester of 211.401-402 or 212.201-202. Freshmen by permission only.
Guillemard   3 credits

210.417 (H, W) Eloquent French
This highly interactive, writing intensive course places emphasis on: 1) providing students with linguistic tools that will help them reach a high level of written proficiency (advanced lexical, stylistic and idiomatic expressions, linking words used to develop and enrich complex sentences, stylistic and grammatical differences between

French and English) 2) enhancing students' analytical skills by introducing them to the French method of Explication de textes 3) teaching students to develop an academic style of writing by studying the different components of the dissertation française (introduction, problématique, argumentation, conclusion, utilisation de sources) 4) teaching students to develop their own style of writing. To that effect, we will study excerpts of French literary texts that deal with themes likely to enhance their own creative writing (lieux imaginaires, mémoire et autobiographie, création d'un personnage de roman, for example).
Cook-Gailloud   3 credits

210.500 (W) French Language Independent Study
Staff   3 credits

211.340 (H) Topics in French Cinema
This course will explore different topics in French cinema. This semester the course will focus on love, marriage, and sexuality in French films. Strong focus on discussion and analyses of film sequences in class and on oral presentations. Additional assignments will involve vocabulary and grammar study. Requirements for this course include completion of Conversation and Composition (after fall 2010, Advanced Writing and Speaking in French), or equivalent
Roos   3 credits

211.346 (H) 20th Century French Theater and Performance
Taught in English. In this course, we will survey the themes and techniques that marked the theory and practice of theater in France in the 20th century. As we make our way from the early century avant-garde movements such as Futurism and Surrealism to Antonin Artaud's Theater of Cruelty, from the Theater of the Absurd and mid-century existentialists to the post-1968 turn to collective authorship, our goal will be twofold: First, we will examine the prominent plays of the era as literary products, generated from within specific socio-political contexts. Second, we will attempt to re-construct their three-dimensional lives in performance, how they looked, sounded and felt to those watching. In addition, we will examine how French theater went from being a playwright-centered institution to a director-centered one, and how acting styles transitioned from psychological realism to a focus on the human body. Course materials will include plays, theoretical texts on the theater, as well as directors' manifestos, rehearsal notes, set and costume designs and filmed recordings of theatrical events. Cross-listed with Theatre Arts and Studies.
Staff   3 credits

211.401-402 (H) La France Contemporaine I, II
Both semesters are required for the minor in French culture. This course proposes to study contemporary French culture and society through newspapers, directed readings, French broadcast news and movies. Class discussions will focus on: political institutions, the notion of "Etat-Providence," immigration and the problem of the "banlieues," anti-Americanism, the European Union,

globalization, laicity, education, culture (and counter-culture), feminism, abortion, and gastronomy. We will also analyze important 20th century events that inform present day France, such as the "Front populaire," the WW2, the war with Algeria, decolonization, "mai 68." Prerequisites: 210.301-302 or 210.301 and permission of instructor.
Anderson, B   3 credits

211.405 French Doctors: Insights on 19th and 20th Century Medicine in France
The course presents past and present interactions between society and medicine in France. From Pasteur's discoveries to the development of humanitarian medicine, we will consider historical and political contexts of the 19th and 20th century France. We will discuss a broad range of readings, from Claude Bernard to Bruno Latour, and films, whenever appropriate. The course raises critical questions of how the evolution of medicine takes part in political issues and social change.
Staff   3 credits

211.414 Body as Vehicle: Antonin Artaud and the French 20th Century Approach to Theatrical Performance
From Greek tragedy to Balinese theater, Antonin Artaud revisits performance through the ritual and emotional experience of physical action on the stage. Hence, the actor's body operates as a bridge relating traditional forms of expression to theatrical performance, as well as a creative—and sensitive—source of emotions. This vehicle becomes in the hands of some 20th century practitioners an object of experimentation, inititating the concepts and practices of an Anthropology of the Theater: Artaud's "Theater of Cruelty" caused a scandal. A thorough study of his works, travels and turbulent life, reveals not only the philosophy of his theatrical approach, but also the way his revolutionary theories influenced theater practice in France and worldwide.
Staff   3 credits

211.420 (H) Real French: From Slang to Sophistication
This class will teach the realities of the French language as it is used in French-speaking countries, ranging from slang to more sophisticated forms of expression. We will study excerpts of films, literary works, television programs, political speeches, etc., in order to examine which level of speech is at work. Prerequisite: 210.301-302 or supplementary test or by permission.
Cook-Gailloud   3 credits

211.426 (H) Paris 1900: the Great World Exhibition and the Beginning of Modernism
This course proposes to examine the momentous world exhibition organized in Paris in the year 1900 along with the new technologies and concepts it introduced into the modern world: the first subway line in Paris, talking films on giant screens, escalators, moving walkways, the first large-scale exhibit of the rising Art nouveau, the first display of Picasso's painting on French territory, and even a presentation on the idea of television at the Palais de l'électricité. Our discussions will include the social, political, cultural and artistic events that led to this

pivotal moment which constituted an emblematic stepping stone between the old world and the new.
Cook-Gailloud   3 credits

211.428 (H) Eloquent French
This highly interactive, writing intensive course places emphasis on: 1) providing students with linguistic tools that will help them reach a high level of written proficiency (advanced lexical, stylistic and idiomatic expressions, linking words used to develop and enrich complex sentences, stylistic and grammatical differences between French and English) 2) enhancing students' analytical skills by introducing them to the French method of Explication de textes 3) teaching students to develop an academic style of writing by studying the different components of the dissertation française (introduction, problématique, argumentation, conclusion, utilisation de sources) 4) teaching students to develop their own style of writing. To that effect, we will study excerpts of French literary texts that deal with themes likely to enhance their own creative writing (lieux imaginaires, mémoire et autobiographie, création d'un personnage de roman, for example).
Cook-Gailloud   3 credits

211.430 L'affaire Dreyfus
Course will focus on the socio-political events that framed the Dreyfus Affair (anti-Semitism in 19th-century France, caricatures and polemical writings in the press, the consequences of the Franco-Prussian War and of the Commune, the bipolar division that split French society into Dreyfusards and anti-Dreyfusards), as well as its long-term effects (the rise of the "intellectual" in public life, the creation of the Human Rights League, the consolidation of Zionism which led to the creation of a Jewish state). Prerequisites: 210.301-302 or supplementary test or permission.
Cook-Gailloud   3 credits

German

Final placement in language courses is determined by a placement exam taken during orientation week or by the completion of the prerequisite courses at Johns Hopkins.

210.161-162 Elementary German
Introduction to the German language and a development of reading, speaking, writing, and listening skills through the use of basic texts and communicative language activities. Language lab is required. Both semesters must be completed with passing grades to receive credit. May not be taken on a satisfactory/unsatisfactory basis.
Mifflin   4 credits

210.163-164 Elementary Yiddish
Yearlong course. Includes the four language skills—reading, writing, listening, and speaking—and introduces students to Yiddish culture through text, song, and film. Emphasis is placed both on the acquisition of Yiddish as a tool for the study of Yiddish literature and Ashkenazic history and culture, and on the active use of the language in oral and written communication. Both semesters must

be taken with a passing grade to receive credit. Cannot be taken satisfactory/unsatisfactory.

B. Caplan   3 credits

210.261-262 (H) Intermediate German

This course is designed to continue the four skills (reading, writing, speaking, and listening) approach to learning German. Readings and discussions are topically based and expanded upon through audio-visual materials. Students will also review and deepen their understanding of the grammatical concepts of German. Language lab is required. Conducted in German. Prerequisites: 210.161-162 or equivalent.

Mifflin   3 credits

210.263-264 (H) Intermediate Yiddish

This course will focus on understanding the Yiddish language as a key to understanding the culture of Yiddish-speaking Jews. Emphasis will be placed on reading literary texts and historical documents. These primary sources will be used as a springboard for work on the other language skills: writing, listening, and speaking. Prerequisite: 210.164 or equivalent; or two years of German and permission of instructor.

B. Caplan   3 credits

210.266 (H) German Conversation

This course is designed for students who wish to improve their conversational language skills, achieving up to an advanced level in oral production. The syllabus aims to provide useful, relevant language and necessary discourse structures to hold conversations on varied topics. Students will practice German to build confidence, develop fluency, and improve pronunciation and accuracy. Weekly topics will be determined to some extent by the interests and ability level of the group as a whole. Prerequisite: 210.262 or two years of college German or equivalent. May be taken concurrently with other courses in German. Students currently enrolled in 210.262 may take concurrently, with permission. May be taken Pass/Fail. Not for major or minor credit.

Wheeler   1 credit

210.361 (H,W) Advanced German I. Cultural Foundations of Modern German Society

Topically, this course focuses on defining moments in German cultural history of the second half of the 20th century. Films, texts and other media provide a basis for discussing events in post-war Germany through reunification and beyond. A review and expansion of advanced grammatical concepts and vocabulary underlies the course. Focus on improving expression in writing and speaking. Prerequisite: 210.262 or placement by exam. Taught in German

Mifflin   3 credits

210.362 (H,W) Advanced German Composition and Conversation II: Contemporary German Issues

Topically, this course focuses on contemporary issues such as national identity, multiculturalism and the lingering social consequences of major 20th-century historical events. Readings include literary and journalistic texts, as well as radio broadcasts, internet sites, music, and film. Emphasis is placed on improving mastery of German grammar, development of self-editing skills and practice in spoken German for academic use. Introduction/Review of advanced grammar. Prerequisite: 210.361 or equivalent. Taught in German.

Mifflin   3 credits

210.363 (H) Business German

This course sequence is designed as an introduction into the language and culture of German business, commerce, and industry. Combines the study of foreign language (with its four essential skills: reading, speaking, writing, and listening comprehension) with business skills, including presentation. Students will learn basic economic and business vocabulary; investigate the current status of the German and European economy; and become familiar with economic and political structures as well as specific business practices, customs, and codes of behavior in the business world. Analysis and discussion of German economic and business texts and translation of economic and business materials. Taught in German. Prerequisites: 210.261-262 or equivalent.

Staff   3 credits

210.365 (H) German for Science and Engineering

This course is designed as an introduction to the language used by scientists and engineers. Analysis of texts, preparation of presentations, and discussion of topics. Specific areas of interest to the course members will guide the selection of materials. While focusing on the language of science, students will develop their skills in reading, writing, and oral expression. Prerequisites: 210.261-262 or equivalent.

Staff   3 credits

210.461 (H) Introduction to Literary Genres & Movements, 1650-1890

Literary forms and literary movements: (how) do they all fit together? In this class we will read poetry, prose and drama from a variety of literary periods (Baroque, Enlightenment, Sturm and Drang, Romanticism, Realism, Naturalism, etc.). Students will learn what cultural, ideological, technological, historical and stylistic trends define a literary movement. But we will also peer into those most famous works (by Gryphius, Lessing, Schiller, Goethe, Hebbel, Meyer, Storm, Hoffmann, etc.) and ask whether they define or defy their categorizations. At the end of the semester, students will have a clearer, more comprehensive understanding not only of who wrote what when and why, but also of the complications of defining a movement. Readings will be organized by genre, and literary movements will be thrice scrutinized. This course serves as both an overview of German literature and as a building block for further literary study and cultural analysis. Readings and discussion will be in German. Prerequisite 210.362 or placement.

Wheeler   3 credits

210.462 (H) Introduction to German Literature and Culture: 1900–1945.

This course is designed to introduce students to the analysis of literary and cultural topics. A variety of 20th-century texts and visual media will form the basis for discussion of literature and cultural phenomena specific to the time period. This semester will focus on the European capitals of Zurich, Vienna, and Berlin, thereby offering a "European" perspective on literary, cultural, and political events after 1900. Continuities between and differences among the three German-speaking countries will be investigated. Attention is given to improving student writing. Readings, discussion, and written assignments in German. Prerequisite: 210.361-362 or equivalent.

Staff   3 credits

210.463-464 (H) Reading and Translating German for Academic Purposes

Seniors and Graduate Students only. Designed for graduate students in other fields who wish to gain a reading knowledge of the German language. Seniors who intend to do graduate study in other disciplines are also welcome. Instruction includes an introduction to German volcabulary and grammatical structures as well as discussion of relevant translation practices. The goal of the course is for students to gain confidence in reading a variety of texts, including those in their own fields of study. No knowledge of German is assumed.

Staff   3 credits

210.561 (H) German Language Independent Study
Mifflin

211.202 (H) Freshman Seminar: A Thousand Years of Jewish Culture

This course will introduce students to the history and culture of Ashkenazi Jews through their vernacular, Yiddish, from the settlement of Jews in German-speaking lands in medieval times to the present day. Particular emphasis will be placed on the responses of Yiddish- speaking Jews to the challenges posed by modernity to a traditional society: Should a Jew be religious or secular? Should the Jewish future be in Europe, the Land of Israel, or elsewhere? Should Jews create a specific Jewish culture, or participate in the culture of their non-Jewish neighbors? Texts will include fiction, poetry, memoir, song, and film. All readings and discussion will be in English.

B. Caplan   3 credits

211.211 (H) Introduction to Yiddish Culture

This course will explore a thousand years of European Jewish culture through its vernacular, Yiddish. Topics covered will demonstrate the geographical, intellectual, and artistic breadth of this culture, and will include the history of the Yiddish language, selections of pre-modern and modern Yiddish literature, folklore, the press, film, theater, and song. All readings will be in English.

B. Caplan   3 credits

Italian

Final placement in all Italian language courses will be determined by an Italian placement exam, or by the previous completion of an Italian course at Hopkins. See the Italian language director to arrange to take the exam.

210.151-152 Italian Elements
The aim of the course is to provide the student with the basic skills in listening, reading, writing, and speaking the language through the use of elementary texts, videos, and electronic materials. All classes are conducted in Italian; oral participation is encouraged from the beginning. Both semesters must be completed with passing grades to receive credit. May not be taken satisfactory/unsatisfactory.
Zannirato   4 credits

210.251-252 (H) Intermediate Italian
Continues building on the four essential skills for communication presented in Italian Elements courses. Improvement of reading and composition skills through the use of contemporary texts, reinforcement of the student's knowledge of the language through weekly oral and written presentations on predetermined subjects. Class participation is essential. All classes are conducted in Italian. May not be taken satisfactory/unsatisfactory. Prerequisites: 210.151-152 or equivalent.
Zannirato   3 credits

210.351-352 (H,W) Advanced Italian Conversation and Composition
This third-year-level course presents a systematic introduction to a variety of contemporary cultural topics, emphasizing role-playing, vocabulary building, and style and clarity in writing. Texts drawn from different media (newspapers, magazines, and literary work), and ample use of audio-visual and electronic materials will stress everyday spoken Italian. May not be taken satisfactory/unsatisfactory. Prerequisites: 210.251-252 or equivalent.
Zannirato   3 credits

210.354 Learning to Learn a Foreign Language
Course presents an overview of contemporary foreign language (L2) learning theories and methodologies, and encourages a critical reflection on previous and current L2 learning experiences. Participants will draw from Second Language Acquisition research and learn how to be more effective L2 learners. Course taught in English with examples in English, French, Italian and Spanish.
Zannirato   3 credits

210.451 (H,W) Corso di Perfezionamento
This task-based course is designed to prepare students to acquire Effective Operational Proficiency in Italian, (C1 level of the Common European Framework). By the end of the course, successful students will be able to: 1) understand a wide range of demanding, longer texts, and recognize implicit meaning; 2) produce clear, well-constructed, detailed texts on complex subjects; 3) express themselves fluently and spontaneously without

much obvious searching for expressions; 4) use language flexibly and effectively for social, academic, and professional purposes. Extensive independent work required. No S/U option. Prerequisites: 210.352 with a grade of B+ or higher, or appropriate placement exam score and interview with language program director.
Zannirato   3 credits

211.212 (H) Holocaust and Film

Taught in English. This class will examine the history of Holocaust films in regard to the possibilities of genre (documentary versus feature), the use of historical and archival materials, as well as general questions of representation and trauma. **I Cinema of The Victims, II Cinema of The Perpetrators, III Cinema of The Second and Third Generations Witnesses**. Students will be writing weekly response papers to all screenings, and will choose to work with films in the original languages German, English, Italian, and French. This class will be writing-intensive. Cross-listed with Film and Media Studies, Political Science, History, and Jewish Studies.
Wegenstein   3 credits

211.221 (H) Italian Matters, Italian Manners

This is an introductory course to Italian culture relying on a tradition of books of conduct including the Middle Ages, the Renaissance, and today.
Forni   3 credits

211.357 (H) Mafia Wars in Literature and Film

The course will examine the discourse of and about mafia wars in literature, film, and television. We will read the mafia novels of Sicilian authors Vitaliano Brancati and Leonardo Sciascia, analyze the legendary films made from their novels (e.g., *Cadaveri Eccellenti* by Francesco Rosi), as well as discuss possibilities of the translation of the classic mafia tale into comedy as in such films as *Mio cognato* (2003) by Alessandro Piva. The representation of the mafia in the U.S. will be a theme of the course as exemplified in Coppola's *Godfather* trilogy, or in the format of evening entertainment in the mafia soap TV series *The Sopranos*. Course taught in Italian.
Wegenstein   3 credits

211.358 (H) Bodyworks: Body, Medicine and Technology in the 21st Century

This course analyses concepts and representations of the human body under the influence of new technologies. In an interdisciplinary framework, evidence from both scientific (medical) and artistic "body talk" will be taken into account. For instance, we will look at the latest medical body imaging technology developed at our own university, and ask why and how we can read these images; we will also read bodily narratives of the visual and the virtual by such feminist authors as Jewelle Gomez and Elisbeth Vornarburg, who emphasize a body that transgresses human—especially gender—boundaries; finally, we will examine the status of the human body in art installations, and ask if the body is re- or de-emphasized in these new media environments. Readings will include the anthology re: skin, ed. Mary Flanagan and Austin Booth , The MIT Press 2006.
Wegenstein   3 credits

211.581 Independent Study Italian Civilization

Staff   3 credits

Portuguese

Final placement in all Portuguese language courses will be determined by a Portuguese placement exam to be taken during orientation week and in the department office at other times, or by the previous completion of a Portuguese class at Hopkins. See the Portuguese language coordinator to arrange to take the exam.

210.177-178 Portuguese Elements

This one-year course is conducted entirely in Portuguese. It introduces students to the basic language skills: reading, writing, listening, speaking. The focus of the course is on oral communication with, however, extensive training in written and listening skills. Language lab is required. Students must complete both semesters with passing grades to receive credit. No satisfactory/unsatisfactory.
Bensabat-Ott   4 credits

210.277-278 (H) Intermediate/Advanced Portuguese

This one-year course is conducted entirely in Portuguese. Emphasis is placed on vocabulary building, ease and fluency in the language through the use of a multifaceted approach. Materials used immerse students in the cultures of Brazil, Portugal, and Portuguese-speaking Africa, and reflect the mix of cultures at work in the contemporary Lusophone world. Lab work required. Both semesters must be completed with passing grades to receive credit. No satisfactory/unsatisfactory. Prerequisites: 210.177-178 or placement exam.
Bensabat-Ott   3 credits

210.391-392 (H,W) Portuguese Language and Literature

This third-year Portuguese course focuses on reading, writing, and oral expression. Under the supervision of the instructor, students will read one or two complete works by major Brazilian, Portuguese, and/or Afro-Portuguese writers each semester, followed by intensive writing and oral discussion on the topics covered. Grammar will be reviewed as necessary. Lab work required. The course is conducted entirely in Portuguese. Prerequisites: 210.177-178 or placement exam.
Bensabat-Ott   3 credits

211.394 (H,W) Brazilian Culture and Civilization

This course is intended as an introduction to the culture and civilization of Brazil. It is designed to provide students with basic information about Brazilian history, art, literature, popular culture, theater, cinema, and music. The course will focus on how indigenous Asian, African, and European cultural influences have interacted to create the new and unique civilization that is Brazil today. The course is taught in English, but ONE extra credit will be given to students who wish to do the course work in Portuguese. Those wishing to do the course work in English for 3 credits should register for section 1. Those wishing to earn 4 credits by doing the course work in

Portuguese should register for section 2. The sections will be taught simultaneously.

Bensabat-Ott   3 credits or 4 credits

Spanish

Final placement in all Spanish language courses will be determined by a Spanish placement exam. This exam is available online year-round.

210.111-112 Spanish Elements I, II

Development of the four basic language skills of reading, writing, listening, and speaking in concrete, real-life situations and in culturally appropriate ways. The course explores the diverse language and culture of the Spanish speaking world. Extensive use of an online component delivered via Blackboard, sustained class participation, and three hourly exams (no midterm and no final). Section 01 Elements I (fall semesters) and Section 01 Elements II (spring semesters) is offered totally online. Both semesters must be completed with passing grades to receive credit. May not be taken satisfactory/unsatisfactory.

Tracy   4 credits

210.211-212 (H) Intermediate Spanish I, II

Continues building on the four essential skills for communication presented in Spanish Elements courses. Spanish culture, history, current events, and geography provide the context for instruction of grammatical structures, vocabulary, pronunciation, and composition. Extensive use of an online component delivered via Blackboard, sustained class participation, and three hourly exams (no midterm and no final). May not be taken satisfactory/unsatisfactory. Prerequisites: Spanish Elements I and II, or appropriate WebCape score.

Weingarten   3 credits

210.311 (H) Advanced Spanish I

A review and expansion of Spanish communicative skills. Students will be able to express opinions, narrate and describe in a variety of personal and professional contexts. Students will continue to improve linguistic proficiency while increasing cultural awareness. Students will also engage in more formal levels of written communication. This course also focuses on refinement of grammar. Extensive use of an online component delivered via Blackboard, sustained class participation, and three hourly exams (no midterm and no final). May not be taken satisfactory/unsatisfactory. Prerequisites: 210.212 or appropriate WebCape score.

Moreno   3 credits

210.312 (H) Advanced Spanish II

An in-depth review and expansion of Spanish communicative skills by focusing on the use of standard, spoken Spanish with an emphasis on colloquial and idiomatic expressions. Students will continue to improve linguistic proficiency while increasing cultural awareness, as well as engage in more formal levels of communication by discussing assigned literary and non-literary topics. They will increase their listening skills through movies and other listening comprehension exercises. The course

will also focus on vocabulary acquisition. Extensive use of an online component delivered via Blackboard, sustained class participation, and three hourly exams (no midterm and no final). May not be taken satisfactory/unsatisfactory. Prerequisites: 210.311 (Advanced Spanish) or appropriate S-Cape score.

Moreno   3 credits

210.313 (H) Medical Spanish

Students will increase their vocabulary and practice grammar structures closely related to the medical and health administration professions. All language skills are equally emphasized. Highly recommended to students in any of the health-related majors. There will be an intensive online component. May not be taken satisfactory/unsatisfactory. Prerequisites: 210.311 (Advanced Spanish I) or appropriate WebCape score.

Ramos   3 credits

210.314 (H) Business Spanish

Students will increase their vocabulary and practice grammar structures closely related to trade and business practices in the public and private sectors. All language skills are equally emphasized. Highly recommended to students majoring in Business and International Relations. There will be an intensive online component. May not be taken satisfactory/unsatisfactory. Prerequisites: 210.311 (Advanced Spanish I) or appropriate WebCape .

Ramos   3 credits

210.315 (H) Legal Spanish

Students will increase their vocabulary and practice grammar structures closely related to judicial services. All language skills are equally emphasized. Highly recommended to students majoring in law, business and international relations. There will be an intensive online component. May not be taken satisfactory/unsatisfactory. Prerequisites: 210.311 (Advanced Spanish I) or appropriate WebCape score.

Ramos   3 credits

210.316 (H) Conversational Spanish

This course is designed for students who have attained an advanced level of proficiency in Spanish 210.312 and wish to improve their oral skills by focusing on the use of standard, spoken Spanish with an emphasis on colloquial and idiomatic expressions. Students are exposed to a deeper understanding of the cultures of the Spanish-speaking world through movies and other listening comprehension exercises. The course will mainly focus on conversation and vocabulary acquisition. This course is highly recommended for students going to JHU study abroad programs. Prerequisite: 210.311 or appropriate WebCape score.

Ramos   3 credits

210.317 (H) Advanced Composition—Spanish

This third-year course aims at improving the students' reading and writing skills by focusing on various types of texts. Students will also engage in more formal levels of written communication on both literary and non-literary topics. The course also focuses on refinement

of grammar. Prerequisite: 210.312 or appropriate Web-Cape score.

Sánchez-Serrano   3 credits

210.411(H,W) Curso de Traducción para las Professiones

Students will be introduced to the basics of translation theory and be presented with the tools needed (specialized dictionaries, web resources, etc.) for the translation of literature, business, medical, legal, technological, political, and journalistic texts from Spanish to English and English to Spanish. May not be taken satisfactory/unsatisfactory. Prerequisites: 210.313, 210.314, or 210.315.

Ramos   3 credits

210.412 (W) Spanish Language Practicum

Internship involves a specially designed project related to student's minor concentration. Provides an opportunity to use Spanish language in real world contexts. May be related to current employment context or developed in agencies or organizations that complement student's research and experimental background while contributing to the improvement of language proficiency. May not be taken satisfactory/unsatisfactory. Prerequisite: 210.411.

Sánchez-Serrano   3 credits

210.413 (H,W) Curso de Perfeccionamiento

This course is designed for students who, having attained an advanced level of proficiency, wish to master Spanish grammar as well as oral and written expression. The course seeks to acquaint the students with a wider range of idiomatic expression and usages than they have previously managed. May not be taken satisfactory/unsatisfactory. Prerequisites: 210.311 and 210.312 or 210.317 plus one of the following: 210.313, 210.314 or 210.315; or appropriate WebCape score.

Sánchez-Serrano   3 credits

211.380 Modern Latin American Culture

An introduction to the literature and culture of Latin-America from the formation of independent states through the present—in light of the social, political, and economic histories of the region. Taught in Spanish. May not be taken satisfactory/unsatisfactory. Prerequisites: Intermediate Spanish 210.211 or appropriate WebCape score.

Staff   3 credits

211.390 Modern Spanish Culture

This course will explore the fundamental traits of Spanish culture as it has developed in the 20th to the 21st centuries (although the first weeks will serve as a general overview of the historical development of Spain). Class time will focus on discussion of different texts, movies, songs, pictures, and paintings, considering their relation to the specific historical, political, and social contexts. The active participation of students in debates and discussions is fundamental. In addition, students will be expected to make oral presentations on assigned topics.

Prerequisites: Intermediate Spanish 210.212 or appropriate WebCape score

Sánchez-Serrano   3 credits

211.291 (H) Modern Central American and Hispanic Caribbean Literature and Culture

An introduction to the literature and culture of Central America and the Hispanic Caribbean—from the formation of independent states through the present—in light of the social, political, and economic histories of the region. Taught in Spanish. Prerequisites: Intermediate Spanish 210.212 or 210.213 or appropriate Web-Capescore.

Staff   3 credits

211.576 (H) Independent Study Spanish Civilization

Staff   3 credits

Undergraduate Literature Courses

French

212.101 (H) What Makes a Novel Interesting? Gilman Lecture Course in Humanities

Do novels afford a distinctive kind of knowledge about society, history, psychology, human beliefs, ethical and spiritual experiences? How do fictional works retain their interest and vitality over time? How are perennially provocative topics such as power, politics, love, sexuality, social concerns, symbolic figures renewed through formal inventions in narrative. We will consider the interrelation of the form and content of novels, reading some major fictions by Balzac, Hugo, Dickens, Flaubert, Melville, Perec.

Neefs   3 credits

212.316 (H) 18th-Century French Theater

The development of the drame bourgeois and the theater criticism of the French Enlightenment. Authors to be studied include Racine, Le Sage, Marivaux, Voltaire, Diderot, Beaumarchais and others. The final exercise of this course is a short performance from one of the plays. Prerequisite: 212.333.

Anderson   3 credits

212.317 (H,W) The 18th-Century French Novel

Key novels will be studied from a variety of approaches. Authors to include Marivaux, Montesquieu, Prévost, Diderot, Crébillon, Rousseau, Laclos, and Voltaire. Prerequisite: 212.333.

Anderson   3 credits

212.318 (H,W) Women in French Literature of the 17th and 18th Centuries

This course will examine the changes in the relationship of women to literature in France before the French Revolution from several points of view: (1) What were the social and intellectual contexts of gender distinctions? (2) How did men writing about women differ

from women writing about women? (3) How were these questions affected by the changing norms of literary productions? Texts by Mme. de Sévigné, Molière, Mme. de Lafayette, Prévost, Diderot, Rousseau, Laclos, and Beaumarchais and from the *Encyclopédie*. Prerequisite: 212.333-334.
Anderson   3 credits

212.319 (H,W) Literature Confronts Science: Zola
Zola worked with the theories of heredity of his time in the Rougon-Macquart novels. But he also attempted to use his understanding of biology and thermodynamics to reform the theory of the novel in general. This course will examine these two different effects of science on literature and try to see what leads an author to undertake such a project. Prerequisite: 212.333-334.
Anderson   3 credits

212.320 (H) Alexandre Dumas
The genre of historical romance analyzed through the novels of the cycle of the *Trois Mousquetaires* and *Le Comte de Monte Cristo*. Attention will be paid to Dumas' use of 17th-century historical accounts and memoirs, and to film adaptations of the novels. Pre-requisite: 212.333-334.
Anderson   3 credits

212.321 (H,W) French 19th Century: The Equivocal Birth of Modernity
Reading texts by Chateaubriand, Balzac, Hugo, Flaubert, Baudelaire, considering also other arts, mainly painting. Course will examine the literary and aesthetic representation of modern democratic society in France during the 19th century.
Neefs   3 credits

212.333-334 (H,W) Introduction à la littérature française I, II
Readings and discussion of texts of various genres from the Middle Ages to the 20th century. The two semesters may be taken in either order. This sequence is a prerequisite to all further literature courses. Students may coregister with an upper-level course during their second semester. Prerequisites: both semesters of 210.301-302 or at least one semester of 210.301-302 with a grade of A and written permission of the instructor. Note: 210.301-302 are prerequisites for all undergraduate courses with higher numbers. These courses count as advanced courses and carry both university and major credit.
Staff   3 credits

212.394 (H) Renoir, Vigo, Carne: French Cinema of the 1930s
Conducted in English. An exploration of French cinema of the 1930s and the movement that produced some of the most influential masterworks of world cinema; focus on close analysis of films. Lecture Tuesday 1:30—4 pm, Screening Monday 7:30–10 pm. $40 Lab fee
Staff 3   credits

212.411 (H,W) Libertinage and Galanterie in 17th- and 18th-Century French Fiction
A study of representations of love, eroticism, and gender in the novel and theater. From Neo-Platonist ideals to the cru-elties of libertinage, love was seen in turn as an instrument of social initiation, a civilizing force, a source of dissolution, a disenchanted game, a heroic ideal or a bitter failure: in any case, it was the stuff of novels and the kernel of the literary imagination. Focus on the relationship between love and the novel as a genre, more specifically on the strategies of disguise and deceit, the euphemistic veiling of the body, eroticism, and reading, the shifting boundaries between feminine and masculine identities. Works by D'Urfé, Marivaux, Crébillon, Laclos, Denon, Choisy.
Russo   3 credits

212.414 (H) French Masculinities: Fops, Dandies and Reactionaries
A selection of novels, essays and plays from the 17th to the 21st century illustrating the intersection of gender, taste and politics in the construction of a French masculine identity. From the courtly gentleman, to the effeminate male, to the Romantic dandy, to the visionary, post-human man, masculine sexuality is alternately portrayed as normative ideal, as satire, social critique, tragi-comedy or utopia. Texts by Crébillon, Marivaux, Laclos, Stendhal, Chateaubriand, Baudelaire, Proust, Houellebecq.
Russo   3 credits

212.415 (H,W) Dumas & Verne: The Spirit of a New Age
Alexandre Dumas' "industrial" production of the historical novel and Jules Verne's invention of the novels of technology embodied opposing modes of the 19th century's post-Revolutionary optimism. This course investigates the sources of these new genres and their cultural impact. Titles to include the *Trois Mousquetaires* cycle, *Le comte de Monte-cristo*, *L'île mystérieuse*, *le Sphinx des glaces*, *Robur le conquérant*, *De la Terre à la lune*. Prerequisite: 212.333-334.
Anderson   3 credits

212.416 (H,W) French Enlightenment
The French Enlightenment was not a monolithic theoretical and universalizing program as its English name suggests, but, as Les Lumières implies, a complex historical event composed of three intertwined strains. This course will investigate the productive tension between the Lumières du savoir, the Lumières poétiques, and the Lumières du pouvoir that generated the greatest literary works from 1710 to the early Revolution. For full description, see **www.wilda.org/Course/CourseVault/Undergrad/Enlighten/home.html**. Prerequisite 212.333-334 or permission of instructor.
Anderson   3 credits

212.421 (H) Textes et Performances: le théâtre français du 17e au 19e siècle
"Le théâtre français, des classiques aux romantiques". There will be a performance component to this course.
Anderson   3 credits

212.428 (H) Reading Poetry
The course will offer a close reading and interpretation of prominent poems, from Early Modern to Contemporary, from Du Bellay and Ronsard to Ponge, Char, Roubaud and some of the most recent works. This course will

present an opportunity to question the historical variations of Poetry, of its function and importance in Society. What mean the changes in poetic forms, how work the tensions between verse and prose in modern Poetry, what's interesting in writing and reading Poetry will be some of the main topics of the course. The students will be asked to compose and comment on their own "French Poetry Anthology." Course held in French, but including researches on the poetical translatability.
Neefs   3 credits

212.429 (H) Senior Thesis Preparation
This course, a one-hour tutorial, is intended to engage the student in producing a well-formulated description of their senior thesis topic, the bibliography and reading list and to begin the research prior to writing the thesis. It shall therefore be taken the semester preceding 212.430 Senior Seminar, usually in the fall of the senior year.
Staff   1 credit

212.430 (H,W) Senior Seminar
An in-depth and closely supervised initiation to research and thinking, oral and written expression, which leads to the composition of a senior thesis in French.
Staff   3 credits

212.435 (H) Savages, Women, and Eccentrics:
The Invention of Society in Eighteenth-Century France
This course will focus on the Enlightenment taste for social experiment: from the clash with the primitive other, to the creation of utopian sexualities, to devising new and perilous methods of education, novelists, playwrights, and philosophers seek to develop new conceptions of the social bond through odd encounters and the invention of a new human being. Texts by Voltaire, Diderot, Rousseau, Marivaux, Sade, Mercier, and others. In French.
Russo   3 credits

212.448 (H) Baudelaire: Art, Poetry, Modernity
Seminar taught in French and English. Charles Baudelaire is widely regarded as the decisive figure in 19th Century literary and artistic Modernity. In this seminar we will read his magnificent Les Fleurs du mal and Spleen de Paris and his equally remarkable art criticism, as well as various critical discussions of his achievement.
Neefs   3 credits

212.501-502 Independent Study

German

213.251 (H) Freshman Seminar on Nietzsche
Friedrich Nietzsche continues to be one of the most radical and influential philosophers of the West. Famous and infamous for announcing the death of God and the advent of the superhuman, his irreverence for philosophical tradition culminated in the call to "philosophize with a hammer" (so as to demolish the constructions of Western metaphysics). He embarrassed the old philosophers exposing their, as he put it, clumsy lovemaking with truth. And he stunned generations of intellectuals

after him with his idea of the eternal return of the same. But Nietzsche was also a hilariously funny writer, a light-footed and poetic thinker, a bold defender of the experiences of the body, a tender human being, and a sharp critic of German narrow-mindedness. This seminar offers an introduction to Nietzsche's work and a first journey into a world of German thought, culture, and literature. Readings and discussion will be in English.
Pahl   3 credits

213.252 (H) Freshman Seminar: What Is a University?
Although the first European universities date back to the ninth century, the idea of a modern research institution is of fairly recent provenance. In this course we will discuss some of the most important works from the 18th and 19th centuries that provided the theoretical framework for institutions like Johns Hopkins and the U of Chicago. A consistent concern of the course will be the relation of the university to the state, and of education to moral edification and civic duty. Enrollment limited to 20 freshmen.
Tobias   3 credits

213.253 (H) Freshman Seminar: Jewish Humor and the Construction of Cultural Discourse
Are all Jews funny, or only the ones from New York? This freshman seminar will offer an examination of literary, theatrical, cinematic, and televised representations of Jewish culture focusing on the ways in which Jews interacted with the modern world via comedy and humor. Authors and performers to be examined will include Avrom Golfaden, Sholem Aleichem, Franz Kafka, Dzigan and Schumacher, the Marx Brothers, Phillip Roth, Woody Allen, Mel Brooks, Fran Drescher, Larry David, Sarah Silverman, and Sacha Baron Cohen. All readings and discussions conducted in English.
Caplan   3 credits

213.314 (H) Berlin and Modernity
Explanation of literature and film from early 20th century. Focus will be on literary movements which developed in Berlin (Expressionism, Neue, Sachlichkeit, Agitprop) and effects of urban life on artistic technique. Readings in German, discussion in English.
Tobias   3 credits

213.316 (H) Story, Song, Food and Film: Modern Yiddish Identities
To cling to Jewish tradition or to embrace secular ideals? To engage with non-Jewish culture or utterly ignore it? To express oneself as a Jew through religion, politics, or the arts? This course will examine a range of Jewish responses to modernity through the prism of Yiddish language and culture. The topic will be explored through a number of media, including text, song, and film. The course will include a small Yiddish language component, although all readings will be in English.
B. Caplan   3 credits

213.318 (H) The Making of Modern Gender
Taught in English. Gender as we know it is not timeless. Today, gender roles and the assumption that there are only two genders are diligently contested and debated.

With the binary gender system thus perhaps nearing its end, we might wonder if it has had a beginning. In fact, the idea that there are two sexes and that they not only assume different roles in society but also exhibit different character traits, has emerged historically around 1800. Early German Romanticism played a seminal role in the making of modern gender and sexuality. For the first time, woman was considered not a lesser version of man, but a different being with a value of her own. The idea of gender complementation emerged, and this idea, in turn, put more pressure than ever on heterosexuality. In this course, we will explore the role of literature and the other arts in the making and unmaking of gender. Authors discussed will include Thomas Laqueur, Michel Foucault, Friedrich Schlegel, Dorothea Schlegel, Karoline von Günderode, Novalis, Goethe, Kleist, and Bettina von Arnim. Cross-listed with WGS and English.

Pahl   3 credits

213.322 (H) Fin de siècle Vienna

Exploration of the major currents in turn-of-the-century Viennese culture: dreams, eroticism, violence, literary experimentation, and crisis in paternity. Authors to include Freud, Musil, Schnitzler, Zweig, Trakl, and Wittgenstein. Readings and discussion in English.

Tobias   3 credits

213.331 (H) Detective Fiction in its Nascence

The detective novel has roots in German Romanticism. Kleist and E.T.A. Hoffmann wrote novellas concerning historical crimes and mysteries from the past. We will read several 18th and 19th C mysteries as well as contemporary essays on the detective genre. Readings and discussion in German. Prerequisites: German 361/362.

Tobias   3 credits

213.333 (H) Transformation in Modern Jewish Literature

This course will be an advanced-undergraduate, writing-intensive examination of the theme of transformation as a defining metaphor for the Jewish encounter with modernity, from Reb Nakhman of Breslov at the beginning of the 19th century to Tony Kushner at the end of the 20th. Among the topics we will consider are the means by which Jewish authors adapt modern literary forms such as the novel, the short story, and the drama to the needs of Jews at a recurring moment of historical and political transition; we will also consider the negotiation between fantasy and realism as a means of representing the interaction of local tradition with global modernity. An additional consideration of the question of language will inform our discussion of works written in Yiddish, Hebrew, German, Russian, and English. These issues will be juxtaposed against historical developments such as the gradual industrialization of Eastern Europe, political anti-Semitism, immigration, Zionism and other nationalist movements, warfare, the Holocaust, and changing notions of gender and family roles. All readings and discussions conducted in English.

M. Caplan   3 credits

213.336 (H,W) Dancing About Architecture: Jewish Humor and the Construction of Cultural Discourse

Are all Jews funny, or only the ones from New York? This course will be an advanced-undergraduate, writing-intensive examination of literary, theatrical, cinematic, and televised representations of Jewish culture focusing on the construction of cultural discourse through comedy. Taking as a point of departure Sigmund Freud's *Jokes and Their Relation to the Unconscious*, we will consider the joke as a mode of narration and cultural coding with specific resonances for the Jewish encounter with modernity. Among the topics to be addressed in this course will be the origins of modern Jewish humor in traditional modes of storytelling and study; the problems of anxiety and otherness articulated and neutralized through humor; the significance of Jews in creating popular culture through mass mediums (particularly though not exclusively in the United States) as well as the role of these mediums in transmitting and translating Jewish references to the general culture; the status of the Yiddish language as a vehicle for satire and a vehicle of resistance between tradition and modernity; the uses and abuses of Jewish stereotypes and the relationship of Jewish humor to anti-Semitism; the connections between Jewish humor and other modes of minority discourse; and the question of translation of Jewish humor both from Yiddish into other languages and from the Jewish "in-group" to a "post-ethnic" audience. Authors and performers to be examined will include Aaron Halle-Wolfssohn, Sholem Aleichem, Franz Kafka, Moshe Nadir, Dzigan and Schumacher, the Marx Brothers, Phillip Roth, Woody Allen, Mel Brooks, Jerry Seinfeld, Larry David, and Sascha Baron Cohen. All readings and discussions conducted in English.

M. Caplan   3 credits

213.343 (H,W) The Holocaust in Modern Literature: The Limits of Representation

This course will be an advanced-undergraduate, writing-intensive examination of literary, memoiristic, philosophical, and cinematic representations of the Nazi genocide of European Jewry during World War II. In addition to the problems of defining this genocide against larger catastrophes of world war, totalitarianism, racism, and the technologies of mass destruction, we will consider this event as a moment of crisis in the historical, moral, and ideological understanding of European modernity that underscores the limits of language, subjectivity, and representation. Parallel to these discussions we will also consider the Holocaust in the context of Jewish responses to anti-Semitism, the role of the Holocaust in generating subsequent models for Jewish cultural representation, and the role of the Holocaust in underscoring the anomalous position of Jews within the history of modern Europe. Works to be considered will be taken from Czech, English, French, German, Hebrew, Italian, Polish, and Yiddish sources, and will include writers and theorists such as Theodor Adorno, Aharon Appelfeld, Jurek Becker, Tadeuz Borowski, Jacques Derrida, Raul Hilberg, Primo Levi, Georges Perec, Philip Roth, I.B. Singer, Art Spiegelman, and Jirí Weil. All readings and discussions conducted in English.

M. Caplan   3 credits

213.344 (H) Holocaust and Film

Taught in English. This class will examine the history of Holocaust films in regard to the possibilities of genre (documentary versus feature), the use of historical and archival materials, as well as general questions of representation and trauma. **I Cinema of The Victims, II Cinema of The Perpetrators, III Cinema of The Second and Third Generations Witnesses**. Students will be writing weekly response papers to all screenings, and will choose to work with films in the original languages German, English, Italian, and French. This class will be writing-intensive. Cross-listed with Film and Media Studies, Political Science, History, and Jewish Studies.

Wegenstein   3 credits

213.346 (H) Faust Legends

The legendary figure of *Faust*, a man who sells his soul to the devil in exchange for knowledge, self-fulfillment and power, has attracted continuous interest from writers, artists, composers and thinkers over the last 400 years. This course will analyze the various transformations of the Faust legend as they emerged in German literature since the 18th century. It will focus especially on how the different treatments of the legend adapt the motif to its particular historical situation, and where exactly the elements of (dis)continuity lie. By means of close readings, the seminar will also investigate the multiple forms and genres by which the legends have been represented, as narrative texts, dramas, poems or films. Authors include Lessing, Klinger, Goethe, Grabbe, Heine, Hesse, Lasker-Schüler, Klaus Mann, Brecht. We will also consider F.W. Murnau's and P. Gorski's film versions of Faust, as well as I. Szabó's movie Mephisto based on Klaus Mann's novel of the same title. Readings and discussions in German.

Krauss   3 credits

213.349 (H) Weimar Cinema

German cinema of the 1920s is regarded as one of the "golden ages" of world cinema. The course centers on close readings of works which belong to the canon of German film, including The Cabinet of Dr. Caligari, Nosferatu, Metropolis, The Blue Angel, The Last Laugh, and M. Focusing on the question of cinema and modernity, we will discuss topics like modern aesthetics and visual perception; Expressionism in film; technology and the metropolis; the emergence of film genres (e.g. horror film, film noir, science-fiction film, and melodrama). The film analyses will be accompanied by a discussion of the varied scholarly approaches to Weimar Cinema (Sigfried Kracauer, Lotte Eisner, Thomas Elsaesser). The course will be taught in English.

Strowick   3 credits

213.353 (H) Realism

Introduction to mid- and late-19th-century literature focusing on the reinvention of the sentimental narrative, the tension between the natural and the supernatural, and the emphasis on local or regional folklore. Authors include Keller, Stifter, Droste-Hülshoff, Storm, Fontane. Readings and discussion in German. Prerequisites: 091.201-202 or equivalent.

Tobias   3 credits

213.354 (H) Yiddish Literature in Translation

This course will provide an overview of the major figures and tendencies in modern Yiddish literature from the beginning of the 19th century to the present. Focusing primarily, though not exclusively, on prose narratives, we will examine this literature in its aesthetic, historical, and cultural dimensions. Topics for discussion will include the traditional functions assigned to Yiddish in East European Jewish culture; the attitude toward Yiddish expressed by rival early-modern social movements; the increasing politicization and secularization of most East European Jewry throughout the 19th century; the reaction of Yiddish culture to the upheavals caused by immigration, revolution, and world war; and inevitably the aftermath of Yiddish culture following the Holocaust. All readings will be in English and will include such central figures as Reb Nakhman Breslover, Mendele Moykher-Sforim, Y.L. Peretz, Sholem Aleichem, I.B. Singer, and Avrom Sutzkever, among others. Prior knowledge of Jewish culture helpful, but not required; no knowledge of Yiddish required. Cross-listed with Jewish Studies.

Caplan   3 credits

213.359 (H) Kleist

Heinrich von Kleist was one of the most intriguing literary figures of the early nineteenth century in Germany. Neither Classicist nor Romanticist, he developed a unique style that combines such different elements as complex rhythmicality, drastic imagery, and philosophical precision. His novellas, plays, and nonfiction prose explore questions of gender, colonialism, the tragic, and of innocence and double dealing. Among the texts we will read together are The Betrothal in St. Domingo (Kleist's literary response to the Haitian revolution), Penthesilea (the play about lovers who can find each other only in war ends in a splatter scene), and The Marquise of O (the story of a woman whose father rejects her because she finds herself pregnant, and yet she has no memory of the sexual intercourse that must have led to her current situation). Language of Instruction: German

Pahl   3 credits

213.362 Sigmund Freud

The course will examine Freud's writings from a two-fold perspective: On the one hand, we will analyze the contributions of psychoanalysis to modern thought. Lining himself up with Copernicus and Darwin, Freud considers his concept of the "unconscious" a further insult to mankind's narcissism and revolution of thought. In this respect, psychoanalysis affects a vast array of concepts of modern thought such as subject, language, sexuality, morality, culture, history, religion and art which we will discuss alongside with key terms of psychoanalysis (unconscious, repetition, transference etc.). On the other hand, the course will address the specific relation between psychoanalysis and literature. Throughout Freud's writings, literature enjoys vivid interest. Not only are psychoanalytic concepts (e.g. Oedipus complex, narcissism, the uncanny) crucially informed by literary texts, but also Freud's *Interpretation of Drea* proves to be a theory of representation and reading. We will investigate the

ways in which literature and psychoanalysis are involved with each other considering narrative forms, performative aspects and aspects of the genre (novel, novella).
Strowick   3 credits

213.372 (H) Literature and Dream
Dreams seem to be mysterious and enigmatic. Since the Renaissance, their particular forms of imagination have attracted the interest of both scientists and literary authors. As the other or dark side of reason, dreams provoke scientific claims for order; literature, however, explores the relation, if not affinity of dreams to poetic representation. Still, science and literature are oriented toward each other. Both discourses generate knowledge of dreams but in different ways. By means of close readings, the seminar will analyze the knowledge of dreams produced by literature and examine how this knowledge in its formal figuration differs from philosophical, anthropological and psychological theories of dreams. Authors to include Kant, Moritz, Karl Friedrich Pockels, Salomon Maimon, Goethe, Jean Paul, Novalis, Kleist, Schopenhauer, E.T.A. Hoffmann, Freud, Schnitzler, and Kafka. Readings and discussions in German.
Krauss   3 credits

213.377 (H) Mermaids and Water Sprites
Many stories have been told about different kinds of water people. What kind of fascination does life in the water hold? What is so interesting about these hybrid creaturemen with webs between their fingers, and women with fishtails? What is lost when these amphibians settle on land for good? We will read literary texts from different periods to pursue these questions. Readings and discussion in German. Prerequisite: 213.361-362 or special permission.
Pahl   3 credits

213.380-381 Ghost Stories, Haunted Houses and Other Occult Phenomena (H)
From the eighteenth-century poet E.T.A. Hoffmann to the modern writer W.G. Sebald, German authors have been obsessed with uncanny phenomena that blur the line between the natural world and the supernatural and animate creatures and inanimate things. We will explore these encounters with ghosts, automatons, and other apparitions. Readings in English and German; discussion in English.
Tobias   3 credits

213.382 (H) Orphans: Literature's Pursuit of Paternity
This course will examine how literature reflects on the source of its own images and scenarios through the motif of orphans. As will become evident in our discussions, orphans do not merely constitute a figure among others in literary works. Instead they have a special function as an allegory of literature itself which is of uncertain origin. Authors to include Lessing, Schiller, Goethe, Tieck, Kleist, Stifter, Hofmannstahl, and Walser.
Tobias   3 credits

213.386 (H) German-Jewish Thought Since the Enlightenment
Survey of trends in German-Jewish thought since Haskala (Enlightenment). Emphasis on debate regarding "Deutschtum" and "Judentum" in 18th and 19th centuries; rationalist interpretations of Judaism; rediscovery of mysticism in 20th-century and anti-rationalist tendencies. Readings in German and English; discussion in English. Prerequisites: 091.201-202 or equivalent.
Tobias   3 credits

213.395 (H) Literature and Photography
Investigation of the intersection of literature and photography in 20th-century fiction. How does the frozen image of photography affect narrative representation? The syllabus will include works conceived as collages (Sebald, Roth) as well as theoretical works (Sontag, Barthes, Benjamin) and literary texts indebted to the visual arts (Rilke, Baudelaire, Calvino, Bernhard).
Tobias   3 credits

213.399 (H) Realism
The course will examine German realism in two respects. First, we will analyze how narrative techniques create what Roland Barthes has called the "reality effect." Secondly, we will explore how the poetics of realism and media technologies (e.g. photography, stereoscopy) are intertwined. Forms of temporal and spatial representation as developed in the German literature of the second half of the 19th century call into question the opposition between realism and modernism. Readings will include Gottfried Keller, Adalbert Stifter, Wilhelm Raabe, Theodor Storm, Theodor Fontane, Conrad Ferdinand Meyer. The course will be conducted in German.
Strowick   3 credits

213.408 (H) The Literatures of Blacks and Jews in the 20th Century
This course will be a seminar comparing representative narratives and poetry by African, Caribbean, and African-American authors of the past 100 years, together with European and American Jewish authors writing in Yiddish, Hebrew, and English. This comparison will examine the paradoxically central role played by minority, "marginal" groups in the creation of modern literature and the articulation of the modern experience. Among the topics to be considered in this course will be the question of whether minority literatures require a distinct interpretive strategy from "mainstream" literary traditions; the problem of political discrimination and the question of identity politics in the creation, and interpretation, of literature; the commonalities of historical experience between Black and Jewish peoples; and the challenge of multiculturalism in modern society. Authors discussed will include, among others, Sholem Aleichem, Charles Chesnutt, Sh. Ansky, Jean Toomer, Sh. Y. Agnon, Amos Tutuola, Bernard Malamud, Caryl Phillips, and Anna Deavere Smith. All readings and discussions conducted in English; enrollment open to graduate and advanced undergraduate students.
M. Caplan   3 credits

213.410 (H) Modernism and the Metropolis
This course will be an advanced-undergraduate, writing-intensive examination of the theme of urban space in literature (poetry, drama, fiction) from Europe, Africa,

and the United States, spanning the mid-19th century until the mid-20th century, and drawing from English, French, German, Hebrew, and Yiddish sources. Among the topics we will consider are the role of mobility and urbanization in creating modern culture, the dislocations and juxtapositions that constitute urban culture, and the aesthetic role of modernist literature in reflecting the kaleidoscopic experience of the city through techniques such as free verse, multimedia theater, and stream-of-consciousness narration. Authors discussed will include, among others, Charles Baudelaire, T. S. Eliot, Moyshe-Leyb Halpern, Allen Ginsburg, Bertolt Brecht, Knut Hamsun, Dovid Bergelson, Sh. Y. Agnon, André Breton, Chinua Achebe, and John Kennedy Toole. All readings and discussions conducted in English.
M. Caplan   3 credits

213.412 (H) What is Enlightenment?
Readings and discussions in German. "Enlightenment", a European intellectual and social reform movement of the 18th century, advocated reason as the primary basis of authority and the means to scrutinize previously accepted doctrines and traditions. Thinkers in England, France, and later in Germany began to question the authoritarian state, and the orthodoxy of the Church. They attacked intolerance, censorship, and social restraints and argued in favour of the emancipation of the bourgeois individual on the basis of universally valid principles. This course offers an introduction to German Enlightenment through close readings of philosophical and literary texts. The analysis will focus on concepts of freedom, humanity and education, the significance of feelings and emotions for the constitution of individuality, and the critique of reason in late Enlightenment. Authors include Gottsched, Lessing, Herder, Goethe, Mendelssohn, Kant.
Krauss   3 credits

213.419 (H) Critical Love: The Theory and Practice of Literary Criticism
"The Sandman," a fantastic, ironic, and uncanny story by the German Romantic E.T.A. Hoffmann will function as the cornerstone of this course. Around this self-reflexive piece of literature we will study some of the most important approaches to literary criticism from continental philosophy, German romanticism, psychoanalysis, hermeneutics, post-structuralism, deconstruction, postcolonial feminism, and queer theory. The course will explore our amorous relations to literary texts and develop an ethics of transformative reading. Readings and discussion in English.
Pahl   3 credits

213.426 (H) Thomas Mann
The course will be taught in German. In this course we will explore one of the most fascinating German authors of the 20th century. Exceptional in its stylistic elegance, its irony and coldness, Mann's prose addresses major topics of modernism such as the tension between rationality and passion, between artistic and bourgeois existence, between modernity and myth. In close readings of selected novellas and novels (excerpts), we will analyze Mann's rhetorical style, his narrative technique of leitmotif and the intertexuality of his prose; further we will examine the substantial relationship of Mann's writing to philosophy (Schopenhauer, Nietzsche), medicine, psychoanalysis, and music (Wagner, Schönberg).
Strowick   3 credits

213.429 (H) The Lyric
Survey of 19th- and 20th-century German lyric poetry for beginning graduate students and advanced undergraduates. Course will focus on intersection of theoretical writings on the lyric with lyric form itself. Authors include Eichendorf, Brentano, Heine, Droste-Hülshoff, Hoffmannstahl, George, Trakl, Rilke, Bachmann, Celan. Prerequisites: 091.201-202 or equivalent.
Tobias   3 credits

213.440 (H) Franz Kafka: The Power of Writing
The course analyzes texts by Franz Kafka from a twofold perspective. Inasmuch as his work tirelessly addresses processes of administration, law, punishment, knowledge production and family structures, it can be considered an analysis of modern institutions and forms of power by means of literature. But these forms of power also inform Kafka's poetic practice. His literary techniques relate to modern communication systems (postal system) and media technologies used in modern bureaucracy (typewriter, phonograph/sound writer, telephone). In close readings we will examine how the specific performative, rhetorical and material character of Kafka's texts contribute to the power of writing or what Deleuze/Guattari call a 'minor literature.' The course will also explore Kafka's impact on 20th-century literary theory and philosophy (Benjamin, Canetti, Deleuze/Guattari). Readings and discussions in German.
Strowick   3 credits

213.450 (H) Decadence
Early 20th-century literature has been identified variously as nihilist, fascist, revolutionary, and anti-bourgeois. This course will explore the complex political dimensions of a movement that sought to fashion a purely aesthetic existence. We will trace the development of this movement from the turn-of-the-century in Vienna to the Roaring '20s in Berlin. Authors to include Musil, George, Hofmannsthal, Nietzsche, Rilke, and Mann. Readings in English and German, discussions in English and German.
Tobias   3 credits

213.501-502 Independent Study
Staff

213.509-510 (H) German Honors Program
Staff

Italian

These courses count as advanced courses and carry both university and major credit.

214.301 (H) Survey of Italian Literature

Taught entirely in Italian. An overview of the key texts, authors, and movements in the Italian literary tradition, from the Middle Ages to the present. Recommended for all Italian majors and minors, and for Romance Languages majors who include Italian. Completion of Italian 210.252 Intermediate recommended; the Survey of Italian Literature may be taken concurrently with Advanced Italian 210.352.

Staff   3 credits

214.340 (H,W) Holocaust & Film

This course examines the question of the Holocaust and its representation in the filmic media. We will analyze such themes as post-traumatic documentary (e.g., *Night and Fog*, Alain Resnais 1955), the resistance to representation (*Shoah*, Claude Lanzmann 1985), Holocaust drama and the ethics of entertainment (e.g., *Schindler's List*, Steven Spielberg 1993), the question of filmic adaptation (e.g., *The Grey Zone*, Tim Blake Nelson 2002—based on Primo Levi's *The Drowned and the Saved* 1986), and the new genre of confessional first person video-diary (e.g., *Two or Three Things I Know About Him*, Malte Ludin 2005). On this last theme we hosted a two-day symposium "The Holocaust: Children of the Perpetrators Confront Their Parents' Nazi Past through Documentary Film," in March '09. The symposium featured three international documentary filmmakers and their recent films: *The End of the Neubacher Project*, Marcus Carney 2007, *Fatherland*, Manfred Becker 2006, and *Two or Three Things I Know About Him*, Malte Ludin 2005, in which the filmmakers—children of Nazi perpetrators—are asking the question "Who am I in relation to my father's deeds?" The symposium further included a number of experts on the topic of Holocaust, commemoration, and documentary film. Students were involved in the preparation and the panel discussions of the symposium. This class is reading-intensive and writing-intensive; weekly response papers will be written about the films and the course topic at large. All films will be screened with English subtitles.

Wegenstein   3 credits

214.342 (H) Documentary Film and Ethics

This class will look at questions of how documentary filmmakers have attempted to and indeed changed the law by making such documentaries as "Capturing the Friedmans," "Super Size Me," and "The Corporation." It will look at the area of human rights films, and the ethical filmic intention of mobilizing communities, or helping people in need with films such as "The Thin Blue Line," "Darwin's Nightmare" and "Sand and Sorrow." We will analyze which documentary genre can address issues of information, mobilization, convincement, truth and propaganda with which means of expression (e.g., direct cinema). Overall, the ethics of all these attempts of filmmaking will be examined cross-culturally and historically.

Wegenstein   3 credits

214.344 (H) Love of Poetry and Poetry of Love

This course examines love poems in which poetry is seen as an ally of love in the conquest of the object of desire. It is a course on the pleasure of writing and the pleasure of reading. Part of it is theoretical and part of it is an analysis of a number of outstanding poems in the Italian tradition—from the Middle Ages to the Novecento. Among the examined theorists are Aristotle, Foscolo, Freud and the Russian Formalists. Among the chosen poets are Dante, Petrarca, Cino da Pistoia, Leopardi, Pascoli, Gozzano and Saba. Class discussion is in English. Texts are read in the original and in English.

Forni   3 credits

214.352 (H) Writing and Wonder: Books, Libraries, and Discovery, 1350-1550

The invention of printing occurred amid two centuries of intense development in the conduct and material means of European scholarship. The transition from writing by hand to movable type was accompanied by a revolution in scholarship that involved a new attitude to Classical and Biblical antiquity, the recovery of neglected and "lost" works, the formation of secular libraries, and the development of tools for the study of ancient handwriting, writing materials, and the history of language and of history itself. The revolution in attitudes to and uses of the book eventually transformed every discipline related to reading, writing, and the organization of knowledge. Topics to be covered include writing as an object of wonder, the transformation of a mythology of writing into a true history of books, writing, and libraries, the scientific study of writing and of language, and the representation of writing and books in the art and literature of the Middle Ages and Renaissance. Extensive use will be made of Johns Hopkins' large collection of books published before 1600, and student projects will be oriented toward reliving the experiences of scholars in this period, including via computer-assisted means.

Celenza, Stephens   3 credits

214.356 (H) Science and Heresy in Galileo's Italy

The class will be conducted in English. In the wake of Copernicus, the still dominant geocentric model of the cosmos was challenged in Italy by two equally brilliant but very different thinkers: Giordano Bruno, iconoclastic philosopher and theorist of magic, and Galileo Galilei, who has been called the "father of modern science." Both of these revolutionary intellectuals faced strong opposition from within the Catholic Church: Bruno was executed as a heretic, while Galileo was forced to formally recant his heliocentric views. We will study the principal writings of both thinkers, focusing on both the literary qualities and the historical context of their works. We will also examine the cosmological visions of earlier writers, including Dante. Additional section will be offered for Italian majors (and others with a strong command of the language) in which we will read and discuss texts in Italian.

Coleman   3 credits

214.359 (H) 3 Renaissance Books of Conduct
A reading of Erasmus, Castiglione, and Della Casa on conduct.
Forni   3 credits

214.361 (H) The World of Dante
This course focuses on the social, cultural, political, and moral concerns that shape Dante's *Divine Comedy*. Together with selected cantos from *Inferno*, *Purgatory*, and *Paradise*, students read parts of Dante's *New Life* and *On World Government*.
Forni   3 credits

214.363 (H) Dante in Translation, *Divine Comedy,* *Inferno*
A lecture and discussion course which focuses on readings from Dante's *Divine Comedy*. The structural aspect of the poem, as well as the historical and theological ones will be emphasized. One paper and final examination.
Forni   3 credits

214.364 (H,W) Italian History in the Italian Novel
This course examines the different ways in which Italian writers of the past two centuries have included historical events in their novels. A. Manzoni's *The Betrothed*, G. Tomasi di Lampedusa's *The Leopard* and E. Morante's *History: A Novel* are among the examined works.
Forni   3 credits

214.366 (H) Literature and Ethics
This course focuses on the moral implications of the acts of reading and writing literature. Aristotle, Horace, Dante, Boccaccio, and Freud are among the featured authors.
Forni   3 credits

214.368 (H) Italian Novel of the 20th Century
Forni   3 credits

214.370 (H) Magic and Marvel of the Italian Renaissance
Discover the Magic and Marvels—both literal and figurative—of Italian literature between 1350 and 1550. Poets, philosophers, political theorists, dramatists, and fiction writers ponder the nature of humanity, in itself and in its relations with the supra-human beings described by religion and literature. Readings include Machiavelli's *Prince* and Ariosto's *Orlando furioso,* the epic romance that inspired works as varied as Spenser's *Faerie Queene* and Cervantes' *Don Quixote*.
Stephens   3 credits

214.371 (H) *The Name of the Rose* **and the Middle Ages**
Umberto Eco's acclaimed novel as an introduction to the study of the Middle Ages. An optional third hour for readers and speakers of Italian.
Stephens   3 credits

214.373 (H) Italian Comedy
For students who have completed Intermediate Italian (210.251-252). Readings and discussion, in Italian, of the grand tradition of comedy, satire, and humor in Italian

literature: from the humor of the Middle Ages through the Romance Languages and Literatures/313 rebirth of the theater around 1500, to the modern classics of opera, stage, and film. Class will be paced to build linguistic and literary competence; emphasis on reading, writing, speaking, and recitation. If enrollment suffices, a one-act play can be produced. Readings in Dante, Boccaccio, Machiavelli, Ariosto, Goldoni, Mozart's librettist Da Ponte, Pirandello, Calvino; films by Toto, Roberto Benigni, and others.
Stephens   3 credits

214.379 (H) Intellectual World of the Italian Renaissance
This course will allow students to explore the intellectual background to the 15th-century Italian Renaissance. Most Italian intellectuals from the late 14th century through to the early 16th century wrote, not in Italian, but in a "new" Latin, like the Latin used in ancient Rome, rather than (what they saw as) the inauthentic Latin of medieval universities and the Church. Recent scholarship has allowed us to have greatly increased access to these authors who wrote in the era between Dante (1265-1321) and Niccolò Machiavelli (1469-1527). Thinkers such as Leonardo Bruni (perhaps the best-selling author of the 15th century), Lorenzo Valla (who is now emerging as a major philosopher of language), and Marsilio Ficino (whose influence on literature and the arts in his own era is comparable to that of Freud in ours), are comparatively little known today. But their work represented the intellectual backbone of Renaissance Italy and was widely diffused in succeeding centuries in early modern Europe. This course will allow students to explore this forgotten legacy and thus to understand a missing chapter.
Celenza   3 credits

214.380 Italian Short Fiction
Course will read major examples of the short story and novella, beginning with contemporary writers and working backward through several centuries of Italian fiction to build vocabulary and literary-historical knowledge. Taught entirely in Italian.
Stephens   3 credits

214.381 (H) 'La commedia all'italiana:' the films of Dino Risi, Mario Monicelli and other Italian filmmakers of the 1960s
This class will be taught in English, but good knowledge of Italian will be a necessity. Films will be screened in Italian language.
Wegenstein   3 credits

214.382 (H) Dante and Aeneas in the Age of Google
This course examines Dante's Inferno and Virgil's Aeneid with the goal of showcasing both enduring and new reasons of relevance in the two masterpieces.
Forni   3 credits

214.390 (H) Machiavelli in Context
This seminar course will offer students the chance to read most of Machiavelli's major works in English trans-

lation. In addition, Machiavelli will be examined both in the context out of which he emerged—the Latinate Italian humanism of the 15th century—and in the context in which he carried out his daily activities—the bustling day-to-day world of Florentine politics. A separate section will be offered for students with adequate reading knowledge of Italian, in which we will read Machiavelli's *Prince* in Italian, in a new, definitive critical edition.

Celenza   3 credits

214.391 (H) Western Intellectual History 1200-1500
High and late medieval philosophy will be covered in its historical context. Thinkers such as Thomas Aquinas, William of Ockham, and Lorenzo Valla will be treated, as will the contexts for high and late medieval learning, such as universities, courts, and the new, "state" libraries of the 15th century in Italy.

Celenza   3 credits

214.420 (H) Italian Neorealismo and Its Impact on the International Documentary Film Tradition
This course starts out by revealing the birth of the Italian New Realist movement in the early 1940s, when Roberto Rossellini and others made their first documentaries for the fascist istituto LUCE. We will then analyze the highlights of the Italian new realist film movement with the films and scripts by Cesare Zavattini, Vittorio de Sica, Luchino Visconti, and others; the second half of the semester will be dedicated to the question of the Italian new realist cinema's impact on other international documentary movements and traditions of the 20th century, from the French Nouvelle Vague to the US and Canadian Direct Cinema movement, from the Scandinavian Dogme films to such reality TV phenomena as FOX's recent "The moment of truth." Screenings will be held in original language with English subtitles. Readings to be announced.

Wegenstein   3 credits

214.462 (H) Story and History in Italian Novecento
Prose texts, considered classics of contemporary Italian literature will be read and studied in their historical context. Works by Giuseppe Tomasi di Lampedusa, Giorgio Bassani, Italo Calvino, and Primo Levi will be read in Italian.

Forni   3 credits

214.479 (H) *The Divine Comedy*: An Intensive Reading in English
A reading and discussion of Dante's masterpiece, the *Inferno, Purgatorio,* and *Paradiso,* in its entirety, in English translation. Concentration on its structure and relation to the most pressing theological, philosophical, social, and political problems of Dante's time. Its ongoing relevance to our own concerns about ethics, government, art, and mortality.

Stephens   3 credits

214.561-562 Italian Independent Study

214.563 Italian Internship

Spanish

These courses count as advanced courses and carry both university and major credit.

215.231 (H,W) Introduction to Literature in Spanish
The main objective of this course is to examine and discuss specific authors and topics in literature in Spanish from the Middle Ages to the 20th century. The course is designed to cover a selection of Hispanic texts from Spain and Latin America. Literary genres to be studied will include narratives, poetry and drama. The bulk of each class session will be dedicated to the discussion of the assigned readings. This course is taught in Spanish. This course is required for the major in Spanish.

Staff   3 credits

215.232 (H) Spain and its Literature in Modern and Medieval Times
This course will explore the fundamental aspects of Spanish Peninsular literature in reverse chronological order from the twentieth to the tenth centuries. The course will offer a general survey of the literature of Spain. Students will be asked to read, analyze and comment on representative texts from the Spanish canon.

Staff   3 credits

215.336 (H) Don Quijote
A close reading and discussion in English and/or Spanish of Cervantes' masterpiece, with concentration on its major themes, historical and literary contexts, and contributions to the formation of the modern novel. Active participation is required. Prerequisite: Advanced Spanish or equivalent.

Sieber   3 credits

215.337 (H) Golden Age Spanish Theater
This undergraduate seminar will begin with a lecture on the history of Spanish theater, from Medieval to Early Modern times. A close reading of Lope de Vega's *Arte Nuevo de hacer comedias* will follow. Plays by Lope de Vega, Tirso de Molina, Rojas Zorilla, Moreto and Calderon are some of the authors covered in this course. Prerequisite: Advanced Spanish or equivalent.

Sieber   3 credits

215.338 (H) Introduction to Argentine Literature
Taught in Spanish . This course examines representative works and genres of Argentine literature from the nineteenth and twentieth centuries. Among numerous other authors, students will read Eduardo Holmberg, Horacio Quiroga, Roberto Arlt, Jorge Luis Borges, Alfonsina Storni, and Julio Cortázar.

Altschul   3 credits

215.339 (H) Borges and Philosophy
In this course we will read some of the most important works of the Argentinian writer, thinker, and critic Jorge Luis Borges, as they intersect with fundamental questions in modern philosophy. The relation of Borges to thinkers like Kant, Leibniz, Heidegger, and Derrida will be at the core of our discussions.

Egginton   3 credits

215.340 (H,W) Narrating Self and Nation in Modern Latin American Literature and Film

The course will focus on a critical reading of major modern Latin American writers. We will read entire books as well as selections from major works from the following authors. J.F. Sarmiento, Euclides da Cunha, Machado de Assis, Gabriela Mistral, Pablo Nerua, Octavio Paz, J.M. Arguedas, Carlos Fuentes, Clarise Lispector, Diamela Eltit and Bolano. The course will view five recent Latin American films also.

Castro-Klarén   3 credits

215.341 (H,W) Introduction to the Study of Latin America

An interdisciplinary approach to the study of Latin America since Independence. The course will reply of a historical approach to the the study of literature, art and the formation of cultural epochs and periods.

Castro-Klarén   3 credits

215.342 (H) Introduction to Latin America: The Formative Years

The course will explore the cultural continuities and fractures in the unfolding of life in the Andes from the appearance of the first urban center on the coastal valleys—2000BC— to the aftermath of the Spanish conquest at about 1600. Readings will be taken from archaeology and anthropology. Andean and Christian myths of origin and theories of state formation will be examined along with the chronicles written by Spanish conquistadores, Indian and Mestizo intellectuals.

Castro-Klarén   3 credits

215.343 (H) Nación crilla: cultura y literatura en el siglo XIX

El curso examina la formación de nuevas identidadeslatinoamericanas y la búsqueda de un pasado que las haga legítimas. Consid-eraremos en particular la apropiación del pasado amerindio y la relación con el pasado español en discursos cívicos, himnos nacionales y textos de figuras como Sarmiento, Bello, Lastarria, y Letelier.

Altschul   3 credits

215.346 (H) Contemporary Latin American Novel

This course explores the contemporary Latin American novel, including work by Machado de Assis, Teresa de la Parra, Jose Maria Arguedas, Rosario Castellanos, Clarise Lispector, Carlos Fuentes, and Garcia Marquez.

Castro-Klarén   3 credits

215.347 (H) 20th-Century Latin American Literature

A survey of the major Latin American prose writing in the 20th century.

Castro-Klarén   3 credits

215.354 (H) El Caribe/The Caribbean

The Caribbean in art and literature from Shakespeare's *The Tempest* to contemporary writers in English and Spanish. (Cross-listed with Film and Media Studies and Program for Comparative American Cultures.)

E. González   3 credits

215.355 (H) Film and Literature in Spanish

Learning to discuss film and literature through Spanish and Latin American sensibilities.

E. González   3 credits

215.370 (H) Studies in Spanish and Latin American Poetry

In this course we will approach the question of what poetry is and how to read it through the examples of two Spanish poets—Federico García Lorca and Antonio Machado—and two Latin American poets—Ruben Darío and Pablo Neruda. We will read their work in the context of questions opened up by the German philosopher Martin Heidegger around the nature of poetry and its relation to human being. The course will be taught in English with readings in Spanish.

Egginton   3 credits

215.371 (H) Modern Spanish Literature

A survey of the literature of Spain from the 18th through the 20th Centuries. This course will be taught in Spanish.

Egginton 3 credits

215.440 (H) Picaresque Novel in Spain

This course will consist of close readings of the *Lazarillo de Tormes*, selections from Mateo Aleman's *Guzman de Alfarache*, and three of Cervantes' *Novelas ejemplares*. These texts reveal the impact that Spanish fiction exerted on Golden- Age Spanish literary history and on the European novel in general. Conducted in Spanish and/or English. Prerequisite: Advanced Spanish or permission of instructor.

Sieber   3 credits

215.441 (H) Borges and Cortázar on Self-Writing

Castro-Klarén   3 credits

215.443 (H) Hispanic Literatures and the Arts

Literary works from different genres (fiction, drama, poetry) by authors from Spain and Latin American are studied and illustrated in reference to the plastic and visual arts and cinema, indigenous, popular, and religious cultures.

González, E   3 credits

215.447 (H) Borges and His Times

An examination of Borges' life and major works. Taught in Spanish. Prerequisite: Advanced Spanish or instructor's consent.

Castro-Klarén   3 credits

215.451 (H) El Cine de Almodóvar

From *Pepi* to *Hable con ella*, the films will be studied in form, content, and socio-political terms.

E. González   3 credits

215.453 (H) The Cuban Diaspora
In sites such as Havana, Miami, Washington, New York, London, Madrid, currents in urban culture among Cubans on the island and elsewhere. Taught in Spanish. Prerequisite: Advanced Spanish.
E. González   3 credits

215.455 (H) Cuban Noir
The genre of noir in and around detective fiction as portrayed in novels, short stories, and movies. Readings and viewings centered on mutual influences and flow between Cuba and the U.S., from Hemingway and the Mafia to the now foreclosed cultural openings between the two countries in the 1990s. Taught in Spanish.
E. González   3 credits

215.456 (H) Gauchos, Negros, Gitanos
Study of the literature and music inspired by three groups of great liminal influence in the cultural and political affairs of their respective nations. Gauchos (Argentina). Afro Hispanics (Cuba, Puerto Rico, Santo Domingo). Gitanos (Spain). Attention given to popular and learned myths and stereotypes and the history of efforts to establish self-identity. Conducted in Spanish. Prerequisite: Advanced Spanish or permission of instructor.
E. González   3 credits

215.458 (H) Cuba and its Culture since the Revolution
We will study the visual and textual arts, cinema, political culture, and blogosphere; reaching back to the first phases in the building of the revolutionary state apparatus and its sovereign mandate. Taught in Spanish.
E. González   3 credits

215.460 (H) Modern Mexico and the Culture of Death
We will examine the cultural resonance of death in Mexico's colonial and postcolonial history and the impact of the 1910 revolution in the nation's popular and elite self-image. Emphasis placed on the visual arts, literature, music, and the view of Mexico created by foreign writers and artists.
E. González   3 credits

215.467 (H) Mexico en su Literatura y su Artes
Estudio del México contemporaneo en su literatura, música, pintura y cine. Clase dictada enteramente en español.
E. González   3 credits

215.484 (H) Orientalismo al Sur
Taught in Spanish. Este curso examina la presencia del Islam y el concepto del "oriente" en el Cono Sur, especialmente Argentina. Leeremos obras de los siglos 19 y 20 que representan al oriente, y discutiremos los significados y cambios que la llegada de inmi-grantes "islámicos" produjo en la cultura literaria de esta zona de América Latina. Tendremos en cuenta de forma particular que el problema del "oriente" en España y sus colonias es un problema "interno". Debido a que la península ibérica tuvo una importante presencia musulmana durante toda la edad media (711-1609), en los círculos europeos España fue considerada "islámica" u "ori-ental" también durante los tiempos modernos. Es así que el Oriente llega a América con la conquista de los españoles "islamiza-dos." Cross-listed with PLAS.
Altschul   3 credits

215.486 (H) Contemporary Retellings of Medieval Spain
This course focuses on contemporary fiction written in Spain after 1980, especially on the topic of al-Andalus, the multiethnic society of Muslim, Christian and Jewish cultures in medieval Iberia. These contemporary narratives will lead the discussion to both the history of medieval Iberia, and the meanings of historical memory in modern Spanish fiction. Writers include Juan Goytisolo, Magdalena Lasala, Ángeles de Irisarri, Leopoldo Azancot, César Vidal, and Jesús Greus.
Altschul   3 credits

215.488 (H) Postcolonial Middle Ages
This course focuses on perspectives on the literatures and cultures of the Middle Ages that have stemmed from renewed recognition of medieval times as marked by cultural contact, conquest, and colonization. The course examines both postcolonial theory and its relationships with medieval Iberia through topics such as mimicry, race relations, hybridity, settlement and transculturation, feminization of enemies, nationalism, temporality and periodization. Taught in Spanish.
Altschul   3 credits

215.491 (H) Muslim Spain
From 711 to 1492 the Iberian Peninsula was a multilingual and multiethnic society inhabited by members of the three monotheistic faiths. This course will discuss the interactions and literatures of the Muslim, Jewish, and Christian peoples of Iberia during medieval times. Readings include Ibn Hazm, Shem Tov, Petrus Alfonsus, and Juan Manuel, as well as Kalilah wa Dimnah and Sendebar.
Altschul   3 credits

215.494 (H) Metaphysical Fictions in Latin American Literature
All readings and discussions will be in Spanish. Perhaps more than in the Anglophone tradition, the literatures of Latin America have exhibited a strong current of metaphysical speculation, leading to the image of the Latin American literary intellectual as a kind of philosopher poet. In this course we will read salient examples of the metaphysical fictions that have led to this reception, including books and stories by Julio Cortazar, Jorge Luis Borges, Alejo Carpentier, Adolfo Bioy Casares, Gabriel García Márquez, Augusto Roa Bastos, and others. Cross-listed with PLAS.
Egginton   3 credits

215.496 (H) Formations of the Unconscious: Bunuel, Garcia Lorca and Dali
In this course we will study the enormous contribution to art, literature, and thought made by three Spaniards in the early part of the 20th century. Buñuel, Garcia Lorca, and Dali each revolutionized his specific artistic medium, and were influential in each other's lives and work as well.

We will examine their body of work and their relationship to psychoanalysis, particularly the work of Jacques Lacan, whose seminar we will also be reading.

Egginton   3 credits

215.525-526 Spanish Independent Study
Staff   3 credits

Department-Wide and Interdepartmental Courses

212.-, 213.-, 214.-, 215.355 (H,W) Literature and Opera
In this course we will look at the relation between some of the great opera's of the 18th and 19th centuries and their literary sources. We will also discuss some recent philosophical interpretations of opera. At stake will be the question of how literature is translated into music and stagecraft, and what these translations say about the times and cultures in which they were produced. Each week we will view and listen to an opera, and read its source materials as well as critical works about both. The course will be conducted in English, and will be writing intensive.

Egginton   3 credits

360.133 Great Books at Hopkins
Staff   3 credits

360.233 Feminist and Queer Theory
This course is an introduction to theories of feminism, gender, and sexuality. It examines classic and recent texts and considers problems and cases from a variety of cultures and historical periods in local, national, and global contexts.

Pahl   3 credits

360.410 (H,W) Light and Enlightenment: Newton's Opticks and 18th-Century Culture
This seminar, taught in English, will examine the Newtonian legacy for Enlightenment culture through a close study of his influential book, the Opticks. Special attention will be paid to the impact of this book on the sciences of electricity, heat, light, and chemistry and on the literature, philosophy, and painting of the Enlightenment. Open to upper division undergraduates and graduate students. (Cross-listed with History of Science and Technology.)

Anderson   3 credits

360.453 (H,S) Culture of Reasons
This seminar is a close examination of how the changing understanding of Newtonianism (and its translation across language, disciplinary, and cultural barriers) transformed the worlds of arts and letters. It will also discuss related 18th-century attempts to articulate social, moral, and political issues relating to gender and class and conclude with a close reading of the anti-Newtonian movement and a final discussion of the continuing relevance of issues of Newtonianism and cultural translation to modern humanistic research. A full description of the course, including the proposed syllabus can be found at **www.wilda.org/Courses/CourseVault/Grad/Newtonianism**.

Taught with 360.653. (Cross-listed with History of Science and Technology.)

Anderson, Kargon   3 credits

Graduate Courses

210.610-611 Methodology and Instructional Practices in Foreign Language Teaching
Yearlong course required for all incoming teaching assistants in the Department of German and Romance Languages; involves a series of workshops which will focus on an overview of the tenets of second language acquisition (SLA) and the research which informs current teaching practice. Students will both study the current state of the second language acquisition profession and look at different methods and techniques for effective second language teaching and learning. The focus of the course will be on the practical applications of the theoretical foundations of SLA. The course will encourage the students to become critical observers of their own language teaching.

Sanchez, Mifflin, Zannirato

212.-, 213.-, 214.-, 215.601 Word and Image
Taught in English, this course is a primer in the linguistics and the rhetoric of literary and cinematic texts. Students will familiarize themselves with the notion of the literary language's exceptionality by studying Aristotle, Plato, Viktor Sklovskij and Roman Jakobson among others. They will then compare the power of the literary with the language of cinema by studying Andre Bazin's take of New Realism, Christian Metz's structuralist approach to cinema and psychoanalysis, Gilles Deleuze's theory of the moving-image and the time-image, a feminist approach to cinema by E.Ann Kaplan and others, as well as theories of digital cinema from Peter Weibel to Lev Manovich, among others. We will place the language of literature and film within a context that includes religion music, magic, prophecy and medicine.

Forni and Wegenstein

212.-, 213.-, 214.-, and 215.605 The Idea of Literature
European languages document the evolution of the concept of literature from a generic term indicating the body of writings produced in a particular country or period to one that more particularly signifies works endowed with an aesthetic quality. The concept of literature thus seems to take form in connection with the emergence of a critical discourse, the search for a standard of taste. The dream of founding a "science littéraire" modeled on the principles of structural semiotics searching for an elusive "literariness", literature as a system, a set of formal features, not a collection of discrete, ineffable individuals; it thus involved a rejection of the aesthetic, or at least a reconsideration of its assumptions. This course will pursue the question of "The Idea of Literature" simultaneously from a philosophical and a historical perspective; in moving from formalist literariness to the rediscovery of categories like the ethical, the subject, the reader, the author, and the aesthetic, we will ask such questions as:

Can there be a return to an aesthetic education, as some wish, and what would that be? Would such a move resuscitate the ghost of Hume's gentleman scholar, which the New Critics tried to do away with? Is there a way of formally distinguishing between literature and its various contexts? Authors will include Hume, Kant, Taine, Lanson, Sainte-Beuve, Brunetière, Arnold, Proust, Benjamin, Bréton, Sartre, Bourdieu, De Man, and Eco.
Egginton, Russo

212.692 Research Methods
Seminar and lab in the methods, resources, and systems of research for graduate students of literature.
Waterman

212.673 Graduate Seminar in Film and Film Theory: European Auteurs
This course examines the notion of the "auteur," which has been in use for European filmmakers since the New Wave (1959–1963). After studying the theory of the auteur since the 1960s, we will focus on two directors from each of four national traditions: Federico Fellini and Michelangelo Antonioni from Italy; Jean-Luc Godard and Agnès Varda from France; Rainer Werner Fassbinder and Werner Herzog from Germany; and Julio Medem and Pedro Almodóvar from Spain. At stake will be the historical circumstances of the rise of the European "auteur," with special regard to factors that differentiate the national traditions in question. Theoretical readings will include *Cinema 2: the Time-Image* (Gilles Deleuze) and *The Cinema Effect* (Sean Cubitt).
Wegenstein

French

210.601 French for Reading and Translation
Intensive study of French grammar structure plus experience in reading and translating expository prose. Students do independent work (vocabulary acquisition and translation) in their particular field of study. Designed for graduate students in other departments who need to complete a language requirement in French. Open to undergraduates only with the permission of the language coordinator.
Staff

210.603 Cours de Perfectionnement
In this course, graduate students will reach grammatical fluency while learning how to explain French effectively to undergraduate learners. Online component. Mandatory depending on diagnostic test score.
Staff

210.611-612 Teaching French: Theory and Practice
Cook-Gailloud

212.606 Flaubert's Madame Bovary, Prose as Modern Art
Through a close reading of Flaubert's novel and selective consideration of the drafts, we shall examine the making of that masterpiece of narrative prose, which Flaubert himself conceived under the sign of modern art. Our central concern, in other words, is with Madame Bovary as a crucial event in aesthetic modernity, one that has had a prodigious afterlife in both literature and visual arts. Seminar will be taught in French and English.
Neefs, Fried

212.607 Tragedy on Stage and in Theory
Perhaps more than any other genre, tragedy tempts us to search for origins, to recover its previously pristine state, to lament its decadence, even its death. But is there an essence of tragedy? Is tragedy the product of a specific historical moment (sixth-century Greece) or is it a universal quality of human experience? Is it a philosophical notion or a strictly theatrical one? Through selected readings of plays and theories we shall explore some of the significant metamorphosis of tragedy, from Aeschylus to Corneille, Racine, Voltaire, Hegel, Nietzsche, Freud, Anouilh and others.
Russo

212.613 Marivaux and French Taste
A travers la lecture des oeuvres les plus significatifs dans la vaste production théâtrale, narrative et journalistique de Marivaux, nous allons explorer l'écriture des Lumières avant la montée des philosophes, en particulier les rapports entre les Lumières et ce qu'on nomme l'esthétique rococo. Parmi les sujets traités: les suites de la querelle des Anciens et des Modernes; le burlesque et la parodie; la controverse du marivaudage et du néologisme; la théâtralisation de l'écriture; le bel esprit et la critique du sublime.
Russo

212.615 Encyclopedic narratives, 19th–20th Century
Novels use and give many kinds of knowledge. The seminar will examine how narratives consume and expose facts, notions, ideas, technical devices, highly complex learning, and present themselves as encyclopedic narratives. We'll work on novels conceived as pedagogical instrument (Jules Verne), or allegorical epic (Victor Hugo), or deeply ironic and skeptical prose (Flaubert, Raymond Queneau), or intimate historical vivid memory (Pierre Michon). We'll examine how narrative prose can build strong worlds of knowledge.
Neefs

212.616 Rousseau
Le Discours sur les sciences et les arts, Le Discours sur l'origine de l'inégalité parmi les hommes, Le Contrat social, La Nouvelle Héloïse, L'Émile, Books I and XII of the *Confessions, les Lettres botaniques*: a reflection on the relationship of Rousseau's political writings to his literary and scientific projects.
Anderson

212.617 Eighteenth-Century French Theater
The development of the drame bourgeois and the theater criticism of the French Enlightenment. Authors to be studied include Racine, Le Sage, Marivaux, Voltaire, Diderot, Beaumarchais, and others.
Anderson

212.618 Les Lumieres: reseaux de communication au 18e siecle

Les réseaux des littérateurs et penseurs au 18e siècle, leurs modes de communication et influences réciproques, et les effets de ces communications sur leur production littéraire, par exemple chez les newtoniens (Buffon, Diderot, Voltaire, etc.), mais aussi chez les antinewtoniens (Marat, etc.).
Anderson

212.620 The *Encyclopédie*

In its attempt to realize fully the potential of a group description of knowledge, the *Encyclopédie* of Diderot and d'Alembert displays the program of the philosophes in a particularly intense and idiosyncratic form. This intellectual dialogue will be studied through the investigation of several different subjects treated in the *Encyclopédie*; for example, the theory of the encyclopedia itself, history, natural history, literature, medicine, theories of language.
Anderson

212.622 The Making of the Work: Introduction to Genetic Criticism

Sketches, Drafts, Copies, Final Manuscript: what do we learn reading work's preparatory manuscripts, before printing? The seminar will stress some esthetical interrogations raised by the study of the Working Process: narrative imagination, formal conception, what is an ending? the making of narrative prose, the Form and the Shape of the Poem, what can be and endless work?… the seminar will be an introduction to Genetic Criticism theory and methodology. We'll examine some paradigmatic examples: Stendhal's *Vie de Henry Brulard*, Flaubert's *Three Tales*, Proust's *La Recherche du temps perdu* (Le Temps retrouvé), Ponge's *La Fabrique du pré*.
Neefs

212.623 The Narrative Prose as a Modern Art: From Flaubert to Proust

Seminar will examine the new aesthetic purpose of narrative prose, from Flaubert to Proust, also considering the importance of prose in poetry (Baudelaire, Rimbaud, Mallarmé), including a study of the manuscripts and the genetic process of Flaubert's and Proust's writing.
Neefs

212.627 Litterature, Mythes, Religions au 19ème siecle

Le dix-neuvième siècle est le temps d'une interrogation profonde, nouvelle, sur les mythes et les religions. Des formes nouvelles d'études mythographiques et d'histoires des religions apparaissent. La littérature occupe une place privilégiée dans cette interrogation. Le séminaire s'attachera essentiellement aux œuvres littéraires et aux écritures de la "modernité": Chateaubriand, *La Vie de Rancé*, Balzac, *Le Curé de Village*, Nerval, *Les Filles du feu*, *Les Chimères*, Flaubert, *La Tentation de saint Antoine*, Victor Hugo, *La fin de Satan*, Baudelaire, *Les fleurs du mal*, tout en considérant le contexte idéologique nouveau (Renan, Michelet, Quinet principalement).
Neefs

212.628 Racine

A partir de la lecture de l'ouevre de Racine on se propose d'analyser la poétique de la passion tragique et la spécificite de l'écriture dramatique classique.
Russo

212.636 Beaudelaire: Art, Poetry, Modernity

Seminar taught in French and English. Charles Baudelaire is widely regarded as the decisive figure in 19th Century literary and artistic Modernity. In this seminar we will read his magnificent Les Fleurs du mal and Spleen de Paris and his equally remarkable art criticism, as well as various critical discussions of his achievement. Cross-listed with Humanities Cente r.
Neefs

212.638 Literature and Politics I: Equality

Writing about equality during the French Revolution: In this seminar we will be looking at three categories of readings: those dealing with theoretical questions, those dealing with places and events, and those which explicitly address the literary and aesthetic issues of writing about the Revolution.
Anderson

212.639 Changing Practices and Cultures of Literacy

What does it mean to read? Who reads, how, and how have those practices changed from the late 17th century to the early 21st? How do the material conditions of publication and the material support of the text affect readership and interpretation? How do authors of literary works embody such issues within their texts? To be discussed within the French context from Molière through modern digital humanities research environments and to focus critically on recent work in the history of the book.
Anderson

212.661 Post-Revolutionary Passions

Coming to terms with the Enlightenment, the French revolution and the collapse of the political and spiritual authority that grounded the old regime, post-revolutionary thinkers confronted critically the responsibility of the intellectual and the nature of ideological violence; they reinvented the sacred in an attempt to shape a new self and redraw the boundaries between reason and belief. Classes in English, readings in French (some available in translation). Works by Constant, De Staël, Chateaubriand, De Maistre, Ballanche, Tocqueville, Michelet, Taine.
Russo

212.662 Why Does Theory Matter to Literature?

A critical and historical approach to the notion of theory in literary studies. In English, reading knowledge of French. Cross-listed with Humanities.
Russo

212.667 Contextualizing the French Enlightenment Novel

The French Enlightenment novel studied in the intellectual and historical context of its time. Texts from Montesquieu, the Encyclopédie, Diderot, Rousseau, Laclos, Voltaire, Buffon, Rétif de la Bretonne. Please see provi-

sional syllabus at **www.wilda.org/Courses/CourseVault/ Grad/ContextNovel/Syllabus.html**.
Anderson

212.696 Literature Confronts Science: Zola
Zola worked with the theories of heredity of his time in the Rougon-Macquart novels. But he also attempted to use his understanding of biology and thermodynamics to reform the theory of the novel in general.
Anderson

212.706 The Invention of the Grail Legend: Identity and the Language of Romance
Since the 19th century, the legend of the Holy Grail, Arthur, Merlin, and the knights of the Round Table have conveyed both the past and present of what we mean by "medieval." The Grail has come to define the hope of romance, and its darker, destructive facets, an ambivalence perfectly captured by Henry James's novel *The Golden Bowl*. So pervasive has the Grail become in Western culture, that we have all but forgotten that this legend was "invented" in 1200 by a French cleric. He wanted to claim a crucial relic of Christ's Passion for France. The Grail is that object, although, as Umberto Eco's Baudolino ironically notes, a relic invented by romance, for its own ends. The Grail thus becomes a symbol of romance's ability to "make history," to create "fictional truth." By studying Grail romances of Chrétien de Troyes, Robert de Boron, Malory, and others, the seminar will pose the question of what is romance and how it came to define French history and identity. It will also ask how something so quintessentially French, came to be universalized, its French origins largely forgotten.
Nichols

212.707 Trust and Truth: Artistic Value and Aesthetical Property
The impact of photography, cinema, and even television on the system of Fine Arts as well as their social success leads to a question on the veracity of art. The compassion that images produce and the disgust they arouse beyond their historical value as documents, take us back to their truth content. What can truth mean outside the realm of propositions? Can we say that trust is the sensible quality of truth? From an analysis of literary, plastic and musical works, we shall wonder about the possibility of a morality of art works. We shall confront this "ethical" view with the close of the paradigm of art's autonomy.
Cohn

212.716 Diderot and the Human Sciences
Diderot's early work was dominated by his work on the natural sciences and the *Encyclopédie*. But in later years, his literature addresses the social applications of his knowledge: economic, anthropological, political, and moral issues structure his aesthetic concerns. Texts to be studied include *Le Supplément au voyage de Bougainville, Essai sur les règnes de Claude et de Néron, The Salon of 1767, Le Rêve de d'Alembert, Le Neveu de Rameau*.
Anderson

212.731 Passé, Present, Futur au 19ème Siècle
Neefs

212.733 Literature and Knowledge from Balzac to Proust
Quelle forme de connaissance apporte l'œuvre littéraire? Quels rapports entretient-elle avec les savoirs de son temps? Savoirs sur la société, sur la psychologie humaine, sur le monde, concurrence avec les savoirs «scientifiques», nous interrogerons à l'aide de quelques exemples particulièrement significatifs la portée cognitive des œuvres littéraires. Les œuvres proposées sont, parmi d'autres exemples qui seront choisis avec les étudiants du séminaire: Balzac, *La Peau de chagrin, La recherche de l'Absolu* ; Stendhal, *De l'Amour* ; Flaubert, *Bouvard et Pécuchet* ; Zola, *Le Docteur Pascal* ; Proust, *Le Temps retrouvé.*
Neefs

212.734 De l'Ecriture au Livre, Questions de Genetique
Le séminare s'attachera à la tension entre l'ecriture comme pratique et invention, dans l'espace de manuscrit et le <livre> des oeuvres, dans leur existence <imprimée>, en s'appliquant à quelques exemples de genèses et d'editions problématiques en ce sens: Chateaubriand, *Les Mémoires de'outre-tombe*, etc. Nous mettrons l'accent sur ce qui compose la notion meme d'<oeuvre> et sur la question de <l'inachevé>, ainsi que sur les questions d'edition et de genèse.
Neefs

212.735 Narratives of Ordinary
What we may understand by "Ordinary"? The Seminar will attempt to consider the aesthetic apparition and the historical, sociological, political, and anthropological meaning of that notion: narrative prose and poetry, from Flaubert to Queneau and Perec, from Baudelaire to Ponge and Roubaud will be examined under this point of view, in relation with what we could conceive as an aesthetical development of the notion, including its sociological and philosophical aspects (Lepenies, Boltanski, De Certeau, Danto, Rancière, Cavell). The course will be held in French, on French texts, but could include references to works in English or German or other languages, in English or French translation.
Neefs

212.737 Literature and History, 19th and 20th Century
Literature belongs to history. But does literature tell something about history and how? The seminar will examine the main theories dealing with the relationship between literature and history since the 19th century. The seminar will give a close reading of a few highly significant works by Balzac, Flaubert, Hugo, Claude Simon, Georges Perec.
Neefs

212.741 Jean-Jacques Rousseau: Enlightenment and Dissent
A reading of Rousseau's major works in light of the debates they have triggered both within the Enlightenment and in postmodernism. Secondary readings by Starobinski, de Man, Derrida.
Russo

212.742 Framing the Aesthetic Experience in France 1630-1780

An exploration of the emergence of aesthetic experience at a time when there was no such thing as an autonomous aesthetic object separate from other forms of value, such as social distinction and the exaltation of energy. Aesthetics was a way of organizing cognition, experience and feelings linked to the body; through such notions as sympathy, taste and esprit, aesthetic discourse frames the beholder both as a cognitive, feeling subject, and as a social being member of an elite community defined culturally and politically. Topics will include the epistemology of confused perception and the poetics of incompleteness; the je ne sais quoi and the sublime; the dialectics of pleasure and pain; taste and decadence. Works by Félibien, Bouhours, Dubos, Boileau, Fénelon, Marivaux, Montesquieu, Diderot, Leibniz, Smith, Burke, Lessing.

Russo

212.801 French Independent Study
Staff

212.802 French Dissertation Research
Staff

212.803 French Proposal Preparation
Staff

German

210.661-662 Reading and Translating German for Academic Purposes

This course sequence is designed for graduate students in other departments who wish to gain a reading knowledge of the German language. The first semester assumes no knowledge of German and covers the grammatical principles of the language. The second semester assumes a basic knowledge of German grammar and vocabulary and concentrates on reading practice. For certification or credit.

Staff

213.605 The Life of Stones: Geology in the Works of Goethe, Novalis, and Celan

Examination of the geological motifs in all three authors' literary works. Emphasis on geological theories of the 18th and 19th centuries, particularly the debates between the neptunists and plutonists. Consideration of theological, aesthetic, and philosophical ramifications of debate.

Tobias, Campe

213.608 The Literatures of Blacks and Jews in the 20th Century

This course will be a seminar comparing representative narratives and poetry by African, Caribbean, and African-American authors of the past 100 years, together with European and American Jewish authors writing in Yiddish, Hebrew, and English. This comparison will examine the paradoxically central role played by minority, "marginal" groups in the creation of modern literature and the articulation of the modern experience. Among the topics to be considered in this course will be the question of whether minority literatures require a distinct interpretive strategy from "mainstream" literary traditions; the problem of political discrimination and the question of identity politics in the creation, and interpretation, of literature; the commonalities of historical experience between black and Jewish peoples; and the challenge of multiculturalism in modern society. Authors discussed will include, among others, Sholem Aleichem, Charles Chesnutt, Sh. Ansky, Jean Toomer, Sh. Y. Agnon, Amos Tutuola, Bernard Malamud, Caryl Phillips, and Anna Deavere Smith.

M. Caplan

213.609 Anti-Novels: Narrative Failure and the Poetics of the Periphery

Insofar as the novel as a form can be taken as the representative narrative mode of the modern era, this graduate seminar will identify an inverted literary tradition of digression, fragmentation, stasis, and proliferation in the assemblage of narratives that either structurally or thematically violate conventions of novelistic mimesis and verisimilitude. Paramount among the themes to be considered in this survey will be whether such an inverted or counter-tradition is possible at all, given the plasticity of the novel form. To the extent that such a tradition constitutes itself, however, to what extent does its attraction for peripheral writers—defined linguistically, culturally, and politically—offer a critique of the homogenizing and hegemonic aspects of modernity? Does the persistence of pre-modern narrative conventions serve to anticipate subsequent innovations attributed specifically to the modernist novel? Do the cues such anti-novelistic narratives take from non-belletristic modes of writing as well as visual or musical arts signify a violation of literary decorum or an integration of the arts, and of art with life, that actually valorizes the modernizing processes these writers would critique? What is the difference, both figuratively and critically, between a literature of failure and a failed literature? In what sense can these modes of failure be considered productive? Authors to be considered will include Laurence Sterne, Jan Potocki, Ivan Turgenev, Sholem Aleichem, Gertrude Stein, Robert Walser, Der Nister, Yosef Haim Brenner, Moyshe Kulbak, André Breton, Thomas Bernhard, and Georges Perec. All readings and discussions conducted in English.

M. Caplan

213.614 Proto-Modernist Fiction 1890-1914

This course will be a graduate seminar tracing the tentative beginnings of global modernism in late-19th and early-20th century fiction taken from American, Brazilian, French, German, Italian, Hebrew, Norwegian, Russian, and Yiddish sources. Among the topics we will consider are the radical loss of faith in scientific, political, and philosophical narratives of progress and self-improvement at the end of the 19th century; the breakdown of imperial orders and their impact on social relations as well as definitions of the self; the reconfiguration of narrative conventions in response to technological and intellectual innovations such as photography,

film, electricity, and the advent of the social sciences; the intensifying predominance of urban life in the formulation of modern culture; and the interrelations among aesthetic trends such as realism, naturalism, symbolism, impressionism, and expressionism in a variety of artistic media of the era. To what extent does the crisis of faith in political, aesthetic, and philosophical certitudes of a previous age result in the liberation of narrative conventions? To what extent do fin-de-siècle writers throughout the Western world participate in a common literary aesthetic? Authors to be considered will include Dovid Bergelson, Yosef Haim Brenner, Anton Chekhov, Éduard Dujardin, Knut Hamsun, Franz Kafka, Machado de Assis, Italo Svevo, and Gertrude Stein.

M. Caplan

213.615 Narrative Theory: A Critical Reevaluation

A commonplace of narrative theory is that narratives produce a semblance of life. We will analyze the notions of semblance and life that permit such a statement in works by Lukacs, Genette, Hamburger, Benjamin, Ricoeur, and Barthes.

Tobias

213.616 Understanding Irony

Course will examine some of the classic texts on irony (Schlegel, Novalis, Solger, Hegel) and important 20th-century interpretations of them (Szondi, de Man, Lacoue-Labarthe, Nancy). Key concern of course will be whether there can be a conception of irony without recourse to transcendental philosophy.

Tobias

213.627 Constellations: JMR Lenz Among Others

The writing of Jakob Michael Reinhold Lenz (1751-1792) is marked by a peculiarity. His texts constitute themselves through references to other modes of speaking; they originate as it were in literary and discursive cooperation. This course will examine how Lenz's practice of *writing in relation to others* is formed in individual cases. What forms of representation and poetic theories apply in these cases? What does Lenz's relational mode of writing indicate in terms of literary theory and with respect to the notion of originality postulated in 1770? We will read Lenz's Shakespeare translations; texts explicity addressed to Goethe (*Der Waldbruder, Pandaemonium Germanikum*); dramas and theoretical writings pointing to 18th-century orders of knowledge (*Der Hofmeister, Philosophische Vorlesungen*); and finally Buechner's *Lenz* and Celan's *Meridian*. The term *constellation* designates not only the relational order of the literary material, but also the methodological problem involved in reading such works. How are texts to be read, which produce themselves in relation to others and which cannot be referred to a single author or an individualized author function? The questions of constellations is equally a question of the constitution of objects in literary criticism. This course will reflect on the ways in which objects are constituted and represented in literary analysis. Course conducted in German.

Krauss

213.628 Literary Hermeneutics

Starting with Schleiermacher, hermeneutics has defined itself as a universal theory of understanding which no longer focuses only on biblical and juridical exegeses but on linguistic utterances in general. This systematic approach to understanding generated further differentiations: toward philological analysis, the methodological basis of Geisteswissenschaften, the phenomenology of existence (in the mode of understanding), the interpretation of mythic and symbolic worlds of meaning, and the aesthetics of reception. The seminar will examine these different approaches of hermeneutics through readings of works by Schleiermacher, Dilthey, Heidegger, Gadamer, Ricoeur, and Jauss. Key issues will be the underlying concepts of textuality and language, historicity and the subject. Problems of literary hermeneutics will be specified with respect to works by Szondi and Derrida. Readings and discussions in German.

Krauss

213.632 Celan

Examination of Celan's work from middle/late period with attention to temporal aspects of his verse, i.e., treatment of time in his work and experience of time fostered. Investigation of distinctions "early," "middle," and "late" period, assumptions underlying distinctions, and relevance of such genealogical categories in Celan's case.

Tobias

213.634 Schiller's Aesthetic Writings

Schiller's theoretical writings might be approached by the sentence 'it is only through beauty that man makes his way to freedom'. Discussing the assumption that humans live in a condition of unfreedom resulting from social and economic divisions, Schiller's notion of beauty crosses boundaries between ethics, politics and aesthetics to formulate a theory of modernity in which beauty functions as a medium to reconcile man's sensuous nature and his capacity for reason. The course will examine Schiller's concept of beauty in relation to the anthropological, political, ethical and aesthetic discourses of his time especially with respect to Kant's view of aesthetic judgment which Schiller at the same time embraced and criticized. Particular attention will be paid to Schiller's reflexions on representation as well as to the poetics of his aesthetic discourse. Readings include *Kallias-Briefe* (1793), *Über Anmut und Würde* (1793), *Vom Erhabenen* (1793), *Über die ästhetische Erziehung des Menschen in einer Reihe von Briefen* (1793), *Über naive und sentimentalische Dichtung* (1795/96).

Krauss

213.638 Epistemology in Historical Perspective

In this seminar, we will discuss the French and German traditions of introducing historical thinking into philosophy of science. Readings will include Gaston Bachelard, Georges Canguilhem, Michel Foucault, and Jacques Derrida (his reading of Husserl) on the French part, and Ernst Cassirer, Edmund Husserl (his late Crisis work), and Martin Heidegger on the German part. Reading and discussion in English.

Rheinberger

213.640 The Concept of Philological Aesthetics

"Aesthetics" is Alexander Baumgarten's title for a new way of thinking about the (liberal) "arts" in the framework of the basic concepts of modern philosophy, like (re-) presentation, activity, subjectivity, humanity, and freedom. Since Heidegger's lectures on Nietzsche, this relation between aesthetics and philosophical modernity has often been described in such a way that the discourse of philosophical aesthetics expresses an "ideology" (as de Man and Eagleton have put it) of reconciliation or foundation. The course wants to question this interpretation by way of reading texts mainly from the German aesthetic debate in the 18th century. The course will especially focus on the development of two concepts which are of central importance for any critique of metaphysics till today: the concepts of "force" (over against "ability") and "self-reflection" (over against "self-grounding").

Menke

213.641 Hegel: On Ethics and the Theory of Tragedy

Two-month intensive course that will deal with Hegel's conceptions of art, politics, and ethical life (*Sittlichkeit*), as they are elaborated in his *Lectures on Aesthetics* and *Philosophy of Right*. The goal of the course is to unfold these conceptions in their internal coherence and to ask for their contemporary significance. Special consideration will be given to the question of the systematic relation between Hegel's theories of art, politics, and ethical life. Hegel's theory of tragedy, especially in the version of his *Phenomenology of the Spirit*, is a good case for addressing this question.

Menke

213.646 Fantasy Narratives of the 19th Century

This course will be a graduate seminar considering in structural and historical terms the significance of fantastic genres in the era of literary realism. Among the topics we will consider are the place of folklore and oral storytelling techniques in creating fantastic or anti-realistic narratives; the persistence of pre-modern narrative genres such as satire, monologue, and fable in 19th-century fantasy; the uneasy relationship between romanticism and modernity; the appeal of non-realistic genres to the peripheral cultures of 19th century modernity; the relationship of new literary genres such as the detective story or science-fiction to earlier fantastic motifs; and the uses of fantastic genres as a subversive critique of modern rationalism and the myth of progress. The overarching theme of the course will be the extent to which 19th-century fantasy might be considered a precursor to specific trends in 20th-century modernism. Authors to be considered will include Reb Nakhman of Breslov, E.T.A. Hoffmann, Edgar Allan Poe, Gerard de Nerval, Nikolai Gogol, Gustave Flaubert, Mendele Moykher-Sforim, Charles Chesnutt, and Sholem Aleichem. These writers will be considered comparatively in the light of theoretical discussions by, among others, Freud, Benjamin, Horkheimer and Adorno, Deleuze and Guattari, Todorov, and Henry Louis Gates. All readings and discussions conducted in English.

M. Caplan

213.648 The Multilingual Culture of Weimar Berlin

This course will be a graduate-level seminar examining Berlin in the interwar era as a multilingual metropolis and center of global modernism. Juxtaposing German-language authors such as Walter Benjamin, Bertolt Brecht, Alfred Döblin, and Joseph Roth with expatriate figures such as Christopher Isherwood, Vladimir Nabokov, Dovid Bergelson, and Sh. Y. Agnon, we will consider the significance of urban space in the conceptualization of literary modernism; the role of the refugee in defining urban literary culture; the applicability of German aesthetic movements such as Expressionism or Neue Sachlichkeit to other "national" literatures active in Berlin; and the notion of Berlin as a meeting point for several trends within European modernism. To what extent can one consider Weimar-Era Berlin to be "the capital of the 20th century"? All readings and discussions conducted in English.

M. Caplan

213.649 Aestheticism Reconsidered

Few terms are more maligned in contemporary criticism than aestheticism and enchantment. This course will reconsider conventional definitions of aestheticism as a privileging of art over life through readings of Weber, Adorno, Horkheimer, Simmel, Mann, Huysmans, Klages, George, Adrian and Rilke.

Tobias

213.653 Beieinander: Double Dealing

Reading Kleist, Hegel, Derrida, and perhaps Freud in a first (larger) section and Eva Meyer, Yoko Tawada, and perhaps Deleuze in a second (shorter) section, we will analyze different models of doubling and relating words, bodies, feelings, and thoughts.

Pahl

213.654 Folklore and Modernism

This course will be a graduate seminar considering in structural and historical terms the impact of folklore on modern literary forms, particularly in minority and marginalized literary cultures. Among the topics we will consider are the role of folklore in the development of a national consciousness; the transformation of religious beliefs and related traditions in the context of modernization; the structural features of folk tales and how they influence (or undermine) belletristic narrative forms; the relationship between folklore and various modes of satire and parody; the place of folklore in creating fantasy or anti-realist narratives; and the preservation of oral narrative techniques in works of literature. Authors to be considered will include the Brothers Grimm, Reb Nakhman of Breslov, Nikolai Leskov, Charles Chesnutt, Sholem Aleichem, Lu Xun, Franz Kafka, Zora Neale Hurston, and Amos Tutuola. These writers will be considered comparatively in the light of theoretical discussions by, among others, Freud, Benjamin, Propp, Deleuze and Guattari, Frederic Jameson, and Aijaz Ahmad.

M. Caplan

213.655 'Beautiful Soul' and Romantic Irony: Feeling, Gender, and Theory

One might be tempted to oppose the critical attitudes of Sensibility and early Romanticism: one allegedly simpler and more conservative, complementing enlightened rationality by cultivating feeling, and the other playful and sophisticated, bending the Enlightenment's firm stance with its complex theory and practice of irony. In this course, we will try to mix up the two discourses of the 'beautiful soul' and of Romantic irony and, since they tend to fall along gender lines, this will also be a way of troubling gender constructions. Readings and discussion in English.
Pahl

213.656 Theorizing Emotionality

Accounts of affect, passion, feeling, mood by Spinoza, Descartes, Rousseau, Kant, Nietzsche, Heidegger, etc., and their relevance for contemporary thought. Reading and discussion in English.
Pahl

213.657 Friedrich Hölderlin

Reading some of Hölderlin's major works (*Hyperion*, *Empedokles*, poems, theoretical texts) we will discuss their complex relation to German Idealism as well as their increased reception in the 20th century. Reading knowledge of German required.
Pahl

213.659 Rhythm

Starting from Hölderlin's poetry and poetological reflections, we will look to Klopstock's free meters and to Celan's work with a shattered language. We will analyze the rhythmic interplay of various elements of poetry such as meter, syntax, visual layout, tone and lexicon. Rhythm will concern us in its potential to disrupt or dissolve set shapes, dispositions, and ideas. The aim is to consider poetic rhythm as a form of critique.
Pahl

213.661 Boredom: The Empty Time of Writing

In the [eighteen-]forties," Benjamin writes in "The Arcades Project," "boredom began to felt on an epidemic scale". It is, however, as early as in German Enlightenment that boredom ("Langeweile") haunts aesthetics and discourses on sensitivity: The construction of the sensitive man is beleaguered by figures of insensitivity—boredom among others. In boredom, aesthetics encounters its anesthetic pendant. From the beginning of its discursive emergence, boredom combines an "existential and a temporal connotation" (Goodstein): an emotional emptiness/apathy with a particular experience of time. Against the backdrop of the discursive history of boredom from the 18th to the 20th century, the course addresses the specific connection between boredom and modern literature. How can we understand the "ecstasy glimpsed from the banks of desire", the "warm gray muffle lined with glowing silk" in which "we wrap ourselves when we dream"—as Barthes and Benjamin describe boredom respectively—with regard to literary representation? How does modern literature transform boredom into the empty time of writing? We will analyze poetics of boredom with respect to their temporal structures, the monotony of the everyday, the loss of meaning, the differentiation of perception and the time of reading/reading time. Readings include Kant, Herder, Tieck, Büchner, Kierkegaard, Schopenhauer, Stifter, Nietzsche, Hofmannsthal, Thomas Mann, Heidegger, Benjamin, Barthes, Max Frisch, Hans Blumenberg. Readings and discussions in German.
Strowick

213.665 The Subject-Object Relation in Experimental Fiction: The Poetics of the Periphery

Can experiments in narrative form–which have constituted one of the most dynamic and productive aspects of modern aesthetics—be traced grammatically, philosophically, and theoretically to an instability in subject-object relationships? This graduate seminar will examine these potentialities through a series of paired readings of belletristic narratives with critical sources, from the beginnings of the modern novel to contemporary fiction and theory. Authors to be considered include Denis Diderot, Fyodor Dostoevsky, Sholem Aleichem, Gertrude Stein, Robert Walser, Der Nister, Moyshe Kulbak, and Thomas Bernhard. Theoretical readings will be taken from Hegel, Freud, Lacan, Deleuze, Butler, and Zupancic. All readings and discussions conducted in English.
Caplan, M

213.669 Heidegger and the Poets

Heidegger's interpretations of the poets Hölderlin, Trakl, Rilke, and George are more often maligned than praised. The philosopher ignored the specificity of each poet's idiom in order to establish poetry as the consummate event in the history of being. This course will not seek to justify Heidegger's idiosyncratic approach to individual poets and poems. Instead it will attend to the questions he raises about the relation of "Dichten" to "Denken" as well as the role that literature plays in defining the world we inhabit, the place we dwell. To what degree do Heidegger's arguably reductive readings of lyric poems nonetheless address the essence of poetry and/or the poetic experience?
Tobias

213.671 The Bildungsroman and Its Critique

Departing from *Wilhelm Meisters Lehrjahre* and Wieland's *Geschichte des Agathon*, this course will consider how the *Bildungsroman* was conceived in the 18th and 19th centuries in texts by Blankenburg, Morgenstern, Schlegel, Hegel, and Dilthey.
Tobias

213.672 Literature of Terror, Terror of Literature

We will investigate competing notions of justice and jurisdiction in Kleist's novella *Michael Kohlhaas*. A key concern of the course will be who has the authority to determine the law and to authorize violence to maintain it. Readings available in German and English translation.
Tobias

213.674 Spiritual Poverty: Meister Eckart, Musil, and Benjamin on Experience in Modernity

This course will take as its point of departure Meister Eckart's paradoxical thought on spiritual poverty as a state of infinite richness and illumination. We will consider how Musil expands on this concept in his shorter fictional work, especially "Die Versuchung der stillen Veronika" which has proven all but resistant to interpretation. A key concern of the class will be what it means to have an experience when the one experience of truth is that of abandon, impoverishment. Benjamin's reflections on experience in "Armut und Erfahrung" will be crucial to our investigations.

Tobias

213.676 Irony and the Beautiful Soul: Feeling, Gender, Theory

One might be tempted to oppose the attitudes of Sensibility and Romanticism: one allegedly simpler and more conservative, complementing enlightened rationality by cultivating feeling, and the other playful and sophisticated, bending the Enlightenment's firm stance with its complex theory and practice of irony. In this course, we will mix up the opposition between the Beautiful Soul and Irony (the two organizing figures of Sensibility and Romanticism) and, since they tend to fall along gender lines, this will also be a way of troubling gender constructions. We will read literary and theoretical texts by Bettina von Arnim, Gisela von Arnim, Cleland, Goethe, Hegel, Hoffmann, Kleist, Laroche, Rousseau, Schiller, Schlegel, and others.

Pahl

213.678 The Birth of Aesthetics: Alexander G. Baumgarten

The course will be taught in German. With Alexander Gottlieb Baumgarten's thesis "Philosophical meditations pertaining to some matters concerning poetry" (1735) the term "aesthetics" was introduced to philosophical discourse. The new name for the discipline did not signify a complete break with previous philosophical positions, that is, with the perfectionist aesthetics of Leibniz and Wolff. However, by conceptualizing sensible cognition as "analogue of reason" (analogon rationis) Baumgarten depicted the aesthetic sense as a locus of perfection in its own right and, thus, did transform the Wolffian model and paved the way for much more radical revisions of aesthetic experience in Germany. The course will study the emergence and specificity of Baumgarten's concept of aesthetics in relation to the Wolffian framework, Gottsched's poetics, (Georg Friedrich) Meier's adaptions of Baumgarten, and Herders response to Baumgarten. Readings include Baumgarten's early Meditations on Poetry (Meditationes philosophicae de nonnullis ad poema pertinentibus, 1735), excerpts from his Metaphysics (Metaphysica, 1739) and Aesthetics (Aesthetica, 1750-58). Cross-listed with Philosophy

Krauss

213.680 Suspicion–Signs of Modernity

Modernity gives rise to various forms of suspicion, including modern forms of resentment and practices of self-discipline (a suspicion of oneself), as well as to an epistemology of suspicion as it is developed in the modern human sciences. The course starts out with an analysis of the detective genre and of the specific transformations it undergoes in modern German literature. In a next step, we will examine literary representations of suspicion within a broader cultural-historical frame: Nietzsche's analysis of resentment serves as one point of reference; another is what Carlo Ginzburg has called the "paradigm of clues." The modern human sciences, since the last third of the 19th century, have relied on a method that produces knowledge by way of interpreting clues. While suspicion in the human sciences is related to the production of truth, literature uses suspicion as a way to produce aesthetic and logical undecidabilities. We will analyze literary representations of suspicion with respect to the narrative structure (unreliable narration) and the mediality of suspicion. Finally, the course emphasizes the methodological relevance of suspicion: As a practice of deciphering, interpreting and reading traces, suspicion calls for being reformulated literary-theoretically. Readings will include Heinrich von Kleist, E.T.A. Hoffmann, Nietzsche, Theodor Fontane, Freud, Kafka, Thomas Mann, Heimito von Doderer, Peter Handke, Uwe Johnson. Readings and discussion in German.

Strowick

213.682 Poetics of Possibility

"So the sense of possibility might be defined outright as the capacity to think how everything could 'just as easily' be, and to attach no more importance to what is than to what is not." What Robert Musil in *The Man without Qualities* defines as the "sense of possibility" might be taken to characterize literature. Drawing on literary and philosophical texts, the course will analyze aspects of a poetics of possibility (forms of fictionality, 'as if', subjunctive). Inasmuch as the "sense of possibility" is linked to an order of knowledge as it emerges in modernity, a poetics of possibility raises the question of the epistemological status of literature or fiction. We will address this question by taking into account aspects of genre. The course will focus mainly on *The Man without Qualities*; the Musil reading, however, will be accompanied by reading texts by Leibniz, Kierkegaard, Heidegger, Mach, and Agamben. Conducted in German.

Strowick

213.683 Dilettantism

From the 18th century to the present, literature and aesthetics show recurrent interest in dilettantism. While in German classicism the figure of the dilettante is developed in opposition to mastery, around 1900 the debates on dilettantism shift toward cultural-critical and psychological questions. Drawing on Nietzsche, Bourget and Kassner, literary depictions of dilettantism in texts by Hugo von Hofmannsthal, Heinrich and Thomas Mann and Carl Einstein explore the relationship between literature and experiment, figures of increased sensitivity or failed life. More recently, the pop-literature of the 1990s promoted dilettantism as a technique of literary production. Dilettantism, however, is not to be restricted to the

fields of literature and aesthetics. Rather it intervenes in epistemological questions (innovation), allows for reflecting processes of professionalization and specialization of knowledge and is linked to techniques of medial reproduction (Benjamin). The course interweaves literary texts, aesthetic debates and cultural and media theory positions in order to explore the discourse and poetics of Dilettantism. Readings include Goethe, Schiller, Keller, Bourget, Kassner, Hofmannsthal, Thomas Mann, Carl Einstein, Kafka, Max Weber, Benjamin and Rainald Goetz. The course will be taught in German.
Strowick

213.684 Aesthetics of Description
Since the enduring disavowal of description by Lessing, characteristics commonly assigned to description include structural endlessness and exorbitance; the simple succession of elements; the "breakdown of composition" (Lukács) in a proliferation of details; the parity of described details; its failed ability at illusion; also its tendency to mortify, insofar as it transforms its subject into something static, stagnant. The course will undertake a critical revision of these characteristics by analyzing aesthetical debates and literary descriptions from the 18th to the 20th centuries. Topics leading the discussion will be: text-image relations; description between literature and science; observation through description; dynamization of description; motion and motionlessness; poetics of perception; performativity of description; the boredom of reading. Readings include Bodmer, Breitinger, von Haller, Winck-elmann, Lessing, Alexander von Humboldt, Hebbel, Stifter, Darwin, Ossip Mandelstam, Aby Warburg, Lukács, Peter Weiss, Peter Handke.
Strowick

213.685 Hegel: *The Phänomenologie des Geistes*
A close reading of Hegel's *Phänomenologie des Geistes*. We will pay particular attention to the work of emotionality in the development of Spirit's self-reflection.
Pahl

213.686 Uncanny Realism: Theodor Storm
Readings and discussions in German. Both Fontane und Lukács point to the spatial confinement in Storm's world, though in different ways: Fontane sneeringly speaks of Storm's "Husumerei" and "Provinzialsimpelei"(provincial simplicity); Storm—according to Fontane—seriously believes that it needs a Husum teapot to get a "real cup of tea." Lukács states in his essay on Storm that only a "local eye" ("einheimische Augen") is capable of seeing colors in the "grey monotony" of Storm's world. Attentively observing the home-boundness of Storm's fictional world, they neglect the importance of the uncanny for Storm's Realism. It is precisely in the home that the uncanny resides: Storm's poetics alienates the "local eye" rather than it produces perceptual knowledge. The course will examine various aspects of the uncanny in Storm and address the relation between Realism and the uncanny more generally. A passionate collector and teller of ghost stories himself, Storm is however not interested in any supernatural quality of the uncanny but rather in how it questions everyday perception. Thus the uncanny

allows for an analysis of the conditions of the perception and representation of reality in the first place. We will discuss Storm's modernity with respect to the form of the 'novella' which he famously called "the sister of the drama" the transgression of frames, image-text relations, elliptic narratives, elements of the grotesque, and the relation between literature and media technologies.
Strowick

213.703 Intercultural Literature
We will read contemporary intercultural literature (Turkish-German, Japanese-German, authors from Central and Eastern Europe who write in German) with particular attention to the poetics of translingualism. When appropriate, we will discuss historical links (Celan, Canetti, Kafka, Chamisso, etc.). Readings in German. Discussion in English or German.
Pahl

213.705 Nietzsche – Mann – Adorno
This course will examine two novels by Thomas Mann (*Doktor Faustus*, *Felix Krull*), which draw heavily on Nietzsche (*Geburt der Tragödie*) and Adorno (*Philosophie der neuen Musik*). Of concern will be the "power" the texts attribute to art and the political dimensions of the aesthetic sphere.
Tobias

213.744 Modern Poetry
An introduction to modern German poetry with emphasis on the fate of the lyric subject in twentieth-century verse. Of particular interest to the course will be the tension between lyric freedom on the one hand and poetic constraint on the other. How does modern poetry come to resist the traditional definition of the lyric as an expression of subjectivity and replace it with a concept of the poem as a vehicle for the dissolution of the self or the dispossession of the speaker? Authors to include Rilke, Trakl, George, Benn, and Celan.
Tobias

213.746 Anti-Mimesis: Modern Poetry and Aesthetic Theory
In "Das Zeitalter des Weltbildes," Heidegger argues that the modern period is one in which the subject establishes a relation with the world by producing an image of it. We will draw on this definition of the post-Cartesian world to analyze the rejection of images and more broadly mimesis in Adorno's *Aesthetic Theory*, Celan's poetry, Kafka's fiction, and Benjamin's writings.
Tobias

213.747 From Kultus to Kultur: Poetry, Tragedy and the Ritual of Art
In a radical departure from Enlightenment and Romantic aesthetics, Nietzsche praised the cultic origins of art and argued for the creation of a modern art form that would enable the same collective experience of transcendence as Attic tragedy did. Since Nietzsche, however, the idea that art has ritualistic significance has been treated with disdain. In this course we will read Mendelssohn's and Lessing's writings on compassion and

catharsis, Schelling's and Hegel's account of tragedy, and finally the work of various members of the George-Kreis to determine where *Kultus* and *Kultur* meet and also diverge.
Tobias

213.748 Drifters, Footprints, Telling Time

This course will examine the meandering path of such drifters as Büchner's Lenz, Rilke's Malte Laurids Brigge, Kafka's Hunter Gracchus, and Walser's Simon Tanner. A key concern of the course will be how a means of measuring space (walking) becomes a mode for reflecting on time—time which, according to the conceit of walking, can circle back, jump ahead, drift, and splinter into multiple trajectories. An equally important concern of the course will be how literature produces space and generates time by retracing its birth or origin. What is unique to the experience of time in and through literature? We will read a selection of philosophical texts (Aristotle, Nietzsche, Rousseau), lyric poems (Goethe, Mörike, Trakl, Celan), and fictional works (Büchner, Stifter, Rilke, Kafka, Walser, Bernhard).
Tobias

213.800-801 Independent Study
Staff

213.811-812 Directed Dissertation Research
Staff

Italian

210.652 Curso Intensivo di Perfezionamento

This course is designed to help students attain very high levels in reading, writing, speaking, and listening. Intensive use will be made of sight translation, written translation, paraphrasing, active reading, memory training, and text analysis techniques. The course seeks to acquaint the students with a wider range of idiomatic expression and usages than they have previously managed, and to help them convey finer shades of meaning while consistently maintaining grammatical control of complex language.
Zannirato

214.650 The Cosmetic Gaze: Body Modification and the Construction of Beauty in the 21st Century

This course is situated in the fields of techno-science studies, the history of medical technologies, and new media studies. Throughout the course's readings and screenings we will trace the "cosmetic gaze"—a gaze through which the act of looking at our bodies and those of others is already informed by the techniques, expectations, and strategies of bodily modification—to both its cultural-historical as well as technological roots from 18th-century physiognomy treatises (e.g., Johann Kaspar Lavater) to the 19th- and 20th-century politicized discourses of beauty (with their racist counterparts) from the works of Francis Galton and Cesare Lombroso to the Nazis; this material will be compared to current day reality television makeover shows and the beauty ideals they refer to.
Wegenstein

214.651 Confessions

This course examines the genre of the confession and the confessional narration of autobiography. What is the performative impact of this speech act? Who is it for? Who is it by? We will look at the genre diachronically, and through various media. Starting with St. Augustine and his *Confessions*—probably the most famous autobiographical account of conversion to Christianity—we will read such literary and philosophical examinations as Rousseau's *Confessions* and Primo Levi's *Survival in Auschwitz*. In the second half of the course we will shift our attention to the medium of film and its more recent impact on the confession genre, particularly via the confessional first person video-diary (e.g., *Capturing the Freedmans* by Andrew Jarecki 2003, and *Tarnation* by Jonathan Caouette 2003), including the recent genre of confessional documentaries told through the voices of the children of Nazi perpetrators (e.g., *The End of the Neubacher Project* by Marcus Carney 2007). Finally, we will confront such questions as why authors are drawn to publish confessional accounts of their lives in the first place; how an audience can redeem an author or filmmaker; or why a mass-murderer such as Cho Seung-Hui of the Virgina Tech-shooting of 2007 would decide to leave a final video message with NBC. Secondary readings include Thomas C. Heller/ Morton Sosna/ David E Wellbery, *Reconstructing Individualism: Autonomy, Individuality, and the Self in Western Thought*, Stanford: Stanford UP, 1986; Michael Renov, *The Subject of Documentary*, University of Minnesota Press, 2004, among others.
Wegenstein

214.654 Creating and Teaching the Undergraduate Survey of Italian Literature

Materials for teaching the undergraduate survey are rarely entirely satisfactory "as is." This course will undertake the research and creation of an undergraduate Italian literature survey tailored to the needs of Johns Hopkins undergraduates, and fully integrated into the language and literature curriculum of the Italian program. Participants will observe and contribute to the instructor's undergraduate survey, Italian 214.251, and, at the end of their own course will have produced a textbook that will serve them in good stead in their future teaching career.
Stephens

214.656 Media and Art Theory

This class will read basic texts in media theory, history, and philosophy—from Marshall McLuhan, and the school of French structuralists, to film semiotics and current approaches to media analysis within ubiquitous computing. We will look at some media artists from Nam June Paik to Cindy Sherman and ask the question of how their art-work incorporates a specific media-theoretical and -philosophical background. Readings from Mark Hansen, Tom Mitchell, Ulrik Ekman, Vivian Sobchack, Amelia Jones a.o.
Wegenstein

214.658 Dante's Inferno: A Reading for Teaching
This reading of the first cantica of Dante's Commedia is aimed at preparing future professionals in the humanities for the teaching of Dante at the college level.
Forni

214.665 Letturatura Italiana III
This is a basic course presenting the Italian literature of the 18th, 19th, and 20th centuries.
Forni

214.668 First Seminar on Boccaccio (Boccaccio I)
Readings from Boccaccio's early works (*Filocolo, Filostrato, Teseida, Ninfale Fiesolano*) prepare the students for the study of the *Decameron* (Boccaccio II). Particular attention is given to the different cultural traditions that enrich young Boccaccio's imagination. The question of the writer's humanism is seen against the background of his Neapolitan years.
Forni

214.669 Second Seminar on Boccaccio (Boccaccio II)
A reading of Boccaccio's *Decameron*. A brief history of the criticism on the work is followed by an extensive treatment of matters of structure, style, and theory of narrative. Also included is an assessment of the meaning of the *Decameron* within the development of Italian literary prose.
Forni

214.670 Scrivere di Letteratura
An introduction to scholarly writing in Italian and English.
Forni

214.671 *I Promessi Sposi*
A detailed analysis of Alessandro Manzoni's novel within its European context. This course aims at showing how the religious and political components of Manzoni's imagination shaped this major work of Italian literature.
Forni

214.672 Tasso, the Epic, and Tradition
A reading of Tasso's epics in relation to literary, religious, and artistic tradition. Reading knowledge of Italian required.
Stephens

214.677 Umberto Eco's Postmodern Middle Ages
Since the 1960s Umberto Eco has been at the forefront of European critical theory. Since 1980, he has been one of the best-known European novelists. *The Name of the Rose* and *Foucault's Pendulum* have revitalized "theory-rich" fiction in Europe and North America, inspiring numerous imitators. Course will explore the relation of Eco's fiction to his most characteristic contributions to literary and cultural theory.
Stephens

214.678 Ariosto
A study of Ariosto's *Orlando furioso* in the context of humanistic culture and of his own literary production in shorter genres. The relation of *Orlando furioso* to the traditions of epic and romance, especially Boiardo and Tasso, will be a major focus.
Stephens

214.681 Representing the Ancient Italian Past in the Renaissance
The Renaissance was, among other aspects, a nationalistic movement, aimed at recovering the prestigious culture of the Roman and Etruscan past and counteracting the perceived decadence of the "modern" or "middle" age. Writers in both Italian and Latin pursued the "rebirth" of ancient Italic culture through a variety of literary and political strategies. After a brief review of familiar authors and texts from Petrarch to the Cinquecento, we will examine in depth a variety of texts in Latin and Italian that defended—often politically, and at times mendaciously—the ancient Italic cultural hegemony. Responses from other European cultures will be considered.
Stephens

214.686 The Renaissance Dialogue with the Past: Humanism in Europe, 1300–1600
Students will explore the conditions governing elite and popular modes of scholarly communication, and their implications for access to and interrogation of ancient and new forms of knowledge. We will focus on material culture as represented by holdings in the Department of Rare Books and Manuscripts of the Sheridan Libraries, and on the histories of reading, writing, and the accumulation of libraries. Ancient texts will be assigned alongside Renaissance texts reflecting their influence, appropriation, or imitation. Topics and texts will address theology, historiography, imaginative literature in prose and verse, natural philosophy (i.e., the forerunner of science), ethics and moral philosophy, rhetoric and language, art (including iconophilia and iconoclasm), political theory, mythography, literary and historical forgery, and other topics related to the craft of research between the eras of Dante and Galileo. Good reading ability in a Romance Language or German required; familiarity with Latin helpful.
Stephens

214.688 Critical Terms in Media Studies: an Introduction
This class examines the areas of aesthetics, technology, and society critically in regard to media theory and practice following the 2010 anthology Critical Terms in Media Studies. The class also thematically accompanies the international conference Technologies of Meaning, March 3-4, 2011 with such speakers as Avital Ronell, Tom Gunning, and Sam Weber. Cross-listed with English, Political Science, and Anthropology.
Wegenstein

214.693 Platonism in the Italian Renaissance
This course will offer students a foundation for understanding the Platonic revival in 15th-century Italy. Transmission of sources, translation, cultural mediation, and pre-modern styles of philosophizing will all come under discussion. We will read a mixture of primary and secondary sources.
Celenza

214.700 Lorenzo Valla

The life and work of this 15th-century philosopher will be treated.

Celenza

214.721 Eighteenth-Century Italian Autobiography

Notions of autobiography since Jean-Jacques Rousseau as a perspective onto 18th- and early 19th-century autobiographies (Vittorio Alfieri, Carlo Goldoni, Giambattista Vico and selections from Giacomo Leopardi's *Zibaldone*). Readings and discussion will be in Italian.

Zatti

214.748 Vico and the Old Science

Giambattista Vico proposed a new science, but in relation to what? We shall read *La scienza nuova* against the background of some of the texts and ideas that inspired Vico's redefinitions.

Stephens

214.749 The Scholar's Bookshelf, Part I: Medieval Authors' Authors

Course will examine a variety of examples from the genres and authors most read by medieval authors in the Romance languages canon, and relate them to authors of that canon. Examples will include theology, philosophy, encyclopedias, poetry, hagiography, and historiography. Translations will be used, but reading knowledge of simple Latin is helpful.

Stephens

214.750 The Scholar's Bookshelf, Part II

Stephens

214.761 Reading and Writing in Pre-Modern Europe

This course has a fourfold aim: First, it is designed to familiarize participants with the basics of Latin paleography from Roman antiquity through the age of printing with moveable type; throughout, we will practice deciphering literary and documentary sources of various types, even as we concentrate on the evolution of different writing styles. Second, we will think about paleography's status as a "discipline." That is, the term "paleography" dates back to 1708 and Montfaucon's classic work, Palaeographia Graeca. However, it was only in the late nineteenth century in the world of the German research university that paleography came into the orbit of the Geisteswissenschaften as a "Hilfswissenschaft." Both implicitly and explicitly throughout the seminar we shall be asking what consequences that move entailed. Third, we will study the manner in which printing with moveable type changed western graphic culture: was printing "revolutionary" or "evolutionary"? Did printing and its radical graphic changes introduce new forms of consciousness in readers? Fourth, we will become familiar with certain aspects of "the history of the book," discovering as we do what sorts of questions scholars in this broad field of scholarly endeavor have been asking recently.

Celenza

214.763 Carlo Emilio Gadda

An introduction to the work of the Milanese engineer considered by many the greatest Italian fiction writer of the 20th century.

Forni

214.764 Dante's *Inferno*: A Reading for Teaching

This reading of the first cantica of Dante's *Commedia* is aimed at preparing future professionals in the humanities for the teaching of Dante at the college level.

Forni

214.765 Castiglione e Della Casa

A reading of two major Renaissance books of conduct, the *Cortegiano* and the *Galateo*.

Forni

214.766 "Impious" Classics and their Reception in Renaissance Italy

Lucretius, Plautus, and Lucian were among the classical authors whose works, largely unknown in medieval Europe, were rediscovered by Italian humanists in the fifteenth century. The rediscovery of these authors generated not only excitement but also suspicion and scandal: all three were criticized as "impious' writers capable of corrupting the moral values or even the Christian orthodoxy of readers. This was particularly true of Lucretius, whose great poem of Epicurean philosophy declares that there is no afterlife, that no God cares about or influences human affairs, and that pleasure is the proper goal of life. We will study the ways in which these controversial classics influenced Renaissance authors, including Alberti, Valla, Erasmus, and Machiavelli. Discussions will be in English. Ability to read Italian is required; some knowledge of Latin desireable.

Coleman

214.768 Tasso's Prose: The Dialogues

Torquato Tasso was not only a poet, dramatist, and literary critic, but also wrote over 20 philosophical dialogues. This course examines several of his major dialogues in terms of their compositional strategies, pertinence or consonance to his poetics, and contribution to Tasso's self-fashioning as Counter-Reformation public intellectual. Solid reading knowledge of Italian required.

Stephens

214.769 Poesia Italiana Delle Origini

This course is an introduction to the Scuola siciliana and the Dolce stil nuovo.

Forni

214.771 Literature, Philosophy, and Christianity: Gianfrancesco Pico Della Mirandola (1469–1533)

Reading and commentary of texts by a major author in the Renaissance philosophical canon. Gianfrancesco Pico was a key figure in the reintroduction of classical skepticism, but also a pietist, a theorist of witchcraft, and a persecutor of witches. We will read selected works on skepticism, imagination, Christianity, and witchcraft, both in their Latin originals and in 16th-century Italian translations. Gianfrancesco's intellectual inheritance from his uncle

Giovanni Pico and other humanists will be examined, as will his influence on later writers in the philosophical and literary traditions, both Latin and vernacular. Reading knowledge of Latin and Italian required.
Stephens

214.772 Petrarch and Augustine

Among his favorite authors Petrarch mentions over and over Augustine. Indeed, Petrarch's works, not only the *Secretum*, but his lyric poetry as well, are imbued with vestiges of Augustine's thinking. The use Petrarch makes of the church father's main theological concepts, though, is highly provocative. The graduate course focuses on the relation between theological and literary discourse. Under this perspective, Petrarch's writings can be considered as paradigmatic for a wide range of early modern literature, from Dante to Montaigne.
Küpper

214.780 Italian Short Fiction
Stephens

214.861 Italian Independent Study
Staff

214.862 Italian Dissertation Research
Staff

214.863 Italian Proposal Preparation
Staff

Spanish

215.632 The New World Baroque

This seminar we will look at the theories and source texts comprising the cultural production known as the New World Baroque. With its origins in the Colonial period in Latin America, the New World Baroque extends to and includes some twentieth-century and contemporary aesthetic practices. Although the focus of the seminar will be largely literary and theoretical, we will look at some examples of visual culture as well. Cross-listed with PLAS.
Egginton

215.634 The Picaresque Novel in Spain

A close reading of the *Lazarillo de Tormes*, Alemán's *Guzmán de Alfarache*, two of Cervantes' *Novelas ejemplares,* and the *Pícara Justina*. These novels' socio-historical references will be researched; the picaresque as literary genre will also be a primary topic.
Sieber

215.635 Spanish Classical Drama

Seminar on Early 17th-Century Spanish Drama: Lope de Vega and his followers. Readings in theory of the drama and various plays and their relationships to the corrales will be the primary topic covered; analysis of individual plays from the viewpoint of court theater will also be included.
Sieber

215.639 Seminar on Don Quijote de la Mancha

The novel will be the focus of the entire seminar. Recent trends in Cervantes criticism, textual issues related to the novel's publication, biographical, cultural and social history, and patronage in the Courts of Philip II and III will be topics of discussion and research. The goal is a wide-ranging appreciation and understanding of the novel's original contexts.
Sieber

215.640 Self-Representation in Latin American Fiction, Testimonio and Memoir

Taking into account the crisis is self (national) representation and the fluidity of identities, the course will delve into the work of various major Latin American writers in order to study issues of self-representation across time and specific contexts. The course wil start with Sarmiento's memoirs, move on to Teresa de la Parra and Clarise Lispector. Machado de Asis, Borges, Arguedas will preface reading the memoirs by Rosario Castellanos, Garcia Marquez and Mario Vargas.
Castro-Klarén

215.643 Frontera, conquista, y revolución: España, Argentina y México

The seminar explores frontiers and contact zones through the literatures of three crucial cases in trans-Atlantic history. It starts with an examination of the frontiers of Muslim invasions and Christian conquests in medieval Iberia. It continues with links between medieval Reconquista and American Conquista. In the case of Argentina, it considers the clash between Indigenous cultures and colonialism in the Pampas, the national wars of independence and civil strife between Buenos Aires and the provinces, and the constitution of the Gaucho national ethos. In the case of Mexico, it concentrates on the northern frontier during the colonial and postcolonial periods, the loss of territory to Texas and the United States, and the theaters of insurgency during the 1910 revolution and its aftermath.
González and Altschul

215.644 Travel and the Displacement of the Subject

This course examines the displacement of the subject in modern travel narrative written in Latin America and about Latin America. Special focus is given to the construction of self and place.
Castro-Klarén

215.645 Colonial Texts and Postcolonial Theory

This seminar considers the production of subject identities in the "chronicles" authored by Spanish and Indian *letrados* during the early period of Iberian colonization of this hemisphere.
Castro-Klarén

215.646 The Narrative of Conquest in the Andes, 1530–1680

Departing form narratology and the perspective of postcolonial studies, the course will analyze the narrative of conquest as developed by Cieza de Leon, Garcilaso de la Vega, Inca, Guaman Poma, Jose de Acosta and William Prescott.
Castro-Klarén

215.647 Writing and Reading the Andes: An Interdisciplinary Approach to our Current Understanding of Andean Civilization

The objective of the course is to bring together the work of the early 16th century Indian, Mestizo and Spanish cronistas that wrote the Andes for the first time in light of the most recent work on Andean pre and post conquest civilization coming from the fields or archaeology, ethnohistory, cultural history and historiography. Besides reading from the work of the Inca Garcilaso and Guaman Poma, we will also read from Jose de Acosta and Bernabe Cobo. The scholarly bibliography will include the work of Tom Zuidema, Frank Solomon, Gary Urton, Bryan Bauer and Juan Ossio.

Castro-Klarén

215.648 Writing Mexico: Conquest & Culture 1200–1600

Deploying post-colonial theory, the course will examine the discursive modes in which "Mexico" appears as both an object of knowledge and of memory in selected readings of Sahagun's work.

Castro-Klarén

215.658 Whose Caribbean? Colonialism and Human Bondage

The seminar will explore the Hispanophone and Anglophone cultures of the region with emphasis on literature as a hegemonic practice confronting the legacies of slavery. It will also study authors from outside the region whose work has been imaginatively and politically involved with it. Novels, stories, poems, and essays by Alejo Carpentier, Lydia Cabrera, Nicolás Guillén, Virgilio Piñera, Miguel Barnet, Luis Palés Matos, Mayra Montero, Jean Rhys, Toni Morrison, Derek Walcott, V. S. Naipaul, George Lamming.

E. González

215.659 Noir Nation

Noir has become the default genre for sex-and-violence best-selling novels in the global market. From its putative origins in hard-boiled crime pulps, on the eve of the Great Depression, the imprint nowadays embodies the leading post-territorial fiction machine. We will zigzag the high-and-low noir belt in the company of masters sharply at odds with their respective nations and the cleansing of dark legacies: J. L. Borges, "El Zahir;" W. Faulkner, Sanctuary; Dashiell Hammett, Red Harvest; Leonardo Sciascia, The Day of the Owl (Il giorno della civetta); Ishmael Reed, Mumbo Jumbo; Carlos Fuentes, La cabeza de la hidra; Mario Vargas Llosa, Lituma en los Andes, Javier Marías, Mañana en la batalla piensa en mí; Orhan Pamuk, The Black Book Kara Kitap).

E. González

215.666 Founding and Refashioning the Nation: Sarmiento, Euclides de Cunha, Gavedos, Carlos Fuentes, Dimela Eltit

The course will focus on the historical and discursive possibilities of the nation's narration in post-colonial Latin America. Special attention will be given to the historical record, to discursive and narrative theory, to recent critical assessment of the issue and the question of the nation in the age of globalization.

Castro-Klarén

215.685 Literature and Religious Experience

The focus of this course is how the mystical, the sacred, the ineffable are expressed in literary language. We will look at both contemporary theoretical discussions of religion and its renewed importance in philosophical debates, as well as examine cases of literary religious expression from the Middle Ages to the modern period. Case studies will be comparative, but the emphasis will be on Spanish examples. Reading knowledge of Spanish is required.

Egginton

215.686 All About Zizek

In this seminar we will undertake a critical exploration of the work of today's most visible and influential philosopher and public intellectual. We will read several of Slavoj Zizek's most important books, as well as view two films, *Zizek* and *A Pervert's Guide to Cinema*. At issue will be his adaptation of Lacanian psychoanalysis for political theory and cultural studies.

Egginton

215.687 Theater and Ideology in the Spanish Golden Age

An examination of the first mass entertainment industry of urban modernity: the Spanish Golden Age theater. In addition to many canonical works from the period, by authors such as Lope de Vega, Tirso de Molina, and Calderon de la Barca, we will analyze the political circumstances of their production and a variety of theoretical frameworks for understanding their impact, including works by Adorno, Bourdieu, Maravall, Laclau, and Zizek.

Egginton

215.715 Romanticism

In this course we will examine the literary and cultural discourse of the early 19th century in Europe and specifically Spain, focusing on the literary aesthetic movement known as Romanticism. As Romanticism was an international and intercultural movement, our approach will necessarily involve a comparative analysis of romantic writing. In addition, although mostly centered on the romantic form of expression par excellence, namely poetry, the course will delve into other media of romantic expression, specifically other literary forms like drama and the essay, as well as musical forms such as opera. In particular, the influence of Spanish romantic works of literature on the Italian opera will be discussed.

Egginton

215.716 Partiality

In this seminar we will explore the idea of the partial, not as secondary to wholeness, but as prior to and independent of any presumption of totality. From the partial drives of psychoanalysis to the Heideggerian concept of *Eigentlichkeit* to the deconstructive understanding of essences as being always secondary and parasitic, the concept of partiality can help us understand how human desire is as inextricably bound to temporality and

incompletion as it is to corporate fantasies of eternity and wholeness. Weaving together a series of literary and philosophical readings from sources like Borges, Kafka, Cervantes, Plato, Augustine, Maimonides, Derrida, Lacan, and Zizek, we will explore how being partial entails both the impossibility of truly impartial judgments and the inevitability of our being always partial to other people, experiences, and objects. Ultimately at stake will be the role literature and the reading of literature can have in taking stock of partiality in all its forms and effects.
Egginton

215.738 Novelas Ejemplares de Cervantes
A close reading of Cervantes' short stories, with concentration on their literary tradition and their relationship to some of his other works. Will also investigate Spanish court society, politics, and history between 1598 and 1621.
Sieber

215.739 Novela, cine y teoría
Highlights in the philosophy and theory of the novel and narration from Lukacs to Barthes, Bahktin, and Derrida, examined in reference to leading approaches to cinema in the 20th century. Works of fiction from Cervantes to Manuel Puig and Javier Marías and films from classical Hollywood to Almodóvar.
E. González

215.747 Borges in Theory
An in-depth reading of Borges' major work and its relation to critical theory.
Castro-Klarén

215.749 La Novela Actual en Perspectiva Transatlantica
Javier Marías, *Corazón tan blanco*, Antonio Muñoz Molina, *Beltenebros*, Luis Leante, *Mira si yo te querré* (España); Tomás Eloy Martínez, *El vuelo de la reina* (Argentina); Roberto Bolaño, *Los detectives salvajes* (Chile); Santiago Roncagliolo, *Pudor*, Mario Vargas Llosa, *Travesuras de la niña mala* (Perú); Laura Restrepo, *Delirio* (Colombia); Xavier Velazco, *Diablo guardián* (México).
E. González

215.756 Conquest and Writing in the Andes: 1430–1630
In view of the latest arguments and revision of the history of Andean cultures in the work of Gary Urton, Frank Salomon, Maria Rostoworosky, and Irene Silverblatt, the course will consider the problem of writing and memory in the Andes together with the relation of writing to the formation of both imperial and colonial cultural formations. Readings will include the Huarochiri myths, the Inca relations of the war with the Waris, the narrative of conquest authored by Betanzos, Cieza de Leon, Garcilaso de la Vega Inca, and Guaman Poma. The course will depart from a post-colonial perspective and approach to studies of conquest and colonial formations.
Castro-Klarén

215.758 La Novela de la Tierra en America y España
Novels written in Spanish America and Spain in the 19th and 20th centuries characterized by rural and pastoral themes, barbarism and civility, and the question

of nationhood. Ignacio Manuel Altamirano (México), *La navidad en las montañas* (1871); Emilia Pardo Bazán (Spain), *Los pazos de Ulloa* (1886); José Eustacio Rivera (Colombia), *La vorágine* (1924); Ricardo Güiraldes (La Argentina), *Don Segundo Sombra* (1926); Rómulo Gallego (Venezuela), *Doña Bárbara* (1929); Alejo Carpentier (Cuba/Venezuela), *Los Pasos perdidos* (1953); Juan Benet (Spain), *Volverás a región* (1967).
E. González

215.759 Authorship and Nobility in Early Lyric Poetry
This seminar will begin with discussions of the 15th century as a threshold in intellectual and literary history, explore the writings of aristocratic poets, and end with a close reading of the work of Gomez Manrique.
Sieber/Altschul

215.760 Authority and Nobility in 15th-Century Castile
This seminar will begin with a discussion of the 1400s as a threshold in European intellectual and literary history. Classes will consider authorship, print history, nobility in a converso society and, in particular, we will examine differing perspectives on the beginnings of the "sense of history" as a marker of European modernity. Along these lines, this seminar will explore writings of aristocratic and court poets as well as historiographical works that traverse the 15th century and include, among others, Juan de Mena, Gómez Manrique, Marqués of Santillana, Fernán Pérez de Guzmán, and Fernando del Pulgar.
Sieber/Altschul

215.773 Baroque and Neo-Baroque Aesthetics
Works from the Spanish Baroque and colonial period will be read in conjunction with that aesthetic production of the 20th century that has come to be known as neobaroque. We will attempt to confront the question of what, if anything, connects these periods aesthetically, politically, and philosophically. Media beyond the textual will be included in our considerations.
Egginton

215.776 Canon Formation in the Idea of Latin America
The seminar explores, in the work of major Latin American writers and critics such as Rodo, Borges, Mariategui, Neruda, Jean Franco, Antonio Cornejo, Angel Rama, Antonio Candido, Elena Parente Cunha, Rosario Castellanos, John Beverley, and Walter Mignolo, the key concepts that have allowed for the construction of a canon in Latin American culture and literature.
Castro-Klarén

215.826 Spanish Independent Study
Staff

215.827 Spanish Dissertation Research
Staff

215.828 Spanish Proposal Preparation
Staff

Global Studies in Culture, Power, and History

The Institute for Global Studies in Culture, Power, and History was established in 1993 as a multidisciplinary research center devoted to the study of societies worldwide. It expands upon the work done in the previous 20 years by the Program in Atlantic History, Culture, and Society.

The object of the institute is to stimulate dialogue, reflection, and research on culture, power, and history in a global perspective. The focus is on historically situated individuals and groups dealing with specific resources and constraints, especially in the non-West the impact of global processes on culture history at the local level.

The institute sponsors seminars, speaker series, visiting scholars-in-residence, and graduate research in associated departments. Each year, visitors from around the world are invited to present their work in progress to the General Seminar, attended primarily by graduate students and faculty but also open to the general public. Summer research grants for graduate and undergraduate students associated with institute programs are available on a competitive basis.

Advisory Committee

Giovanni Arrighi, Professor, Sociology (In Memoriam 1937–2009).

Sara S. Berry, Professor, History.

Veena Das, Professor, Anthropology.

Siba Grovogui, Associate Professor, Political Science.

Margaret Keck, Professor, Political Science.

M. Ali Khan, Professor, Economics.

Beverly Silver, Professor, Sociology.

History

The Department of History offers students the opportunity to work intensively in the classroom and with individual faculty to discover the richness and complexity of history. Undergraduates begin with general courses, but progress quickly to courses that explore topics in depth and provide experience in researching, analyzing, and writing about the past. Graduate students work independently and with faculty advisors on reading and research in their fields of interest, while departmental seminars bring them together to discuss their research, forging a collegial intellectual culture. The department emphasizes European history, United States history, and the histories of Africa, Latin America, and China. Faculty and students participate in a number of cross-disciplinary programs, among them Women's Studies, the Humanities Center, Medieval Studies, Latin American Studies, the Institute for Global Studies, the Seminar in Moral and Political Thought, and two programs at Villa Spelman in Florence, Italy: the Villa Spelman Program in Social Theory and Historical Inquiry and the Seminar in Italian Studies.

The Faculty

John W. Baldwin, Charles Homer Haskins Professor Emeritus.

Sara S. Berry, Professor: economic and social history of Africa with special interest in agrarian studies.

Jeffrey Brooks, Professor: Russian and Soviet history, with an emphasis on culture and society, the press, and popular culture.

Angus Burgin, Assistant Professor: 20th-century United States; political history; intellectual history; history of capitalism.

Nathan Connolly, Assistant Professor: 20th-century America; race and real estate, tourism, Caribbean Diaspora in the United States.

Toby L. Ditz, Professor: early American cultural and social history, with a special interest in the history of women and gender.

Robert Forster, Professor Emeritus.

Louis Galambos, Professor: economic, business, and political history of the United States with emphasis on institutional change in the period since 1880.

Richard Goldthwaite, Professor Emeritus.

Jack P. Greene, Andrew W. Mellon Professor of the Humanities Emeritus.

Peter Jelavich, Professor: modern European cultural and intellectual history.

Michael Johnson, Professor: 19th-century United States history with emphasis on slavery and the South.

Richard L. Kagan, Professor: early modern European history with an emphasis on Spain and Iberian expansion.

Franklin W. Knight, Leonard and Helen R. Stulman Professor of History: Latin American and Caribbean social and economic history with emphasis on the late colonial period, an interest in American slave systems, and the modern Caribbean.

Michael A. Kwass, Associate Professor: early modern France.

Pier M. Larson, Professor: African history with specialization in East Africa, Madagascar, the Indian Ocean, and the history of slavery and the slave trade in the Atlantic world.

Vernon Lidtke, Professor Emeritus.

John Marshall, Professor: early modern Europe, with emphasis on British and intellectual history.

Tobie Meyer-Fong, Associate Professor: East Asia, cultural and social history, race, gender, and nationalism in 20th-century Asia, the Cultural Revolution, contemporary Chinese popular culture, and urban life in China.

Philip D. Morgan, Professor: early American history, with subsidiary interests in African-American history and the study of the Atlantic world.

Kenneth Moss, Associate Professor: Jewish history, modern Russian, and East European history.

Gabriel Paquette, Assistant Professor: Iberian history, colonial Latin America, political and intellectual history.

John G. A. Pocock, Harry C. Black Professor Emeritus.

Orest Ranum, Professor Emeritus.

Willie Lee Rose, Professor Emerita.

Dorothy Ross, Arthur O. Lovejoy Professor Emerita.

William T. Rowe, John and Diane Cooke Professor of Chinese History: modern East Asia, especially socioeconomic, urban history.

Marina Rustow, Associate Professor: Jewish history, medieval Middle Eastern history, the Islamic Mediterranean.

Mary Ryan, John Martin Vincent Professor: 19th-century United States history with emphasis on women, gender, urban history, and the cultural landscape.

Todd Shepard, Associate Professor: 20th-century France and the French Empire.

Gabrielle Spiegel, Krieger-Eisenhower Professor: medieval history, with special interest in historiography and linguistic analysis.

Nancy Struever, Professor Emerita.

Ben Vinson, Professor: Latin American history with a particular interest in race relations, especially the experience of the African Diaspora.

Mack Walker, Professor Emeritus.

Judith Walkowitz, Professor: modern European cultural and social history with special interest in Great Britain, comparative women's history.

Ronald G. Walters, Professor: social and cultural history of the United States with special interest in radicalism, reform, race, and popular culture.

Facilities

In addition to the Milton S. Eisenhower Library at the university, students in the Department of History can use the collections of the Peabody Institute Library, the Enoch Pratt Free Library, and the Maryland Historical Society in Baltimore, and of the Library of Congress, the National Archives, the Folger Shakespeare Library, and other specialized libraries in nearby Washington, D.C. There is provision for regular transportation to and from the Library of Congress. Also within easy distance are the holdings of specialized historical libraries and archives in Annapolis, Richmond, Williamsburg, Charlottesville, Wilmington, Harrisburg, Philadelphia, Trenton, Princeton, Newark, and New York.

Undergraduate Programs

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 48.)

Programs are prepared in collaboration with the student's advisor, who is a member of the History Department. History majors are required to take two related introductory courses in history chosen from among the following options: two History of Occidental Civilization courses; or two introductory U.S. history courses; or two introductory courses in Comparative World History (African, East Asian, Latin American, or Russian history). The Undergraduate Seminar in History 100.193-194 is also required of all history majors and is normally taken during the sophomore year. The seminar introduces students to the methodologies of history and the variety of current styles of historical writing. It also guides students in writing an original research paper on a topic of their choice.

Eight additional one-semester courses in history are required, including six at the 300-level or above. For students who concentrate in one geographical area (Europe, United States, Latin America, Africa, or Asia) two courses are required outside the field of concentration. Students with a GPA of 3.0 by the end of their junior year are strongly encouraged to undertake the research and writing of a senior thesis, a prerequisite for graduation with honors. Senior thesis work is directly supervised by a member of the department and coordinated through a required seminar: Senior Thesis 100.507-508, which replaces two of the required six courses at the advanced level. Normally, students select thesis topics and thesis directors during the spring semester of their junior year, in advance of the pre-registration period for the following fall.

Speed and accuracy are required in reading one foreign language, usually French, German, Italian, or Spanish. This requirement may be fulfilled either by taking courses through the intermediate level or by taking a special departmental examination.

The History Department also strongly encourages interdisciplinary work in cognate fields of learning. History majors are therefore strongly advised to take two clusters of courses outside the department—preferably one in the social sciences and one in the humanities—consonant with their interests and complementing their areas of concentration in history.

Minor in History

The minor in history offers to students majoring in other departments a program in which to pursue a serious interest in history, including the history of their major discipline. The requirements are:

• Two semesters of related introductory courses.

• Four upper-level (300 or above) courses.

• Two additional courses at any level, offered by any department, including the Department of History, that treat the student's major discipline in a historical way and are selected with the approval of the director of undergraduate studies.

Students wishing to minor in history should consult the director of undergraduate studies no later than their junior year.

The B.A./M.A. Program

A four-year program for B.A./M.A. degrees in history may be elected after a probationary period of one year, usually the year in which the student takes the undergraduate seminar. Interested students must apply to the program. Once admitted to the program by the sponsoring professor, the student must complete:

• 120 undergraduate credits, based on the customary requirements of the bachelor's degree.

- One foreign language.
- One graduate seminar in the field of specialization and in which the research and writing of an M.A. thesis are supervised, to be taken in the student's fourth year.
- One Graduate Field Examination in the field of specialization, to be taken in the fourth year.

Graduate Program

The graduate program prepares professionally motivated students for careers as research scholars and college and university teachers. Hence it is designed for candidates who want to proceed directly to the Ph.D. degree, who have developed historical interests, and who are prepared to work independently. Within the areas of European history, American history, and the histories of Africa, Latin America, and China, the department emphasizes social/economic and intellectual/cultural history. Although diplomatic and political history are not emphasized, attention is given to the social, economic, and cultural bases of politics.

The program is organized around seminars rather than courses, credits, or grades. The Seminar 100.781-782 and satellite seminars in European, American, and Comparative World History bring together students, faculty, and invited scholars from outside the university to discuss their research work. These departmental seminars create a lively intellectual community in which graduate students quickly become contributing members. The combination of flexibility, independence, and scholarly collegiality offered by the Hopkins program gives it a distinctive character.

Students select four fields (one major and three minor) and make their own arrangements with professors for a study program leading to comprehensive examinations at the end of the second year. Those arrangements may include taking a seminar in the field. One, and exceptionally two, minor field may be taken outside the Department of History. Students have maximum flexibility in the construction of individual plans of study, as well as the opportunity to work closely with several professors.

Admission and Financial Aid

In judging applications, the department puts particularly heavy emphasis on the quality of the student's historical interests and prior research experience. Each applicant must submit a sample of written work. Applicants must also take the general aptitude portions of the Graduate Record Examination. Ordinarily no candidate for admission is accepted whose record does not indicate an ability to read at least one foreign language.

The department accepts only those students who plan to work in the specific fields of the faculty, and each student is admitted only with the approval of a particular professor. Applicants should indicate the proposed field of specialization at the time of application. With the concurrence of a new faculty advisor, students may, of course, later change their major professor.

The department has a number of fellowships that provide tuition and a stipend for students of unusual promise.

Requirements for the Ph.D. Degree

Students are required to have a reading knowledge of those foreign languages that are necessary for the satisfactory completion of their program of graduate study. Students in European history must have a reading knowledge of at least two languages, and students in medieval history must also have a reading knowledge of Latin. Students in the Latin American area must have a reading knowledge of two of the following, depending upon their particular specialties: French, Spanish, Portuguese, or Dutch. In African history, students must have a reading knowledge of three languages including English and French. Depending upon their fields of specialization, students in African history may have other language needs. Students are expected to pass a written examination in one language within a month after entering the department, and they are required to do so before the end of the first year.

Each student is required to take a seminar under his/her major professor and to participate in at least one departmental seminar each semester.

The student's knowledge of four fields will be tested by written and oral examinations before the end of the second year of graduate study.

The student must write and defend a dissertation that is a major piece of historical research and interpretation based on primary sources and representing a contribution to historical knowledge. Its content, form, and style must be adequate to make it suitable for publication.

Normally, each student is required to perform some supervised teaching or research duties at some point during the graduate program, most often as a teaching fellow during the second and fourth years.

Interdisciplinary Ph.D. Degree

The departments of History and Anthropology offer an interdisciplinary doctoral degree. For details concerning this degree students should contact either department.

M.A. Degree

The master of arts degree is automatically awarded to each doctoral candidate following the passing of field examinations and the completion of the language requirements. In special circumstances, a student may be permitted to take an M.A. degree after one full year of graduate study. In such cases students will be required to demonstrate by examination an ability to read at least one foreign language, write a satisfactory research essay, and satisfy the director of their research that they have a mastery of the field of history that forms its background. The essay must be submitted to the Graduate Board.

Admission as an M.A. candidate occurs only under exceptional circumstances, at the initiative of a faculty sponsor and with approval of the department chair. Such students are expected to be fully matriculated students and to pursue the normal course of study expected of all first-year graduate students as well as to fulfill the particular requirements for an M.A.

Undergraduate Courses

Courses with numbers 101-299 are designed for freshmen and sophomores but are open to all undergraduate students. Advanced courses, with numbers 300-599, are generally designed for students who have completed introductory courses in the appropriate area. For courses offered during any particular semester, see the schedule of Arts and Sciences and Engineering courses.

Introductory Courses

100.101 (H,S,W) History of Occidental Civilization: The Ancient World
An examination of the history of the various cultures that arose in the Mediterranean world from the beginnings in the Near East to the collapse of the Roman Empire in the West.
3 credits

100.102 (H,S,W) History of Occidental Civilizations: The Medieval World
The course explores selected topics in the political, economic, social, and intellectual history of Western Europe in the period between the fall of the Roman Empire and the 13th century. Special emphasis is given to understanding the ways in which medieval society functioned as a pioneer civilization, compelled to reorganize itself after the almost total collapse of the ancient world, and to the interplay between material and cultural forces in the process of social organization.
Spiegel   3 credits

100.103 (H,S,W) History of Occidental Civilization: Europe and the Wider World
A survey of European history in the period from the Renaissance and Reformation to the late 18th century. This wide-ranging and topical course discusses social, cultural, and intellectual developments in Europe, and the diversity and complexity of European societies as they evolved through contact with other cultures.
Kagan, Marshall   3 credits

100.104 (H,S,W) History of Occidental Civilization: Modern Europe
A survey of European history from the French Revolution to the present that provides political, social, economic, and cultural perspectives. Nineteenth-century topics include the rise of democracies, the Industrial Revolution, the development of capitalism and socialist responses, nationalism and nation-building, and imperialism. Themes from the 20th century include the two world wars, fascism and the Holocaust, decolonization, the rise and decline of the Soviet Union, and the formation of the European Union.
Brooks, Moss, Jelavich, Shepard   3 credits   fall

100.109 (H,S) Making America: Slavery and Freedom, 1776–1876
Exploration of the interrelated histories of U.S. slavery and freedom from the American Revolution through Reconstruction. Readings include primary sources and historical accounts.
Johnson, Morgan   3 credits

100.112 (H,S,W) Making America: Mastery and Freedom in British Mainland America, 1607–1789
This course examines society, politics, and culture in colonial British mainland America and the early United States, with special emphasis on the history of domination and freedom in the context of empire and revolution.
Ditz, Morgan   3 credits

100.113 (H,S) Making America: Race, Radicalism, and Reform in America, 1787–1919
Beginning with the political framework established by the Constitution and concluding with Progressivism and its immediate consequences, this course will examine the complicated ways in which Americans attempted to come to terms with racial, ethnic, cultural, and other forms of diversity.
Walters, Morgan   3 credits

100.120 (H,S) Slavery: From Africa to America
An introductory history of African enslavement in the Atlantic that considers the African origins of slaves and their subsequent experiences in North America.
Larson   3 credits

100.121-122 (H,S) History of Africa
An introduction to the African past. First term: to 1880. Second term: since 1880.
Berry, Larson   3 credits

100.123 (H,S,W) Problems in American Social History: The American West
An examination of the West and the "frontier" as lived and as the subject of literature and popular culture.
Walters   3 credits

100.128 (H,S,W) History of 20th-Century Russia
The purpose of this course is to explore the large changes in Soviet life and society, intellectual and literary life, economic development, and the revolutionary movement.
Brooks   3 credits

100.129 (H,S) Introduction to Modern Jewish History, 1789–2000
Introduction to Jewish experience of modernity in Europe, America, and the Middle East. New forms of Jewish identity, politics, religion, and culture in context of emancipation, enlightenment, nationalism, and modern anti-semitism to be explored.
Moss   3 credits

100.131 (H,S,W) History of East Asia
A topical introduction to the histories of China and Japan. Major topics include the classical traditions of ethical and political thought; the development of statecraft; the foundations of rural society; and cultural interaction within East Asia and between East Asia and the West.
Rowe   3 credits

100.132 Jewish History in Modern Eastern Europe, 1772–1943
The Jewish experience in the hot zone of empire, nationalism, class, and cultural conflict, and the movements from Hasidism to Zionism to socialism—which this community created.
Moss   3 credits

100.134 (H,S) African Encounters with Development
Berry   3 credits

100.136 (H,S) Abraham Lincoln and His America
Freshmen seminar that explores the life and times of Abraham Lincoln though contemporary sources and texts by historians.
Johnson   3 credits

100.157 (H,S) History of Race and Empire
Many states, in a number of historical periods, and across diverse cultures and civilizations, can be defined as empires. Similarly, many cultures and civilizations have identified groups of people as distinct from other people on the basis of diverse criteria. This class will examine how the pursuit and maintenance of empires by European states in the modern period were uniquely linked to distinctions between groups of people on the basis of "race."
Shepard   3 credits

100.159 (H,S) The American Civil War
Analysis of the American Civil War from the perspectives of government leaders, political activists, military officers, common soldiers, whites and blacks, men and women, North and South.
Johnson   3 credits

100.166 (H,S) United States History, 1933-2001
Lecture course on the history of the United States from the administration of Franklin D. Roosevelt through the events surrounding September 11, 2001.
Connolly   3 credits

100.180 (H,S) Classics of American Thought
An introduction to American intellectual history by way of some of the classic texts in the American intellectual tradition, from the Puritans to the postmoderns.
Ross   3 credits

100.182 (H,S) U.S. since 1929
This course explores the interplay between economic growth and instability, communism and anti-communism, diversity and conformity, war and protest, and liberalism and conservatism in American politics and society since the Great Depression.
Burgin   3 credits

100.191 (H,S) Family History in the U.S. and Europe
Seminar format. Introduces students to major themes in family history: sentiment and family authority, family and gender, history of sexuality, family, and work, the dynamics of family and race. Scholarly readings stress interdisciplinary perspectives. We also examine examples of the historical evidence, such as letters, diaries, and short stories, upon which our knowledge of family life in past time depends. The emphasis is on pre-industrial and early industrial settings, with some attention to the politics of the family and gender in the contemporary United States. First- and second-year undergraduates have first priority.
Ditz   3 credits

100.193-194 (H,S,W) Undergraduate Seminar in History
Required for all history majors and normally taken during the sophomore year. Deals with the elements of historical thinking and writing. Must be taken in sequence.
Staff   3 credits

100.208 (H,S) China: Neolithic to Song
This class offers a broad overview of changes in China from Neolithic times through the Song dynasty (roughly from 5000 BCE through the 13th century CE) and will include discussion of art, material culture, and literature as well as politics and society. Close readings of primary sources in discussion sections and extensive use of visual material in lectures will help students gain firsthand perspective on the materials covered.
Meyer-Fong   3 credits

100.209 (H,S) Weimar Culture
Literature and visual and performing arts within the political context of Germany: 1918–1933.
Jelavich   3 credits

100.219 (H,S,W) The Chinese Cultural Revolution
This introductory class will explore the Cultural Revolution (1966–1976), Mao's last attempt to transform China, and a period marked by social upheaval, personal vendettas, violence, massive youth movements, and ideological pressure.
Meyer-Fong   3 credits

100.232 (H,S) Contemporary Latin America

An overview of Latin America today including geography, culture, politics, economics, religion, and race relations.

Knight   3 credits

100.241 (H,S,W) Visions of the Self: The Autobiography as History

An inquiry, through the use of autobiographies, diaries, and letters, into attitudes toward family, politics, relations, work, and the self with emphasis on traditional Europe. Emphasis is on reading and discussion of original sources.

Kagan   3 credits

100.269 (H,S) Revolutionary America

This course provides an intensive introduction to the causes, character, and consequences of the American Revolution, the colonial rebellion that produced the modern world's first republic, restructured the British Empire, and set in motion an age of democratic revolutions in the Atlantic world. A remarkable epoch in world history, the revolutionary era was of momentous significance. The full impact and scope of the American Revolution will be addressed in a sweeping Atlantic context.

Morgan   3 credits

100.280 (H,S) The Civil War Era

Analysis of the American Civil War and its aftermath with emphasis on social, political, economic, and cultural dimensions of the military conflict.

Johnson   3 credits

Advanced Courses

100.301 (H,S) America after the Civil Rights Movement

Explores the role of the 1964 Civil Rights Act and mid-20th century reform movements in transforming American politics, economy, and culture since the late 1960's.

Connolly   3 credits

100.304 (H,S) New World Slavery, 1500-1800

This course examines the development of the institution, its importance for understanding early America, the world of slaves and of masters.

Morgan   3 credits

100.305 (H,S) Russia in the Age of Dostoevsky

This course explores the explosion of creativity that brought Russian literature and the arts to the forefront of European culture at the time when Dostoevsky wrote his greatest novels.

Brooks   3 credits

100.312 (H) Capitalism, Class, and Community in Modern Jewish History

The interplay of economic change, social class, religion, and ethnicity in modern Jewish history; capitalism as integrative and disintegrative force; class conflict and socialism in Jewish life.

Moss   3 credits

100.313 (H,S) The Construction of the African Diaspora in the Americas

An examination of the various ways in which an African Diaspora developed across the Americas between 1492 and the present. Attention will be paid to the period of the trans-Atlantic slave trade, but the greater emphasis will be on the complex societies that emerged by the early 20th century and the responses of people of African descent to these societies. Readings will range across history, demography, economics, politics and culture in order to define a diaspora and examine the factors that encourage or inhibit its formation.

Knight   3 credits

100.319 (H,S,W) Colloquium in the Society of Early Modern Europe

Readings and discussions on selected topics including bureaucracy, social groups, and the structure of communities.

Kagan   3 credits

100.321 (H,S) Visions of the Self

Examines a variety of autobiographical texts—male and female, Western and non-Western, from the Middle Ages to the present—with an eye toward using these texts as "windows" into the society in which they were written. Course will require weekly reports, a term paper, and final exam. Organized as a seminar, student-run discussion will be integral to the course.

Kagan   3 credits

100.325 (H,S) The Jewish Condition

The 20 years following the First World War were characterized by manifold political crises: the apotheosis of radical left-wing and radical right-wing politics at the heart of Europe, hyper-nationalism in post-imperial Eastern and southern Europe, violent confrontations in Europe's overseas colonies and mandates, and worldwide economic depression. This course asks how the 16-18 million Jews of Europe, America, and the Near East were affected by these processes and traces their opposing political, religious, and cultural responses to them.

Moss   3 credits

100.326 (H,S) Cultural History of 20th-Century Russia

Issues include developments in literature and the arts during the revolutionary era, efforts to create a revolutionary culture, repression and official culture, dissident movements, popular culture, and the cultural crisis of the Soviet old regime.

Brooks   3 credits

100.329 (H,S) Chinese Thought

Introduction to the classics of Confucianism and Daoism.

Lievens   3 credits

100.330 (H,S) National Identity in 20th-Century China and Japan

Using primary sources, including literature and film, we will explore the changing ways in which ideologues, intellectuals, and ordinary citizens defined national identity in 20th-century China and Japan.

Meyer-Fong   3 credits

100.333 (H,S) Global Public Health since WWII
Galambos   3 credits

100.338 (H,S,W) Contemporary African Political Economics in Historical Perspective
Course examines contemporary economic and political trends and problems in selected African countries with reference to colonialism, independence, globalization, and internal struggles over economic opportunity and nation-building.
Berry   3 credits

100.339 (H,S) Art and Politics in 20th-Century Europe
Explores the problematic, controversial, and sometimes productive relationship between art and politics, with emphasis on Germany, Russia, Italy, and France.
Brooks   3 credits

100.341 (H,S) History of Spain
A survey from Moorish times to the present. Knowledge of Spanish is desirable but not required.
Kagan   3 credits

100.342 (H,S,W) Spain: The Golden Age
Primarily a reading and discussion course: emphasis is on Spain's important cultural achievements during the 16th and 17th centuries. Knowledge of Spanish is desirable but not required. Prerequisite: 100.341 or its equivalent, or permission of instructor.
Kagan   3 credits

100.347 (H,S,W) Early Modern China
The history of China from the 16th to the late 19th centuries.
Rowe   3 credits

100.348 (H,S,W) 20th-Century China
The history of China from about 1900 to the present.
Rowe   3 credits

100.349 (H,S) Reforms and Its Discontents in the Southern Atlantic World
A seminar on Spain, Portugal, and Ibero-America, c. 1650-1830, situated in the wider Atlantic/European context. Topics include enlightenment, warfare, absolutism, resistance and revolution, and transitions from empire.
Paquette   3 credits

100.350 (H,S) The Art of Collecting in America's Gilded Age, 1880-1920
Course is organized as an upper-division seminar for students with interest in history, art history, and museum studies, focuses on the art collections of wealthy Americans during the fabled Gilded Age, ca. 1880 – ca. 1920. Topics to be discussed include the motives, both personal and patriotic, underlying the formation of these collections, the ideas and circumstances that contributed to the creation of municipal museums such as New York City's Metropolitan Museum of Art, and the relationship between these collections, both private and public, and America's national identity.
Kagan   3 credits

100.352 (H,S) Politics and Culture in the Age of Pasternak
Brooks   3 credits

100.353 (H,S) Remembering Vietnam: Documenting, Capturing, and Preserving a Divisive War
This is a course to teach students about a divisive war through gathering images, interviews, and other data. A lab unit in digital media is required (represented by Thurs 10 to 12 component of the course scheduled in the Digital Media Center).
Walters   3 credits

100.354 (H,S) Russia and the World: From Peter the Great to Putin
This is a survey of modern Russian history with an emphasis on Russia's engagement with the West and some attention to the rise and fall of the Russian empire. Topics also include the political tradition, society and culture, wars, Cold War , and the post-communist transition.
Brooks   3 credits

100.355 (H,S) The City in Modern Jewish History
The city in key processes of Jewish modernity (emancipation, Enlightenment, social mobility, anti-semitism); Jewish mass politics, secular culture, popular culture, assimilation, Orthodoxy, producing Jewish space; city/ "shtetl;" Israel's "Jewish cities."
Moss   3 credits

100.356 (H,S) Buddhist Experience
Lievens   3 credits

100.361 (H,S) Age of Tolstoy
Politics and culture in Russia from 1850 to WWI.
Brooks   3 credits

100.365 (H,S) Culture and Society in the High Middle Ages
Spiegel   3 credits

100.366 (H,S) Women in Europe, 1780–1918
In this course we shall explore how women of different classes and ethnicities experienced transformations in daily life as well as cataclysmic social and political change. Topics include revolution, war, family, cultural production, work, sexuality, political thought, feminist movements.
Walkowitz   3 credits

100.370 (H,S) The U.S. Antislavery Movement
Examination of the opposition to slavery in the U.S., 1750-1865. Reading and analysis of primary sources and historical accounts.
Johnson   3 credits

100.371 (H,S) The Global Economy of the 20th Century
This course surveys the development of the global economy and its political and economic institutions from the period before WWI, through the ultra-nationalism of the interwar era, and into the emergence of three major economic blocks (Europe, Asia, and the Americas) in the years since WWII.
Galambos   3 credits

100.372 (H,S) The Victorians
This course focuses on the politics of everyday life, consumption, intimate relations, and concepts of the self in Victorian Britain (1837-1901). Particular attention will be devoted to Victorian visual culture, including exhibitions, built environment, decorative arts, and leisure culture. Other themes include popular nationalism, class cultures, feminism and body politics, Empire, and racial thought.
Walkowitz   3 credits

100.373 (H,S) Renaissance to Enlightenment Intellectual History
Includes readings by Machiavelli, More, Erasmus, Castiglione, Montaigne, Shakespeare, Hobbes, Locke, and Voltaire.
Marshall   3 credits

100.375 (H,S,W) Colloquium: Problems in American Social History
Discussion, intensive reading, and short papers treating selected topics in American social and cultural history. The topics to be examined will vary from year to year, but will include such matters as social stratification, family patterns, sex roles, reform movements, race relations, urbanization, and ethnicity.
Walters   3 credits

100.376 (H,S) Baltimore as Historical Site
This class will use the historical sites of Baltimore to demonstrate the spatial context of major events in U.S. and urban history.
Ryan   3 credits

100.381 (H) Tradition and Modernity in Modern Jewish Culture
The intellectual, cultural, and social dilemmas of Jewish tradition in the modern age—crisis, reconstructions, and appropriations of tradition.
Moss   3 credits

100.383 (H,S) History of Imperial Russia
This is a survey of Russian history from Peter the Great to the Revolution.
Brooks   3 credits

100.388 (H,S) European Intellectual History from Adam Smith to Nietzsche
A survey of major thinkers who supported or opposed capitalism and democracy.
Jelavich   3 credits

100.396 (H,S,W) Histories: Male and Female
In order to trace the changing meaning of gender in American history, the class will compare the fiction and autobiographical writings of young men and young women.
Ryan   3 credits

100.397 (H,S) Politics and Culture in Modern Britain
Topics include nationalism, war, imperialism, material culture, feminism, social investigation, radicalism, and politics of sexuality in the time period of 1780 to 1918.
Walkowitz   3 credits

100.399 (H,S) Decolonization and Nationalism in Africa
The end of European colonization in Africa after World War II and its causes, with an examination of the emergence and various forms of African nationalism.
Larson   3 credits

100.402 The Enlightenment
Seminar-style course discussing Enlightenment thought from Locke and Spinoza to the Scottish Enlightenment, Rousseau, and Kant, combining readings of their works with historians' accounts of Enlightenment thought and culture.
Marshall   3 credits

100.404 (H,S) John Locke
Seminar-style course in which John Locke's major works will be read intensively, together with some of his contemporaries' works, and select scholarly inter-pretations.
Marshall   3 credits

100.405 (H,S,W) European Socialist Thought, 1840–1940
Extensive reading of works by Proudhon, Marx, Bakunin, Sorel, Bernstein, Luxemberg, Lenin, and Gramsci.
Jelavich   3 credits

100.406 (H,S,W) American Business in the Age of the Modern Corporation
This course will focus on business organizations, their performance, and sociopolitical relations in the 20th century.
Galambos   3 credits

100.413 (H,S) Britain from the Revolutions of 1688 to 1691 to the Industrial Revolution
Analyzes society, culture, gender, religion, politics, and intellectual history from the revolutions of 1688–1691 through to the Industrial Revolution.
Marshall   3 credits

100.419 (H,S) U.S. Slavery, 1607–1865
Analysis of U.S. slavery, focusing on the politics, culture, and society of both slaves and slave owners.
Johnson   3 credits

100.422 (H,S) Society and Social Change in 18th-Century China
Reading knowledge of Chinese recommended but not required.
Rowe   3 credits

100.424 (H,S) Women and Modern Chinese
This course examines the experience of Chinese women, and also how writers, scholars, and politicians (often male, sometimes foreign) have represented women's experiences for their own political and social agendas.
Meyer-Fong   3 credits

100.425 (H,S) Problems in Advanced Islamic History
Seminar on the making of the Middle East to 1500 focusing on conversion to Islam, the development of the state and slave-soldier regimes, the survival and efflorescence of religious minorities, and trade and commerce across the Mediterranean and Indian Ocean.
Rustow   3 credits

100.426 (H,S) Popular Culture in Early Modern Europe and the United Kingdom

Witchcraft, magic, carnivals, riots, folk tales, gender roles; fertility cults and violence especially in Britain, Germany, France, Italy.

Marshall   3 credits

100.428 (H,S,W) London—World City (1790–1918)

Walkowitz   3 credits

100.433 (H,S) Censorship in Europe and the U.S.

History of censorship in Europe and the U.S., 18th century to present.

Jelavich   3 credits

100.437 (H,S) Late Imperial China: History and Fantasy

Students in this seminar will look at the ways in which Chinese and Western scholars, novelists, film-makers, and artists have represented China's Late Imperial period. We will look at the way foreigners have imagined China, and the ways in which Chinese writers past and present have fancifully, nostalgically, and inventively rendered their personal and national pasts. The course will explore issues of historical, geographical, and literary imagination.

Meyer-Fong   3 credits

100.438 (H,S,W) Modern Mexico and the Mexican Revolution

The history of Mexico since 1810, looking at general social, political, and economic factors, the Wars of the Reforma, intervention of Maximilian, the Revolution of 1910, and the contemporary scene with the discovery of large oil resources.

Knight   3 credits

100.439 (H,S,W) The Cuban Revolution and the Contemporary Caribbean

A lecture course dealing with the development of the Cuban Revolution and tortuous history of the Caribbean during the 19th and 20th centuries.

Knight   3 credits

100.440 (H,S,W) The Revolutionary Experience in Modern Latin America

This course will examine the conditions which produced revolutionary changes in Haiti (1782–1810), Mexico (1910–1930), Bolivia (1952–1960), and Cuba (1959–1978). The experiences of these states will be compared with Vargas's Brazil, Peron's Argentina, and Betancourt's Venezuela. Apart from the concept of revolutionary change, the course will try to come to grips with the nature of the State in Latin America, its changing impact on local societies, and the reciprocal effects of international politics and economics.

Knight   3 credits

100.441 (H,S,W) Society, Politics, and Economics in Contemporary Latin America

A survey of Latin America after World War II with special emphasis on social structures, political systems, economic development and trade, grassroots organizations, and the informal economy as well as international relations.

Knight   3 credits

100.442 (H,S) The Intellectual History of Capitalism: 1900 to the Present

This course examines shifting understandings of the philosophical foundations, political implications, and social effects of the market economy since the early 20th century.

Burgin   3 credits

100.445 (H,S) African Fiction as History

An exploration of African history through historical fiction.

Larson   3 credits

100.453 (H,S) Africa and the Atlantic

Larson   3 credits

100.456 (H,S) The Anthropology and History of Conversion

An examination of the process of religious conversion from anthropological and historical perspectives.

Larson   3 credits

100.457 (H,S) Abraham Lincoln, Slavery, and the American Civil War

Examination of slavery and the American Civil War through the speeches and writings of Abraham Lincoln and related works by and about his contemporaries.

Johnson   3 credits

100.459 (H,S) Women, Gender, and Politics in Modern Britain, 1780–1939

Topics covered include feminism, sexuality, work, socialism, war, and imperialism.

Walkowitz   3 credits

100.460 (H,S) History of Sexuality in Modern Britain, U.S., and Europe

Concentrates on sexuality in Great Britain from 1700 to the present, with some examples also drawn from the United States and Europe. Topics covered include gender and sexual identity, sexual theories, sexual politics and strategies, abortion and birth control, religion and its discontents, sexual spaces and the city.

Walkowitz   3 credits

100.461 (H,S,W) Power, Identity, and the Production of African History

This course examines representations of the African past in historical scholarship, literature, film, and popular discourse, to see how interpretations of the past are shaped by the interests of the interpreters, and how they influence social and political relations in the present.

Berry   3 credits

100.468 (H,S,W) Britain from the English Revolution to the Industrial Revolution

Analyses society, culture, gender, religion, politics, and intellectual history from the causes, nature, and significance of the English Revolution through to the late 18th-century beginnings of industrialization. Seminar-style.

Marshall   3 credits

100.470 (H,S) Monuments and Memory in Asian History
This seminar will explore the ritual, political, and religious significance of architectural sites in Asia. We will also examine their more recent role as signifiers of cultural and national identities—and in tourism.
Meyer-Fong   3 credits

100.472 (H,S) U.S. Women in the 20th Century
A survey of a century of fundamental change in the meaning of gender, this course will focus on individual women of varying class and racial background. Faculty identified course which includes discussion on race, ethnicity, gender, or non-Western cultures.
Ryan   3 credits

100.473 (H,S,W) The Indian Ocean: Economy, Society, Diaspora
A seminar-level survey of the history of the Indian Ocean with an emphasis on human diaspora.
Larson   3 credits

100.478 (H,S) Colloquium: Problems in Chinese Agrarian History
Reading and discussion of major Western-language studies of the Chinese countryside, ca. 1368 to the present. Topics include land utilization, land tenure, community formation, class relations, popular movements, and the role of the state. Prerequisite: permission of instructor.
Rowe   3 credits

100.479 (H,S,W) Colloquium: Problems in Chinese Urban History
Reading and discussion of works in Western languages on the role of cities in Chinese society, from the Tang dynasty (618-906 A.D.) to the present. Topics include city formation; rural-urban and inter-urban relations; urban social structure; conflict and community; and urban policies of the imperial, republican, and communist states. Prerequisite: permission of instructor.
Rowe   3 credits

100.482 (H,S,W) Colloquium: Historiography of Modern China
A survey of assumptions and approaches in the study of modern Chinese history, as written by Chinese, Japanese, and Western historians. Prerequisite: permission of instructor.
Rowe   3 credits

100.483 (H,S) Brazil and the Southern America
This course focuses on Brazil, Argentina, Chile, and Peru, exploring their commonalities and their differences. It spans a number of fields: culture, economics, history, political science, and anthropology. Although there are no prerequisites, this course requires some reading and participation in the discussions. At the end of the course students should be able to place the selected countries within the wider context of the rest of the Americas.
Knight   3 credits

100.485 (H,S) Children and Disaster in Africa
Examines the history of children and disaster from the slave trade to colonial famine and war, to the modern child soldier and refugee.
Larson   3 credits

100.488 (H,S) The Early Caribbean and the Atlantic World Seminar
No other part of the world has been shaped so completely as the Caribbean by the two institutions of European colonialism and plantation slavery. This course, which covers the development of colonization in the Caribbean, is designed to give students an understanding of the making of the region. It begins with the Amerindian societies that Columbus encountered and ends with the slave revolution that created Haiti. The region will be approached from the inside and the outside, and placed in comparative perspective. The intention is to provide a composite analysis of life in the colonial Caribbean and the influences that shaped it.
Morgan   3 credits

100.489-490 (H,S) Bondage and Culture: Slavery and Cultural Transformations in the Atlantic
The purpose of this seminar is to explore a variety of ways in which the Atlantic economy fostered cultural transformations in the Africas and the Americas. The thematic focus will be on slavery as a trans-oceanic phenomenon, investigating how the linked experiences of enslavement, movement along the "way of death," and life/labor in destination societies on both sides of the Atlantic changed identities and cultural practices. Geographical focus will be primarily on the Western half of Africa, the Caribbean, and Brazil. Investigations will include such topics as gender, ethnicity, race, witchcraft, and religion.
Larson   3 credits

100.492 (H,S) Comparative Urban History
Reading and discussion of representative works on the history of cities in a variety of cultures, with primary emphasis on the early modern era. Relevant theoretical work from other disciplines will be introduced. Topics include regional systems, urban economies, urban space, urban culture, and social relations.
Rowe   3 credits

100.497 (H,S) Comparative Agrarian History
Reading and discussion of representative works on the history of agrarian life in a variety of cultures. Topics include land utilization, crop selection, commercialization, technology, land tenure systems, rural social relations, the bases of rural community, and the roles of cultural systems and the state.
Rowe   3 credits

100.498 (H,S,W) Colloquium: History of Family and Gender in the United States
Reading and discussion, topics vary from year to year, but may include patriarchal households and property relations in early America; women and wage work during early industrialization; ideology of domesticity and its critics; African American family and gender relations; the politics of reproduction and childbearing. Emphasis is on the 18th and 19th centuries, with some attention to the 20th century. Readings stress interdisciplinary perspectives.
Ditz   3 credits

100.501-502 Independent Reading

100.507-508 (W) Senior Thesis
A seminar supervised by the director of undergraduate studies and designed to provide a forum for collective exchange among seniors undertaking the senior thesis. All students undertaking the senior thesis must register and attend.
Staff   3 credits

100.535-536 Independent Study, Intermediate Level
Staff

Cross-Listed

The departments of Classics and Near Eastern Studies offer courses in ancient history and civilizations. Credits earned in certain of these courses by undergraduate students who are history majors may be applied toward departmental requirements.

Graduate Courses

Courses numbered 600-799 are seminars, either general or in special fields. They are designed to give doctoral candidates, according to their individual needs and capacities: (1) training in historical methods; (2) introduction to bibliography; (3) direction for individual reading; and (4) supervision in research, exposition, and interpretation in the preparation of papers and dissertations. Each candidate for an advanced degree will take one seminar in a special field and one general seminar every semester. They are offered every year.

Field Seminars

100.632 The Literature and Art of Russian Modernism
The course will explore the art and literature of Russian modernism, 1890-1935. Participants will discuss critical and original works, design a research project, and write a short essay on a central theme.
Brooks

100.633-634 Spain and Its Empire
Kagan

100.635-636 Seminar in Russian and Soviet History
Brooks

100.641-642 China: Late Ming/Early Qing
This graduate seminar will explore the historiography of the Ming-Qing transition with emphasis on social, cultural, and political conditions in China both before and after the Qing conquest.
Meyer-Fong

100.645-646 Production of History
Spiegel

100.647-648 Nineteenth-Century America
Johnson

100.649-650 The American South
Johnson

100.651 Readings on 20th Century America
Introduces students to intellectual trends shaping academic treatments of twentieth-century American history.
Connolly

100.652 European Socialist Thought
Socialist, communist, and anarchist theories since Marx.
Jelavich

100.653 Russian Politics and Culture: 1850–1950
The purpose of this course is to investigate certain themes of Russian high and low culture in the context of Russian politics.
Brooks

100.655 Villa Spelman Program in Social Theory and Historical Inquiry
Open to advanced graduate students in historical and theoretical disciplines. Topics and staff will vary. Held at the Villa Spelman, Florence, Italy. Prerequisite: elementary spoken Italian.

100.662 Desegregating American History
Graduate seminar exploring the problem of race in the shaping of archives and arguments in American historiography.
Connolly

100.665 The Indian Ocean
The history of trade, labor, colonization, ideas, and nationalism in the Indian Ocean.
Larson

100.667-100.668 Topics in Modern Jewish History
Moss

100.668 Reading Seminar: Graduate Introduction to Modern Jewish History
Moss

100.669-670 Reading Seminar: Cultural History of Colonial America and the Early United States

100.671 German since 1918
Political, social, and cultural developments from the Weimar Republic to reunification.
Jelavich

100.672 Colonial Latin American Historical Research and Methodology Seminar
This course is designed to introduce students to a range of colonial Latin American source documentation and to familiarize them with basic issues in conducting primary source research. Focusing on textual analysis, the use of economic and social data, and archival survey, students will write a series of papers that will build basic competency and skills in the area of Latin American colonial methodology. Advanced Spanish is required. Familiarity and some background in colonial Latin American history is strongly encouraged. The course adopts a practicum style.
Vinson

100.673-674 Research Seminar in Colonial British America and Early United States
Ditz

100.677-678 Research Seminar in Early Modern Colonial British America
Greene

100.679 Directed Readings in Colonial Latin American History and Historiography
This course is designed to provide students with a comprehensive understanding of colonial Latin American history up until the era of independence. Reading list is based upon classic and modern texts.
Vinson

100.680-681 Research Seminar in Atlantic History, 1600–1800
Morgan

100.684 Readings in Atlantic History, 1500–1810
A graduate course designed to provide an introduction to the liveliness of Atlantic history by surveying a range of genres and topics.
Morgan

100.686 Russia at War
This seminar explores Russian society and culture in wartime with particular emphasis on Russia's relationship with Europe.
Brooks

100.687-688 American Economic and Political History
Galambos

100.695-696 Problems in American Social and Cultural History
Walters

100.704 Africa and the Indian Ocean
An examination of Africa and its relationship to the Indian Ocean from antiquity to the present. A counterpoint to Africa and the Atlantic.
Larson

100.705 Nationalism and Nationhood: Theory, History, Sociology
Interdisciplinary introduction to the topic. Major synthetic accounts of nationalism; historical case studies; recent theory emphasizing systemic and relational emergence, institutionality, and practice over origins, spread, and ideology; nationalism in relation to ethnicity, religion, class, and gender; in relation to different types of states, state-systems, empires; in relation to language and cultural identity. Readings include Gellner, Smith, Hobsbawm, Anderson, Calhoun, Sahlins, Bell, Brubaker, Bourdieu, Porter, Chatterjee, Rafael, Verdery, Mosse.
Moss

100.706 Topics in Early African History
Selected topics in African history prior to 1900.
Larson

100.709-710 Modern Latin America
Knight

100.713 Consumer Culture in Historical Perspective, 1780–1920
Cultural theory and historiography of consumer culture, with attention to the following: state and the market; imperialism; the public sphere; reorganization of urban space, rise of mass media, commercialized leisure, advertising, and the fashion system; theories of the self, sexuality, and pleasure. The focus will be on Great Britain, with some examples drawn from U.S. and French cases.
Walkowitz

100.716 Cultural Theory for Historians
An examination of modern cultural theories, such as the Frankfurt School, structuralism, and poststructuralism. Theorists include Benjamin, Horkheimer, Adorno, Barthes, Debord, Baudrillard, Levi-Strauss, Derrida, Foucault, and Bourdieu.
Jelavich

100.721-722 Problems in African History
Berry

100.724 Space, Place, and History
The seminar will read theory and monographs about the physical grounds of history in place, space, architecture, and the built environment.
Ryan

100.725 Readings on U.S. Gender
Taking off from recent writing on the history of women, masculinity, and sexuality, we will explore the impact of gender on American history.
Ryan

100.727-728 Medieval Seminar: Renaissance of the 12th Century
Spiegel

100.729-730 Reading Seminar: Colonial British America and the Atlantic World
Ditz, Morgan

100.731-732 Colonial Africa
Larson

100.733 Reading Qing Documents
A hands-on document reading class designed to familiarize students with the skills, sources, and reference materials necessary to conduct research in Qing history. Open to advanced undergraduates by permission. Prerequisite: one semester of classical Chinese.
Meyer-Fong

100.735-736 Early Modern Britain
Marshall

100.737-738 Seminar in Modern Chinese History
Rowe

100.739 The Power of Place in U.S. History
Through readings in urban history as well as other scholarship that is situated firmly in physical space, the seminar will explore the intricate and interactive relationship between space and power (a two-semester sequence: the fall will focus on the long 19th century, the spring on the 20th and 21st).
Ryan

100.740 The Power of Place in U.S. History

Through readings in urban history as well as other scholarship that is situated firmly in physical space, the seminar will explore the intricate and interactive relationship between space and power (a two-semester sequence: the fall will focus on the long 19th century, the spring on the 20th and 21st).

Ryan

100.743 The City and the Sexes

This semester will be focused on 20th-century literature and research presentations on the 19th or 20th centuries.

Ryan

100.744 Twentieth-Century France and the French Empire

We will discuss the historiography of 20th-century France and the French empire.

Shepard

100.746 History of South Africa

A reading seminar in the recent historiography of South Africa.

Larson

100.748 France and the Maghreb in Modern European History

This graduate course will explore the intersections between the histories of France, Algeria (most particularly), Morocco, and Tunisia since the 1820's.

Shepard

100.749 Social Theory for Historians

Jelavich

100.754 Advanced Topics in Chinese History: Early-Middle Period

This course will survey and attempt to contextualize recent developments in the historiography of China's "early" and "middle" periods. Intended for graduate students, this class is open to advanced undergraduates who have taken either East Asian Civilizations or Neolithic-Song—or by permission of instructor.

Meyer-Fong

100.765-766 Problems in Women's History

Exploration of recent work in European and U.S. women's history, focusing on some of the following: sexuality, cultural production, politics, family formation, work, religion, differences, civic orders.

Walkowitz, Ditz

100.767 Victorian Culture and Society

This course focuses on the exploration of recent work in Victorian history on class, gender, and race, with attention to some of the following: physical transformations and representations of the city, popular culture, religion, science and medicine, sexuality, family forms, and work.

Walkowitz

100.768 London World City

Walkowitz

100.769 Gender History Workshop

A forum for the discussion of research in progress about women, gender, and sexuality.

Ditz

100.771-772 Reading Seminar in Family History

Ditz

100.773 Problems in Gender and Empire

Exploration of recent work in the history of gender in European empire focusing on some of the following: economy, labor, administration, resistance, sexuality, reproduction, health, cultural and religious transformation.

Larson

100.775 Nineteenth-Century America

Readings on nineteenth-century U.S. history from a spatial perspective, particularly attentive to gender, politics, and the city.

Ryan

100.778 Topics in Gender History

The seminar continues the discussion of gender in a transnational perspective with a focus on the geographical specializations and research interests of the participants.

Ryan

100.780 Research Seminar in the History of Women and Gender

Ditz

100.801-802 Dissertation Research

Staff

100.803-804 Independent Study, Graduate Level

Staff

General Seminars

All but one of the general seminars are for the presentation and critical discussion of research papers by first- and second-year graduate students. The Seminar (100.781-782) is for the presentation of research-in-progress by faculty, invited scholars, and advanced graduate students.

100.763-764 Comparative World History Seminar

100.773-774 History of the Social Sciences

100.781-782 The Seminar

100.783-784 Medieval European Seminar

100.785-786 Early Modern European Seminar

100.787-788 Modern European Seminar

100.789-790 American Seminar

100.791-792 Latin American Seminar

100.793-794 African Seminar

Cross-Listed Courses

Anthropology

070.614 Anthropological Subjects: On Method
Course compares methodological approaches in historical and ethnographic studies and examines their influence on theoretical and interpretive debates in anthropology.
Staff

Interdepartmental

360.321 The Social History of Languages
Haeri   3 credits

360.323 Modern Latin America: I
Knight, Castro-Klarén   3 credits

360.324 Modern Latin America: II
An introduction to contemporary Latin America with invited speakers and cultural events.

Knight, Castro-Klarén   3 credits

360.373 (H,S,W) Family in African History
An interdisciplinary inquiry into changing ideas and practices of kinship and family in African societies and cultures, past and present.
Berry   3 credits

360.607 Methodology Seminar in History and Anthropology
Staff

360.620 Seminar on Gender and Politics
Interdisciplinary exploration of recent works on gender, politics, and culture: United States, Europe, and ethnographic comparisons.
Ditz

360.669-670 General Seminar of the Institute for Global Studies in Culture, Power, and History

History of Art

Located in a region known for its artistic riches, Johns Hopkins University offers special opportunities for the study of art history. Students work closely with a faculty of research scholars on aspects of European and American art and have access to the remarkable collections in Baltimore and Washington. In small classes and informal excursions, they integrate their direct experience of works of art with knowledge acquired through historical research. Programs leading to the B.A. and Ph.D. degrees emphasize the value of investigating works of art in various historical contexts and enable students to deepen their understanding of cultural history through courses in other departments.

The Faculty

Stephen J. Campbell, Henry and Elizabeth Wiesenfeld Professor (Chair): Italian Renaissance art.

Michael Fried, Professor, Herbert Boone Chair in the Humanities (The Humanities Center): modern art.

Herbert L. Kessler, Professor: early Christian and medieval art.

Mitchell Merback, Associate Professor: Northern Renaissance art.

Felipe Pereda, Nancy H. and Robert E. Hall Professor: late medieval and early modern Spanish art.

Pier Luigi Tucci, Assistant Professor: Roman art and architecture.

Kathryn Tuma, Assistant Professor, Second Decade Society Career Development Chair: modern art.

Joint Appointments

Betsy M. Bryan, Professor (Near Eastern Studies): Egyptian art and archaeology, Egyptology.

H. Alan Shapiro, Professor (Classics): Greek and Roman art.

Adjunct, Associate, and Visiting Faculty

Martina Bagnoli, Adjunct Associate Professor (and Curator, Walters Art Museum): medieval art.

Doreen Bolger, Adjunct Professor (and Director of The Baltimore Museum of Art): modern art.

Rebecca M. Brown, Visiting Associate Professor: Asian art.

Lisa DeLeonardis, Senior Lecturer and Austen-Stokes Term Professor in the Art of the Ancient Americas.

William Noel, Adjunct Professor (and Curator, Walters Art Museum): medieval art.

Peter Parshall, Adjunct Professor (and Curator, National Gallery of Art): Northern Renaissance art.

Martin Perschler, Lecturer (and Preservation Specialist, U.S. Department of State): architecture.

Elizabeth Rodini, Senior Lecturer, Associate Director of the Program in Museums and Society: Renaissance art and museum studies.

Carl Strehlke, Adjunct Professor (and Adjunct Curator, Philadelphia Museum of Art): Italian Renaissance art.

Gary Vikan, Adjunct Professor (and Director of The Walters Art Museum): Byzantine art.

Faculty Emeriti

Charles Dempsey, Professor Emeritus: Renaissance and baroque art.

Henry Maguire, Professor Emeritus: Byzantine and medieval art.

Facilities and Opportunities

Johns Hopkins is well situated for the study of art history. The university maintains an extensive art library which includes the Fowler Collection of treatises on architecture. Research materials in numerous regional libraries and museums and in the Library of Congress are also accessible to art history students.

Diverse and extraordinarily active museums and research institutions provide a rich environment for the study of art history at Johns Hopkins. The Baltimore Museum of Art, adjacent to the campus, has recently completed a new addition to house its growing collections and exhibitions. A short distance from Hopkins, the Walters Art Museum preserves rare collections of ancient and medieval art, Renaissance and 19th-century painting.

Washington, only an hour away, is one of the most exciting art centers in the world. The National Gallery of Art specializes in painting, sculpture, and the graphic arts from the Renaissance to the present day. Modern art is presented in the permanent collections and exhibitions of the Hirshhorn Museum, the National Museum of American Art, and the Phillips Collection. Unique exhibitions of Byzantine and pre-Columbian art are maintained at Dumbarton Oaks, and collections of Asian and African art are housed in the Freer Museum and the Museum of African Art.

Undergraduate Program

(See also General Requirements for Departmental Majors, page 48.)

Because the department emphasizes the historical, cultural, and social context of art, art history is an excellent program for undergraduates interested

in a broadly humanistic education as well as for those preparing for a career in the field. A departmental advisor assigned to each undergraduate major helps plan individual courses of study. Undergraduates are encouraged to participate fully in all departmental activities.

Requirements for the B.A. Degree

The undergraduate will learn about European art and the methodologies of art history. Students begin their work with the introductory survey, 010.101-102 Introduction to the History of European Art, and then deepen their knowledge by taking seven advanced courses: one each in Ancient, Medieval, Renaissance/Baroque, and Modern, and three additional advanced courses, with no more than two taken in the same chronological field; these may include courses in Asian or African Art. A secondary field consisting of three courses taken outside of the Department of the History of Art is developed in consultation with the undergraduate advisor.

Students must acquire intermediate-level knowledge of French, German, or Italian and must demonstrate this proficiency either by the successful completion of two intermediate-level courses or, on special request, by departmental examination. Spanish may be used only with prior departmental approval and is not recommended for those intending to pursue graduate studies in History of Art.

A minimum grade of C- is required for any course to be applied to meeting requirements for the major, including courses taken first semester freshman year.

Departmental honors are awarded at commencement to undergraduate majors in the history of art who achieve a GPA of 3.6 or better within the major.

Minor in the History of Art

Students majoring in another department may minor in art history by completing the introductory survey, 010.101-102 Introduction to the History of European Art, and by taking six advanced courses: one each in Ancient, Medieval, Renaissance/Baroque, and Modern, and two additional advanced courses, with no more than two taken in the same chronological field; these may include courses Asian or African Art.

Graduate Programs

The Ph.D. program is designed to give students a systematic knowledge of the history of European art and an understanding of the methods of art-historical research. The program emphasizes close working relationships among students and faculty in seminars and acquaintance with the outstanding artistic works in the Baltimore-Washington area.

Students also have access to such research facilities as the Center for Advanced Study in the Visual Arts (National Gallery) and Dumbarton Oaks.

Admission and Financial Aid

Applicants for the M.A. and Ph.D. programs in the history of art must complete the general university requirements and must also submit a recent paper, preferably in the area of their special interest. The department requires students to take the Graduate Record Examination. The application deadline falls in mid-January but varies slightly from year to year. The departmental website should be consulted for the current deadline. To maintain close student-faculty relationships and the greatest flexibility in developing individual curricula, the department strictly limits the number of students it admits each year.

Financial assistance is provided in the form of tuition grants, fellowships, and teaching assistantships. In addition, the department awards the Adolf Katzenellenbogen Prize and the Sadie and Louis Roth Fellowship each year to support a graduate student research project. Advanced students are also eligible for research grants provided by the Charles Singleton Center for the Study of Pre-Modern Europe.

Requirements for the in-process M.A. Degree

There is no terminal M.A. program; graduate students accepted into the Ph.D. program with a B.A. qualify for an M.A. upon completion of two semesters of course work (six courses) and completion of language requirements.

Requirements for the Ph.D. Degree

A student who has received the M.A. degree from Johns Hopkins or another institution may apply for admission to the Ph.D. program. Acceptance requires the approval of the instructors in the areas chosen by the student as major and minor fields; in the case of transfer students, acceptance may be provisional. Unless they can present acceptable language certificates, students entering directly into the Ph.D. program will be required to pass language examinations in both German and either French or Italian during the first term.

Students usually take one and one-half years beyond the M.A. to complete course requirements for the Ph.D., but may take up to five terms. In discussions with major and minor field advisors, the Ph.D. student develops areas of concentration and courses of study to suit his/her needs and interests. The art history faculty encourages students to take full advantage of offerings in other departments,

and students may, if they choose, develop a minor field in another discipline. Every Ph.D. student is expected to gain classroom experience by serving as a teaching assistant for at least one term.

After they have completed their course work, students must pass an examination in their major and minor fields and must submit a dissertation proposal to be approved by the department. When a student has completed the dissertation, he or she is examined by a Graduate Board appointed by the dean.

For further information on graduate study, write to Department of the History of Art.

Art History Fields

Ancient
Students who wish to study ancient art work will work with Pier Luigi Tucci and Alan Shapiro. Facilities available to students of Greek and Roman art include the Archaeological Collection on campus and the extraordinary holdings of The Walters Art Museum.

Medieval
Ever since it was established by Adolf Katzenellenbogen, the department has given special emphasis to the study of medieval art. Students work under the direction of Herbert Kessler. As adjunct members of the faculty, William Noel and Martina Bagnoli of the Walters Art Museum are available for consultation. Seminars in Byzantine art, offered each year at Dumbarton Oaks, are open to Hopkins students.

The extraordinary holdings at the Walters Art Museum and at Dumbarton Oaks are especially valuable for students interested in manuscript illumination and the so-called minor arts. Students also have access to the Dumbarton Oaks research facilities, which include a copy of the Princeton Index of Christian Art.

Renaissance and Baroque
Students work with Professors Stephen Campbell, Mitchell Merback, and Felipe Pereda. Associates of the department include Dr. Elizabeth Rodini, who directs the undergraduate program in Museums and Society, Dr. Carl Strehlke (Philadelphia Museum of Art), and Dr. Peter Parshall (National Gallery). Graduate students in medieval and Renaissance can also participate in the programs of the Singleton Center for Pre-Modern Studies.

Modern
Students interested in 18th-, 19th-, and 20th-century art work with Professors Michael Fried, Kathryn Tuma, and visiting scholars. In addition, students can develop critical skills by taking courses offered through the Humanities Center, the Philosophy Department, and the departments of the various literatures.

The Baltimore Museum of Art, which houses the Cone Collection, and museums in Washington provide stimulating resources and activities for students of modern art.

Undergraduate Courses

010.101 (H,W) Introduction to the History of European Art I
A survey of painting, sculpture, and architecture from Egyptian, Greek, Roman, and medieval culture.
Staff   4 credits

010.102 (H) Introduction to the History of European Art II
A survey of painting, sculpture, and architecture from the Renaissance to the present.
Staff   4 credits

010.105 (H) Ancient Art of the Americas
Survey of the art and architecture of Mesoamerica with special reference to Olmec, Teotihuacan, Maya, and Aztec. On-site museum visits and collections analysis.
DeLeonardis   3 credits

010.122 (H) Leonardo, Michelangelo, Raphael
An examination of the three most celebrated artists of the Italian Renaissance, focusing on the relation between their achievements in architecture, sculpture, and painting, and the historical conditions in which the works were produced. Through these figures, Renaissance and modern myths of artistic independence and individuality will be subjected to a critical scrutiny. Lectures will deal with the interpretation of the works themselves, and with the artist's careers, their interactions and rivalries, their relation to patrons and other artists.
Campbell   3 credits

010.146 East Asian Art: Pottery to Propaganda
This course surveys the visual culture of East Asia (China, Japan, Korea, Southeast Asia) from the earliest ceramics to contemporary performance art. Topics include patronage, originality, landscape, ritual space, modernity, postsocialism. Cross-listed with East Asian Studies and International Studies.
Brown   3 credits

010.147 (H) South Asian Art
This course explores the visual culture of South Asia from archaeology to installation art. Themes will include the patron, the text and image, ritual/political space, nationalism, modernity, and postcoloniality.
Brown   3 credits

010.225 (H) Early Renaissance Art: Giotto to Leonardo
The circumstances of artistic production in Florence compared with those operating in Naples, Rome, Milan, and Venice. The city as site of divergent uses of art by different communities and interests, employing images for the expression of identity and status and as a strategic means of producing consensus or exploiting social division. Note: This offering may be counted toward the major requirement for Renaissance courses.
Campbell   3 credits

010.250 (H) Early Netherlandish Painting
Explores the major painters working in the Low Countries during the 15th-century: Robert Campin, Jan van Eyck, Roger van der Weyden, Hugo van der Goes, Hieronymus Bosch, and others.
Merback   3 credits

010.291 Architectural History of Baltimore
Focusing on Baltimore's built environment and drawing upon primary sources, this course will explore the major European and American design theories, values, and practices of the last several centuries with an eye toward establishing Baltimore's place within a national and global urban environmental context. Topics addressed in this course include city building, class and race, architectural revivalism, transportation, urban renewal, and post-industrialism.
Perschler   3 credits

010.296 Studies in French Modernist Painting
This course investigates French modernist painting from the mid-19th century through the early 20th by way of close examinations of pictures that changed the face of modern art, from Courbet's Burial at Ornans to Manet's Dejeuner sur l'Herbe to Picasso's Demoiselles d'Avignon.
Tuma   3 credits

010.306 (H) Renaissance Art in Florence
The city of Florence, Italy, is the classroom for this intensive study of the art, architecture, and culture of the Renaissance. Students will analyze individual works of art and be expected to present their findings to others. There will be side trips to other cities. Otherwise, the course takes the form of a rigorous three-week walk through the city. Selection of students is based on preparation in the history of art and seniority. For information about prerequisites, travel, and accommodation costs, see the undergraduate coordinator.
Staff   3 credits   intersession

010.317 (H) Face of God
Examines how the belief that God had assumed flesh was fundamental to the development of Christian art. Works of art remain the focus, but the course also considers manuscripts, relics, the Eucharist, and other manifestations.
Kessler   3 credits

010.320 (H) Art of Colonial Peru
Surveys the art and architecture of Viceregal Peru (1526–1825) and examines the role of religious orders, art schools, artisan guilds, and cofradía and considers the social and political implications of art patronage.
DeLeonardis   3 credits

010.322 (H,W) Picturing the Bible
The course examines the ways in which theology, politics, and other cultural interests were mapped onto biblical narratives in manuscripts, murals, and small objects during the Middle Ages. Research paper and final exam.
Kessler   3 credits

010.327 The Harem and the Veil
This course explores the constructed imagery of the harem and the veil in relation to politics and visual culture in the Middle East, North Africa, India, and Euro-America. Topics will include Ottoman palace architecture, Orientalist painting, mandating/banning the veil, Islamic feminisms. We will address visual culture broadly, including advertising, architecture, contemporary art, film, news media.
Brown   3 credits

010.332 (H) Rome: Art and Culture in the Eternal City
The course traces the urban and artistic history from the earliest period until the present day. Special emphasis is given to urban planning and political patronage.
Kessler   3 credits

010.333 (H) The Making of Renaissance Rome 1300–1600
The multiple identities of the ancient city as these are understood and represented through the work of artists such as Giotto, Filarete, Raphael, Bramante, and Caravaggio; the writings of Petrarch, Pius II, Alberti, and Montaigne; the statecraft and patronage of the Renaissance popes.
Campbell   3 credits

010.334 (H) Problems in Ancient American Art
Selected topics which may include art of the ancient scribe and visual communication (Maya, Aztec, Mixtec, Inka), imperial art and architecture (Aztec, Moche, Inka), sacred media and indigenous aesthetics (Mesoamerica, Andes).
DeLeonardis   3 credits

010.340 (H) The Court Artist in Renaissance Italy 1330–1530
The course will examine the careers of several artists who became the imagemakers to the makers of states who inspired Machiavelli's *The Prince*: Pisanello, Piero della Francesca, Andrea Mantegna, Cosmè Tura, Leonardo da Vinci, Giulio Romano. We will consider not only the major works of these artists from the point of view of those for whom they were made, but also the artists' own attempts to transform their social status, or to dominate the field of artistic production in a particular court or city, by placing their skills at the service of warlords and autocrats.
Campbell   3 credits

010.348 (H) Art and Faith in Golden Age Spain
Introduction to Spanish painting and sculpture of the XVIth and XVIIth centuries, with special focus on religious art.
Pereda   3 credits

010.351 (H) Asian Art after 1945

This course examines the art and architecture of East, South, and Southeast Asia produced since the mid-20th century. We will engage with theoretical, visual, and political developments in the recent art of this region, reading statements by artists and architects, discussing the rising commercial and international profile of contemporary Asian art, and exploring established and emerging art histories of this period.

Brown   3 credits

010.355 (H) Art and Religion in the Roman World

This course explores the relationships between Roman art and religion through a survey of key topics and issues, from the archaic period to late antiquity, providing an introduction into how to use and analyse both textual and material evidence as sources for understanding Roman society. Temples, altars, public and private buildings, reliefs, statues, sarcophagi, paintings, mosaics, coins, metalware, glass and pottery, all get increasingly complex and interesting as the Roman world developed and are important forms of evidence for political, intellectual, social and economical life.

Tucci   3 credits

010.356 (H) Greek and Roman Art and Architecture

This course explores the principal forms and contexts in which art and architecture developed in the Greek and Roman world. It surveys Greek art and architecture from the archaic through the Hellenistic periods, and Roman art and architecture from the foundation of the city of Rome—against the background of the Etruscan tradition—to the divergent trends of late antiquity, including the interaction between Rome and the provinces of the empire. Overall the course encourages critical thinking about the purpose of studying art and architecture as a tool for understanding the Greek and Roman worlds, and provides an introduction into how to use visual and material evidence as a historical source. On completion of this course students will be able to describe and evaluate the architectural style and decorative of key Greek and Roman monuments, as well as their function in ancient society.

Tucci   3 credits

010.353 (H) Key Moments in East Asian Politics and Visual Culture

Examines key political moments in China, Japan, and Korea from 1850 to the present, focusing on the way visual imagery shapes these events. Includes Japanese occupation of Korea, Hiroshima and Nagasaki bombings, 1989 Tiananmen Square protests, North Korean propaganda.

Brown   3 credits

010.365 (H) Ancient Andean Art

Course surveys the visual arts of Andean South America and includes discussion of royal Inka tunics, Nasca death imagery, and the gold sculptural traditions of Colombia.

DeLeonardis   3 credits

010.366 (H) Native American Art

Survey of the principal visual arts of North America (1500 B.C. – A.D. 1600) including discussion of Adena-Hopewell, Mogollon, Punuk, and Taino. Introduction to interpretive theory and methodology. Collections study in local and regional museums.

DeLeonardis   3 credits

010.367 (H) Cezanne, Matisse, Picasso

This course addresses the development of modernist painting in France between 1890 and 1918 through an examination of the work of these three essential figures. Note: No strict pre-requisites, though satisfactory completion of Art History 010.102 (Introduction to the History of European Art II) is strongly recommended.

Tuma   3 credits

010.369 (H) According to What: The Work of Jasper Johns, Robert Rauschenberg, and Cy Twombly

This senior seminar examines the work of three artists who transformed American postwar art, with an emphasis on their work of the late 1940s through the early 1970s.

Tuma   3 credits

010.380 (H) Abstract Expressionism: de Kooning, Rothko, Newman, Pollock

This course addresses what is arguably the most significant moment in the history of American art: Abstract Expressionism. By looking closely at the careers of four painters from this period—Willem de Kooning, Mark Rothko, Barnett Newman and Jackson Pollock—we will explore both larger issues relevant to this crucial and controversial moment in art history and topics specific to the work of each of these pillars of American abstract art

Tuma   3 credits

010.382 (H,W) Politics of Display in South Asia

Through examining collecting, patronage, colonial exhibitions, and museums, this course examines how South Asia has been constructed in practices of display. Themes: politics of representation, spectacle, ethnography, and economies of desire related to colonialism and the rise of modernity. Cross-listed with Anthropology and Museums and Society.

Brown   3 credits

010.396 (H) Art After 1945

This course surveys the major artistic movements in the United States and Europe following World War II. Beginning with abstract expressionism, we will explore the European Informel, post-painterly abstraction, Neo-Dada, new realism, pop, minimalism, postminimalism, land art, arte povera, conceptualism, neo-expressionism, postmodernism, and key developments in contemporary art.

Tuma   3 credits

010.397 (H) Games of Eros and Mars: Art and Music of Renaissance Ferrara

The course will examine the artistic and musical patronage of the court of Ferrara under the rule of the Este from 1400 to 1598. Particular attention will be devoted to the work of the painters and well-known composers. The creative role of princely patrons such as Duke Ercole d' Este and his daughter Isabella, marchioness of Man-

tua, will also be examined. Crosslisted with the Peabody Institute.
Campbell/Weiss   3 credits

010.398 (H) Tombs for the Living
Centers on analysis of the tomb as a context that informs our understanding of art and beliefs about life and the afterlife. Case studies drawn from the ancient Americas.
DeLeonardis   3 credits

010.407 (H) Ancient Americas Metallurgy
This course addresses the technology, iconography, and social significance of metals and draws on case studies from Colombia, Peru, Hispaniola, and Panama. Collections study in museums.
DeLeonardis   3 credits

010.411 (H) Art Collecting and the Rise of the Museum
Case studies ranging from the Renaissance studiolo and kunstkammer, the Uffizi and the Roman College Museum in the 1600s, the formation of state museums in nineteenth century Europe. Can be taken as part of the Program in Museums and Society.
Campbell   3 credits

010.412 (H) The Art of Describing
This course explores the role of description in the analysis and interpretation of works of art. Emphasis will be placed on texts by 20th-century authors, though not exclusively on 20th-century subject matter. Our primary focus will be the use of different rhetorical strategies to meet the formidable challenge of "translating" visual phenomena into language.
Tuma   3 credits

010.415 (H) Modernism and Postmodernism in Architecture
"Form forever follows function," "the house is a machine for living in," "less is more," "less is a bore"—when and where on earth did these architectural catch phrases originate, and what did they mean to the people who coined them and attempted to express them in their designs for buildings? In this course we will study the major architectural theories and design trends of the late 19th and 20th centuries in Europe and the United States—a turbulent and complicated period in the history of architecture commonly known as modernism and postmodernism. Topics and personalities addressed in this course will include expressionism, the Bauhaus, Le Corbusier, urbanism, functionalism, and Frank Lloyd Wright.
Perschler   3 credits

010.419 (H, W) Passion Cult, Passion Image, Passion Drama
A set of interdisciplinary explorations of the Passion of Christ theme, viewed as a mythic paradigm within European visual culture, religious consciousness, and cultic practice since the High Middle Ages.
Merback   3 credits

010.421 (H) Michelangelo and His Contemporaries: License, Controversy, and Reform in 16th-Century Italian Art
An approach to the later work of Michelangelo (1520–64) and the response to his art by writers and artists in Rome, Florence, and the Veneto before and after the call for a "reform of art" by the Council of Trent.
Staff   3 credits

010.422 (H) Early Modern Dutch and Flemish Painting
Explores the major painters working in the Netherlands during the 16th and early 17th centuries: Lucas van Leyden, Pieter Aertsen, Pieter Brueghel, Peter Paul Rubens and many others.
Merback   3 credits

010.430 (H) History of Roman Art and Architecture
This course explores the principal forms and contexts in which art and architecture developed in the Roman world. It surveys Roman art and architecture from the foundation of the city of Rome—against the background of the Etruscan tradition—to the divergent trends of late antiquity, including the interaction between Rome and the provinces of the empire. Overall the course encourages critical thinking about the purpose of studying art and architecture as a tool for understanding the Roman world, and provides an introduction into how to use visual and material evidence as a historical source. On completion of this course students will be able to describe and evaluate the architectural style and decorative of key Roman monuments, as well as their function in ancient society.
Tucci   3 credits

010.460 (H) The Medieval Art and Architecture of Venice and Constantinople
An introduction to the rival cities, Venice and Constantinople, studied through their medieval art and architecture
Maguire   3 credits

010.521-522 (H,W) Honors Thesis
Open to students by arrangement with a faculty advisor in the History of Art Department. Interested students should review program description available in department office.
Staff   3 credits

Cross-Listed

040.355 (H) Roman Landscapes in Context
Valladares   3 credits

040.360 (H) The Archaeology of Daily Life
Valladares   3 credits

040.368 (H) Ancient Greek Seafaring
Shapiro   3 credits

389.201 (H) Introduction to the Museum: Past and Present
Rodini   3 credits

389.202 (H) Introduction to the Museum: Issues and Ideas
Rodini   3 credits

389.345 (H) Introduction to Museum Practice
Balachandran   3 credits

389.440 (H) Who Owns Culture?
Rodini   3 credits

Graduate Courses

010.604 Medieval Manuscript Illumination
The seminar considers the sources, meaning, and function of medieval book illumination during the Early Middle Ages.
Kessler   2 hours

010.607 The Epistemology of Photography
This seminar will ask how photography produces ways of knowing: how does photography's reality-effect shape its dissemination and absorption? Is photography's emergence during the colonial era coincidental or catalytic? How is memory (re)constituted in a photography-saturated world? What kinds of histories does photography encourage and discourage? Is a photograph an object? We will read across disciplines (literature, anthropology, history, history of art, political science, theory) to investigate the epistemology of photography and the photograph.
Brown   2 hours

010.609 Image and Incarnation
The seminar will examine the theoretical and actual intersections of art theory and practice with theological arguments about the two natures of Christ.
Kessler   2 hours

010.610 Carolingian Art
The course considers works in various media to determine the character of the revival sponsored by Charlemagne and his successors.
Kessler   2 hours

010.611 Florence 1490–1530
Art, politics, and society during a period of political and religious turmoil, culminating in the Last Republic.
Campbell   2 hours

010.612 The Medieval Image
Drawing on recent work by Belting, Camille, Cormack, Didi-Huberman, Gouillard, Pelikan, Rudolph, Vernant, Wirth, and others, the seminar will examine theories of medieval images in Byzantium and the Latin West.
Kessler   2 hours

010.613 Problems in the Renaissance Small Engraving
Focused research on German innovators in the genre of the small-scale engraving in the early 16th century: Albrecht Altdorfer, Barthel and Sebald Beham, Georg Pencz, Jacob Binck, and others.
Merback   2 hours

010.615 The Court of Cosimo I deMedici
Problems in the art of Pontormo, Cellini, Bronzino, and others, and the historiography of mannerism.
Campbell   2 hours

010.616 Monumental Narrative
The seminar investigates the depictions of Old and New Testament themes on the walls of early medieval buildings. The programs and sources of Early Christian cycles, the adjustments made to address the public, and such technical issues as the role of model books are studied.
Kessler   2 hours

010.618 Topics in 19th-Century Art
This semester will examine the painting of Gustave Courbet and Edouard Manet. Cross-listed with Humanities.
Fried   2 hours

010.619 Origins of the German Renaissance
Traces the origins of German Renaissance art—the age of Dürer, Cranach, and Holbein—through changes in religion, politics, intellectual culture, and new visual media across the "long 15th-century."
Merback   2 hours

010.623 Topics in Modern Art
Co-taught by the professor with three successive visitors—Stephen Melville, Elizabeth Legger, and Eric Michaud—on topics of the visitors' choosing.
Fried   3 hours

010.629 Materials in Postwar Art
Through case studies of specific artists and works of art, this course examines the use of new materials in the postwar period: bricks, felt, fiberglass, fluorescent light, house paint, kapok, latex, lead, rocks, rubber, sponges, vinyl, wax, etc.
Tuma   2 hours

010.630 Art of Medieval Italy
Duecento and Trecento art from the medievalist's point of view.
Kessler   2 hours

010.632 Mannerism
Transformations in central Italian art following the Sack of Rome and the Florentine Last Republic, with a particular focus on the court of Cosimo I in Florence (1537–1574).
Campbell   2 hours

010.634 The Politics of Visual Culture
In-depth reading and discussion at the intersection of visual culture and the political. Issues may include photography and colonialism, national symbolism, commodification of culture, visual and ethnographic display, the national museum, repatriation, modernity and the spectacle.
Brown   2 hours

010.635 Art and Representation in Nineteenth Century Peru
Graduate, nineteenth-century Peru, nationalism, visual sources and interpretation
DeLeonardis

010.636 Cézanne and Interpretation
This course explores key interpretations of Cézanne's art from the late 19th century to the present, including formalist, socio-historical, psychoanalytic, phenomenological, deconstructive, and post-deconstructive perspectives.
Tuma   2 hours

010.642 Man of Sorrows
Focusing on the cultic and devotional imagery of Christ as the Man of Sorrows, this seminar explores modes of reception in Byzantine, medieval and Renaissance art (painting, sculpture, and prints).
Merback   2 hours

010.644 Sites of Knowledge: The Renaissance Studiolo
The culture of reading and collecting in the Renaissance court *studiolo, kunstkammer*, and museum.
Campbell   2 hours

010.648 Topics in Venetian Art
This seminar examines artistic exchanges between Venice and its territorial state.
Campbell   2 hours

010.649 Mantegna and the Renaissance Court Artist
Mantegna's work will be considered in the context of humanist and antiquarian culture of Padua and Mantua, and the cultural politics of Italian princely states.
Campbell   2 hours

010.650 Reform Art in Italy
This course is a consideration of initiatives to reform religious art in Italy before and after the Council of Trent.
Campbell   2 hours

010.653 The Crisis in Postwar Painting: 1950–1975
This seminar investigates the fate of painting in the decades following abstract expressionism. Topics to be addressed include the legacy of Jackson Pollock, anti-gesture, European décollage, painting and photography, modularity/seriality/chance, painting and conceptualism, monochrome and the fate of color.
Tuma   2 hours

010.658 Special Topics in the Art of Lombardy and the Veneto, 1500–1600
An approach to the problem of regionalism in Italian art, focusing on art production in the Lombard cities of Bergamo, Brescia, and Cremona, 1520–90.
Campbell   2 hours

010.681 The Medieval Art and Architecture of Venice and Constantinople
An introduction to the rival cities, Venice and Constantinople, studied through their medieval art and architecture.
Maguire

010.684 Topics in Recent Art: Jeff Wall, Joseph Marioni, Anri Sala
A consideration of the work of at least three contemporary artists in different media: the photographer Jeff Wall, the painter Joseph Marioni, and the video artist Anri Sala.

Open to advanced undergraduates with permission of the instructor.
Fried

010.689 Problems in 19th-Century Painting
Courbet, Manet, Impressionism.
Fried   2 hours

010.690 Toward a New Art History
In recent years various developments in and around the history of art have begun to hold out the promise of an expanded definition of the field. In this seminar we will consider a number of those developments, chiefly through close reading of books and articles by such writers as Alpers, T. J. Clark, Steinberg, Summers, Baxandall, Paulson, Krauss, Bryson, Wolf, Marin, Barthes, Foucault, and Derrida.
Fried   2 hours

010.691 Modernism and Postmodernism
Readings in criticism and theory from Greenberg to the present.
Fried   3 hours

010.693 Classics of Art Criticism
Readings include Diderot, Baudelaire, Fry, Greenberg, and Jeff Wall.
Fried   2 hours

010.696 Serra, Hesse, Nauman
This seminar investigates the careers of three American artists who emerged in the 1960s: Richard Serra, Eva Hesse, and Bruce Nauman. We will be examining work in a variety of media, including sculpture, painting, drawing, installation, performance, film and video.
Tuma   2 hours

010.697 Topics in Venetian Art
This seminar examines artistic exchanges between Venice and its territorial state.
Campbell   2 hours

010.703 Art History's Interdisciplinary Turn
Examines the ways art history has opened itself to paradigms in other disciplines since the 1970s. What has been gained and lost? What does it mean to be "interdisciplinary" today?
Merback   2 hours

010.717 Alternative Histories through Art and Archaeology: From Archaic to Late Antique Rome
This seminar investigates important areas and buildings of ancient Rome in relation to the culture and events of their time, and explores the role of art and architecture in Roman society. Methodologically the focus is on the integration of diverse sources (archaeological evidence, architecture, sculpture, mosaic, painting) to reconstruct and understand different aspects of Rome's development, from its foundation to the late antique period. This course provides a framework for critical discussion of historical and socio-cultural themes through the analysis and interpretation of material and visual culture as well

as other forms of archaeological evidence. It addresses key debates on the construction and transformation of ancient Rome, exploring notions of identity, cult, language, and economy as well as forms of political organization. Overall the course aims to give graduate students the tools to access those histories and ideologies which appear unattainable through the literary sources alone, allowing for the expansion of existing narratives and challenging the underlying models which inform our understanding of key historical and cultural processes.
Tucci   2 hours

010.718 Art and Archaeology in the Augustan Age
This seminar investigates Roman art and architecture during the Augustan age (31 BC – AD 14), in Rome and in the provinces of the empire. Augustus' cultural program influenced many aspects of the Roman way of life (religious ritual, clothing, state ceremony), leading to the creation of a new visual language that expressed and furthered the transformation of Roman society. Methodologically the focus will be on the integration of diverse sources (archaeological evidence, architecture, sculpture, mosaic, painting) to reconstruct and discuss the images that a contemporary would have experienced in Rome and elsewhere.
Tucci   2 hours

010.719 Art and Architecture under the Flavian dynasty
This seminar investigates Roman art and architecture during the Flavian age (AD 69-96) in Rome and in the provinces. With the Flavian dynasty the empire enjoyed a period of renewed political and economic stability: and this was the result of the principate of Vespasian. The 2009-celebration of the bimillenary of Vespasian's birth gave the opportunity to reassess the figure of this emperor and the role of his dynasty in the development of Rome. With the Flavians, the capital of the empire enjoyed a period of intense building activity (e.g. the Colosseum). The great projects of Vespasian and Domitian radically transformed its image. The embellishment of the city and the global re-planning of the urban spaces were the visible signs of the political revival of the empire. Methodologically the focus will be on the integration of diverse sources (archaeological evidence, architecture, sculpture, mosaic, painting, epigraphy and literary sources) to reconstruct the built environment of Rome during the last three decades of the 1st century AD.
Tucci

010.731 Artists and Patrons in XVth century Spain
Focuses on Spanish Visual Culture of the Late XVth century with special interest on Flemish imports and intercultural dialogue.
Pereda

010.730 Sacred Images in Early Modern Spain
This seminar will study religious imagery in baroque Spain. We will examine the work of artists such as Zurbarán and Velázquez, the theory of the representation of the sacred in artistic literature, and its practice in sculpture and painting.
Pereda   2 hours

010.750 Medieval Seeing: The History of Vision and Perspective
This course investigates medieval practices and theories of 'seeing' (broadly defined) in relation to the visual arts. Topics will include the history of perspective, ancient and medieval optics, medieval histories of vision and perception, the allegorization of optics in theological tracts and literature, and the application of the theories in art, preaching, and liturgy.
Kessler/Lakey   2 hours

010.801-802 Special Research and Problems in Art History
This course is for students who wish or need special instruction in areas of art history not included in the currently offered courses.
Staff

010.803-804 Individual Work
Students preparing dissertations will enroll in this course with the permission of their doctoral advisors.
Staff

Cross-Listed

040.621 Proseminar to Classical Archaeology
Shapiro

040.642 (H) Greek Vases in the Johns Hopkins Archaeological Collection
Shapiro

300.602 Theory, Painting, Vision
Fried

300.625 Theories of Representation
Fried

History of Science and Technology

The Department of the History of Science and Technology offers an undergraduate program leading to the degree of Bachelor of Arts with a major in science, medicine and technology, and a graduate program leading to the degree of Doctor of Philosophy.

The Faculty

Robert H. Kargon, Willis K. Shepard Professor of the History of Science: history of physics; science and social change; science in America.

Sharon Kingsland, Professor (Chair): history of biology, especially ecology, genetics and behavioral biology; science in America.

Stuart W. Leslie, Professor: history of technology, history of science-based industry.

Maria Portuondo, Assistant Professor: history of science, science and exploration, science and technology in Latin America, early modern Spanish and Latin American Cosmography and geography.

Lawrence M. Principe, Professor: history of chemistry and alchemy, early modern science, science and religion.

Affiliated Faculty School of Medicine

Nathaniel C. Comfort, Associate Professor: history of biology, especially genetics, molecular biology, and biomedicine; history of recent science, oral-history and interviewing. Current project: History of human and medical genetics in America.

Mary E. Fissell, Professor: European health care and popular medicine, 17th and 18th centuries; early modern gender and the body.

Marta Hanson, Assistant Professor: history of East Asian Medicine; History of Chinese science and medicine; history of epidemics and disease in China.

Graham Mooney, Assistant Professor: history of public health, 19th and 20th centuries; historical epidemiology; historical demography; disease surveillance and risk.

Randall M. Packard, William H. Welch Professor of History of Medicine: history of disease; public health; and medicine, health, and disease in Africa.

Gianna Pomata, Professor: medieval and Renaissance European medicine; natural history; Italy; history of history and of scholarship.

Daniel P. Todes, Professor: history of Russian medicine and science, social relations of scientific thought, history of biomedical sciences.

Part-Time and Joint Appointments

Elizabeth Rodini, Associate Director, Program in Museums and Society.

Undergraduate Program

(See also General Requirements for Departmental Majors, page 48.)

The department offers a variety of courses that deal with the history of the conceptual and technical development of the sciences, as well as the cultural and social impact of science and technology on Western civilization. These courses are open to all undergraduates in the Schools of Arts and Sciences and Engineering. A few of the courses require some background in an appropriate science, but others are accessible to those with no specialized knowledge who want to understand the part science has played in shaping modern culture. Students who have concerns about their technical competence for a given course should consult the professor involved.

Major in History of Science, Medicine and Technology

Offered in cooperation with the Institute of the History of Medicine, this major allows students to combine substantive work in science with study of the social and historical context of modern science, medicine, and technology. The aim of the program is to produce graduates who are scientifically literate and technically competent, and who at the same time understand science and medicine not as static, autonomous enterprises but rather as modes of thought that have developed in specific social contexts.

The major is appropriate for any student planning a career in medicine or other areas of the health care industry. It is also flexible enough to serve as a basis for a variety of careers where an informed knowledge of science and technology and their impact on society is important. Such careers include broad areas of business and industry, journalism, teaching, museum work, and specialized areas of law and public policy.

Requirements for the B.A. Degree

• **Sciences:**

In the sciences, students are required to have one semester of introductory calculus and a total of 30 credits coded (N), of which at least nine credits must be above the 100-level. These may be counted as part of the university's distribu-

tion requirements. Laboratory courses in science count toward this requirement.

- **History of Science, Medicine and Technology:**

  A total of 24 credits of course work in the history of science, medicine and technology are required. These must include at least two survey courses and four additional courses above the 100-level. (Survey courses are those numbered 140.103-109, 301-303, and 321.) Students in their senior year may take graduate courses, with permission. Students who demonstrate excellence in course work are eligible to write an honors thesis in their final year, for four credits. Students must have outstanding recommendations from two department members to be eligible for the thesis. Departmental honors are conferred if overall GPA is 3.5 and the thesis grade is A- or higher.

- **Other Distribution Requirements:**

  Students must take 12 credits outside the department: six credits coded (H) or (S), and six credits coded (H), (S), (E), or (Q). The choice of courses must be approved by the undergraduate advisor.

Minor in the History of Science, Medicine and Technology

The department offers a minor which may be combined with other science, social science, or humanities majors. To complete the requirements for the minor, students must have a total of 21 credits in the history of science, medicine, or technology, including at least one survey course. Students may elect one course outside the department, with the advisor's approval.

Graduate Programs

Ph.D. in the History of Science and Technology

The graduate program in the history of science and technology leads to the Ph.D. degree. Although an M.A. degree is granted, candidates who seek only that degree are not ordinarily admitted. The object of the Ph.D. program is to provide the rigorous training necessary for a scholarly career in teaching and research; consequently, the focus of the student's activity will be the research seminars of the department. Faculty from the Institute of the History of Medicine in the School of Medicine also participate in the program.

Admission

Application deadline is January 15. All supplemental materials (official transcripts, three letters of recommendation, official GRE scores, and, when applicable, official TOFEL scores) should be sent directly to the Graduate Admissions Office at:

Johns Hopkins University
Full-time Graduate Studies in Arts, Sciences and Engineering
Graduate Admissions Office
Shriver Hall 28
3400 North Charles Street
Baltimore, Maryland 21218

For further information on our faculty and programs, please visit our website at: **http://host.jhu. edu.**

Requirements for the Ph.D. Degree

Before candidates begin full-time research on their dissertations, they must prepare themselves adequately in the appropriate fields of knowledge, become skilled in the techniques of historical research, and be able to carry out a sustained piece of historical analysis and writing.

In the first year of the program students are introduced to the methods and techniques of research and complete a yearlong survey course in the history of science or the history of medicine. Students in their second year of study present a research paper to the department. In the second and third years of study, students prepare a field in history and two specialized fields in the history of science, medicine, or technology. The fields are individually arranged and satisfied. The fields entail broad and intensive reading and the passing of a comprehensive examination and/or presentation of a major research paper. Before being admitted for formal candidacy for the degree, the student must also demonstrate a reading knowledge of two foreign languages. The final requirement for the Ph.D. degree is the completion of a dissertation that is an original contribution to historical knowledge and of a standard suitable for publication.

The History of Science and Technology is by its nature interdisciplinary, and students are encouraged to undertake study in related areas such as history, philosophy, and the natural and medical sciences.

Facilities

The Eisenhower Library and the Welch Medical Library contain about 2 million volumes, including the special collections of the Institute of the History of Medicine in Baltimore. These research facilities are supplemented by the rare book holdings at Evergreen House, the Pratt Library, and the Peabody Library.

Other important research collections are available to students. In Philadelphia, collections include the Chemical Heritage Foundation, the American Philosophical Society, and the Academy

of Natural Sciences. The Hagley Museum and Library's collections in the history of American science and technology are within easy distance of campus, as are the incomparable holdings of the Library of Congress, the National Library of Medicine, and other governmental agencies in Washington, D.C.

Financial Aid

The department has several graduate fellowships and teaching assistantships. Students may also be eligible for federal financial support through the National Science Foundation. Information on these and other fellowships can be obtained through the fellowship advisor at the student's college, or from the Fellowship Office of the National Academy of Sciences, National Research Council, Washington, D.C. 20025. In the recent past, doctoral candidates have also won support for their research in the United States and abroad through such sources as the Smithsonian Fellowships, the Fulbright-Hays grants, the Spencer Foundation, and the Deutscher Akademischer Austauschdienst (DAAD) Fellowship.

Undergraduate Courses

140.105 (H,S) History of Medicine: Antiquity through the Scientific Revolution
The first part of this course provides an overview of the medical traditions of six ancient cultures: Egypt, Mesopotamia, China, India, Greece, and Islam. The second part considers the subsequent development of the Greek and Islamic traditions in Europe during the Middle Ages and Renaissance. The last part focuses on the reform and displacement of the classical tradition during the Scientific Revolution of the 16th and 17th centuries. Graduate students register for 150.701, School of Medicine.
Fissell, Pomata   3 credits

140.106 (H,S) History of Medicine: 18th-20th Centuries
This course examines medical and bodily practices in their social and historical settings, in Europe and America, from the 18th century to the present. Graduate students register for 150.701, School of Medicine.
Fissell, Todes   3 credits

140.111 (H,S) Freshman Seminar I
Staff   3 credits

140.115 (H,S,W) Freshman Seminar II
Staff   3 credits

140.143 (H,S) Genetics in Medicine and Society
If you ever become seriously ill, have children, or read the newspaper, you cannot afford to be ignorant of the science of heredity. In this class, we will explore some of the principal concepts of genetics and their social impact, from Gregor Mendel to the Human Genome Project. We will read some original papers as well as review articles and historical analyses. Topics covered will include the rediscovery of Mendel's principles; eugenics; the introduction of genetics into medicine; concepts of genetic disease; genetic and biochemical individuality; genetics, race, and gender; and genetic screening and testing.
Comfort   3 credits

140.215 (H,S) Monuments and Memory
Why do some places, whether manmade or natural, capture and hold our imaginations? Why, and how do we commemorate particular sites? This course will explore the construction or discovery, and the enduring significance, of selected monuments in the West beginning with the Great Pyramid and ending with the World Trade Center.
Leslie   3 credits

140.301 (H,S) History of Science: Antiquity to the Renaissance
The first part of a three-part survey of the history of science. This course deals with the concepts, practice, and the cultural roles of scientific thought from classical antiquity to the time of Copernicus. Topics include the pre-Socratics, the systems of Plato and Aristotle and their continuing influence, Islamic science, Latin medieval scholasticism and the universities, and Renaissance hermeticism/natural magic. Interactions across science, art, technology, and theology are highlighted.
Principe   3 credits

140.302 (H,S) Rise of Modern Science
This is the third part of a three-part survey of the history of science. Course surveys some of the most important developments of modern science from the 18th century to the late 20th century, that is, from the spread of Newtonianism to the rise of molecular biology and big science. The content of scientific theories and the rise of experimental science, the changing relationship between science and technology, and the role of scientific institutions in the scientific enterprise are major themes.
Kingsland   3 credits

140.306 (H,S) Science and Religion
Topics include the Patristic "Athens-Jerusalem" struggle, status of secular and religious thought in medieval society, the Galileo affair, evolution, and the origin of current perspectives in science and religion.
Principe   3 credits

140.313 (H,S) Lives in Science
The lives and scientific work of leading scientists from Galileo to Einstein, also including Newton, Lavoisier, Darwin, Pasteur, and Pavlov.
Todes   3 credits

140.321 (H,S) History of Science: Scientific Revolution
This is the second part of a three-part survey of the history of science. This course concerns developments in

early modern Europe known as the Scientific Revolution. Topics include cosmology, astronomy, mechanics, natural history, and chemistry. Issues involving magic, technology, humanism, and the social content of early modern science will also be studied.

Portuondo, Principe   3 credits

140.323 (H,S) The Natural and the Artificial: The Concept of Man-Made Man

This course will trace the concept of the artificial human being from the medieval-Renaissance Golem legend through Frankenstein, and the contemporary "cyborg," attempting to illustrate changing understanding of human "nature," and the changing relationship of mankind to science and technology. Readings from such authors as Goethe, Mary Shelley, and H. G. Wells will be supplemented by film presentations.

Kargon   3 credits

140.334 (H,S) Science in the Atomic Age

Research seminar on developments in various fields, 1940's–1980's, and the Cold War context of science.

Kingsland   3 credits

140.335 (H,S) Debating Evolution

This seminar examines various controversies in evolutionary biology from Darwin's time to the present. Topics include analysis of Darwin's work and its impact, genetics and evolutionary thought, comparison of approaches to the study of evolution in the field sciences and experimental biology, theories of human evolution, and the rise of Darwinian medicine. Course considers the social impact of science as well as the practice of science and developments of scientific ideas.

Kingsland   3 credits

140.336 (H,S) Health, Risk, and History

Seminar reviews modernist notions of "risk society" and how and why they have come to pervade public health discourse and practice. Broad themes include the idea, computation, and communication of risk.

Mooney   3 credits

140.346 (H,S) History of Chinese Medicine

How did Chinese conceptualize the human body, health and disease over the past 2,000 years? How did these concepts change over time and differ according to region? Why do gender, class, and place matter? Who practiced medicine in China, what did they practice, where, and how do we know what we know about them? These are some of the questions students will engage by discussing the most recent historical, anthropological, and philosophical scholarship on the history of medicine in China and reading a wide range of primary sources on Chinese medicine in English translation.

Hanson   3 credits

140.351-352 (H,S,W) Seminar in the History of Life Sciences

Selected readings from primary and secondary sources, exploring an appropriate theme in the history of the life sciences. Topics to be arranged.

Kingsland   3 credits

140.372 (H,S) Science on Display

History of collecting, exhibiting and interpreting science and technology.

Leslie   3 credits

140.389 (H, S) Exploration and Science.

Hernandez, Cook, Humboldt, Darwin and other voyages of exploration are used to illustrate important themes in the history of science. Course emphasizes research methods used in history.

Portuondo   3 credits

140. 390 (H, S) Science and Technology in Latin America.

Course surveys various national contexts to illustrate major themes in western science and technology in Hispanic America (1492 to the present). Cross-listed with Program in Latin American Studies.

Portuondo   3 credits

140.411-412 (H,S) Senior Research Seminar

For majors pursuing independent research.

Staff   2 credits

140.424 (H,S) Las Vegas: Eighth Wonder of the World

"Learning from Las Vegas" as a distinctly American city, from the building of Hoover Dam to the opening of the Luxor Hotel. Topics will include gambling and organized crime, entertainment, architecture, film and fiction, city planning, and tourism.

Leslie   3 credits

140.432 (H,S) Man and the Natural World

Research seminar explores attitudes toward nature, human-animal relations, urban ecology, from early modern times to the present.

Kingsland   3 credits

140.501-502 Independent Study

Graduate Courses

140.601 Research Methods in the History of Science, Medicine, and Technology

An introductory course at the graduate level to the interpretation of historical evidence; to the social, intellectual, and political analysis of historical data; and to contemporary methods in the history of science, medicine, and technology.

Staff

140.611-612 Seminar in the History of the Physical Sciences

Kargon, Principe

140.613-614 Seminar in the History of Technology

Leslie

140.615-616 Seminar in the Social Relations of Science

Staff

140.617-618 Seminar in the History of the Biological Sciences
Kingsland

140.619-620 Seminar in the History of Medicine
Fissell

140.626 Advanced Seminar in the History of Science, Medicine, and Technology
Staff

140.631-632 Readings in the History of Science
A preliminary directed reading course in the general field of the history of science. Intended primarily for incoming graduate students.
Staff

140.635 Postwar Reconstruction of Science
Examines transformation of science after World War II in comparative perspective.
Kargon, Kingsland

140.641-642 Colloquium
Reports by staff members, students, and invited speakers.
Staff

140.703 Seminar in the Social History of Early Modern Medicine
Fissell

140.705 History of Science: Antiquity to Renaissance
Principe

140.708 Rise of Modern Science
Kingsland

140.710 Scientific Revolution
Portuondo, Principe

140.801-802 Directed Reading and Dissertation
Kargon

140.811-812 Directed Reading and Dissertation
Kingsland

140.831-832 Directed Reading and Dissertation
Leslie

140.835-836 Directed Reading and Dissertation
Principe

140.841-842 Directed Reading and Dissertation
Portuondo

140.853-854 Directed Reading and Dissertation
Packard

140.863-864 Directed Reading and Dissertation
Pomata

140.873-874 Directed Reading and Dissertation
Comfort

140.875-876 Directed Reading and Dissertation
Hanson

140.891-892 Directed Reading and Dissertation
Todes

140.893-894 Directed Reading and Dissertation
Fissell

140.895-896 Directed Reading and Dissertation
Mooney

The Humanities Center

The Humanities Center reflects a characteristic quality of Johns Hopkins University as an intellectual community. The coordinated study of Western civilization through its literature, art, philosophy, and history has been one of the oldest continuing concerns at Hopkins. Because it has remained by design and tradition the smallest of the major American universities and because of the interdisciplinary interests of some of its most distinguished faculty, Hopkins has fostered to a remarkable degree the free exchange between scholars and students across departmental boundaries. In addition to its programmatic concern with comparative literature, intellectual history, and feminist theory, the Humanities Center does much to coordinate such exchange, which it encourages among students and scholars at all levels of their careers.

Supplementing its regular course offerings, the Humanities Center from time to time sponsors conferences, colloquia, and short-term seminars on topics of special interest to its graduate students and to the intellectual community at large. The center is also responsible for publishing annually the Comparative Literature issue of *MLN*; graduate students may apply to work as editorial assistants in its production and are invited to contribute to its reviews of current publications.

A recent development has been the appointment of several distinguished scholars as associates of the Humanities Center for terms of variable length. Each associate visits the campus once a year to teach an intensive seminar open to graduate students (and in certain cases to advanced undergraduates) in the Humanities Center as well as in other departments. The associates also meet informally with interested students and faculty and in general play an active role in the intellectual life of the university.

The Faculty

Secondary appointments in parentheses.

Victoria Cass, Visiting Associate Professor: Chinese vernacular literatures; late Imperial urban culture; women in Chinese religion and myth.

Hent de Vries, Professor, Russ Family Chair in the Humanities (Director) (Philosophy): modern European thought, history and critique of metaphysics, philosophies of religion, political theologies, concepts of violence, literature and temporality.

Michael Fried, Professor, J. R. Herbert Boone Chair in the Humanities (History of Art): modern art and literature, critical theory, modern poetry.

Neil Hertz, Professor Emeritus.

Ruth Leys, Professor, Henry Wiesenfeld Chair in the Humanities (History): history and theory of psychoanalysis, history of psychiatry and psychology, history of the neurosciences; affect theory; history of the emotions; 19th- and 20th-century intellectual history, feminist theory.

Leonardo Lisi, Assistant Professor: Kierkegaard and German idealism, European modernism, 20th-century Latin-American literatures.

Richard A. Macksey, Professor Emeritus.

Paola Marrati, Professor (Philosophy): modern and contemporary French thought, phenomenology, philosophies of life (Bergson, Dilthey, Canguilhem, Deleuze), philosophy and cinema, aesthetics.

Anne Eakin Moss, Visiting Assistant Professor: 19th- and 20th-century Russian literature, Soviet cinema and film theory, concepts of friendship and community.

Yi-Ping Ong, Assistant Professor: 19th- and 20th-century literature and philosophy, the novel, modernism, existentialism, ethics, and justice in contemporary Anglophone literature.

Elizabeth Patton, Visiting Assistant Professor: Renaissance and Reformation literature with special emphasis on women writers.

Sharlyn Rhee, Visiting Assistant Professor.

Neta Stahl, Assistant Professor: comparative and modern Hebrew literature, religion and literature, narrative theory, genre theory.

Nancy S. Struever, Professor Emerita.

Joint Appointments

Primary appointments in parentheses.

Christopher Celenza, Professor (German and Romance Languages and Literatures): Italian literature.

Veena Das, Krieger-Eisenhower Professor (Anthropology): history and myth, philosophy and anthropology, violence, social suffering, medical anthropology; South Asia, Europe.

Frances Ferguson, Professor, Mary Elizabeth Garrett Chair in Arts and Sciences (English): literature, aesthetic theory, and moral/legal philosophy in the 18th and early 19th century.

Eckart Förster, Professor (Philosophy): metaphysics, history of philosophy, Kant and German idealism.

Yitzhak Melamed, Associate Professor (Philosophy):
early modern philosophy, German idealism,
metaphysics.

Jacques Neefs, James M. Beall Professor: French
literature, history and theory of novel, modernity
in Art and literature, literature and knowledge
(19th- and 20th-century), genetic criticism.

Stephen G. Nichols, Professor Emeritus.

Dimitrios Yatromanolakis, Associate Professor
(Classics): Ancient Greek literature, thought,
and sociocultural history; Platonic philosophy;
historical and comparative anthropology; ritual
theory; reception studies; comparative poetics.

Undergraduate Programs

The Humanities Center's activities for undergrad-
uates address two different needs. For students
interested in a general liberal arts preparation
or in one of the university's preprofessional pro-
grams, the Center provides a broad introduction
to the documents and thought of Western culture.
For freshmen the Center offers the Great Books
at Hopkins course, as well as a variable array of
courses taught by the Center's faculty. For stu-
dents interested in preparing for graduate school,
the Center also offers a fundamental preparation
geared to the individual's specific talents that can
be the basis for more specialized humanistic study
at the graduate level. Qualified juniors and seniors,
as well as sophomores planning to study abroad in
their junior year, are provided the opportunity to
pursue an independent and often interdisciplin-
ary research project through the Honors Program.
In either case, the Center stresses skill in critical
reading and writing, sophistication in the use of
research tools, and opportunities for supervised
independent study. The coherence of each indi-
vidual's program depends upon careful consulta-
tion with the faculty advisor.

The Humanities Center does not offer a depart-
mental major. Students who wish to concentrate on
the courses that it offers should consider the area
major in Humanistic Studies or a major in another
humanities department.

Honors Program in the Humanities

The Humanities Center Honors Program was ini-
tiated in 1976, the centennial of the founding of
Johns Hopkins University. The program offers all
qualified undergraduates the possibility of pursu-
ing an independent and often interdisciplinary
research project in the junior and senior year.
Students can propose a topic in any humanistic
discipline, including intellectual or cultural his-
tory, English and comparative literatures, women

and gender studies, minority literatures and cul-
ture, film studies, anthropology, philosophy, and
others. Past topics have also examined points of
intersection between the arts and the sciences, so
that the Honors Program in the Humanities also
gives majors outside the humanities a chance to
broaden and combine their studies.

Requirements for the Honors Program

To be eligible, a student's performance in courses
taken in the humanities, and particularly in the
chosen field/s of study, should be distinctly above
average, and the proposed topic should show
coherence, focus, and seriousness of purpose. Each
project must be sponsored by two faculty members,
one of whom should be a Humanities Center fac-
ulty member or affiliate. In appropriate cases one
of these sponsors may be external to the university.

Application process

This is a two-year program, with applications
accepted in the spring of sophomore year. Inter-
ested sophomores, and second semester freshman
who plan to study abroad in the junior year, should
supply the following:

(1) Application form (available from the Humani-
ties Center Office, 214 Gilman.)

(2) Statement of purpose describing the proposed
thesis in detail, with initial bibliography.

(3) Letter of recommendation from at least one
faculty member who will supervise the thesis.
By the end of the first semester, juniors will
have identified two faculty mentors, at least
one of whom should be a Humanities Center
faculty member or affiliate.

(4) Transcript of undergraduate course work.

Required Course Work:

Junior year: (1) independent study course with
one or both sponsors; (2) two courses chosen from
relevant offerings in the Humanities Center cur-
riculum; and (3) a yearlong Honors Seminar for
all students in the program, in which the general
progress of the students' writing and research will
be discussed, and senior students will present work-
in-progress reports.

Senior year: Independent study courses as needed
with one or both advisors; two courses, as above,
with Humanities Center faculty and affiliates; con-
tinued participation in the two-semester Honors
Seminar with periodic work-in-progress reports;
presentation of the completed honors thesis in
the context of the Honors Seminar. Seniors who
complete the program successfully are awarded

honors at the commencement ceremony and on their transcripts.

All questions should be directed to Professor Elizabeth Patton, Humanities Center.

Graduate Programs

The Center sponsors programs of study leading to the Ph.D. degree in two general fields: comparative literature and intellectual history. These programs are designed with the cooperation of the faculty in the adjacent literary and historical departments. Only a few highly qualified applicants can be admitted; the Center gives priority to candidates whose proposed course of study is congruent with faculty interests and strengths.

Requirements for the Ph.D. Degree

Each student works with an ad hoc committee of three faculty members who help to design a coherent, individual program of studies. During the first two years the candidate works closely with each of his or her advisors. The course of studies, seminars, and tutorials leads to three area examinations administered by the advisory committee. During the second year, qualified students are invited to teach under faculty supervision, and on occasion advanced students have been allowed to offer undergraduate seminars of their own design.

Program in Comparative Literature

Normally, candidates for the Ph.D. in comparative literature should be competent in three national literatures and have a general familiarity with critical theory. Students in this program are encouraged to spend at least one year of study abroad, usually as members of groups working in Paris, Florence, Hamburg, Geneva, or Madrid in programs sponsored by the modern language departments and the Center. The University maintains the Villa Spelman in Florence as a study center, and the departments of German and Romance Languages and Literatures have regular programs of faculty exchange.

Students in the comparative literature program can apply for a joint major with the Department of German and Romance Languages and Literatures. They become supervised teaching assistants in that department and receive a master's degree in German upon completion of the field examinations, before the doctoral degree in comparative literature. On a more ad hoc basis, similar arrangements for well-qualified candidates can generally be made with the departments of Classics, English, and German and Romance Languages and Literatures.

Program in Intellectual History

The Center's doctoral program also allows flexibility in the construction of a course of study in intellectual history involving comparatist and interdisciplinary approaches. Candidates should also note related special programs at Hopkins, such as the program in political theory and the research facilities of the Institute of the History of Medicine.

Advisors

Upon their arrival, entering students should select, in consultation with the Director, a member of the Center's faculty to serve as their academic advisor, pro tem. As time goes on and their interests further define themselves, they may wish to change advisors and may very well wind up working most closely with faculty in another department; should this become the case, they should nevertheless meet regularly—that is, each semester—to discuss their progress with whomever in the Center is serving as Director of Graduate Studies.

Course Work

During their first two years, students are expected to take two seminars for credit each semester, in addition to whatever language courses they may enroll in and whatever courses they choose to audit. They should select seminars—which need not be restricted to Humanities Center offerings—in consultation with their advisors. Students arriving after having taken graduate courses elsewhere should discuss with the director of graduate studies the possibility of having that work counted toward satisfying the Center's course requirements.

Third-Year Review

At some point during their third year of residence—after completing all outstanding seminar papers, and preferably by mid-year—students will have their work reviewed by a faculty committee composed of three teachers from among the Humanities Center faculty and from among the faculty from the other departments with whom the student plans to conduct field exams. The purpose of the review is to allow the faculty to assess the student's progress, to clarify her/his status as regards remaining course work, and to define future fields. In preparation for this review, the student will circulate, in advance of the meeting, materials that the student judges to be work that will best serve the purpose of the review.

Field Examinations

Students are expected, in their third and fourth years, to complete three field exams. The purpose of requirement is two-fold: the exams may serve

to help a student refine her/his thinking about a dissertation topic, or they may be a means of extending and deepening a student's knowledge of an area of studies in which s/he proposes to teach and conduct research. The examinations themselves may take a variety of forms: one could work further on a project begun in a seminar and produce a longer paper that would become part of a dissertation; one could read one's way into and across a particular field, writing a series of short papers on one's reading, or else sitting for a written or oral examination on the material studied; one could design and teach an undergraduate course in one's area of interest; one could complete the requirements for a M. A. degree in another department, as a way of strengthening one's claim to teach in that field. These are choices to be discussed with one's committee at the third-year review.

Undergraduate Teaching

During one's years at the Center one will have a number of opportunities to develop one's skills and confidence as a teacher. In the second year and thereafter, students will ordinarily serve as assistants in courses taught by the Center's faculty or, if appropriate, in courses in other departments: in the past, our students have taught in the French and German language programs, in English composition and literature courses, as well as assisting in history, philosophy and political science courses. More experienced students are encouraged to teach courses of their own invention—as a way of completing a field exam, or in competition for one of the Dean's Teaching Fellowships, or simply to add to the Center's array of offerings.

Dissertation Review

A second formal review of a student's work will take place after the completion of field exams, either in the fourth or in the fall semester of a student's fifth year. The aim of this review is to bring the student together with the faculty with whom s/he will write a dissertation. This review will not take place until the student believes that s/he has a substantial piece of work associated with the dissertation, e.g., the draft of a chapter. This work will be circulated before the review, along with a prospectus of 10-40 pages, to the faculty the student wishes to have as dissertation advisors. (If all of these advisors are from outside the Humanities Center, one of the Center's faculty, selected by the student, will also sit in on the review.) This discussion is not intended to replace the Graduate Board Oral, which will take place after the dissertation has been completed, but will serve to mark the transition from work on the field exams to the preparation and writing of a thesis.

Departmental Presentations

Late in a student's work on a dissertation—preferably in the fifth year or the beginning of the sixth—s/he will be asked to give a talk on material from her/his dissertation to the assembled students and faculty of the Center and invited guests. The aim of this requirement is to give students experience in the more formal presentation of their work, to make possible a wider range of response to that work than a dissertation committee can provide, and to allow all students of the Center—whose research interests vary widely—to become better acquainted with each other's projects.

Financial Aid

Tuition grants, stipends, and teaching fellowships are available to doctoral candidates. Qualified students are eligible for funded internship training as editorial assistants to scholarly publications under the supervision of Center faculty.

Undergraduate Courses

Introductory Courses

300.133 (H,W) Women of Epic Frame

This survey of Western epic and drama examines the role of women in society via Homer's Penelope, Virgil's Dido, Dante's Beatrice (and Petrarch's Laura), Milton's Eve, and the Cleopatra dear to Renaissance playwrights.
Patton   3 credits

300.207 (H) A Mix of Voices: Chinese Literatures from Late Imperial through Modern

This course examines the arts and culture of China from 1368–2000, with major focus on writers. We will begin with artists of the Ming (1368–1644) and Qing (1644–1911), focusing first on canonical voices: court poets, authors of classical fiction, literati essayists, calligraphers and painters. Outside of the court urban artists observed a dramatically changing world around them. Fiction, drama, memoir and mass-produced arts explored new social alignments and freedoms. The 20th-century brought revolution and party governance, along with arts born of mass media: periodicals, film, and wood block print. Finally, post-Mao avant-garde artists both retrieved traditional aesthetics and explored new venues and visions. This look at the literature of China will require both close reading of texts as well as an interdisciplinary examination of the cultural factors that shape literatures.
Cass   3 credits

300.229 (H) Realism and Anti-Realism in Post-Holocaust Hebrew Literature
This course seeks to trace the narrative dynamics and literary means of post-Holocaust Hebrew literature. The course focuses on works that break with the conventions of realism, and studies the specific forms and means by which each work does so. In the center of the discussion will stand questions such as: what are the constraints of the literary discourse on the Holocaust, what is the role of anti-realist depiction of the Holocaust, and in what ways does the fantastic threaten the collective memory?
Stahl   3 credits

Advanced Courses and Seminars

Courses at the 200 level are open to graduate students by permission of the instructor.

300.302 (H) Philosophy as a Way of Life: From Antiquity to Wittgenstein and Foucault
This course will trace the historical tradition of spiritual exercises and its modern transformations as analyzed by Pierre Hadot. Readings include Marcus Aurelius, Augustine, Ignatius of Loyola, Wittgenstein, and Foucault.
de Vries   3 credits

300.303 (H,W) Early Modern Women Writers: Poetry of the European Renaissance
This seminar begins with women orators of the Italian Quattrocento and then explores the poetry of European salons and social circles: Gaspara Stampa, Vittoria Colonna, Louise Lab, Les Dames des Roches, Margaret More Roper, Elizabeth I, Katherine Parr, Mary Sidney, and Elizabeth Cary.
Patton   3 credits

300.304 (H) Philosophy and Cinema
The aim of this course, devoted to the work of Gilles Deleuze and Stanley Cavell, is to analyze how cinema has displaced some traditional problems in aesthetics and ontology.
Marrati   3 credits

300.306 (H,W) Early Modern Women Writers II: The 17th Century
This seminar investigates the poetry, drama, and romance of women writers in Europe and South America: Mary Wroth, Isabella Whitney, Margaret Tyler, Aemelia Lanyer, Elizabeth Cary, Katherine Philips, Margaret Cavendish, Theresa of Avila, Maria de Medici, and Sor Juana Ins de la Cruz.
Patton   3 credits

300.307 (H) Dostoevsky and Critical Theory
Examines novels by Dostoevsky, including *The Idiot and The Brothers Karamazov*, and works of literary theory and philosophy which grapple with his poetics and thought (Bakhtin, Girard, Shestov, Rozanov, Nietzsche, Freud, Levinas).
Moss   3 credits

300.308 (H) The Israeli Novel
This course studies the Israeli novel through close reading of the works of major Israeli writers such as, Ya'akov Shabtai, Amos Oz, A.B Yeshoshua, Amalia Kahana-Carmon, Yehoshua Knaz, David Grossman, Orly Castel-Bloom, Yoel Hoffmann, and Etgar Keret. We will focus on questions of style, genres, and thematic choices. Among the topics to be discussed are Jewish history and tradition, social and political critiques, and minority representations. Classes conducted in English, but students with knowledge of Hebrew are encouraged to read texts in the original.
Stahl   3 credits

300.313 (H) Contemporary Israeli Cinema
This course examines Israeli cinema of the last two decades. Among the films to be discussed are Oscar nominees *Adjami and Waltz with Bashir, Late Marriage, A Matter of Size, Year Zero, Lemon Tree, Sweet Mud,* and *Lebanon.* We will study the different influences and the innovative use of style and genres in these films, as well as the new themes and agendas that they offer.
Stahl   3 credits

300.315 The Sense of Loss, 1880–1930
A comparative study of the aesthetics and representation of loss (personal, political, historical, etc.) in a number of modernist texts originally written in different languages (Danish, Swedish, Spanish, English, and German) and literary forms (drama, the essay, novels, and poetry). The class will focus on the twofold sense of "sense" (both as feeling and as meaning) in order to explore the way these texts seek to come to terms with and capture the nature of loss.
Lisi   3 credits

300.318 (H,W) Justice, Truth, and Reconciliation: Responses to Genocide and Mass Terror
A research seminar on the limits of justice and the possibilities of reconciliation in the aftermath of 20th-century genocides and mass atrocities.
Leys   3 credits

300.327 (H) Organism and Machine
This course explores the differences and overlapping between forms of organic life and technological artifacts. Readings include Canguilhem, Diderot, Bergson, Nancy, Haraway, and others.
Marrati   3 credits

300.329 (H) The Moses Complex
An examination of the role assigned to the story of Moses in the history of monotheism as viewed through the lens of Freud's psychoanalysis, recent work in Egyptology, trauma theory, and political thought.
Leys   3 credits

300.330 (H) Trauma in Theory, Film, and Fiction
What is trauma? How has it been defined by psychoanalysts and psychiatrists? How has it been presented in works of fiction and film? How has it been theorized by cultural critics? And how has trauma been treated after 9/11? Works to be discussed include novels, films, and theoretical texts by W.B. Sebald, Claude Lanzmann (his film Shoah), Don DeLillo, Art Spiegelman, Caruth, and others.
Leys   3 credits

300.331 (H) Modern Tragedy
Over the last two hundred years, tragedy has repeatedly been declared dead on the grounds that the changed social, aesthetic, and philosophical conditions of modernity do not allow for the genre in a strict sense. In this course we read a number of the most important dramatists of this period and examine the extent to which the concept and experience of the tragic have changed in our time. Authors to be read will include Schiller, Büchner, Ibsen, Strindberg, Maeterlinck, Lorca, and Beckett.
Lisi   3 credits

300.335 (H,W) Proust and Philosophy
In addition to the extensive reading of Marcel Proust's *In Search of Lost Time*, with special focus on the novel's use of philosophical tropes, this course will investigate its philosophical reception and significance. Readings will include Bergson, Benjamin, Beckett, Adorno, Jauss, Deleuze, Levinas, Girard, de Man, Ricoeur, Pippin.
de Vries   3 credits

300.336 (H) Classics of Art Criticism I: Diderot and Baudelaire
In this seminar we shall read and discuss the art criticism of Denis Diderot (1713–84) and Charles Baudelaire (1821–67) in the context of the art and thought of their time. All texts to be read in translation.
Fried   3 credits

300.337 (H) Thinking Films
This course examines how films deal with and renew philosophical ways of thinking about reality, perception, ethical choices, identity, personal and historical memory.
Marrati   3 credits

300.339 (H) Asian American Literature and Culture
Topics include conceptions of home, law, loyalty, and belonging as they come up within Asian American texts. Works by Chang-rae Lee, Mei-mei Berssenbrugge, Maxine Hong Kingston, John Okada, Bich Minh Nguyen, and others. The course will also explore theoretical and historical questions about how a literary canon is formed, as well as the idea of a post-ethnic America.
Rhee   3 credits

AS.300.341 (H) East Asian Cinema
A study of select films across East Asia in their aesthetic and institutional contexts. Highlighted directors will include Yasujiro Ozu and Akira Kurosawa, Chen Kaige, Wong Kar-wai, Im Kwon-Taek, and Gen Sekiguchi, Bong Joon-ho.
Rhee   3 credits

300.342 (H,W) The Bible and Philosophy
This course will examine several attempts by ancient, modern, and contemporary thinkers to come to terms with the biblical concept of revelation and prophecy, law and election, apocalyptic and eschatology. We will put special emphasis on the first articulation of the idea of Christian universalism, faith and justification, time and eternity. Readings will include the entire corpus of St. Paul's authentic letters, in addition to the major scriptural

passages on which he draws, but also selections from Philo of Alexandria, St. Augustine, Spinoza, Luther, Nietzsche, Jakob Taubes, Alain Badiou, Giorgio Agamben, and Jean-Luc Nancy.
de Vries   3 credits

300.343 (H) Bergson and the Problem of Novelty in Philosophy
What is the new? This course examines how Bergson has transformed philosophy, asking the question of the production of the new. It will focus mainly on his understanding of the evolution of life forms in biology and its consequences for anthropology, politics, and psychology. Readings will include Henri Bergson, *Creative Evolution*, *The Two Sources of Morality and Religion*, *The Creative Mind*, and Stephen Jay Gould, *The Structure of Evolutionary Theory*.
Marrati   3 credits

300.345 (H) Between the Sacred and the Secular in Modern Hebrew Literature
The opposition between religious and secular tendencies in modern Hebrew literature will stand at the center of this course. We will study the political, ideological, social, and cultural aspects of this tension. The thematic nature of the course will allow us to study the history of modern Hebrew literature from a unique angle, and at the same time to focus on specific themes such as Messianism and Zionism, intertextual choices, secularization of the Bible, and the attempt to give birth to a new Jewish self.
Stahl   3 credits

300.346 (H) Forms of Moral Community: The Contemporary World Novel
Literary and philosophical imaginations of moral community in the post-WWII period (1950–2001). Texts include Coetzee, *Disgrace*; McEwan, *Atonement*; Achebe, *Things Fall Apart*; Ishiguro, *An Artist of the Floating World*; Roy, *The God of Small Things*; Lessing, *The Grass is Singing*; Mistry, *A Fine Balance*; Morrison, *Beloved*; and essays by Levi, Strawson, Adorno, Murdoch, Beauvoir, and Barthes on the deep uncertainty over moral community after the crisis of World War II. Close attention to novelistic style and narrative will inform our study of the philosophical questions that animate these works. What does it means to acknowledge another person's humanity? Who are the members of a moral community? Why do we hold one another responsible for our actions? How do fundamental moral emotions such as contempt, humiliation, compassion, gratitude, forgiveness, and regret reveal the limits of a moral community?
Ong   3 credits

300.347 (H,S,W) Hysteria and Feminism
The aim of this seminar is to analyze the history of the hysteria diagnosis as a problem for feminism.
Leys   3 credits

300.350 (H) Moral Perfectionism
Readings include Cavell, Emerson, Mill, Nietzsche, and others.
Marrati   3 credits

300.351 (H,W) Trauma and Feminism: The Case of Multiple Personality

This seminar addresses the following questions: Why has multiple personality become such a popular diagnosis in America? Why are the majority of cases female? What is the role of violence, especially childhood sexual abuse, in the production of multiple personality? What concepts of the female subject, trauma, and memory are at stake in the concept of multiplicity?

Leys   3 credits

300.354 (H) Philosophy, Films, and TV Series

This course explores how films and TV series can offer new perspectives on philosophical problems and how, in turn, philosophy can help understanding their power of conviction for contemporary culture.

Marrati   3 credits

300.355 (H) Classics of Art Criticism II: Fry and Greenberg

In this seminar we shall read and discuss the art criticism of Roger Fry (1866–1934) and Clement Greenberg (1908–1995) in the context of the art and thought of their time.

Fried   3 credits

300.357 (H) What Counts as Human?

This course analyzes different concepts of the human and its others. Readings include Plato, Descartes, Kant, Levinas, Arendt, Butler.

Marrati   3 credits

300.359 (H, S) The Freud Wars

Who was Freud and why are scientists, psychiatrists, and others still warring over his ideas? An introduction to some of the basic issues and controversies in psychoanalysis.

Leys   3 credits

300.363 (H,W) Reading Judith Shakespeare: Women Playwrights of Early Modern England

Virginia Woolf's account of the thwarted career of Shakespeare's hypothetical sister, Judith, frames our reading of women playwrights, poets, and diarists of 16th- and early 17th-century England.

Patton   3 credits

300.364 (H, S) What is Intellectual History?

Intellectual history today is a field with no hard and fast identity. This can be a problem, but it can also offer unexpected opportunities. In this seminar we will read various books and essays that exemplify this state of affairs and perhaps point to ways beyond it. Texts include works by Foucault, Hayden White, Derrida, and others.

Leys   3 credits

300.365 (H,W) Post-Soviet Cinema and the Poetics of Sovereignty

After the fall of the Soviet Union, Russian filmmakers grappled with the legacy of Soviet power and the nature of the new democracy. This course examines the concept of sovereignty in philosophy and art through the lens of popular films and art cinema from this context.

Eakin Moss   3 credits

300.368 (H) Do Miracles (Still Happen)?

The seminar will seek to establish a conversation between theologies of the miracle and philosophies of causation and the event. Readings will include St. Paul, St. Augustine, St. Thomas Aquinas, Spinoza, Hume, Feuerbach, Rosenzweig, Wittgenstein, Benjamin, Santner, and others.

de Vries   3 credits

300.370 (H,S) Trauma and Testimony

An analysis of the links between trauma and testimony in psychoanalysis, psychiatry, and the history of the Holocaust.

Leys   3 credits

300.371 (H) The Modernist Novel: James, Woolf, and Joyce

The purpose of this course is to survey works by three of the greatest, most relentless innovators of the 20th-century—Henry James, Virginia Woolf, and James Joyce—who explored and exploded narrative techniques for depicting what Woolf called the "luminous halo" of life. Selected novels include The Portrait of a Lady, The Wings of a Dove, Jacob's Room, Mrs. Dalloway, To the Lighthouse, A Portrait of the Artist as a Young Man, and Ulysses.

Ong   3 credits

300.372 (H,S) Holocaust Testimonies

A seminar on topics and issues associated with Holocaust testimony.

Leys   3 credits

300.373 (H) Philosophies of Ecology

This course analyzes classical and modern philosophical conceptions of nature and environment in the context of present debates about ecology.

Marrati   3 credits

300.375 (H) The God of the Hebrew Writer

Who is the God of the Hebrew poet and what kind of being is he? This course will examine the ways in which Hebrew writers conceived God. Against the background of medieval Hebrew poetry we will read modern Hebrew poetry, prose, and drama and analyze the changes in the notion of God and its depictions from the Middle Ages through Jewish Enlightenment to modernity. We will study the role of the poet as a mediator between God and his people and his or her understanding of God in the aftermath of World War I and the Holocaust.

Stahl   3 credits

300.377 (H) Love Lyric from Petrarch to the Elizabethans: Were women writing the same things to men that men were writing to women?

Beginning with Petrarch's Canzoniere and its classical antecedents, we will explore the vernacular lyric tradition of the European renaissance and reformation, with particular attention to poetic pairings or intratextual dialogues between male and female authors. Selected texts include the Italian Petrarchans Vittoria Colonna and Michelangelo, Veronica Gambara, and Gaspara Stampa; the French neoplatonists 'Louise Labe' and Maurice Scéve, Pernette du Guillet, and Les Dames des Roches; and the English Elizabethans, including Shakespeare and his "dark lady" or "fair youth," Mary Herbert Wroth and

her uncle Sir Philip Sidney, and Katherine Philips and John Donne. Our readings will be informed by the religious, political, and cultural concerns of this turbulent period in European history.
Patton   3 credits

300.378 (H) What Can a Body Do?
This course will explore different conceptions of the body and its biological, political, cultural, and ethical boundaries. Readings will include Spinoza, Deleuze, Sartre, Levinas, Butler, Nancy.
Marrati   3 credits

300.383 (H) What Makes Us Desire?
This course will analyze different philosophical and literary conceptions of desire. Readings will include Plato, J. S. Mill, Freud, Proust, Klein, Nietzsche, Cavell, Deleuze, and others.
Marrati   3 credits

300.389 (H) Dziga Vertov's Kinoglaz
This seminar examines the films and writings of the revolutionary filmmaker Dziga Vertov in the context of the Soviet avant-garde and contemporary film theory, as well as their influence on the French New Wave and beyond.
Eakin Moss   3 credits

300.391 (H) Home and Exile
This course examines the concept of home and the condition of exile primarily through the case of 20th-century Russian literature, film, art, and essay, with comparative texts from other cultures. Attention will be paid to the aesthetic, philosophical, and historical implications of home and exile as well as consideration of notions of diaspora and transnational literature and film. All texts will be read in English translation.
Eakin Moss   3 credits

300.400 (H) Philosophy of Tragedy
Since the late 18th-century, philosophers have repeatedly been drawn to investigations of tragedy and the tragic. In this course we study some of the most important thinkers in this tradition, and examine the different implications (philosophical, historical, political, existential, aesthetic, etc.) that these concepts carry in their works. Authors to be read include Schiller, Hegel, Kierkegaard, Nietzsche, Unamuno, Benjamin, and Cavell.
Lisi   3 credits

300.401 Either/Or: Philosophy and Literature in Kierkegaard
A close study of one of Kierkegaard's central works, Either/Or, with particular attention paid to the relation between philosophical analysis and literary modes of representation in the text.
Lisi   3 credits

300.403 (H) Honors Seminar
The Honors Program in the Humanities offers qualified undergraduates the possibility of pursuing an independent research project in their junior and senior years in any humanistic discipline or combination of disciplines:

intellectual history, comparative literature, philosophy, critical theory, psychoanalysis, religion, film, etc., as well as points of intersection between the arts and the sciences. After one year qualified students may apply for admission to the concurrent BA/MA degree program. Sophomores who plan to study abroad in their junior year should also consider attending this seminar.
Lisi   3 credits

300.411 (H) Animal Minds
An examination of some of the scientific and philosophical literature on the nature of animal minds, particularly that of the primates, and the way(s) in which they differ from the human mind. The most important of these apparent differences are the use of language, the exercise of concepts, and instrumental reasoning, including the use of instruments.
Leys, Williams   3 credits

300.413 (H) Israeli poetry
This course examines the works of major Israeli poets such as Yehuda Amichai, Nathan Zach, David Avidan, Dalia Rabikovitch, Yona Wollach, Maya Bejerano, and Yitzhak Laor. These works will be read against the background of the poetry of previous literary generations of writers such as H.N Bialik, Avraham Shlonsky, Natan Alterman and Lea Goldberg in an attempt to uncover changes in style, themes, and aesthetic. Through close reading of the poems, the course traces the unique style and aesthetic of each poet, and aims at presenting a wide picture of contemporary Hebrew poetry. Class will be conducted in English and texts will be read in both English translation and the Hebrew original. Open for both Hebrew and non-Hebrew speakers.
Stahl   3 credits

300.501 Independent Study in Humanities (Tutorial)
Staff

300.503-504 Independent Study: Humanistic Studies Honors Program, Juniors
Open only to students in the Humanistic Studies Honors Program.
Ong/Staff

300.505-506 Independent Study: Humanistic Studies Honors Program, Seniors
Open only to students in the Humanistic Studies Honors Program.
Ong/Staff

300.507 (H) Honors Seminar
Workshop on honors projects in progress and their relation to methods in humanistic studies. Open only to those admitted to the Honors Program in Humanistic Studies.
Ong/Staff   2 credits

300.508 (H,W) Honors Seminar: Methods and Motives
Open only to students admitted to the Honors Program in Humanistic Studies.
Staff   2 credits

Graduate Courses

300.600 Instances: On Living Here and Now
The seminar is devoted to different historical examples and contemporary formalizations of the privileged, fulfilled, yet fleeting moment (the instant, presence, kairos, Augenblick, durée, Jetztzeit). Readings will include Bergson, Bachelard, Heidegger, Badiou, and Hadot.
de Vries

300.601 Philosophy of Tragedy
Since the late 18th-century, philosophers have repeatedly been drawn to investigations of tragedy and the tragic. In this course we study some of the most important thinkers in this tradition, and examine the different implications (philosophical, historical, political, existential, aesthetic, etc.) that these concepts carry in their works. Authors to be read include Schiller, Hegel, Kierkegaard, Nietzsche, Unamuno, Benjamin, and Cavell.
Lisi

300.602 Theory, Painting, Vision
Readings in theoretically interesting texts on painting, photography, vision, the visual arts. Authors studied include Merleau-Ponty, Barthes, Derrida, Cavell, Benjamin, Wittgenstein, and Marin.
Fried

300.607 Topics in the History and Theory of Psychoanalysis
A consideration of historical and theoretical issues in the development of psychoanalysis. The focus of the seminar will vary from year to year. The central emphasis is always likely to be Freud, but readings will also include such gurus as Ferenczi, Lacan, Derrida, Kristeva, Klein, Abraham, Torok, Zizek, and others.
Leys

300.608 Philosophy and the Event
What constitutes or characterizes a genuine event, whether in history and politics or in individual lives and loves? This seminar explores several answers to this philosophical question, starting out from the major works of two contemporary thinkers, Alain Badiou and Jean-Luc Marion, whose central concerns in Being and Event and Being Given and elsewhere—namely, the so-called laicization of grace and the phenomenology of givenness—seem at once close and diametrically opposed to each other. Attention will further be paid to concrete historical and literary examples as well as to other conceptualizations of the event that would seem to either substantiate or contradict their respective claims. Readings will also include writings by Donald Davidson, Stanley Cavell, Sari Nusseibeh, Hannah Arendt, Isaiah Berlin, Barack Obama, and others.
de Vries

300.611 The Good Life
What is a good life? Philosophical and literary texts on the nature of virtue, autonomy, beauty, friendship, and integrity as necessary achievements for a good life. Plato, Aristotle, Montaigne, Shakespeare, Rousseau, Kant, Emerson, Pater, Murdoch, Tolstoy, Chekhov, James, Woolf, Naipaul, Coetzee, Ishiguro, Kundera.
Ong

300.612 Concepts of Life
The aim of this seminar is to analyze the renewed primacy of the concept of life in contemporary French philosophy and to retrace some of its different genealogies.
Marrati

300.614 The Levinas Effect
This seminar will address some of the major writings and concepts of Levinas as well as his critical role as a touchstone and a dividing line in the formation and intellectual demarcation of a wide variety of 20th-century and contemporary philosophical projects (phenomenology, deconstruction, pragmatism, post-analytic philosophy, feminism, political theory, etc.). In addition to Levinas' central texts, we will read and discuss different attempts to come to terms with his oeuvre. Readings will include Bataille, Blanchot, Derrida, Lyotard, Ricoeur, Irigary, Henry, Marion, Badiou, Nancy, Putman, Cavell, Habermas, Honneth, Benhabib, Butler.
de Vries

300.615 Classics of Literary Criticism
The course will include key texts by Erich Auerbach, Northrop Frye, Roland Barthes, Stanley Cavell, Eve Sedgwick, Friedrich Kittler, and Empson.
Fried, Lisi

300.617 Violence and Representation
An examination of problems of trauma, repetition, witnessing, and memory in psychoanalysis and the history of the Holocaust. Texts by Freud, Derrida, Borch-Jacobsen, Blanchot, Felman, Caruth, Yerushalmi, LaCapra, Friedlander, Vidal-Naquet, and others.
Leys

300.619 Trauma Theory Now
A discussion of current debates about trauma, testimony, memory, and representation after Auschwitz. Texts by Freud, Derrida, Felman, Caruth, LaCapra, Zizek, and others. Films by Resnais (*Hiroshima mon amour*) and Lanzmann (*Shoah*).
Leys

300.621 Heidegger's Being and Time
This seminar consists of an integral reading of Martin Heidegger's 1927 magnum opus Being and Time (Sein und Zeit) in light of its historical and philosophical context as well as its contemporary reception in both the phenomenological, existentialist, hermeneutic, and analytic traditions. We will start out, this semester, from the First Division. Readings will include the commentaries by Ryle, Gadamer, Levinas, Derrida, Marion, Dreyfus, Brandom, and others.
de Vries, Marrati

300.622 Derrida and the Philosophies of Life
This seminar explores Derrida's analyses of notions of life, death, and mourning in crucial figures such as Freud,

Heidegger, and Lévinas as well as their implications for important moral and political issues such as death penalty and human rights.

Leys

300.623 Miracles, Events, Effects
The seminar will seek to establish a conversation between theologies of the miracle, philosophies of the event, and media theories of special effects. Readings will include St. Paul, St. Thomas Aquinas, Hume, Feuerbach, Benjamin, Wittgenstein, Davidson, Cavell, Badiou, Marion, Manovich, Pierson, and others.

de Vries

300.624 Secularism and Beyond
This seminar will offer an extensive discussion of recent texts on the so-called deconstruction of Christianity by Jean-Luc Nancy and Ernesto Laclau, Marcel Gauchet and Charles Taylor, Giorgio Agamben and others.

de Vries

300.625 Theories of Representation
A number of texts by major 18th-century theorists will be read and discussed. Authors will include Shaftesbury, Dubos, Addison, Hume, Grimm, Winckelmann, Diderot, Lessing, Rousseau, Burke, Reynolds, and Kant.

Fried

300.631 Topics in Aesthetics and Criticism
Topics and readings will center on the issue of theatricality and antitheatricality from Diderot to the present.

Fried

300.637 History and Event
This seminar analyzes different conceptions of historicity and temporality. Readings include Husserl, Derrida, Foucault, Deleuze, Badiou, and others.

Marrati

300.643 The Turn to Affect
Why is there a turn to affect among cultural theorists today? How do affect theorists reimagine the "relays" between body, brain, and culture? Texts by Damasio, Deleuze, Hansen, LeDoux, Massumi, Maturana, Sedgwick, Tomkins, Varela, and others.

Leys

300.645 Stanley Cavell and the Problem of Moral Perfectionism
Marrati

300.656 The Event and the Ordinary. On the Philosophy of Deleuze and Cavell
This seminar aims at discussing a set of issues shared by Cavell and Deleuze: the meaning of the ordinary and the event, the question of immanence, belief, and moral perfectionism.

Marrati

300.669 Who is the Other?
This course studies the Self-Other opposition as it emerged in German idealism, adopted by psychoanalysis and transformed to post-colonial and feminist theories. These theoretical frameworks will allow us to explore the representations of the Other in 20th-century Western literature. Readings will include Fichte, Hegel, Lacan, Derrida, Woolf, Kafka, Camus, Agnon, Habibi, and A.B Yehoshua.

Stahl

300.670 The Secular Lives of Grace
This seminar will discuss the major works of two contemporary thinkers, Alain Badiou and Jean-Luc Marion, whose central concerns—the laicization of grace and the phenomenology of givenness—seem at once close and diametrically opposed. Readings will include Badiou's *Being and Event* and Marion's *Being Given* as well as selections from authors relevant to these authors' arguments (Descartes, Pascal, Michel Henry, Emmanuel Levinas, Jacques Derrida, Jean-Luc Nancy, and others).

de Vries

300.671 Stanley Cavell's *The Claim of Reason*
This seminar will explore Cavell's magnum opus and discuss his contribution to the understanding of philosophical skepticism, literature, film, ethics, politics, and religion.

de Vries

300.672 The Human and the Inhuman Conversations between Philosophy and Anthropology
This seminar explores different philosophical and anthropological perspectives on what defines human forms of life and their moving boundaries with the inhuman. Readings include Lévy-Strauss, Diderot, Deleuze, Durkheim, Cavell, Ishiguro, and others.

Marrati

300.674 Freud's *Moses*
Psychoanalytic and post-psychoanalytic accounts of the relations between violence, religion, identity, and memory centered on the reception of Freud's *Moses and Monotheism*. Texts by Freud, Yerushalmi, Derrida, Lyotard, Said, Caruth, Assman, and others.

Leys

300.675 The Human and the Inhuman: Conversations between Philosophy and Anthropology
This seminar explores different philosophical and anthropological perspectives on what defines human forms of life and their moving boundaries with the inhuman. Readings include Lévy-Strauss, Diderot, Deleuze, Durkheim, Cavell, Ishiguro, and others.

Das/Marrati

300.677 Transcendence and Imminence: Theodor W. Adorno and Gilles Deleuze
Seminar will consist of a systematic confrontation of two important concepts in two influential 20th-century thinkers by way of a close reading of their two major works: Adorno's *Negative Dialectics* and Deleuze's *Difference and Repetition*. Central topics of discussion will be transcendence and immanence, the concept of the concept and the task of philosophy, difference and dialectics, materialism and empiricism.

de Vries/Marrati

300.678 *Difference and Repetition* **and Its Sources**
This seminar analyzes Gilles Deleuze's major book and its philosophical sources: Plato, Bergson, Kant, Leibniz, and others.
Marrati

300.683 The Animal That I Am: Readings Viewings, Controversies
Texts by John Coetzee, Cora Diamond, Stanley Cavell, Jacques Derrida, John McDowell, Cary Wolfe, and others. Videos by Douglas Gordon, Anri Sala, and (probably) Bill Viola.
Fried/Leys

300.800 Independent Study
Staff

300.801-802 Independent Study: Field Exams
Staff

300.803-804 Dissertation Research
Discussion of dissertations in progress. Limited to students writing dissertations.
Staff

300.805-806 Literary Pedagogy
Staffå

International Studies

The international studies major is an interdisciplinary program drawn from the departments of political science, history, economics, sociology, languages, and anthropology. There are three programs in international studies: a regular undergraduate major leading to the B.A. degree in four years, and two accelerated programs leading to the B.A./M.A. in five years. One of the accelerated programs is in partnership with the Johns Hopkins School of Advanced International Studies in Washington, D.C., and the other with Sciences Po in Paris. All three programs are described below. (For information on more advanced international study, see Political Science, page 333.)

Undergraduate Program

Professor Siba Grovogui, Director

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 48.)

Students who are thinking of majoring in international studies should complete as many of the basic degree requirements as possible and make a decision by the middle or end of sophomore year. All prospective majors should include the following among their basic courses: 3 non-Western history classes, Micro and Macro Economics (180.101-102), and one of Contemporary International Politics (190.209), International Politics (190.213), or Introduction to Comparative Politics (190.229).

Many of the policies are spelled out in greater detail on the International Studies website at http://krieger.jhu.edu/internationalstudies. In addition to the distribution requirements for departmental majors, the requirements for the B.A. degree with a major in international studies are as follows:

Foreign Language

Proficiency in one major foreign language. This requirement may be met either by a year's work beyond the intermediate level or by special examination. If the student can demonstrate proficiency through examination, s/he must take two semesters of either a new language or upper-level literature and culture courses taught in the language.

Core Courses

- Five courses in history. Three must be non-Western history.
- One course in international politics, designated (IR) on the International Studies website, in addition to one of the core courses listed above (190.209 or 190.213).
- One course in American politics, designated as (AP) on the International Studies website.
- Two courses in comparative politics, designated (CP) on the International Studies website.
- One course in political theory, designated (PT) on the International Studies website.
- Four courses in economics. Two must be basic micro and macro 180.101-102. The other two must be on the International Studies website. Students may use AP Macro for one of the requirements, but must substitute an additional fourth course from the International Studies website designating economics courses.

Concentration

Every major in international studies selects a concentration field for intensive and specialized work. The field of interest may be organized in terms of area (Latin America, East Asia) or function (security studies, international economics). The student, in other words, has the widest possible choice. It consists of four semester courses or the equivalent that add up to a coherent field of interest.

Senior Thesis

Students also have the opportunity to write a senior research thesis. To be eligible to write a thesis, seniors must identify a faculty sponsor who will supervise the project. Once a faculty sponsor has approved a topic, students must enroll in a three-credit independent study during the fall semester. Students will work out a specific work plan with their faculty sponsor suitable for their project. At the end of the fall semester the faculty sponsor will assess whether adequate progress has been made and the project warrants further work as an undergraduate thesis. If so, then the faculty sponsor will grant the student permission to enroll in the senior thesis course which will be worth six credits.

Study Abroad

Studying abroad is especially valuable for international studies majors. JHU encourages all IS majors to spend one or both semesters of the junior year abroad. Hopkins offers several of its own study abroad programs. The Bologna program, offered through the Bologna campus of the Paul H. Nitze School of Advanced International Studies (SAIS), offers courses tailored to international studies majors. (Students who spend their junior year in

Bologna and subsequently apply for graduate studies at SAIS will receive one semester of credit at SAIS for their work in Bologna.) A program similarly tailored to international studies students is offered through Sciences Po in Paris. In order to receive credit toward the major for courses taken abroad, prospective classes must be cleared with the director of International Studies prior to departure. Also, the courses taken must conform to the following standards:

• Courses taken to fulfill economics requirements must have basic micro and macro economics as their prerequisites.

• Courses taken to fulfill history requirements must be taught in a history department or by someone with a Ph.D. in history.

Courses in general must conform to the type and level of course one could take here at Hopkins as its equivalent.

In addition to these, Hopkins recognizes and accepts transfer credits from many overseas programs. In particular, programs that participate in the Consortium of International Educational Exchange (CIEE), of which Hopkins is a member, allow for easy transfer of credits and financial aid. Prior to enrolling in these programs, students meet with the director of Study Abroad to discuss those study abroad courses they wish to use toward International Studies requirements.

Five-Year Accelerated B.A./M.A. Program with the Paul H. Nitze School of Advanced International Studies (SAIS)

For declared International Studies program majors with a clear intent to pursue an M.A. after graduation from Hopkins, the university offers an accelerated and competitive International Studies B.A./M.A. Program drawing upon its resources at SAIS, located in Washington, D.C. Combining liberal arts with a strong concentration in international studies, it allows those enrolled to receive the B.A. and M.A. degrees in five years instead of the usual six.

Each year about eight sophomores are selected for the program. Admission is limited to those who are highly motivated toward careers for which a background in international studies is essential: research, teaching, or practice in international affairs. Financial assistance is available to those admitted. In accordance with university policies, it is based both on need and on superior academic achievement. Students interested in the B.A./M.A. program should see the international studies website http://krieger.jhu.edu/internationalstudies for details.

Five-Year Accelerated B.A./M.A. Program with Sciences Po

Declared international studies majors may also apply to participate in a five-year accelerated B.A./M.A. program with Sciences Po, one of Europe's finest schools of political science. After the junior year, students spend two years completing graduate-level course work in international relations, political economy, and history at Sciences Po. They earn the B.A. after their first year in Paris and a master's (Diplôme) from Sciences Po after their second year.

Applicants follow an application and review process similar to the one for the SAIS program, described above. About three sophomores are selected each year for the Sciences Po program. Students pay tuition to Johns Hopkins for the first year in Paris and to Sciences Po for the second. Financial aid from Johns Hopkins continues only through the end of a student's fourth year. Instruction at Sciences Po is in French. Only students with appropriate proficiency in French are admitted.

Progress Toward the B.A./M.A. Degrees

Students in both programs described above spend their first three years at the Homewood campus and the last two at either SAIS or Sciences Po. Students receive the B.A. degree at the end of their first year at either SAIS or Sciences Po and the M.A. at the end of their second year.

Students selected for either of the accelerated programs may not study abroad during their Homewood years.

Undergraduate Courses

(Below is a sample of courses that may be counted towards the International Studies major. For a complete list, please consult the International Studies website at krieger.jhu.edu/InternationalStudies)

Course descriptions for the following courses are listed in the Sociology Department listings:

230.114 Labor and Globalization

230.150 Issues in International Development

230.203 Introduction to Latin American Societies

230.205 Introduction to Social Statistics

230.213 Social Theory

230.225 Population, Health and Development

230.314 International Development

230.318 State and Society Relations in Modern India

230.321 Revolution, Reform, and Social Inequality in China

230.324 Gender and Development

230.337 Global Crises: Past and Present

230.343 Political Sociology of Latin America

230.346 Contemporary Economic Sociology of Latin America

230.365 Labor and Globalization

230.415 Social Problems In Contemporary China

230.421 Revolution, Reform, and Social Inequality in China

Course descriptions for the following courses are listed in the Anthropology Department listings:

070.285 Understanding Aid

070.356 Culture and Power in Contemporary Middle East

070.368 Modern South Asia: Political Culture in Pakistan

070.393 Law and Development: Postcolonial Perspectives

070.397 Introduction to South Asia

Course descriptions for the following courses are listed in the Economics Department listings:

180.101 Elements of Macroeconomics

180.102 Elements of Microeconomics

180.227-228 Economic Development

180.241 International Trade

180.242 International Monetary Economics

180.266 Financial Markets and Institutions

180.289 Economics of Health

180.303 The Global Finance Crisis

180.351 Labor Economics

180.355 Economics of Poverty and Inequality

180.365 Public Economics

180.390 Health Economics and Developing Countries

180.393 Economics of Africa

Course descriptions for the following courses are listed in the History Department listings:

100.101 History of Occidental Civilization: The Ancient World

100.102 History of Occidental Civilizations: The Medieval World

100.103 History of Occidental Civilization: Europe and the Wider World

100.104 History of Occidental Civilization: Modern Europe

100.121-122 History of Africa

100.128 History of 20th-Century Russia

100.131 History of East Asia

100.132 Jewish History in Modern Eastern Europe, 1772–1943

100.134 African Encounters with Development

100.157 History of Race and Empire

100.208 China: Neolithic to Song

100.219 The Chinese Cultural Revolution

100.232 Contemporary Latin America

100.305 Russia in the Age of Dostoevsky

100.313 The Construction of the African Diaspora in the Americas

100.326 Cultural History of 20th-Century Russia

100.329 Chinese Thought

100.330 National Identity in 20th-Century China and Japan

100.333 Global Public Health since WWII

100.338 Contemporary African Political Economics in Historical Perspective

100.341 History of Spain

100.342 Spain: The Golden Age

100.347 Early Modern China

100.348 20th-Century China

100.349 Reforms and its Discontents in the Southern Atlantic World

100.352 Politics and Culture in the Age of Pasternak

100.354 Russia and the World: From Peter the Great to Putin

100.356 Buddhist Experience

100.361 Age of Tolstoy

100.371 The Global Economy of the 20th Century

100.372 The Victorians

100.373 Renaissance to Enlightenment Intellectual History

100.383 History of Imperial Russia

100.388 European Intellectual History from Adam Smith to Nietzsche

100.397 Politics and Culture in Modern Britain

100.399 Decolonization and Nationalism in Africa

100.402 The Enlightenment

100.404 John Locke

100.405 European Socialist Thought, 1840–1940

100.413 Britain from the Revolutions of 1688 to 1691 to the Industrial Revolution

100.422 Society and Social Change in 18th-Century China

100.424 Women and Modern Chinese

100.425 Problems in Advanced Islamic History

100.437 Late Imperial China: History and Fantasy

100.438 Modern Mexico and the Mexican Revolution

100.439 The Cuban Revolution and the Contemporary Caribbean

100.440 The Revolutionary Experience in Modern Latin America

100.441 Society, Politics, and Economics in Contemporary Latin America

100.442 The Intellectual History of Capitalism: 1900 to the Present

100.445 African Fiction as History

100.453 Africa and the Atlantic

100.468 Britain from the English Revolution to the Industrial Revolution

100.473 The Indian Ocean: Economy, Society, Diaspora

100.478 Colloquium: Problems in Chinese Agrarian History

100.479 Colloquium: Problems in Chinese Urban History

100.482 Colloquium: Historiography of Modern China

100.483 Brazil and the Southern America

100.488 The Early Caribbean and the Atlantic World Seminar

100.489-490 Bondage and Culture: Slavery and Cultural Transformations in the Atlantic

Course descriptions for the following courses are listed in the Political Science Department listings:

190.102 Introduction to Comparative Politics

190.209 Contemporary International Politics

190.213 International Politics

190.265 Comparative Political Behavior

190.280 Political Persuasion: Classics of Political Thought

190.281 Virtue , Labor, Power: Classics of Political Thought II)

190.282 Violence, Law, and the Social Contract: Classics of Political Thought III190.301 Global Political Economy

190.308 Ethics of War

190.310 Global Security Politics

190.315 Asian American Politics

190.320 Politics of East Asia

190.323 Introduction to International Law

190.329 National Security in the Nuclear Age

190.330 Japanese Politics

190.331 Race and Racism in Comparative Perspective

190.333-334 Constitutional Law

190.341 Korean Politics

190.343 Nationalism

190.347 Theories of Political Authority

190.348 Domestic Politics of Contemporary China

190.354 Politics of Health Policy

190.355 Imagining Borders

190.365 Politics in Europe

190.370 Baltimore: Race and Place

190.372/412 Political Violence

190.374 Political Economy of the Information Age

190.377 Pluralism

190.379 Mass Media and Politics

190.380 Law, Morality, and the State

190.385 Urban Politics and Policy

190.389 Seminar on the Institutional Development of Congress and the Presidency

190.392 Introduction to Latin American Politics

190.394 Understanding Congress

190.395 Crime and Society

190.397 Why Human Security?

190.398 Politics of Good and Evil

190.399 Capitalism and Christianity

190.404 Realist IR Theory

190.405 Food Politics

190.406 The Executive Branch

190.409 Comparative Politics of Social Movements

190.410 America as a Foreign Country

190.411 Environment and Development in the Third World

190.420 Liberal IR Theory

190.421 Issues in International Relations

190.422 Republicanism

190.434 Advanced Topics in Contemporary Chinese Politics

190.450 Power

190.475 Courts, Politics and Public Policy

Course descriptions for the following courses are listed in the Latin American Studies listings:

361.204 Discussing Violence and Guerrilla Movements in Latin America: Assessment and Lessons from Past Experiences

361.315 Protest, Politics and Democracy in Latin America

361.323 Human Rights in Latin America

361.324 Knowledge, Power, and the Configuration of Territories in Latin America

The Leonard and Helen R. Stulman Jewish Studies Program

The Leonard and Helen R. Stulman Jewish Studies Program was founded in 2002 to coordinate the many academic activities at Johns Hopkins dedicated to the study of Jewish history, literature, language, politics, and religion. The program gives students the opportunity to explore over three millennia of Jewish culture, ranging from biblical to contemporary. The Stulman Program sponsors visiting professors and course offerings in a wide variety of disciplines, awards undergraduate travel funds and graduate fellowships, and provides many opportunities for students, faculty, and the general public to participate in a wide range of lectures, conferences, and other special events.

The program offers a minor to students interested in the many dimensions of Jewish life, religion, and culture, from ancient times to the present. It will also interest students who wish to study cultures and civilizations in which thinking about Jews and Judaism played an important role: Christianity, Islam, or modernity, for example. Because of its interdisciplinary nature, the Jewish studies minor offers students access to a broad array of humanities and social sciences disciplines. It therefore serves as a good complement to any major, as well as providing indispensable intellectual training to anyone interested in Jewish professional life.

The Faculty

Beatrice Caplan, Lecturer (Department of German and Romance Languages and Literatures): Zelda and Myer Tandetnik Lecturer in Yiddish.

Marc Caplan, Assistant Professor (Department of German and Romance Languages and Literatures): Zelda and Myer Tandetnik Professorship in Yiddish Language, Literature, and Culture.

Steven R. David, Professor (Political Science), Vice Dean for Centers and Programs: international relations, security studies, comparative politics.

Hent DeVries, Professor Russ Family Chair in the Humanities, (Humanities): modern European thought, history and critique of metaphysics, philosophies of religion, political theologies, concepts of violence, literature and temporality.

Benjamin Ginsberg, David Bernstein Professor (Political Science), Director, Washington Center for the Study of American Government: American government and politics, political development.

Herbert L. Kessler, Professor (History of Art): Early Christian and medieval art.

Theodore J. Lewis, Blum-Iwry Professor (Near Eastern Studies): Hebrew Bible, Northwest Semitic philology and religion.

Ruth Leys, Professor (Humanities): history and theory of psychoanalysis, history of psychiatry and psychology, 19th- and 20th-century intellectual history, feminist theory.

Kyle P. McCarter, Professor, William Foxwell Albright Chair in Biblical and Ancient Near Eastern Studies (Near Eastern Studies).

Yitzhak Melamed, Associate Professor (Philosophy): Jewish Philosophy, (esp. Maimonides and Crescas), Rabbinics, Kabbalah and Hassidism.

Kenneth Moss, Felix Posen Associate Professor (History) and Director, Jewish Studies Program: modern Jewish history, Russia and Eastern Europe, Yishuv/Palestine and Israel, Jewish political thought, nationalism, theory and practice of cultural history.

Ellen Ann Robbins, Lecturer (Near Eastern Studies).

Marina Rustow, Charlotte Bloomberg Chair in the Humanities; Associate Professor: Medieval and early modern Jewish history; medieval Arab polities and political cultures; rabbinic and karaite Judaisms; religion and society in Fatimid Egypt.

Glenn M. Schwartz, Whiting Professor of Archaeology (Near Eastern Studies): Near Eastern archaeology.

Neta Stahl, Assistant Professor (Humanities): Comparative and Modern Hebrew literature, religion and literature.

Eric Sundquist, Andrew W. Mellon Professor of the Humanities: American Literature and Culture, including African American and Jewish American, Literature of the Holocaust.

Rochelle Tobias, Associate Professor (German): modern literature.

Undergraduate Program

Minor in the Leonard and Helen R. Stulman Jewish Studies Program

The requirements for a minor in Jewish studies are as follows:

- A minimum of six courses (amounting to at least 18 credits) selected from those approved by the Advisory Committee of the Jewish Studies Program. The courses must be from at least two departments, and at least three must be upper-level courses (300-level or above).

- Up to two courses in Hebrew at the intermediate level or higher may be counted toward the minimum number of courses required for the minor. Students are encouraged to acquire intermediate proficiency in Hebrew or some other language central to the Jewish experience (e.g., Yiddish, Arabic, etc.).

Major in the Leonard and Helen R. Stulman Jewish Studies Program

The Jewish Studies Program does not currently offer a major. However, students interested in designing a major in Jewish Studies may petition to do so as an interdisciplinary studies major. Such proposals, designed in consultation with a faculty advisor, should be submitted before the end of a student's sophomore year.

Courses

The following courses are taught regularly but may not be offered every academic semester. Please consult the course schedule for specific times of course offerings.

Additional courses are frequently offered by visiting faculty. For a list of these courses, please consult the course supplement or contact the program administrator.

German and Romance Languages and Literatures

210.163-164 Elementary Yiddish

210.263-264 Intermediate Yiddish

211.211 Introduction to Yiddish Culture

213.322 Fin de Siècle Vienna

213.333 Transformations in Modern Jewish Literature

213.336 Dancing About Architecture: Jewish Humor and the Construction of Cultural Discourse

213.343 The Holocaust in Modern Literature: The Limits of Representation

213.614 Proto-Modernist Fiction, 1890–1914

213.648 The Multilingual Culture of Weimar Berlin

History

100.129 Introduction to Modern Jewish History, 1789–2000

100.241 (H,S,W) Visions of the self: The Autobiography as History

100.132 Jewish History in Modern Eastern Europe 1772–1943

100.312 Capitalism, Class and Community in Modern Jewish History

100.320 (H,S) The Inventions of Modern Jewish Culture: Genealogies, Formations, Dilemmas

100.325 The Jewish Condition

100.331 Shtetl, City, Death Camp, Suburb, State: Spaces of Jewish Modernity in Europe, America and Israel

100.355 The City in Modern Jewish History

100.363 Jewish Society and Selfhood in the Age of Nationalism: Religious, Cultural Civic, and Private Lives of Jews In Eastern Europe, 1860–1939

100.381 Tradition and Modernity in Modern Jewish Culture

100.667 Topics in Modern Jewish History

100.668 Reading Seminar: Graduate Introduction to Modern Jewish History

Humanities

300.229 Realism and Anti-realism in Post-Holocaust Hebrew Literature

300.345 Between the Sacred and the Secular in Modern Hebrew Literature

300.615 Representations of Jesus in Modern Jewish Literature

300.372 Holocaust Testimonies

Near Eastern Studies

130.101 Ancient Near Eastern Civilization

130.140 Introduction to the Hebrew Bible/ Old Testament

130.301 History of Ancient Syria-Palestine, including Ancient Israel

130.305 Law in the Ancient World

130.306 The Origins of Diplomacy

130.330 Sex and the Garden

130.340 The History of the Religion of Israel

130.343 The Dead Sea Scrolls in English

130.372 Prophetic Literature of the Hebrew Bible/ Old Testament

130.440 Elementary Biblical Hebrew

130.442 Reading of Hebrew Prose

130.444 Reading of Hebrew Poetry

134.602 Wisdom Literature of Hebrew Bible

134.608 Book of Ezekiel

134.610 Historical Hebrew Grammar

134.630 Qumran (Dead Sea) Texts

134.650 Seminar in Hebrew or Northwest Semitic

134.700 Northwest Semitic Epigraphy

Political Science

191.335 Arab-Israeli Conflict

Philosophy

150.428 Spinoza's Theological Political Treatise

Center for Language Education

The Center for Language Education (CLE), formerly Language Teaching Center (LTC), was established in 1992 (with name change in 2010). The CLE presently offers foreign-language courses in Arabic, Chinese, Hebrew, Hindi, Japanese, Kiswahili, Korean, Persian/Farsi, and Russian.

The CLE also offers evening, noncredit English as a Second Language (ESL) courses, English for International Teaching Assistants, and a Summer Intensive English Language Program for visiting and pre-college students. The Summer Program consists of classes in Oral Communication, Academic and Professional Writing, Building Fluency through Film, American Culture, TOEFL Preparation, and English for Medical Professionals.

The center is also responsible for the Language Laboratory, which serves all Homewood campus language programs including French, German, Italian, Portuguese, and Spanish.

The Faculty

Fadel Abdallah, Lecturer: Arabic.

Aiguo Chen, Lecturer: Chinese.

Zvi Cohen, Lecturer: Hebrew.

Nancy Gooding, Lecturer: ESL.

Ye Han, Lecturer: Chinese.

Yuki Johnson, Director of CLE, Teaching Professor: Japanese.

Choonwon Kang, Lecturer: Korean.

Satoko Katagiri, Lecturer: Japanese.

Lu Li, Lecturer: Chinese.

Liman Lievens, Lecturer: Chinese.

Makiko Nakao, Lecturer: Japanese.

Uma Saini, Director of ESL; Sr. Lecturer: Hindi.

Khalil Tahrawi, Lecturer: Arabic.

Adjunct Appointments

Annalisa Czeczulin, Adjunct Assistant Professor (Goucher): Russian language and culture.

Olya Samilenko, Adjunct Associate Professor (Goucher): Russian language and literature.

Part-time Faculty

Dariush Dehghan, Lecturer: Persian/Farsi.

Jane Kamau, Lecturer: Kiswahili.

Patricia Palmer, Lecturer: ESL.

Facilities

The Language Laboratory, located on the fifth floor of Krieger Hall, provides in-lab and remote facilities for the use of multimedia materials and assists all foreign language departments in the selection and development of technology-based courseware for their programs. The facility supports individual learning at computerized workstations, as well as classroom instruction via a media distribution system. Satellite news broadcasts, recordings, and high-speed duplication are some of the services offered to students, faculty, and staff of the university. The laboratory has been equipped with current software used for language acquisition.

Undergraduate Program

The Goucher-Hopkins Program in Russian

The Goucher College–Johns Hopkins University Cooperative Program in Russian Language and Literature offers a full range of courses in Russian language, literature, and culture to be drawn upon for an area major in humanistic studies (see page 39).

Minor and Double Major in Russian

The Russian double-major, designed to give students a working command of both the written and spoken language and a deeper understanding of the cultural and literary development of the Russian people from the advent of Christianity to the present day, consists of 30 credits beyond, but not including 377.208 (Intermediate Russian I). The minor consists of 18 credits.

Russian minors and double-majors from both institutions are encouraged to enroll in either the three-week summer JHU/GC Moscow Immersion or the three-week summer JHU/GC Odessa immersion in Ukraine as part of their language study. Prerequisites include Seminar II in the spring or 377.280 Summer Russian Practicum taken in the spring prior to the immersion. All credits earned on the JHU/GC language immersions may be applied toward the minor or double-major. Hopkins Russian majors are strongly encouraged to take a semester abroad in Moscow or St. Petersburg through the Bard-Smolny, ACTR, or CIEE programs.

For beginning courses, only Russian 131 may be taken satisfactory/unsatisfactory. Other languages may be taken satisfactory/unsatisfactory only at the intermediate level and above. A student earning a D in a course is not eligible to pass to the next higher level course. Students are granted credit for each semester course successfully completed, regardless of enrollment or performance in a subsequent course. A third year of study in a few of these languages may not be scheduled for each academic year. Students whose majors require three years of language study should consult with their departments before they enroll. Students are also advised to contact the Center for Language Education for language programs created on an ad hoc basis.

Courses

Arabic

375.115-116 First-Year Arabic
Introductory course in speaking, listening, reading, and writing Modern Standard Arabic. The course presents the basic grammatical structures of the language and a basic vocabulary. Through oral-aural drill in the classroom, work with tapes in the language laboratory, and reading and writing exercises done inside and outside of class, students attain a basic level of competence in the language on which they can build in subsequent years of study. Culture is also introduced as a fifth skill.
Abdallah/Tahrawi   4.5 credits

375.215-216 (H) Second-Year Arabic
This two-semester course is designed to bring the students up to the level of competency required for third-year Arabic. Students will consolidate and expand their mastery of the four basic skills acquired in 375.115-116. More authentic written, audio, and visual material will be used, and culture will be further expanded on as a fifth skill. There will also be more exposure to the three major variants of Arabic introduced in the first year: Classical Arabic, Modern Standard Arabic, and Egyptian Colloquial Arabic. Prerequisite: 375.115-116.
Abdallah   4 credits

375.301-302 (H) Third-Year Arabic
Designed to enhance students' ability to read, discuss, and write about various topics covered in traditional and contemporary Arabic texts. A good part of the texts studied represent media Arabic. Training in idiomatic translation is introduced as an additional skill. Prerequisite: 375.215-216 or equivalent.
Tahrawi   3 credits

375.401-402 (H) Fourth-Year Arabic
This is an introductory course to different periods of the Arabic literature. Selections of literature from famous Arabic poetry and short prose works are the substance of the course, and additional training in idiomatic translation will be pursued. Prerequisite: 375.301-302 or equivalent.
Tahrawi   3 credits

Chinese

373.111-112 First-year Heritage Chinese
This course is designed for students who were raised in an environment in which Chinese is spoken by parents or guardians at home and for those who are familiar with the language and possess native-like abilities in comprehension and speaking. The course therefore focuses on reading and writing (including the correct use of grammar).
Lievens   3 credits

373.115-116 First-Year Chinese
This course is designed primarily for students who have no prior exposure to Chinese. The objective of the course is to help students build a solid foundation of the four basic skills—listening, speaking, reading, and writing in an interactive and communicative learning environment. The emphasis is on correct pronunciation, accurate tones, and mastery of basic grammatical structures. Students cannot begin their study in the spring. Note: Students with existing demonstrable skills in spoken Chinese should take 373.111-112.
Han/Li   4.5 credits

373.211-212 (H) Second-Year Heritage Chinese
This course is designed for students who finished 373.112 with C+ and above (or equivalent). Students in this course possess native-like abilities in comprehension and speaking. The course focuses on reading and writing.
Chen   3 credits

373.215-216 (H) Second-Year Chinese
Consolidation of the foundation that students have laid in their first year of study and continued drill and practice in the spoken language, with continued expansion of reading and writing vocabulary and sentence patterns. Students will work with either simplified or traditional characters. Note: Students who have native-like abilities in comprehension and speaking should take 373.211-212.
Han/Chen   4.5 credits

373.313-314 (H) Third-Year Heritage Chinese
This course is designed for those who have already taken 373.212 or equivalent. Students need to have native-level fluency in speaking and understanding Chinese. The course focuses on reading and writing. In addition to the textbooks, downloaded articles on current affairs may be introduced on a regular basis.
Chen   3 credits

373.315-316 (H) Third-Year Chinese
This two-semester course consolidates and further expands students' knowledge of grammar and vocabulary and further develops reading ability through work with textbook materials and selected modern essays and short stories. Class discussion will be in Chinese insofar as feasible, and written assignments will be given. Prerequisite: 373. 215-216 or equivalent.
Lievens   3 credits

373.415-416 (H) Fourth-Year Chinese
This course is designed for students who finished 373.316 with a C+ or above (or equivalent). Readings in modern Chinese prose, including outstanding examples of literature, newspaper articles, etc. Students are supposed to be able to understand most of the readings with the aid of a dictionary, so that class discussion is not focused on detailed explanation of grammar. Discussion, to be conducted in Chinese, will concentrate on the cultural significance of the readings' content. Prerequisite: 373.315 -316 or equivalent.
Lievens   3 credits

373.451-452 (H) Topics in Chinese Media

The main focus of this course is to expand the student's knowledge of four essential skills in Chinese language and to deepen the student's knowledge of Chinese culture. The course is taught based on various written and visual materials (including newspapers, journals, TV, movies, and short novels) to improve students' reading comprehension, maintain conversation skills through class discussion, increase understanding of the culture and society of China, and enhance writing ability through short compositions and a writing project. Prerequisite: 373.314, 373-416 or equivalent.

Staff   3 credits

English as a Second Language for International Teaching Assistants

370.600 Oral Skills for International Teaching Assistants

Oral Skills for International Teaching Assistants is intended for international TAs who are not native speakers of English. In addition to improving listening comprehension in everyday interactions, students will improve their fluency, accuracy, and intelligibility in a variety of speaking situations. The core curriculum is designed to include a wide range of performance-based communicative activities. Open to international TAs and other full-time graduate students in Arts and Sciences and Engineering.

Gooding   3 hours

370.601 Communication Strategies in the American Classroom

Communication Strategies in the American Classroom is designed to introduce international TAs to the culture of the American classroom. Students will continue to strengthen their English speaking skills, practice basic teaching techniques, and develop strategies for clear, cross-cultural communication. The core curriculum includes many performance-based activities intended to help students interact more effectively with undergraduates in a variety of speaking situations. Open to international TAs and other full-time graduate students in Arts and Sciences and Engineering.

Gooding   3 hours

Hebrew

384.115-116 First-Year Hebrew

Designed to provide reading and writing mastery, to provide a foundation in Hebrew grammar and to provide basic conversational skills.

Cohen   4.5 credits

384.215-216 (H) Second-Year Hebrew

Designed to enrich vocabulary and provide intensive grammatical review, and enhance fluency in reading, writing, and comprehension. Prerequisite 384.115-116 or 130.450-451.

Cohen   3.5 credits

384.315-316 (H) Third-Year Hebrew

Designed to maximize comprehension and the spoken language through literary and newspaper excerpts providing the student with the language of an educated Israeli. Prerequisite 384.215-216 or 130.452-453.

Cohen   3 credits

Hindi

381.101-102 Beginning Hindi

This course prepares students to function in everyday situations in the Hindi-speaking world. Focuses on the acquisition of basic vocabulary and grammatical structures in culturally authentic contexts through listening, speaking, reading, and writing comprehension. Hindi reading and writing are taught in the original Dayva-nagari script. Oral-aural drills in class and work in the Language Lab is required.

Saini   3 credits

381.201-202 (H) Intermediate Hindi

Drawing upon Indian epics, history, fables, and folk tales, the course placed language training in its socio-cultural ethos while imparting instruction for speaking, writing, and comprehending Hindi. At the completion of the course, students will be well equipped to initiate, sustain, and close an everyday conversation; write letters and short compositions; read, with full understanding, simple texts dealing with personal and social needs; grasp the main ideas and information from commonly used audio-visual materials. Prerequisite: 381.101-102 or equivalent.

Saini   3 credits

Japanese

378.115-116 First-Year Japanese

This course is designed for students who have no background or previous knowledge in Japanese. The course consists of lectures on Tuesday/Thursday and conversation classes on Monday/Wednesdays/Fridays. The goal of the course is the simultaneous progression of four skills (speaking, listening, writing, and reading) as well as familiarity with aspects of Japanese culture. By the end of the year, students will have basic speaking and listening comprehension skills, a solid grasp of basic grammar items, reading and writing skills, and a recognition and production of approximately 150 kanji in context. Knowledge of grammar will be expanded significantly in 373.215. May not be taken S/U.

Johnson/Nakao   4.5 credits

378.215-216 (H) Second-Year Japanese

Consolidation of the foundation that students have laid in their first year of study and continued drill and practice in the spoken language, enabling them to engage in spontaneous, short conversations on familiar topics. Students will increase their knowledge of more complex patterns of the language and develop reading skills with edited texts written in native Japanese script. By the end of the second semester, students will have a working knowledge of about 250 Kanji.

Katagiri   4.5 credits

378.315-316 (H) Third-Year Japanese
Continuation of 373.215-216. Students will further develop skills to communicate in Japanese in various cultural contexts, and strengthen their understanding of Japanese culture and society. While there will be continued emphasis on oral skills, students will expand their knowledge of kanji, grammar, and vocabulary necessary to express and understand a wider range of ideas in written format. Students will improve their oral skills though classroom activities and supplementary audio-visual materials.
Katagiri   3 credits

378.396 (H) Fundamentals of Japanese Grammar
This course is designed for students who have already studied first-year Japanese grammar and wish to develop a thorough knowledge of Japanese grammar in order to advance all aspects of language skills to a higher level. It is also appropriate for graduate students who need to be able to read materials written in Japanese.
Johnson   2 credits

378.415-416 (H) Fourth-Year Japanese
Offered for students who have completed 378.315-316 or the equivalent. In this course, students will use four skills in the participatory activities including reading, presentation, and discussion. Students further develop their reading skills in modern Japanese through a variety of edited and unedited reading materials. Study on compound words will deepen and enhance their Kanji knowledge. Lab required.
Nakao   3 credits

378.611-612 (H) Readings in Japanese Studies
This course is designed for graduate students (particularly in East Asian Studies) and undergraduate students whose proficiency level is higher than fourth-year Japanese as offered at Johns Hopkins University or equivalent and those who plan to pursue studies utilizing written Japanese materials. Students will learn effective methods for reading Japanese materials, varying from works of literature to modern academic articles on topics of students' interest..
Johnson   2 credits

Kiswahili

379.151-152 Beginning Kiswahili
This introductory course presents some of the basic grammatical, phonological, and sociological elements of the Kiswahili language. Students are exposed to different facets of the cultures of eastern Africa (especially Tanzanian and Kenyan). The focus in the course is on vocabulary, which is developed through the use of pictures, dialogues, question and answer exercises, audio and/or video tapes. Resources in the Language Lab are incorporated in the course.
Kamau   3 credits

Korean

380.101-102 First-Year Korean
This course focuses on improving speaking fluency to limited proficiency so that one can handle simple daily conversations with confidence. It provides basic high-frequency structures and covers Korean foods and holidays.
Kang   3 credits

380.201-202 (H) Second-Year Korean
This course aims at improving reading and writing skills with correct spelling as well as oral fluency. Topics range from people, places, activities, preferences, experiences, and plans to cultural tips. It reinforces development of writing skills from stating facts and describing people to expressing opinions clearly by practices in various styles. Discussions include traditions, customs, and lifestyle. Prerequisite: 380.101-102 or existing demonstrable skills in spoken Korean.
Kang   3 credits

380.301-302 (H) Third-Year Korean
This course emphasizes all-around reading literacy in classic and modern Korean prose. In-depth research on cultural topics will enhance cultural understanding and awareness. Reading Korean newspapers and professional articles in one's major enables one to be well-versed and truly literate. Prerequisite: 380.201-202 or equivalent.
Kang   3 credits

Persian

382.101-102 Beginning Persian
This course enables students to learn the Persian alphabet, phonology, morphology, and the basic syntax. Modern Persian introduces students to the basic structures of the Persian language. As students build proficiency in all four language skills, they acquire greater confidence to communicate in the target language. Cultural information is integral, and task-based activities invite students to communicate daily. Themes are introduced through readings, multimedia formats, and in-classroom technology.
Dehghan   3 credits

Russian

Some Russian courses are taught at Goucher College. Course numbers differ at Goucher, but course names are the same. Hopkins students should register at Homewood for courses taught at Goucher and use the Hopkins course number.

377.131 Elements of Russian I
Designed to give students a firm foundation in Russian based on the development of vocabulary, basic reading, and conversational skills. Taught with the communicative approach grounded in Russian culture. A second section of this course is taught at GC under the number RUS 110.
Samilenko   4 credits   4 hours class, 1 hour lab   fall

377.132 Elements of Russian II
A continuation of previous elementary work with abundant oral and aural practice. Grammar, vocabulary, reading, discussion centered on contemporary Russian culture. Prerequisite: 377.131 with a minimum grade of C-. A second section of this course is taught at GC under the number RUS 120.
Samilenko   4 credits   4 hours class, 1 hour lab   spring

377.208 (H) Intermediate Russian I
Intensive oral work; continued emphasis on grammar and reading comprehension. Prerequisite: 377.132 with a minimum grade of C-. A second section of this course is taught at GC under the number RUS 130.
Czeczulin   4 credits   fall

377.209 (H) Advanced Russian Grammar for Fluency
In the final course of the grammar sequence students cover advanced grammar topics: participles and gerunds; verbal aspect and formation; and the subjunctive. Students should take this course concurrently with 377.210. Prerequisite: 377.208 with a minimum grade of C-. This course is the only course in the grammar sequence which counts for major and minor credit.
Czeczulin   4 credits   spring

377.210 (H) Conversation and Composition
Development of conversational and writing skills through the study and discussion of animated and classical films from the Soviet era. Acquisition and active practice of everyday vocabulary and idioms are supplemented by grammar exercises, short readings, Web-based assignments, and a project. Prerequisite: 377.208.
Samilenko   3 credits   spring

377.211 (H) Introduction to Russian Literature I
This first intensive reading course of the literary sequence focuses on a survey of major writers, genres, and literary movements of mid-19th-century Russia including select works of Pushkin, Gogol, Lermontov, Turgenev, Tolstoy, and Dostoevsky adapted to the intermediate level. Prerequisites: 377.208 and 377.210. In Russian.
Samilenko   3 credits   fall

377.237 (H) The Russian Press
This translation course focuses on readings from the Russian press and is designed to strengthen the students' command of specialized vocabulary in history, political science, and economics, while providing a deeper insight into the complexities of the post-Soviet period. Prerequisite: 377.209 or 377.210.
Czeczulin   3 credits

377.253 (H) The Soul of Russia: Russian Culture and Civilization
This cultural survey course showcases the evolution of Russian civilization from the Mongol invasion to the present day through the study of select works of literature, folk and classical music, major art movements, dance, and cuisine. In English with a one-credit Russian component. At Goucher.
Czeczulin   3–4 credits   spring

377.254 (H) Russian Literature: Revolution and Purge
Political, social, and ideological factors in the development of Russian literature of the 20th century. A study of leading Russian authors and the conflicts between artistic freedom and political conformity. In English. At Goucher.
Czeczulin/Samilenko   3 credits

377.259 (H) Dimensions of the Russian Literary Mind: The Saint, the Madman, and the Dreamer
Survey of Russian literature from its beginning in the 12th century, with emphasis on the great works by Dostoevsky, Tolstoy, and other writers that exemplify the traits and characteristics of the Russian religious and literary mind. In English. At Goucher.
Czeczulin/Samilenko   3 credits

377.261 (H,W) Russian Advanced Grammar through Readings
Advanced application of essential grammar topics (prefixed verbs of motion, aspects, participles, declension, conjugation, and idioms) through literary texts. Utilization of multimedia when appropriate. Prerequisite: 377.209.
Samilenko   3 credits

377.269 (H,W) The Russian Fairy Tale
A survey course of Russian oral and subsequently written tradition using multimedia and presented against the background of the Indo-European tradition. Taught in English with a one-credit language option. At Goucher.
Czeczulin   3 credits   fall

377.280 (H) Summer Russian Practicum
This course is an optional component of the JHU/GC language-study immersion to Moscow, Russia, or Odessa, Ukraine. Students research an independent project in Russian literature, art, music, or architecture which is due upon completion of the program.
Samilenko   2 credits   spring

377.318 (H,W) Chekhov and Short Story
This intensive writing course requires students to examine the themes and stylistic devices of Anton Chekhov's short stories and novellas in the context of social, political, and philosophic developments of the late 19th -early 20th century and in contrast with other major writers of the short story. Prerequisite: 377.211 or instructor's permission. In Russian.
Samilenko   3 credits   spring

377.335 (H) Technical Translation
Advanced work in translating Russian into English in the sciences and social sciences. Prerequisite: 377.237 or instructor's permission.
Czeczulin   3 credits

377.351 (H) Introduction to Russian Literature II
This reading intensive course continues beyond Introduction to Literature I with a survey of major writers of the late 19th and early 20th century. It includes only short works and annotated materials adapted to the intermediate level and should be taken prior to the seminars. Prerequisite: 377.211 or instructor's permission. In Russian.
Samilenko   3 credits

377.395 (H,W) Seminar I
Advanced study of topics in fiction, poetry, or drama prior to the Revolution of 1917 involving close textual analysis

of a particular author, a body of works, a genre, or a literary movement. In addition to primary sources, students read critical articles, engage in critical thinking, and write longer essays. This advanced course may be taken more than once by majors, minors, and heritage learners. The cycle of topics repeats every four years. Prerequisite: 377.318 or instructor's permission. In Russian.

Samilenko   3 credits   fall

377.396 (H,W) Seminar II
Advanced study of topics in fiction, poetry, drama, or cinema during the Soviet period involving the close textual

analysis of a particular author, a body of works, a genre, a literary movement. In addition to primary sources, students read critical articles, engage in critical thinking, and write longer essays. This advanced course may be taken more than once by majors, minors, and heritage learners. The cycle of topics repeats every four years. Prerequisite: 377.318 or instructor's permission. In Russian.

Samilenko   3 credits   spring

377.500-505 Russian Independent Study
Arranged with the instructor. In Russian.
Samilenko   1–3 credits.

Program in Latin American Studies

The Program in Latin American Studies (PLAS) at Johns Hopkins University seeks to build interdisciplinary understanding among faculty and students of the histories, cultures, societies, and politics of countries in Latin America and the Caribbean.

PLAS courses enhance the Hopkins curriculum by offering students an opportunity to explore the rich political, aesthetic, intellectual, and scientific traditions of Latin America, and by encouraging critical perspectives on Latin America's history and role in the modern world. Workshops by PLAS-affiliated faculty, graduate students, and visit-ing scholars complement the curriculum with discussions of current events and ongoing research projects.

PLAS offers an undergraduate major and minor in Latin American studies. The program encourages undergraduate students to take an active interest in Latin America; in their course work and extracurricular life, and by engaging their other disciplinary and area interests through summer research and study abroad programs in Latin America. The program also supports graduate students whose research focuses on Latin America.

PLAS contributes to the professional training of graduate students through interdisciplinary discussions of ongoing research projects, pre-dissertation summer research travel grants, and student initiated exhibitions, conferences, and special events.

The Faculty

Mary M. Bensabat-Ott, Director, Portuguese Language Program, Senior Lecturer (German and Romance Languages and Literatures): Portuguese language; Brazilian literature and culture.

Sara Castro-Klarén, Professor (German and Romance Languages and Literatures): Latin American literature, colonial studies, discourse analysis, contemporary novel.

Emma Cervone, Associate Director, Assistant Professor (Anthropology): social movements, Andes, Ecuador; indigenous movements, race and gender in Latin America; development and applied anthropology.

Lisa DeLeonardis, Austen-Stokes Professor (History of Art): Art and archaeology of the ancient Americas.

William Egginton, Professor (German and Romance Languages and Literatures): Spanish and Latin American literatures; literary theory; and the relation between literature and philosophy.

James D. Goodyear, Associate Director of Public Health Studies Program, Professor (History of Science, Medicine and Technology): history of medicine, Latin American history, Brazil.

Clara Han, Assistant Professor (Anthropology): Medical Anthropology, Health and the Economy, Public Health, Social Studies of Medicine and Technology, Inequality, Latin America, Chile.

Michael Hanchard, Professor (Political Science): comparative politics, Latin American politics, and comparative racial politics.

Richard L. Kagan, Professor (History): Spain, Iberian expansion, and the Spanish Empire in the New World, especially iconography and cities.

Margaret E. Keck, Professor (Political Science): comparative politics, Latin American politics, and the environment.

Franklin Knight, Professor (History): Latin American and Caribbean social and economic history, comparative history, comparative slave systems.

Juan Obarrio, Assistant Professor (Anthropology): Law, temporality and the political, state and economy, memory and subjectivity, magic, value and violence, Southern Africa, Latin America.

Deborah Poole, Professor (Anthropology): visuality and representation in Latin America, Peru, and Mexico; race and ethnicity; violence, liberalism, and the state; law and judicial reform.

Maria Portuondo, Assistant Professor (History of Science): science and exploration, science and technology in Latin America, early modern Spanish and Latin American Cosmography and geography.

Beverly J. Silver, Professor (Sociology): historical sociology, labor and social movements, political sociology, international development.

Ben Vinson III, Professor (History): Latin American history with a particular interest in race relations, especially the experience of African Diaspora.

Magda von der Heydt-Coca, (Sociology): contemporary sociology, Andean region.

Lea Ybarra, Professor (German and Romance Languages and Literatures): Chicano and Latino studies.

Major/Minor in Latin American Studies

The Program in Latin American Studies aims to provide undergraduate students with a broad understanding of the complexity of Latin American social, political, and cultural problems. As a result of

completing the major (or minor) students will have a deeper understanding of Latin American politics, economy, and culture, as well as of the intricate relationship between the region and the U.S.

The Program in Latin American Studies at The Johns Hopkins University offers a variety of courses across the disciplines and promotes research partnerships between students and faculty.

1. The program offers both a major and a minor. To complete either option, students are required to take either elementary Spanish or Portuguese. Language requirements can be waived for those who demonstrate suitable knowledge of either Spanish or Portuguese, of in an Amerindian language such as Quechua or Guarani.

2. A general introductory course in Latin American studies is required to start either the major or the minor.

3. Though students may choose to emphasize a particular area of specialization within Latin American studies (such as politics, health, literature, etc.), the program requires a distribution of courses in a variety of areas, at different levels.

Students may declare a major in Latin American studies during the second semester of the sophomore year. Students may major in this program in conjunction with other departments. No more than two independent studies are acceptable toward the major or minor in the program.

Requirements for the Major
The requirements for a major in Latin American Studies are as follows:

- Four lower-level courses (100- and 200-level courses) dealing with Latin America, one of which must be the general introductory course to Latin America.
- Five upper-level courses (300-level courses and above) focused on Latin America.
- Three electives courses relevant or with reference to Latin America.
- Language proficiency (i.e., reading fluidity and basic conversational skills) through the intermediate level in either Spanish or Portuguese will be required.
- Language requirements can be waived for those who demonstrate a suitable proficiency in either Spanish or Portuguese.
- To be eligible for honors, a 3.3 GPA in the major's courses as well as a senior thesis will be required.
- No grade below C- will be accepted for the major requirement.

Requirements for the Minor
The requirements for a minor in Latin American Studies are as follows:

- Four upper-level courses (300 or above) focused on Latin America. Intersession courses may not be used to fulfill this requirement.
- Two additional courses at any level dealing with Latin America.
- Language proficiency in either Spanish or Portuguese.
- No grade below C- will be accepted for the minor requirement.

Courses

Latin American Studies

361.124 (H) Latin American Film: Mini-Course
Staff   1 credit

361.130 (H,S,W) Introduction to Latin American Studies I
Staff   3 credits

361.131 (H,W) Introduction to Latin American Studies II
Staff   3 credits

361.215 (H) Ni de Aqui, Ni de Alla: An Introduction to Latino Culture in the U.S.
Staff   3 credits

361.502 Independent Study
3 credits

361.550 (H,S) Internship
Staff   1 credit

Cross-Listed Course Offering

Africana Studies

362.495 (H,W) Afromexican History
Vinson   3 credits

Anthropology

070.218 (H,S,W) The Politics of Multiculturalism
Cervone   3 credits

070.299 (H,S,W) Economies in the Americas
Poole   3 credits

070.351 (H,S,W) Political Life of Gender
Cervone   3 credits

070.378 (H,S) Cultural Property and Politics in Latin America
Poole   3 credits

070.393 (H,S) Law and Development: Post-Colonial Perspectives
Obarrio   3 credits

070.396 (H,S) On the Question of Drugs
Han   3 credits

German and Romance Languages & Literatures

211.380 Modern Latin American Culture
Staff   3 credits

211.394 (H,W) Brazilian Culture and Civilization
Bensabat-Ott   3 or 4 credits

215.339 (H) Borges and Philosophy
Egginton   3 credits

215.340 (H,W) Narrating Self and Nation in Modern Latin American Literature
Castro-Klaren   3 credits

215.342 (H) Introduction to Latin America: the Formative Years
Castro-Klaren   3 credits

215.370 (H) Studies in Spanish and Latin American Poetry
Staff   3 credits

215.456 (H) Gauchos, Negros, Gitanos
Gonzalez   3 credits

215.458 (H) Cuba and its Culture since the Revolution
Gonzalez   3 credits

215.460 (H) Modern Mexico and the Culture of Death
Gonzalez   3 credits

215.487 Islam in America
Altschul   3 credits

215.658 Whose Caribbean? Colonialism and Human Bondage
Gonzalez   3 credits

History

100.438 (H,S,W) Modern Mexico and the Mexican Revolution
Knight   3 credits

100.439 (H,S,W) The Cuban Revolution and the Contemporary Caribbean
Knight   3 credits

100.440 (H,S,W) The Revolutionary Experience in Modern Latin America
Knight   3 credits

100.441 (H,S,W) Society, Politics and Economic in Contemporary Latin America
Knight   3 credits

History of Art

010.105 (H) Art of the Ancient Americas
Deleonardis   3 credits

010.320 (H) Art of Colonial Peru
Deleonardis   3 credits

010.334 (H) Problems in Ancient American Art
Deleonardis   3 credits

010.365 (H) Ancient Andean Art
Deleonardis   3 credits

History of Science

140.390 (H,S) Science and Technology in Latin America
Portuondo   3 credits

Political Science

190.331 (H,S) Race and Racism in Comparative Perspective
Hanchard   3 credits

190.392 (S,W) Introduction to Latin American Politics
Keck   3 credits

190.411 (S,W) Environment and Development in the Third World
Keck   3 credits

190.419 (S,W) Identity and Nations in Latin American Politics
Keck   3 credits

Sociology

230.203 (S) Introduction to Latin American Societies
Heydt-Coca   3 credits

230.307 (S) Sociology of Latin America
Heydt-Coca   3 credits

Mathematics

Mathematics, more than the fundamental language and underlying analytical structure of science and technology, is a formal way of thinking—an art that ties together the abstract structure of reason and the formal development of the logic that defines the scientific method. From the study of just how arguments and theories are formed in language and technology, to the framework of quantitative and qualitative models of the natural and social sciences, mathematics is based upon the development of precise expressions, logical arguments, and the search and exposure of pattern and structure.

The undergraduate program in the Department of Mathematics is intended both for students interested in attaining the proper preparation for graduate study in pure mathematics, and for students interested in using mathematics to define and solve problems in the sciences, engineering, and other areas. With either purpose, the focus of the program is to help those who wish to understand further the logical content, geometric meaning, and abstract reasoning of mathematics itself. A flexible program involving a broad selection of courses is a department tradition. The program begins by introducing students to the basics of algebra and mathematical analysis and then gives them the choice of exploring topics in theoretical mathematics or studying applications to physics, economics, engineering, computer science, probability, statistics, or mechanics.

The graduate program is designed primarily to prepare students for research and teaching in mathematics. It is naturally centered around the research areas of the faculty, which include algebraic geometry, algebraic number theory, differential geometry, partial differential equations, topology, several complex variables, algebraic groups, and representation theory. The program can be supplemented in applied directions by courses in theoretical physics, computer science, mechanics, probability, and statistics offered in other departments of the Krieger School of Arts and Sciences and in the Department of Applied Mathematics in the Whiting School of Engineering.

The Faculty

Richard Brown, Director of Undergraduate Studies: dynamical systems, low-dimensional topology.

Caterina Consani, Associate Professor: algebraic and arithmetic geometry.

Nitu Kitchloo, Professor: symplectic geometry, topology of Kac-Moody groups, classical algebraic topology

Jian Kong, Associate Research Scientist/Lecturer: algebraic geometry.

Hans Lindblad, Professor: harmonic analysis, PDE, fluid dynamics and relativity

Chikako Mese, Professor: geometric analysis.

William Minicozzi, Professor: differential geometry, partial differential equations, minimal surfaces.

Jack Morava, Professor: algebraic topology, mathematical physics.

Kate Okikiolu, Professor: harmonic analysis, spectral theory and geometry

Takashi Ono, Professor: algebra, number theory, algebraic groups.

Bernard Shiffman, Professor: several complex variables, differential geometry.

Vyacheslav V. Shokurov, Professor: algebraic geometry.

Christopher Sogge, Professor: Fourier analysis, partial differential equations.

Joel Spruck, Professor: partial differential equations, geometric analysis.

W. Stephen Wilson, Professor: algebraic topology.

Steven Zelditch, Professor: quantum dynamics, spectral geometry, microlocal analysis.

Steven Zucker, Professor: Hodge theory, algebraic geometry.

Joint Appointments

Jonathan A. Bagger, Professor (Physics and Astronomy): particle theory; theory and phenomenology of supersymmetry, supergravity and superstrings.

Gregory Eyink, Professor (Applied Mathematics): mathematical physics, fluid mechanics, turbulance, and dynamical systems.

Facilities

The university's Milton S. Eisenhower Library has an unusually extensive collection of mathematics literature, including all the major research journals. The stacks are open to students. The department also has a useful reference library, the Philip Hartman Library. Graduate students share departmental offices, and study space can also be reserved in the university library. Graduate student may access the department's Linux and Windows servers, as well as computers in graduate student offices. The department also hosts numerous research seminars, special lectures, and conferences throughout the academic year.

Undergraduate Programs

Course Scheduling

Students usually begin by taking Calculus I-II, which is offered in three versions to meet the needs of students with different goals and interests. Students in mathematics, the physical sciences, and engineering are encouraged to begin with the 110.108-109 sequence or Honors Single Variable Calculus (110.113); students majoring in other subjects may wish to take the 110.106-107 sequence which relates the methods of calculus to the biological and social sciences. A one-term pre-calculus course 110.105 is offered for students who could benefit from additional preparation in the basic tools (algebra and trigonometry) used in calculus.

Entering students may receive course credit for Calculus I or Calculus I-II on the basis of the College Board AP exams. Students without AP credit should take a departmental placement exam to determine which course would be appropriate for them. For more information regarding placement, please visit **www.math.jhu.edu**.

Linear Algebra (110.201), Calculus III (110.202), and Differential Equations With Applications (110.302) may be taken in any order after completing Calculus II (110.107 or 110.109). These courses are especially designed to acquaint students with mathematical methods relevant to engineering and the physical, biological, and social sciences. The department offers honors courses in both Honors Linear Algebra (110.212) and Calculus III (Honors Multivariable Calculus 110.211). Additional courses oriented toward applications include Methods of Complex Analysis (110.311), Partial Differential Equations for Applications (110.417), Dynamical Systems (110.421), Introduction to the Calculus of Variations (110.423), and Fourier Analysis (110.443). Students interested in the theoretical foundations of mathematics may select Advanced Algebra I and II (110.401-402), Elementary Number Theory (110.304), Non-Euclidean Geometry (110.328), Introduction to Real Analysis (110.405-406), Honors Analysis I, II (110.415-416), Introduction to Topology (110.413), and Introduction to Differential Geometry (110.439), as well as others (see below). Students planning to pursue further study in mathematics should work toward taking these theoretical courses as early as possible in their undergraduate years and are encouraged to take graduate-level courses as soon as they are qualified.

Requirements for the B.A. Degree:

In addition to the General Requirements for Departmental Majors, a candidate for the bachelor's degree in mathematics is required to have credit for the courses listed below. All courses used to meet these requirements must be completed with a grade of C- or better. Honors Multivariable Calculus (110.211) and Honors Linear Algebra (110.212) can be used in place of Calculus III (110.202) and Linear Algebra (110.201), respectively.

- Calculus I, II, and III. Majors are encouraged by not required to take Honors variants.

- Advanced Algebra I (110.401) and one other term of algebra, either Elementary Number Theory (110.304) or Advanced Algebra II (110.402). *Note:* Neither Linear Algebra (110.201) nor Honors Linear Algebra (110.212) satisfies this requirement.

- Either Analysis I (110.405) or Honors Analysis I (110.415) and one other term of analysis chosen from Methods of Complex Analysis (110.311), Analysis II (110.406), Introduction to Topology (110.413), Honors Analysis II (110.416), Partial Differential Equations for Applications (110.417), Dynamical Systems (110.421), Introduction to the Calculus of Variations (110.427), Introduction to Differential Geometry (110.439) or Fourier Analysis (110.443).

- One other mathematics course at the 300-level or above.

- Two terms in any one of the following areas of applications of mathematics, or other appropriate advanced and sufficiently quantitative courses as approved by the director of undergraduate studies (Please refer to the list under Degree Requirements on the Web site at **www.math.jhu.edu** for an up-to-date list):

  – *Physics:* Classical Mechanics (171.204), Introduction to Electromagnetic Theory (171.301), Topics in Advanced Electromagnetic Theory (171.302), Introduction to Quantum Mechanics (171.303-304), Statistical Physics and Thermodynamics (171.312).

  – *Chemistry:* Chemical Applications of Group Theory (030.345), Intermediate Quantum Chemistry (030.453), Physical Chemistry II (030.302).

  – *Applied Mathematics and Statistics:* Dynamical Systems (550.391), Introduction to Probability (550.420), Introduction to Stochastic Processes (550.426), Introduction to Statistics (550.430), Mathematical Game Theory (550.453), Combinatorial Analysis (550.471) Graph Theory (550.472).

  – Economics: Microeconomic Theory (180.301), Macroeconomic Theory (180.302).

– Computer Science: Artificial Intelligence (600.435), Algorithms I (600.463), Randomized Algorithms (600.464, 600.488).

Requirements for a Minor in Mathematics:

Students with a major in another department may be awarded a minor in mathematics upon completion of satisfactory work in the following courses:

• Calculus I, II, and III.

• Four mathematics courses at the 200-level or above (excluding Calculus III), of which at least three are at the 300-level. A course in the Applied Mathematics and Statistics Department (at the 300-level or above) may be substituted for one of the four courses.

• All courses used to meet these requirements must be completed with a grade of C- or better.

Honors Program in Mathematics:

As a general guideline, departmental honors are awarded to recipients of the B.A. degree who have completed Methods of Complex Analysis (110.311), as well as Advanced Algebra I, II (110.401-402), the Honors Analysis I, II (110.415-416), and one more course at the 400-level or above with at least a 3.6 average in these six courses.

J. J. Sylvester Prize

The J. J. Sylvester Prize in Mathematics, which carries a cash award, is given each year to the one or two top performing graduating seniors majoring in mathematics for outstanding achievement.

The B.A./M.A. Program

By applying the same courses simultaneously toward the requirements for the B.A. and M.A. degrees, an advanced student can qualify for both degrees in four years. Admission to the program is by the standard graduate application form, which should be completed in the junior year. At least a 3.0 average is required in the 400-level mathematics courses taken while resident at the university. Students may contact the graduate program assistant for further information.

Undergraduate Teaching Assistantships

The department awards many upper level undergraduates the opportunity to act as recitation instructors to our freshman courses, enabling them to practice the art of teaching and talking mathematics and earn a valuable credential while studying for their degree.

Graduate Programs

Admission

Admission to the Ph.D. program is based on academic records, letters of recommendation, and Graduate Record Examination scores. International applicants are required to submit a TOEFL or IELTS score if English is not their native language.

Basic Program

Graduate study is centered around three core areas:

Analysis—Real Variables (110.605), Complex Variables (110.607), Riemann Surfaces (110.608), Several Complex Variables (110.611-612), Partial Differential Equations (110.631-632), and Riemannian Geometry (110.645-646).

Algebra—Algebra (110.601-602), Number Theory (110.617-618), Lie Groups & Lie Algebras (110.619-620), and Algebraic Geometry (110.643-644).

Topology—Algebraic Topology (110.615-616).

These 600-level graduate courses are preliminary to research and are built upon the foundations constituted by the 400-level courses: Advanced Algebra I & II (110.401-402), Analysis (110.405-406 or 110.415-416), Methods of Complex Analysis (110.311), Introduction to Topology (110.413), and Introduction to Differential Geometry (110.439).

The 700-level courses are designed to bring students abreast of recent developments and to prepare them for research in the area of their choice.

Requirements for the M.A. Degree:

Although the Mathematics Department does not admit students seeking a terminal M.A. degree, students in the Ph.D. program may earn an M.A. degree. Advanced undergraduate students may also apply to be admitted to the accelerated B.A./M.A. program.

M.A. candidates must complete:

• Four graduate courses given by the Hopkins Mathematics Department;

• Two additional courses at the graduate or 400-level, other than 110.401, 110.405, and 110.415, given by the Hopkins Mathematics Department, or with the permission of the graduate program director, graduate mathematics courses given by other departments or universities.

All courses used to satisfy the requirements must be completed with a grade of B- or better. (Advanced graduate courses completed with a grade of P can also be used to satisfy the requirements.)

Requirements for the Ph.D. Degree:

The departmental requirements for the Ph.D. degree are:

1. Candidates must show satisfactory work in Algebra (110.601-602), Real Variables (110.605), Complex Variables (110.607), Algebraic Topology (110.615), and one additional mathematics graduate course in their first year. The seminars and qualifying exam preparation course cannot be used to fulfill this requirement. The algebra and analysis requirements can be satisfied by passing the corresponding written qualifying exam in September of the first year; these students must complete at least two courses each semester. Students having sufficient background in topology can substitute an advanced topology course for 110.615, with the permission of the instructor.

2. Candidates must pass written qualifying exams by the beginning of their second year in Analysis (Real and Complex) and in Algebra. Exams are scheduled for September and May of each academic year.

3. Candidates must show satisfactory work in at least two mathematics graduate courses each semester of their second year, and if they have not passed their oral qualifying exam, in the first semester of their third year.

4. Candidates must pass an oral qualifying examination in the student's chosen area of research by April 8th of the third year. The topic of the exam is chosen in consultation with the faculty member who has agreed (provisionally) to be the student's thesis advisor, who will also be involved in administering the exam.

5. There is no longer a Math Department foreign language requirement. With the vast majority of articles written nowadays in English, the importance of having the capability of reading another language has diminished. However, important earlier literature in certain areas of mathematics may be written in French, German or Russian; moreover, some articles are still being written in French. It is now at the discretion of the student's thesis advisor whether to impose a language requirement.

6. Candidates must produce a written dissertation based upon independent and original research.

7. Candidates will have teaching experience in mathematics as a teaching assistant for undergraduate courses. The student will be under the supervision of both the faculty member teaching the course and the director of undergraduate studies. First year students are given a reduced TA workload In the Spring Semester (this is related to Item #2).

8. After completion of the thesis research the student will defend their dissertation by means of the Graduate Board Oral exam. The exam must be held at least three weeks before the Graduate Board deadline that the candidate wishes to meet.

Financial Aid

Students admitted to the Ph.D. program receive teaching assistantships and full tuition fellowships. Exceptional applicants become candidates for one of the university's George E. Owen Fellowships.

William Kelso Morrill Award

The William Kelso Morrill Award for excellence in the teaching of mathematics is awarded every spring to the graduate student who best exemplifies the traits of Kelso Morrill: a love of mathematics, a love of teaching, and a concern for students.

Excellence in Teaching Awards

Three awards are given each year to a junior faculty member and graduate student teaching assistants who have demonstrated exceptional ability and commitment to undergraduate education.

Undergraduate Courses

Please visit the Mathematics Web page at **www. math.jhu.edu** for updated course offerings.

Any course presented as a prerequisite must be completed with a grade of C- or higher.

110.105 (Q) Introduction to Calculus
This course is a pre-calculus course and provides students with all the background necessary for the study of calculus. It includes a review of algebra, trigonometry, exponential and logarithmic functions, coordinates and graphs. Each of these tools will be introduced in its cultural and historical context. The concept of the rate of change of a function will be introduced. Not open to students who have studied calculus in high school.
4 credits

110.106-107 (Q) Calculus I, II (Biological and Social Sciences)
Differential and integral calculus. Includes analytic geometry, functions, limits, integrals and derivatives, introduction to differential equations, functions of several variables, linear systems, applications for systems of

linear differential equations, probability distributions. Applications to the biological and social sciences will be discussed, and the courses are designed to meet the needs of students in these disciplines. This series is to be considered a terminal series and not intended for students who plan to continue taking higher-level mathematics courses.
4 credits

110.108-109 (Q) Calculus I, II (Physical Sciences and Engineering)

Differential and integral calculus. Includes analytic geometry, functions, limits, integrals and derivatives, polar coordinates, parametric equations, Taylor's theorem and applications, infinite sequences and series. Applications to the physical sciences and engineering will be discussed, and the courses are designed to meet the needs of students in these disciplines. This series is to be considered the gateway series to higher-level mathematics courses.
4 credits

110.113 (Q) Honors Single Variable Calculus

This is an honors alternative to the calculus sequences 110.106-107 or 110.108-109 and meets the general requirements for both Calculus I and II (although the credit hours count for only one course). It is a more theoretical treatment of one variable differential and integral calculus and is based on our modern understanding of the real number system as explained by Cantor, Dedekind, and Weierstrass. Students interested in studying the theoretical basis of the calculus of functions of one Independent variable will find this course rewarding. Previous background in calculus is not assumed. Students will learn differential calculus (derivatives, differentiation, chain rule, optimization, related rates, etc.), the theory of integration, the fundamental theorem(s) of calculus, applications of integration, and Taylor series. Prerequisite: A strong ability to learn mathematics quickly and on a higher level than that of the regular calculus sequences.
4 credits

110.201 (Q) Linear Algebra

Vector spaces, matrices, and linear transformations. Solutions of systems of linear equations. Eigenvalues, eigenvectors, and diagonalization of matrices. Applications to differential equations. Prerequisite: Calculus I.
4 credits

110.202 (Q) Calculus III (Calculus of Several Variables)

Calculus of functions of more than one variable: partial derivatives and applications; multiple integrals, line and surface integrals; Greens Theorem, Stokes Theorem, and Gauss Divergence Theorem. Prerequisite: Calculus II.
4 credits

110.211 (Q) Honors Multivariable Calculus

This course includes the material in Calculus III (110.202) but with a strong emphasis of theory and proofs. Recommended only for mathematics majors and mathematically able students majoring in physical science, or engineering. Prerequisite: B+ or better in Calculus II, or 5 on the Calculus BC AP Exam, or 110.113.
4 credits

110.212 (Q) Honors Linear Algebra

This course includes the material in Linear Algebra (110.201) but with a strong emphasis of theory and proofs. Recommended only for mathematics majors and mathematically able students majoring in physical sciences, or engineering. Prerequisite: B+ or better in Calculus II, Linear Algebra, or Honors Linear Algebra (either may be taken as a co-requisite).
4 credits

110.225 (Q) Putman Problem Solving

Problem-solving course to prepare students for the Putman exam.
2 credits

110.302 (Q,E) Differential Equations with Applications

This is a course in the theory and practical applications of differential equations involving one independent variable (ordinary differential equations), with applications in the biological, physical and social sciences, and engineering. Topics include the study and development of possible solution techniques to first order differential equations, including existence and uniqueness of solutions, second and higher order linear differential equations, both homogeneous and nonhomogeneous, systems of linear differential equations, autonomous systems, nonlinear and almost linear systems, the Laplace transforms, bifurcation and Poincare-Bendixson theory, with mathematical models (e.g., in the sciences or economics). Prerequisite: Calculus II.
4 credits

110.304 (Q) Elementary Number Theory

The student is provided with many historical examples of topics, each of which serves as an illustration of and provides a background for many years of current research in number theory. Primes and prime factorization, congruences, Euler's function, quadratic reciprocity, primitive roots, solutions to polynomial congruences (Chevalley's theorem), Diophantine equations including the Pythagorean and Pell equations, Gaussian integers, Dirichlet's theorem on primes. Prerequisites: Calculus II and Linear Algebra.
4 credits

110.311 (Q) Methods of Complex Analysis

This course is an introduction to the theory of functions of one complex variable. Its emphasis is on techniques and applications, and it serves as a basis for more advanced courses. Functions of a complex variable and their derivatives; power series and Laurent expansions; Cauchy integral theorem and formula; Calculus of residues and contour integrals; harmonic functions. Prerequisite: Calculus III.
4 credits

110.328 (Q) Non-Euclidean Geometry

For 2,000 years, Euclidean geometry was the geometry. In the 19th century, new, equally consistent but very different geometries were discovered. This course will delve into these geometries on an elementary but mathematically rigorous level. Prerequisite: high school geometry.
4 credits

110.401 (Q) Advanced Algebra I

An introduction to the basic notions of modern algebra. Elements of group theory: groups, subgroups, normal subgroups, quotients, homomorphisms. Generators and relations, free groups, products, commutative (Abelian) groups, finite groups. Groups acting on sets, the Sylow theorems. Definition and examples of rings and ideals. Introduction to field theory. Linear algebra over a field. Field extensions, constructible polygons, non-trisectability. Prerequisite: Linear Algebra.
4 credits

110.402 (Q) Advanced Algebra II

This is a continuation of 110.401. Theory of fields (continued). Splitting field of a polynomial, algebraic closure of a field. Galois theory: correspondence between subgroups and subfields. Solvability of polynomial equations by radicals. Modules over a ring. Principal ideal domains, structure of finitely generated modules over them. Applications.
4 credits

110.405 (Q) Introduction to Real Analysis

This course is designed to give a firm grounding in the basic tools of analysis. It is recommended as preparation (but may not be a prerequisite) for other advanced analysis courses. Real and complex number systems, topology of metric spaces, limits, continuity, infinite sequences and series, differentiation, Riemann-Stieltjes integration. Prerequisites: Calculus III, Linear Algebra.
4 credits

110.406 (Q) Calculus on Manifolds

An introduction to the Calculus of maps between topological spaces which are not necessarily Euclidean. Topics include manifolds, local parameterization, tangent spaces and bundles, differentiation and integration of maps, vector fields and flows, inverse and implicit functions theorems, transversality, differential forms and multilinear algebra. Prerequisite: 110.405 or 110.415.
4 credits

110.407-408 (Q,N) Geometry and Relativity

Special relativity: Lorentz transformation, Minkowski spacetime, mass, energy-momentum, stress-energy tensor, electrodynamics. Introduction to differential geometry: theory of surfaces, first and second fundamental forms, curvature, Gauss's Theorema Egregium, differentiable manifolds, connections and covariant differentiation, geodesics, differential forms, Stoke's theorem. Gravitation as a geometric theory: Lorentz metrics, Riemann curvature tensor, tidal forces and geodesic deviation, gravitational redshift, Einstein field equation, the Schwarzschild solution, perihelion precession, the deflection of light, black holes, cosmology. Prerequisites: Calculus II, Linear Algebra, General Physics II.
4 credits

110.413 (Q) Introduction to Topology

The basic concepts of point-set topology: topological spaces, connectedness, compactness, quotient spaces, metric spaces, function spaces. An introduction to algebraic topology: covering spaces, the fundamental group, and other topics as time permits. Prerequisite: Calculus III.
4 credits

110.415 (Q) Honors Analysis I

This highly theoretical sequence in analysis is reserved for the most able students. The sequence covers the real number system, metric spaces, basic functional analysis, the Lebesgue integral, and other topics. Prerequisites: Calculus III and Linear Algebra.
4 credits

110.416 (Q) Honors Analysis II

This course continues 110.415, with an emphasis on the fundamental notions of modern analysis. Topics here include functions of bounded variation, Riemann-Stieltjes integration, Riesz representation theorem, along with measures, measurable functions, and the Lebesgue integral, properties of Lp- spaces, and Fourier series. Prerequisite: 110.405 or 110.415.
4 credits

110.417 (Q,E) Partial Differential Equations for Applications

Characteristics, classification of second order equations, well-posed problems, separation of variables and expansions of solutions. The wave equation: Cauchy problem, Poisson's solution, energy inequalities, domains of influence and dependence. Laplace's equation: Poisson's formula, maximum principles, Green's functions, potential theory, Dirichlet and Neumann problems, eigenvalue problems. The heat equation: fundamental solutions, maximum principles. Prerequisites: Calculus III. Recommended: 110.405 or 110.415.
4 credits

110.421 (Q) Dynamical Systems

A basic introduction to the general theory of dynamical systems from a mathematical standpoint, this course studies the properties of continuous and discrete dynamical systems, in the form of ordinary differential and difference equations and iterated maps. Topics include contracting and expanding maps, interval and circle maps, toral flows, billiards, limit sets and recurrence, topological transitivity, bifurcation theory and chaos, fractal dimension and topological entropy. Applications include classical mechanics and optics, inverse and implicit functions theorems, the existence and uniqueness of general ODEs, stable and center manifolds, and structural stability. Prerequisites: Calculus III, Linear Algebra, and 110.302.
4 credits

110.423 (Q) Lie Groups for Undergraduates

This course is an introduction to Lie groups and their representations. It will cover basic Lie groups such as $SU(2)$, $U(n)$, the Euclidean motion group and the Lorentz group, and is designed for students who want a working knowledge of group representations. Some aspects of the role of symmetry groups in particle physics such as some of the formal aspects of the electroweak and the strong interactions will also be discussed. Prerequisite: Calculus III. Prior knowledge of group theory (e.g., 110.401) would be helpful.
4 credits

110.427 (Q) Introduction to the Calculus of Variations

The calculus of variations is concerned with finding optimal solutions (shapes, functions, etc.) where optimality is measured by minimizing a functional (usually an integral involving the unknown functions) possibly with constraints. Applications include mostly one-dimensional (often geometric) problems: brachistochrone, geodesics, minimum surface area of revolution, isoperimetric problem, curvature flows, and some differential geometry of curves and surfaces. Prerequisite: Calculus III.
4 credits

110.429 (Q) Mathematics of Quantum Mechanics

The basis of quantum mechanics is the Schrodinger equation. The focus of this course will be on one-dimensional Schrodinger equations. Topics include eigenvalue problems, bound states, scattering states, tunneling, uncertainty principle, dynamics, semi-classical limit. The ideas will be illustrated through many examples. Prerequisite: 110.302 or permission of the instructor.
4 credits

110.431 (Q) Introduction to Knot Theory

The theory of knots and links is a facet of modern topology. The course will be mostly self-contained, but a good working knowledge of groups will be helpful. Topics include braids, knots and links, the fundamental group of a knot or link complement, spanning surfaces, and low-dimensional homology groups. Prerequisite: Calculus III.
4 credits

110.439 (Q) Introduction to Differential Geometry

Theory of curves and surfaces in Euclidean space: Frenet equations, fundamental forms, curvatures of a surface, theorems of Gauss and Mainardi-Codazzi, curves on a surface; introduction to tensor analysis and Riemannian geometry; Theorema Egregium; elementary global theorems. Prerequisites: Calculus III, Linear Algebra.
4 credits

110.443 (Q,E) Fourier Analysis

An introduction to the Fourier transform and the construction of fundamental solutions of linear partial differential equations. Homogeneous distributions on the real line: the Dirac delta function, the Heaviside step function. Operations with distributions: convolution, differentiation, Fourier transform. Construction of fundamental solutions of the wave, heat, Laplace and Schrödinger equations. Singularities of fundamental solutions and their physical interpretations (e.g., wave fronts). Fourier analysis of singularities, oscillatory integrals, method of stationary phase. Prerequisites: Calculus III, Linear Algebra. Recommended: 110.405 or 110.415.
4 credits

110.462 (Q) Prime Numbers and Riemann's Zeta Function

This course is devoted to such questions as: How many prime numbers are there less than N? How are they spaced apart? Although prime numbers at first sight have nothing to do with complex numbers, the answers to these questions (due to Gauss, Riemann, Hadamard) involve complex analysis and in particular the Riemann zeta function. The best-known unsolved conjecture in mathematics is about the zeros of Riemann zeta function, which control the distribution of primes. This course builds on 110.311 and is an introduction to analytic number theory for undergraduates. Prerequisite: 110.311.
4 credits

110.599 Independent Study, Undergraduate

Graduate Courses

110.601-602 Algebra

An introductory graduate course on fundamental topics in algebra to provide the student with the foundations for number theory, algebraic geometry, and other advanced courses. Topics include group theory, commutative algebra, Noetherian rings, local rings, modules, rudiments of category theory, homological algebra, field theory, Galois theory, and non-commutative algebras. Prerequisites: 110.401-402 or equivalent.

110.605 Real Variables

Measure and integration on abstract and locally compact spaces (extension of measures, decompositions of measures, product measures, the Lebesgue integral, differentiation, Lp-spaces); introduction to functional analysis; integration on groups; Fourier transforms. Prerequisites: 110.405 or 110.415, 110.413, or equivalent.

110.607 Complex Variables

Analytic functions of one complex variable. Topics include Mittag-Leffler theorem, Weierstrass factorization theorem, elliptic functions, Picard theorem, and Nevanlinna theory. Prerequisites: 110.311 and 110.405 or 110.415, or equivalent.

110.608 Riemann Surfaces

Abstract Riemann surfaces. Examples: algebraic curves, elliptic curves and functions on them. Holomorphic and meromorphic functions and differential forms, divisors and the Mittag-Leffler problem. The analytic genus. Bezout's theorem and applications. Introduction to sheaf theory, with applications to constructing linear series of meromorphic functions. Serre duality, the existence of meromorphic functions on Riemann surfaces, the equal-

ity of the topological and analytic genera, the equivalence of algebraic curves and compact Riemann surfaces, the Riemann-Roch theorem. Period matrices and the Abel-Jacobi mapping, Jacobi inversion, the Torelli theorem. Uniformization (time permitting). Prerequisite: 110.607.

110.611-612 Several Complex Variables
Domains of holomorphy and pseudoconvexity, Levi pseudoconvexity. The Weierstrass preparation and division theorems, properties of the local ring of germs of holomorphic functions, complex analytic varieties, the Ruckert Nullstellensatz. Sheaves and cohomology, coherent analytic sheaves, Oka's coherence theorem, Dolbeault cohomology. Additional topics such as Chow's theorem, L2-cohomology, integral formulas, Cartan's theorems A and B, compact complex manifolds. Prerequisite: 110.413. Recommended: 110.605.

110.615-616 Algebraic Topology
Polyhedra, simplicial and singular homology theory, Lefschetz fixed-point theorem, cohomology and products, homological algebra, Künneth and universal coefficient theorems, Poincaré and Alexander duality theorems. Prerequisites: 110.401, 110.413, or equivalent.

110.617-618 Number Theory
Topics in advanced algebra and number theory, including local fields and adeles, Iwasawa-Tate theory of zeta functions and connections with Hecke's treatment, semi-simple algebras over local and number fields, adeles geometry. Prerequisites: 110.601-602.

110.619-620 Lie Groups and Lie Algebras
Lie groups and Lie algebras, classification of complex semi-simple Lie algebras, compact forms, representations and Weyl formulas, symmetric Riemannian spaces. Prerequisite: 110.401 or equivalent.

110.631-632 Partial Differential Equations
An introductory graduate course in partial differential equations. Classical topics include first order equations and characteristics, the Cauchy-Kowalevski theorem, Laplace's equation, heat equation, wave equation, fundamental solutions, weak solutions, Sobolev spaces, maximum principles. The second term focuses on special topics such as second order elliptic theory. Prerequisites: 110.605.

110.635-636 Microlocal Analysis
Microlocal analysis is the geometric study of singularities of solutions of partial differential equations. The course will begin by introducing the geometric theory of (Schwartz) distributions: Fourier transform and Sobolev spaces, pseudo-differential operators, wave front set of a distribution, elliptic operators, Lagrangean distributions, oscillatory integrals, method of stationary phase, Fourier integral operators. The second semester will develop the theory and apply it to special topics such as asymptotics of eigenvalues/eigenfunctions of the Laplace operator on a Riemann manifold, linear and non-linear wave equation asymptotics of quantum systems, Bochner-Riesz means, maximal theorems. Prerequisites: 110.605. Recommended: 110.631.

110.641 Harmonic Analysis
Harmonic analysis begins with Fourier analysis on Euclidean space. Topics include Littlewood-Paley theory, oscillatory integrals, restriction theorems for the Fourier transform, Bochner-Riesz means and multiplier theorems. Prerequisites: 110.605.

110.643-644 Algebraic Geometry
Affine varieties and commutative algebra. Hilbert's theorems about polynomials in several variables with their connections to geometry. General varieties and projective geometry. Dimension theory and smooth varieties. Sheaf theory and cohomology. Applications of sheaves to geometry; e.g., the Riemann-Roch theorem. Other topics may include Jacobian varieties, resolution of singularities, geometry on surfaces, connections with complex analytic geometry and topology, schemes. Prerequisites: 110.601-602.

110.645-646 Riemannian Geometry
Differential manifolds, vector fields, flows, Frobenius' theorem. Differential forms, deRham's theorem, vector bundles, connections, curvature, Chern classes, Cartan structure equations. Riemannian manifolds, Bianchi identities, geodesics, exponential maps. Geometry of submanifolds, hypersurfaces in Euclidean space. Other topics as time permits, e.g., harmonic forms and Hodge theorem, Jacobi equation, variation of arc length and area, Chern-Gauss-Bonnet theorems. Prerequisites: 110.405 or 110.415, 110.413 or equivalent. Recommended: 110.406.

110.660 Qualifying Exam Problems.

110.721-722 Homotopy Theory
Homotopy groups, fiber spaces, fiber bundles, Hurewicz isomorphism theorem, local coefficients, spectral sequences, cohomology operations, obstruction theory, Postnikov systems. Prerequisites: 110.615-616.

110.723-724 Topics in Automorphic Functions

110.725-726 Topics in Analysis

110.727-728 Topics in Algebraic Topology

110.729-730 Topics in Several Complex Variables

110.733-734 Topics in Algebraic Number Theory

110.735-736 Topics in Hodge Theory

110.737-738 Topics in Algebraic Geometry

110.739 Topics in Analytic Number Theory

110.741-742 Topics in Partial Differential Equations

110.751-752 Topics in Group Representations

110.753-754 Topics in Mathematical Physics

110.799 Thesis Research

110.800 Independent Study, Graduate

Military Science

The JHU Army Reserve Officers' Training Corps (ROTC) was among the first to be established by Congress in 1916 and is routinely ranked at the top of the Nation's 273 programs. Nearly 3,000 Hopkins students have received Army officer commissions through the program, with over 40 attaining the rank of general officer. Students can enter the program with as little as two years remaining as an undergraduate or may complete the requirements while pursuing a graduate degree. Upon graduation, Hopkins students are commissioned as a second lieutenant in the U.S. Army. Some are selected to attend a funded law school or several medical programs, while others serve in the Active Army, Reserves or National Guard. ROTC basic classes are open to all students: The Leadership and Management class specializes in leader development and is an excellent course for students aspiring to become leaders on campus and beyond. Additional information on military science or ROTC can be obtained at our building (behind the athletic center), by asking a current cadet, and by calling 1-800-JHU-ROTC or 410-516-7474. You can also email us at rotc@jhu.edu or visit the JHU ROTC website at **www.jhu.edu/rotc**.

The Faculty

Paul Carroll, Director and Professor; Lieutenant Colonel

Jeremy Bushyager, Assistant Professor and Enrollment Officer, Major

Rolando Rodriguez, Assistant Professor, Major

Matt Dusablon, Assistant Professor, Captain

Jeff Wood, Assistant Professor, Captain

Glen Stambone, Adjunct Professor, Captain

Garth Ambersley, Senior Military Instructor, Master Sergeant

Brian O'Neill, Military Instructor, Sergeant 1st Class

Shane Seay, Military Instructor, Sergeant 1st Class

Scholarship and Financial Assistance

Army ROTC offers four-, three-, and two-year scholarships that pay full tuition (or room and board), $1,200 for books and a $300-500 monthly stipend. For students that join after their freshman year, a onetime $5,000 incentive bonus may be available and can be coupled with a loan repayment option. Additional incentives include a monthly language stipend ($100-250 credit), a study abroad program ($6,000), special incentives for nurses, and postgraduate programs for medical and law degrees.

Scholarship opportunities are regularly improved and incentives are added. Applications for scholarships by qualified students are awarded throughout the semester, and are often retroactive. A nonscholarship program is also available. For health profession and nursing students, ROTC can offer numerous opportunities to achieve specialized education, additional postgraduate scholarships and accession/graduation bonuses.

Curriculum

The curriculum normally consists of a two-year Basic Course (freshmen / sophomores) and a two-year Advanced Course (juniors / seniors). Some modification to this curriculum is common, as with graduate or transfer students. Completing the 30-day Leader's Training Course (LTC) at Fort Knox, KY, is equivalent to the Basic Course. Successful graduates of LTC are normally offered ROTC scholarships and an opportunity to enroll in the Advanced Course. Junior-ROTC experience, prior military service and military academy attendance may also qualify for Basic Course completion.

All Advanced Course students are cadets and have a contractual agreement with the Army. These students attend the National Leadership Development and Assessment Course (LDAC) at Fort Lewis, WA, between the 300- and 400-level courses. This is a core requirement to commission in the Army and cannot be waived.

Army ROTC strives to develop values-based graduates who offer expert leadership to the campus, the community and the Army. As such, we offer and encourage cadets to participate in: paid leadership and technical internships; cultural and language immersion programs; a number of Army military school opportunities in: Europe, South America, the Republic of Korea, Alaska, Hawaii and across the continental United States.

Extracurricular activities may also include: community assistance, Red Cross blood drives, tutoring for at-risk children, and volunteering at the Veterans Administration. Cadets may apply for additional military training such as skydiving, helicopter rappelling, mountaineering, and cold weather training. New and challenging opportunities routinely become available.

Courses

Basic Course

374.101 Leadership and Management I

This is an introductory course in basic leadership and management concepts, theories and principles of decision making for application to any professional environment. This course is recommended for those who have leadership aspirations or are currently in student leadership positions. This course is intended to provide a foundation for those desiring to establish and improve their personal leadership philosophy. It establishes a baseline understanding of the US Army's leadership and management principles. This course is taught through a series of lectures and small group discussions. Students are required to conduct research in the areas of leadership and management and present their findings in an oral presentation or written report to their small group. In addition to learning the foundations of leadership, students will learn about the corporate and noncorporate aspects and operations of the US Army, time management, ethics, values, mission statements, and goal setting. Co-requisite: 374.110 for ROTC students; none for non-ROTC students.

Wood, Bushyager   2 credits

374.102 Leadership and Management II

This is an introductory course in which we apply five tracks of instruction in leadership, personal development, values and ethics, officership, and tactics. This course is complementary to 374-101, Leadership and Management I, although either course can be taken independently. This course is recommended for those who want to improve their leadership skills and abilities, whether or not they are currently in leadership positions. This course is intended to provide the student with basic leadership and management tools and abilities that can be applied in any personal or professional endeavor. This course is taught through a series of lectures, small group discussions, and practical exercises. Students are required to present information in a verbal briefing, and to apply their leadership and management skills in small group practical exercises. In addition to learning the foundations of leadership students will learn about the corporate and noncorporate aspects and operations of the US Army organization, time management, ethics and values and mission statements and goals. Co-requisite: 374.120 for ROTC students; none for non-ROTC students.

Wood, Bushyager   2 credits

374.110-120 Basic Leadership Laboratory I, II

These introductory courses in a laboratory environment are designed to expose students to practical experiences, challenges, and individual learning opportunities in a small group. Students learn the fundamentals of an organization and apply principles of leadership and management at the foundation level. Students develop military courtesy, organizational discipline, and communication and basic leadership/management skills. Ultimately,

students understand how to facilitate and lead a small group of four to five people as an integral part of a larger organization of 75-100 people through situational training opportunities in a variety of conditions. As a leadership practicum, students have the opportunity to serve in leadership positions and receive tactical and technical training. In addition to learning to lead groups of five to 100 people, students will be exposed to training on first aid, operating Army equipment, and Army activities such as rappelling and drill and ceremony. These laboratories are required for enrolled ROTC participants who desire to be considered for a commission in the Army. Co-requisite: 374.101-102.

Bushyager, Ambersley   1 credit   2 hours

374.201 Leadership and Communication

The focus of this course is on developing leadership and communication skills. Case studies will provide a tangible context for learning and applying aspects of team building, values, the Army Warrior Ethos, and principles of war as they apply in the contemporary operating environment. The key objective of this course is to develop knowledge of the Army's leadership philosophies and integrate this knowledge into personal skills and team development. At the end of this course, students will be able to describe and perform tasks during the four basic phases of team building; demonstrate the types and elements of interpersonal communication; illustrate, explain, and apply the Principles of War; identify and apply problem-solving steps, and apply basic leadership procedures in simple and complex situations. Co-requisite: 374.210; none for non-ROTC students.

Dusablon, Seay   2 credits

374.202 Leadership and Teamwork

This course will explore how to influence, develop, and achieve success as a leader. It examines the challenges of leading small tactical teams in the complex contemporary operating environment (COE). This course highlights dimensions of terrain analysis, patrolling, and operation orders, and examines broader applications of leadership and team development. Continued study of the theoretical basis of the Army leadership framework explores the dynamics of adaptive leadership in the context of military operations. Students will assess their own leadership styles and practice communication and team-building skills. Several COE case studies give insight into the importance and practice of teamwork and tactics in real-world scenarios. Co-requisite: 374.220; none for non-ROTC students.

Dusablon, Seay   2 credits

374.210 Basic Team Leadership Laboratory

Students lead and assist in leading 4-5 person teams through a variety of training opportunities. They learn the troop-leading procedures, basic problem solving, and tactical skills aimed at military leadership. Students will mentor and assist members of their team with improving their own skills and leadership as well. Co-requisite: 374.201.

Dusablon, Seay   1 credit   2 hours

374.220 Intermediate Team Leadership Laboratory

Students further develop their leadership, as team leaders of 4-5 other students, during a variety of induced training opportunities. They also begin to lead larger groups, from 9 to 60 people, in a variety of situations designed to challenge emerging leaders. Continued emphasis is placed on troop-leading procedures and problem solving. Students lead physical fitness training and mentor subordinates in military, academic, and extracurricular activities. Successful completion of this course allows students to progress into ROTC Advanced Courses. Co-requisite: 374.202.

Dusablon, Seay   1 credit   2 hours

Advanced Course

374.301 Leadership and Tactical Theory I

Students will be introduced to the tenets of Army leadership, officership, Army values and ethics, and personal development. Students will learn the fundamentals of physical training, land navigation, orders production, and small unit tactics at the squad and platoon level. Each student will be given multiple opportunities to plan and lead squad level tactical missions in the classroom and during Leadership Laboratories. Co-requisite: 374.310. Prerequisite: Basic Course completion.

Rodriguez, O'Neill   2 credits

374.302 Leadership and Tactical Theory II

Training will build on the first semester's achievements as students are challenged to study, practice, and apply the fundamentals of Army leadership, officership, Army values and ethics, and small unit tactics at the squad and platoon level. Each student, by the end of the course, will be capable of planning, coordinating, navigating, motivating, and leading in the execution of a tactical mission during a classroom practical exercise, a Leadership Lab, or in a field environment. Students are rotated through a variety of leadership positions that support ROTC events throughout the semester. The student will receive detailed and constructive feedback on their leader attributes and core leader competencies based on Army FM 6-22, Army Leadership. Ultimately, prepares students to excel at the four-week National Leadership Development and Assessment Course at Fort Lewis, WA. Co-requisite: 374.320. Prerequisites: Basic Course and 374.301.

Rodriguez, O'Neill   2 credits

374.307 Leadership in Military History

This course provides students with a historical perspective to decisions made by American military leaders: battlefield complexity, resource limitations, and teamwork deficiencies. Students cover major military engagements from the colonial period through the current operating environment. Students examine how leaders motivated their men, devised battle strategies, implemented rules of engagement, and managed supplies, transportation, and logistics for their troops. Prerequisite: permission of the director of Military Science.

Dusablon, Seay   2 credits

374.310 Basic Tactical Leadership Laboratory

In Leadership Laboratory, students are given the opportunity to apply what they have learned in the classroom, in a tactical or field environment. Students learn and demonstrate the fundamentals of leadership by planning, coordinating, navigating, motivating, and leading squads in the execution of both garrison and tactical missions. Students are evaluated as part of the Leadership Development Program and FM 6-22, Army Leadership. Ultimately, prepares students to excel at the four-week National Leadership Development and Assessment Course at Fort Lewis, WA. Co-requisite: 374.301.

Rodriguez, O'Neill   1 credit   3 hours

374.320 Intermediate Tactical Leadership Laboratory

The laboratory builds on the first semester's achievements as students further develop their leadership skills by planning, coordinating, navigating, motivating, and leading squads in the execution of both garrison and tactical missions. Students are evaluated as part of the Leadership Development Program and FM 6-22, Army Leadership. Ultimately, prepares students to excel at the four-week National Leadership Development and Assessment Course at Fort Lewis, WA. Co-requisite: 374.302.

Rodriguez, O'Neill   1 credit   3 hours

374.401 Adaptive Leadership

Students are assigned the duties and responsibilities of an Army battalion staff officer and must apply the fundamentals of principles of training, the training management, the Army writing style and military decision making to weekly training meetings. Students plan, execute, and assess ROTC training and other mission essential tasks. Students will study how Army values and leader ethics are applied in the contemporary operating environment and how these values and ethics are relevant to everyday life. The student will study the Army officer's role in developing subordinates via counseling and administrative actions, as well as managing their own career. Students will be given numerous opportunities to train, mentor, and evaluate underclass students enrolled in the ROTC Basic Course while being mentored and evaluated by experienced ROTC cadre. Co-requisite: 374.410. Prerequisite: 374.301-302, 310-320, and the Basic Course.

Carroll   2 credits

374.402 Leadership in a Complex World

This course explores the dynamics of leading in the complex situations of current military operations in the contemporary operating environment (COE). Students examine foreign culture and customs and how they affect military operations; military professional ethics, laws governing war and the Uniform Code of Military Justice; the principles of war in relations to the COE; and rules of engagement in the face of international terrorism. They are also introduced to interacting with non-government organizations, civilians, and media on the battlefield and the complexity of host nation support. Ultimately this course provides the final preparations needed to commission and serve as a Second Lieutenant at the Basic Officer Leadership Course's B, as well as in the US Army.

Co-requisite: 374.420. Prerequisites: 374.301-302, 310-320, 374.401, and Basic Course.
Carroll   2 credits

374.410-420 Advanced Planning and Decision Making Laboratory I, II
Students develop a semester-long progression of programmed training activates that support completion of the unit's Mission Essential Task List. The laboratory builds from fall to spring semester as students master advanced problem solving, resource synchronization, and executive decision making. Students evaluate, mentor, and develop subordinate leaders as part of the Leadership Development Program and FM 6-22, Army Leadership. The course serves as the final evaluation and determination on a student's ability to lead soldier's as a second lieutenant in the US Army. Co-requisite: 374.401-402. Prerequisites: 374.301-302, 310-320 and Basic Course.
Carroll   1 credit   3 hours

374.501-502 Independent Study
Prerequisite: permission of the director of military science.
Carroll   1-2 credits

374.505-506 Leadership Internship
Prerequisite: permission of the director of military science.
Carroll   1-2 credits

Air Force ROTC Program

Admission to the Air Force ROTC program is available to JHU students through an agreement with UMCP. AFROTC courses have been scheduled to enable students to complete all the requirements in one morning per week at the College Park campus. JHU students are eligible to compete for all AFROTC scholarships and flying programs. The two-, three-, and four-year scholarships pay tuition, books, fees, and a stipend of $200 per month during the school year. After graduation and the successful completion of AFROTC requirements, students are commissioned second lieutenants in the Air Force. Those interested in this program should call 301-314-3242 or write to AFROTC Det 330, University of Maryland, Cole Field House, Room 2126, College Park, MD 20742-1021. For more information see the website at **www.inform.UMD.edu/AFROTC**.

Program in Museums and Society

The Program in Museums and Society is concerned with the institutions that shape knowledge and understanding through the collection, preservation, interpretation, and/or presentation of material culture. It focuses on the role of museums (broadly defined) and their contents in societies past and present, including their cultural, intellectual, and political significance.

A minor in Museums and Society complements study in a range of fields, including but not limited to anthropology, archaeology, history, history of art, and history of science and technology. Many courses include visits to or focused work in local and regional institutions, as well as in on-campus collections (Archaeological Museum, Homewood Museum, and Evergreen Museum & Library).

Whether they are researching a historical artifact or debating the obligations of public institutions, students in the program are challenged to approach their discipline from a new angle. While some may choose to pursue a museum career, the program has the larger goal of encouraging critical, careful thinking about some of the most influential cultural institutions of our day.

Director

Elizabeth Rodini, Senior Lecturer, History of Art: museum history, theory, and practice.

Advisory Committee

James Archer Abbott, Curator and Director, Evergreen Museum & Library: 19th- and 20th-century American decorative arts and furniture; historic houses; curatorial practice, including collections management and exhibitions.

Catherine Rogers Arthur, Curator and Director, Homewood Museum and Lecturer, History: American decorative arts, historic house museums, museum practice.

Sanchita Balachandran, Curator/Conservator, Johns Hopkins Archaeological Museum and Lecturer, Near Eastern Studies: conservation history and ethics; archaeological conservation and site management; collections management and museum practice.

Betsy M. Bryan, Professor and Alexander Badawy Chair in Egyptian Art and Archaeology, Near Eastern Studies: Egyptian art and archaeology, Egyptology.

Avi Decter, Executive Director, Jewish Museum of Maryland: public history in culturally specific institutions.

Lisa DeLeonardis, Austen Stokes Professor in Art of the Ancient Americas, History of Art.

Jane Guyer, Professor, Anthropology: economic anthropology of Africa.

Earle Havens, Curator, Special Collections: history of collecting, early libraries.

Richard Kagan, Professor, History: Early modern European history with an emphasis on Spain and Iberian expansion.

Stuart W. Leslie, Professor, History of Science and Technology: history of technology, science-based industry, 20th-century American science.

Mary Ryan, John Martin Vincent Professor, History: 19th-century United States history with an emphasis on women, gender, urban history, and the cultural landscape including the public spaces of Baltimore.

Faculty and Staff

Wilda Anderson, Professor, German and Romance Languages: French Enlightenment, science and literature, French Revolution and its aftermath.

Phyllis Arbesman Berger, Instructor and Supervisor of Photography, Homewood Art Workshops: digital fine art photography, artist books.

Rebecca M. Brown, Visiting Associate Professor, History of Art: Southeast Asian art, politics of display.

Stephen Campbell, Henry M. and Elizabeth P. Wiesenfeld Professor, History of Art: Italian Renaissance art, the studiolo and Renaissance collecting.

Gabrielle Dean, Curator, Rare Books and Manuscripts: history of books, libraries, reading, literary culture; books as objects.

Sophia Jordan-Mowery, Joseph Ruzicka and Marie-Ruzicka Feldman Director of Library Preservation, Sheridan Libraries: book and paper conservation, care and assessment.

Robert H. Kargon, Willis K. Shepard Professor of the History of Science, History of Science and Technology: history of physics, science, social change.

Phoebe Evans Letocha, Collections Management Archivist, Alan Mason Chesney Medical Archive: archival management, history of medicine.

Tobie Meyer-Fong, Associate Professor, History: social, cultural history of China since 1600.

Jacqueline M. O'Regan, Curator of Cultural Properties: acquisitions, documentation, and preservation of artifacts and art objects; development of institutional practices and guidelines; collection databases.

Christine A. Ruggere, Lecturer, and Associate Director and Curator, Historical Collections, Institute of the History of Medicine: anatomical collections, history of the book.

H. Alan Shapiro, W. H. Collins Vickers Professor of Archaeology, Classics: Greek and Roman art and archaeology; Greek iconography and religion.

Kathryn Tuma, Assistant Professor, History of Art: modern and contemporary art.

Hérica Valladares, Assistant Professor, Classics: Latin poetry, Roman art and archaeology, Renaissance reception of antiquity, 18th-century antiquarianism.

Judith Walkowitz, Professor, History: modern European cultural and social history with special interest in Great Britain, comparative women's history.

Ronald G. Walters, Professor, History: social and cultural history of the United States with special interest in radicalism, reform, race, and popular culture.

Adjunct and Visiting Appointments

Martina Bagnoli, Visiting Lecturer, History of Art: Associate Curator of Medieval Art, The Walters Art Museum.

Preston Bautista, Visiting Lecturer, History of Art: Director of Public Programs, The Baltimore Museum of Art.

Doreen Bolger, Adjunct Professor, History of Art: Director, The Baltimore Museum of Art.

Peter Bruun, Visiting Lecturer, History of Art: Independent Artist and Curator.

Robert Haywood, Visiting Lecturer, History of Art: Independent Scholar.

Rena Hoisington, Visiting Lecturer, History of Art: Associate Curator of Prints, Drawings and Photographs, The Baltimore Museum of Art.

Anne Manning, Deputy Director for Education, The Baltimore Museum of Art.

Arthur Molella, Visiting Lecturer, History of Science and Technology: Director, Lemelson Center for the Study of Invention and Innovation, National Museum of American History, Smithsonian Institution.

Gary Vikan, Adjunct Professor, History of Art: Director, The Walters Art Museum.

Alicia Weisberg-Roberts, Visiting Lecturer, History of Art: Associate Curator, 18th and 19th Century Art, The Walters Art Museum.

Requirements for a Minor in Museums and Society

Six different courses (minimum 18 credits) from those approved by the program, including:

• Introduction to the Museum: Past and Present (389.201)

• Introduction to the Museum: Issues and Ideas (389.202)

The remaining 12 credits must include:

• At least two courses from two different primary departments beyond Museums and Society (to be selected in consultation with the program's associate director).

• At least two courses at 300-level or higher.

• At least three credits of practicum work, but no more than three of internship work, selected from:

– Museum Matters (389.203)

– Courses designated as M&S practicum courses

– Independent Study and/or Internship (389. 501/502, 389.511/512).

Courses

389.201 (H,S) Introduction to the Museum:
Past and Present
This course surveys museums, from their origins to their most contemporary forms, in the context of broader historical, intellectual, and cultural trends. Anthropology, art, history, and science museums are considered. Offered fall semester. Cross-listed with Anthropology, History, History of Art.
Rodini, Staff   3 credits

389.202 (H,S) Introduction to the Museum:
Issues and Ideas
Focusing primarily on the contemporary scene, this course looks closely at the ethical, political, and practical challenges facing museums. These include debates over cultural property, control of museum content and narratives, economic pressures, and the impact of a global, technological outlook. Offered spring semester. Cross-listed with History of Art.
Rodini, Staff   3 credits

389.203 (H,W) Museum Matters
Through weekly field trips, group discussion, and analytical writing assignments, this course examines how museums organize, interpret, and present their holdings. Museum controversies, challenges, conflicts are examined. Offered alternate spring semesters; instructor permission required; prospective minors, freshmen, and sophomores given priority. M&S practicum course.
Arthur, Staff   3 credits

389.330 (H) Critique of the Museum in Contemporary Art
Since the 1960s, many artists have challenged art museum conventions, contesting the assumption that museums are ideologically neutral spaces of display. This institutional critique is examined in artworks, installations, literature. Cross-listed with History of Art.
Haywood   3 credits

389.340 (H) Critical Issues in Art Conservation
The course examines recent controversies in the conservation of major global artworks and sites, raising questions concerning the basic theoretical assumptions, practical methods, and ethical implications of art conservation. Cross-listed with Anthropology, History of Art.
Balachandran   3 credits

389.341 (H) Examining Archaeological Objects
Students examine objects in the Archaeological Museum to understand and recognize ancient materials and manufacturing techniques, identify conservation concerns, and pursue technical research questions related to specific artifacts. Cross-listed with History of Art, Near Eastern Studies, Classics. M&S practicum course.
Balachandran   3 credits

389.342 (H) Objects in Focus: Materials, Techniques, History
What can art and archaeological objects reveal about materials, their craftsmanship and preservation? We investigate artists' treatises, visit studios and museum conservation laboratories, and closely examine artworks. Cross-listed with History of Art, Classics, Near Eastern Studies. M&S practicum course.
Balachandran   3 credits

389.343 (H) Conservation of Modern and Contemporary Art
We examine how museums care for, interpret, and preserve modern and contemporary artworks that defy the traditional materials, display methods, and uses of ancient or historic art. Cross-listed with History of Art.
Balachandran   3 credits

389.345 (H) Introduction to Museum Practice
Taking the JHU Archaeological Museum as a case study and working closely with its holdings, we discuss the principles and practice of managing and preserving museum collections. Cross-listed with Anthropology, Classics, History of Art, Near Eastern Studies. M&S practicum course.
Balachandran   3 credits

389.354 (H) Paper Museums: Exhibiting Prints at the BMA
Students work with Baltimore Museum of Art print collection and staff to develop, organize, and design an exhibition. Many aspects of museum work are explored, including research, interpretation, presentation, programming, marketing. Cross-listed with History of Art. M&S practicum course.
Rodini, staff   3 credits

389.355 (H, W) Reading Culture in the 19th-Century Library
Students reconstruct the culture of reading in 19th-century America through an investigation of the Peabody Library (founded 1856) as a space and collection. Meets at Peabody. M&S practicum course. Cross-listed with English.
Dean   3 credits

389.356 (H) Halls of Wonder: Art, Science, and Literature in the Age of the Marvelous, 1500–1800
Explore the material culture of "wonder" from the Renaissance to the Enlightenment in literature, science, and art, with Hopkins' rare book collections and the Walters Art Museum. Cross-listed with German and Romance Languages, History, History of Art. M&S practicum course.
Havens   3 credits

389.361 (H) Introduction to Material Culture
Students work with the Homewood Museum curator to explore early American life. Directed primary research and object study culminate in a student-curated exhibition. Cross-listed with History. M&S practicum course; optional intersession practicum possible.
Arthur   3 credits

389.362 (H) Behind the Scenes at The Walters Art Museum
Work with Walters staff to learn about the workings of a professional art museum while developing an exhibition or other museum project. Cross-listed with History of Art. M&S practicum course.
Rodini   3 credits

389.365 (H) Close Looking at the BMA
This course takes an interdisciplinary approach to careful consideration of one or several works of art in the BMA's collection. Creative final projects enhance the educational mission of the museum. Cross-listed with History of Art. M&S practicum course.
Rodini   3 credits

389.366 (H) An Introduction to Museum Education
A hybrid between art history and an introduction to museum practices, this course culminates in developing education programs for an upcoming exhibition at the Baltimore Museum of Art. Cross-listed with History of Art. M&S practicum course.
Bautista   3 credits

389.367 (H) Walking with Reliquaries
Students studied medieval objects from the Walters Art Museum collection with the curator, and designed interpretative tools used in an exhibition at the museum. Cross-listed with History of Art. M&S practicum course.
Bagnoli   3 credits

389.368 (H) Artists, Museums, and Social Purpose: Contemporary Models
How do artists working today engage with museums? Students explore these partnerships in theory and practice, proposing a local installation in collaboration with an artist. Cross-listed with History of Art, Homewood Art Workshops. M&S practicum course.
Bruun   3 credits

389.370 (H) Camera Arts: Photographing Evergreen Museum & Library
Curator and photography instructor lead students in a photographic exploration of the Evergreen collection. Fine arts approach to digital photography and printing. Final project exhibition at Evergreen. Cross-listed with Homewood Art Workshops. M&S practicum course.
Berger, Abbott   3 credits

389.371 (H) The Artist in the Museum: Making Books
In this course, curatorial staff from the Evergreen, Peabody, Walters, and JHU libraries introduce students to the concept of books as art. Guided by a photography instructor and curator, students create their own artist's books inspired by these collections, and these become part of an exhibition at Evergreen Museum & Library. Cross-listed with Homewood Art Workshops. M&S practicum course.
Berger, Abbott   3 credits

389.440 (H,S) Who Owns Culture?
This seminar explores the complicated, often explosive concept of cultural property, including questions surrounding the ownership, preservation, and interpretation of artifacts, monuments, heritage sites, and living traditions. Cross-listed with Anthropology, History of Art.
Rodini   3 credits

389.501/502 Independent Study in Museums and Society
Independent study allows students to develop and carry out their own research project in a related field. Projects must be approved and overseen by a supervising faculty member and approved by the program's associate director. Students should also consult the university's Independent Work Policy.
Rodini, Staff   up to 3 credits

389.511/512 Internship in Museums and Society
Students may seek credit for academic work connected to an unpaid museum internship. Projects may be in the area of research, exhibition development, conservation science, or other related fields. All projects must be approved and overseen by a supervising faculty member and approved by the program's associate director, and must be in keeping with the university's Independent Work Policy.
Rodini, Staff   1 credit

Cross-Listed

Africana Studies

362.103 (H,S) Introduction to the Arts of Africa
This course provides an overview of principal visual arts of Africa, pre-historic to contemporary. Traditions-based and contemporary arts made by African artists from across the continent will be examined alongside their various contexts of creation, use, understanding, and social history. Theoretical perspectives on the collection, appropriation, and exhibition of African arts in the West will be introduced. Course work will be complemented by frequent collections-based study at The Baltimore Museum of Art.
Bridges   3 credits

Anthropology

070.103 (H,S,W) Africa and the Museum
Freshman seminar course on African material life, as created, used, collected, displayed, and discussed. Aims to introduce both Africa and its representation in the West.
Guyer   3 credits

Classics

040.119 (H) The World of Pompeii
This course focuses on the history and archaeology of Pompeii. Close attention is also paid to the reception of Pompeian materials in European and American culture.
Valladares   3 credits

040.360 (H) The Archaeology of Daily Life
This course examines objects of daily life from the Greco-Roman world in the Johns Hopkins University Archaeological Museum. Students collaborate on an online catalog, featuring their research. Cross-listed with History of Art, Near Eastern Studies, and Museums and Society. M&S practicum course.
Valladares   3 credits

040.368 (H) The Authority of Ruins: Antiquarianism in Italy, 1690–1890
This seminar focuses on the transformation of antiquarianism in Italy after the discovery of Herculaneum and Pompeii. Students work primarily with rare books from the collections at JHU and contribute to an online exhibition. M&S practice course.
Valladares   3 credits

Film and Media Studies

061.395 (H) Film Programming
This course is run in close conjunction with the Johns Hopkins Film Society and work centers on curating a film festival. Students explore all aspects of the curating process, from researching and crafting a proposal to presenting the final product to audiences through a Q&A session.
Ward   3 credits

History

100.350 (H,S) The Art of Collecting in America's Gilded Age, ca. 1880 ca. 1920
This course is organized as an upper division seminar for students with interest in history, art history, and museum studies, focuses on the art collections of wealthy Americans during the fabled Gilded Age, ca. 1880 – ca. 1920. Topics to be discussed include the motives, both personal and patriotic, underlying the formation of these collections, the ideas and circumstances that contributed to the creation of municipal museums such as New York City's Metropolitan Museum of Art, and the relationship between these collections, both private and public, and America's national identity.
Kagan   3 credits

100.372 (H,S) The Victorians
This course focuses on the politics of everyday life, consumption, intimate relations, and concepts of the self in Victorian Britain (1837–1901). Particular attention is devoted to Victorian visual culture, including exhibitions, built environment, decorative arts, and leisure culture. Other themes include popular nationalism, class cultures, feminism and body politics, Empire, and racial thought.
Walkowitz   3 credits

100.376 (H,S) Baltimore as Historical Site
This class will use the historical site of Baltimore to demonstrate the spatial context of major events in U.S. and urban history.
Ryan   3 credits

100.470 (H,S) Monuments and Memory in Asian History
This seminar explores the ritual, political, and religious significance of architectural sites in Asia. We also examine their more recent role as signifiers of cultural and national identities—and in tourism.
Meyer-Fong   3 credits

History of Art

010.382 (H) The Politics of Display in South Asia
Through examining collecting, patronage, colonial exhibitions, and museums, this course examines how South Asia has been constructed in practices of display. Themes: politics of representation, spectacle, ethnography, and economies of desire related to colonialism and the rise of modernity.
Brown   3 credits

010.398 (H) Tombs for the Living
Centering on the tomb as a unit of analysis, this course examines how death and funerary ritual reflect the cultural values of the living and are an active force in shaping them. Drawing on case studies from Mesoamerica and the Andes we consider various approaches to entombment and funerary ritual.
DeLeonardis   3 credits

010.411 (H) Art Collecting and the Rise of the Museum
This class looks at the history of collecting and displaying art from the Renaissance studiolo through the 19th century.
Campbell   3 credits

History of Science and Technology

140.215 (H,S) Monuments and Memory
This course explores the construction or discovery, and the enduring significance, of selected monuments in the West, including national memorials, national parks, and other architectural and engineering milestones. It investigates how they were made, interpreted, and represented in art, literature, popular culture, and tourism.
Leslie   3 credits

140.359 (H,S) Museums and Globalization
Examines how museums are linked to wider national and cultural communities, and how they mobilize resources to address political, economic, and social concerns and questions of heritage.
Kargon   3 credits

140.363 (H,S) Museums and Controversy: From the Enola Gay to Body Worlds
Exhibitions on Freud, Darwin, the Bomb, environment, the human body, and similar "hot" topics have stirred unexpected controversy. This seminar explores the origins of such heated public and scientific disagreements.
Molella   3 credits

140.372 (H,S) Science on Display
History of collecting, exhibiting, and interpreting science and technology, from Renaissance cabinets of curiosities to modern world's fairs, zoos, aquariums, films, and science centers. Students will present their own exhibits as dioramas, websites, documentaries, or other formats.
Leslie   3 credits

Near Eastern Studies

130.334 (H) Museum Study of Objects from the Eton College Myers Collection
Students are introduced to studying Egyptian objects through an investigation of some pieces from the Eton College Myers Collection on long-term loan to the university. Cataloging and research for these objects are part of the course. Taught with 133.706. M&S practicum course.
Bryan   3 credits

Music

The Peabody Institute of The Johns Hopkins University is an internationally acclaimed music conservatory. The Peabody campus, located at historic Mount Vernon Place, is on the university shuttle bus route between Homewood campus and the medical institutions in East Baltimore. Faculty of the Peabody Institute offer some classes on the Homewood campus that are open to all undergraduates.

Qualified Hopkins undergraduates may, for no extra charge, register for classes in music history, music theory, music education, recording techniques, and computer music offered on the Peabody campus. There are also limited opportunities to take private lessons and participate in ensembles.

The Faculty

(Peabody faculty who teach courses on the Homewood campus)

Richard Giarusso, Department of Musicology: 19th- and 20th-century music, German song, Wagner, Mahler, English music, music appreciation.

Sharon Gail Levy, Department of Music Theory: Piano literature 1750–1950, music analysis, baroque counterpoint, music appreciation.

David Smooke, Department of Music Theory: Song Analysis, Theories of Rhythm, Popular Music.

Stephen Stone, Department of Music Theory: music theory courses. Advisor for the minor in music theory.

Andrew Talle, Department of Musicology: J.S. Bach, German music, 18th- and 19th-century music, music appreciation.

Elizabeth D. Tolbert, Department of Musicology: expressive culture and intercultural aesthetics, performance, gender, ritual, ethnomusicology, music and language.

Susan Forscher Weiss, Department of Musicology (joint appointment in Romance Languages and Literatures): medieval and Renaissance music, social history, performance practice, history of instruments.

Adjunct Faculty

Faye Chiao, Adjunct Theory Faculty
John Crouch, Adjunct Theory Faculty
Travis Hardaway, Adjunct Theory Faculty

Concerts

Homewood students are welcome to attend Peabody's many concerts and are entitled to student prices for most concerts, provided they present their Hopkins ID and pick up the ticket during daytime Box Office hours, Monday through Friday, 10 a.m. to 4 p.m. Declared music minors can receive complimentary tickets to select concerts. The Box Office is in the lower level of the Grand Arcade in the Conservatory building; call 410-234-4800.

Private Lessons

Private lessons are available to students at varying levels of accomplishment on a musical instrument.

• Half-hour or hour lessons **are offered for credit** in the Peabody Conservatory for the intermediate to advanced musician.

• Non-credit lessons are available in the Peabody Preparatory, space permitting.

The annual registration fee will be waived for all JHU students. School of Arts and Sciences and Engineering students are eligible to receive a cross-registration discount of 25 percent by obtaining a cross-registration form from their division each semester.

Students wishing to take advantage of this opportunity should consult the Peabody Conservatory and/or Preparatory catalogs for more information.

Auditions for lesson assignments at the intermediate or advanced level take place at the beginning of each term. Students wishing to audition should contact the Peabody Registrar's Office, 410-234-4578, for information. Hopkins students may arrange for instrumental practice facilities through the Homewood Office of Student Activities, 410-516-8209.

Ensemble Membership

Membership in the Hopkins Symphony Orchestra, the Johns Hopkins University Band, the Hopkins Glee Club, which rehearse and perform on the Homewood campus, and Peabody choral groups, which rehearse and perform at Peabody, is open to all university students. An audition is required for acceptance to a choral group at Peabody.

Advanced students also may audition for the Peabody Symphony Orchestra, Peabody Concert Orchestra, Peabody Wind Ensemble, Peabody Camerata (contemporary music), Peabody Jazz Orchestra, and for Peabody chamber music ensembles on a space-available basis. In the orchestras, positions for wind instruments are limited, and priority is thus given to Peabody degree majors for whom orchestra is a requirement.

Membership in the Hopkins Symphony Orchestra is by audition on a space-available basis. Seating is limited, especially in the winds. Contact the HSO Office in Shriver Hall at 410-516-6542 for audition information.

Auditions for Peabody ensembles usually take place in the week prior to Peabody fall registration. Homewood students wishing to audition for ensembles should confirm the dates and send their names and instrument designation to the Peabody Ensemble Office, 1 E. Mt. Vernon Place, Baltimore, MD 21202, 410-234-4511, no later than August 15 for an audition assignment.

Undergraduate Program: Minor in Music

The School of Arts and Sciences offers a music minor to students majoring in other fields. The minor is intended for students who have some training and background in music and wish to pursue their interest in a systematic way without getting their degree in the field. It consists of a selection of music courses, including music history, music theory, ensembles, and/or lessons at Peabody.

Requirements for the Music Minor

	credits
Music Theory and Musicianship I	3
Music Theory and Musicianship II	3
Music Theory III Elective	3
Introduction to Western Classical Music	3
Music History electives	6
Applied music experience Two semesters of lessons or ensembles with the approval of minor advisor	
Total	18 credits plus lessons/ensembles

Applied Music Experience

Since the study of music should always take place in the context of practical music making, students completing the minor in music must participate in an applied music experience for at least two semesters. Students must select an applied music experience in consultation with their advisor, who will approve the applied music experience on the minor checklist. Most students will select either private instrument lessons at Peabody or participation in an ensemble at Peabody or on the Homewood campus.

Courses at Homewood

376.111 Rudiments of Music Theory and Musicianship
This course introduces written and aural fundamentals including notation, scales, intervals, chords, rhythm, meter, and sightsinging. Composition of melodies and short pieces as well as listening projects will be undertaken. There are no prerequisites for this course.
Staff   3 credits   fall/spring

376.211 Music Theory and Musicianship I
Introduction to basic principles of tonal music through listening, analysis, and music making. Students will study melody, harmony, voice leading, figured bass and dissonance treatment, and will also undertake short composition projects. Prerequisite: qualifying examination or Rudiments of Music Theory and Musicianship.
Staff   3 credits   fall/spring

376.212 Music Theory and Musicianship II
This course continues the aural and written work of the previous course, but focuses on chromatic harmony while continuing the study of melody, counterpoint, and figured bass. Prerequisite: Music Theory and Musicianship I.
Staff   3 credits   fall/spring

376.214 Music Theory III - Formal Analysis
An examination of the musical forms of the Common Practice Period and the logic of their structures. Forms studied will include variation, binary, rounded binary, ternary, rondo, sonata-allegro, and sonata-rondo. Prerequisite: Music Theory and Musicianship II.
Staff   3 credits

376.215 Music Theory III—Twentieth Century Music
An exploration of the music and analytical tools of the twentieth century. Topics will include set analysis, serial techniques, exotic and synthetic scales, neo-tonality, and geometric proportions. Prerequisite: Music Theory and Musicianship II.
Staff   3 credits

376.216 Music Theory III—Counterpoint
A study of contrapuntal music, emphasizing composition in both the sixteenth- and eighteenth-century styles as epitomized by Palestrina and Bach. Prerequisite: Music Theory and Musicianship II.
Staff   3 credits

376.217 Music Theory III – Song
An examination of text-setting and song-writing in a variety of eras and styles. Topics will include art song, lieder, jazz standards, and pop tunes. Prerequisite: Music Theory and Musicianship II.
Staff   3 credits

376.231 (H) Introduction to Western Classical Music
Students will learn aural strategies to focus their listening, as well as vocabulary, cultural, and historical context

for music of the baroque, classical, Romantic, and 20th-century periods. Composers studied will include Bach, Handel, Haydn, Mozart, Beethoven, Schubert, Chopin, Brahms, Debussy, Schoenberg, and Stravinsky.
Staff   3 credits   fall

376.242 (H) Introduction to Popular Music
A survey of the stylistic features and social contexts of American popular music since the 1950s.
Staff   3 credits   spring

376.335 (H,W) Mozart's Piano Music
The music of Mozart is often considered the epitome of the classical style, setting both the standard for our ideals of classical balance and providing the archetypal models of both sonata and concerto forms. In this class, we will explore the music of Mozart in some detail, focusing on his works for piano, an instrument which occupied him throughout his life and for which he wrote some of his greatest compositions. Important scholarly writings on the style will also be read and discussed. We will pay particular attention to the sonatas and concertos, though shorter works and chamber music may be considered as time allows.
Levy   3 credits

376.340 (H,W) Music and Literature: Thomas Mann's Doctor Faustus
A study of Thomas Mann's novel, supplemented through a detailed examination of the many works mentioned in the text. In studying pieces of Beethoven, Brahms, Bach, Wagner, Schoenberg, and others, we will sketch out an historical and aesthetic context essential to an understanding of the book. Students should possess a basic knowledge of twentieth-century European history. The ability to read music, while certainly helpful, is not required. All course readings and discussion will be conducted in English
Giarusso   3 credits

376.401 (H,W) Music and Ritual
An examination of the role of music in ritual performance, with emphasis on indigenous music theories and ethnoaesthetics. Examples will be drawn from a variety of ethnographic contexts.
Tolbert   3 credits

376.404 (H,W) A History of Musical Instruments
A study of the evolution of musical instruments and their functions from the earliest manifestations of rhythmic sound in prehistoric civilization to the most sophisticated electronic instruments of the 20th century, fusing the disciplines of music, anthropology, and the visual arts. Trips to museums and galleries will include a visit to the Instrumental Collections of the Library of Congress and the Smithsonian.
Weiss   3 credits

376.407 (H,W) Music and Evolution
This course will examine the bio-cultural evolution of music in light of recent interdisciplinary research on the social bases of human cognitive evolution, and explore its implications for current debates in musicology, ethnomusicology, psychology of music, and human cognitive evolution.
Tolbert   3 credits

Near Eastern Studies

The Department of Near Eastern Studies offers programs in four main areas: Egyptology, Assyriology, Northwest Semitic languages and literatures (including the Hebrew Bible), and Near Eastern Archaeology. The department approaches Near Eastern civilizations primarily through their own records, and language study is therefore an important part of the curriculum. However, many undergraduate courses require no knowledge of foreign languages and any interested student may take them.

The Faculty

Betsy M. Bryan, Professor, Alexander Badawy Chair in Egyptian Art and Archaeology: Egyptian art and archaeology, Egyptology.

Paul Delnero, Assistant Professor: Assyriology.

Michael Harrower, Assistant Professor: archaeology.

Richard Jasnow, Professor: Egyptology.

Jacob Lauinger, Assistant Professor: Assyriology.

Theodore J. Lewis, Blum-Iwry Professor (Chair): Hebrew Bible, Northwest Semitic philology and religion.

P. Kyle McCarter Jr., Professor, William Foxwell Albright Chair in Biblical and Ancient Near Eastern Studies: Hebrew Bible, Northwest Semitic philology.

Glenn M. Schwartz, Professor, Whiting Professorship of Archaeology: Near Eastern archaeology.

Adjunct, Emeritus

Sanchita Balachandran, Lecturer: museum studies.

Jerrold S. Cooper, W.W. Spence Professor Emeritus of Semitic Languages.

Hans Goedicke, Professor Emeritus.

Susan McCarter, Adjunct Assistant Professor: prehistory.

Ellen Robbins, Lecturer: Hebrew Bible.

Melinda Zeder, Adjunct Professor: Near Eastern archaeology.

Facilities

The university's Milton S. Eisenhower Library contains an outstanding collection of books and journals in the branches of Near Eastern studies pursued by the department. The Johns Hopkins Archaeological Museum has a collection of Near Eastern antiquities, including excellent study collections of Egyptian artifacts and Palestinian pottery. The Baltimore-Washington area is especially rich in library and museum facilities. Of special interest to students of the Near East are the Walters Art Museum, the Smithsonian Institution, and the Library of Congress.

Undergraduate Programs

The ancient Near East is where history begins. It is where the first crops were sown, the first towns built, and where writing was first invented. The origins of Western culture are to be found in its great civilizations, from the three great monotheistic religions—Christianity, Islam, and Judaism —to everyday aspects of our life that we take for granted, such as the alphabet and marking time by hours and minutes. The Near Eastern studies major can be the focal point of a broad liberal arts education, as well as a basis for graduate study. An undergraduate major can specialize in one of the four main areas mentioned above or in the civilizations of the ancient Near East in general. The student can also major in ancient history, in conjunction with courses in other departments.

Requirements for the B.A. Degree

All students majoring in Near Eastern Studies must take two 100-level introductory courses on civilizations of the ancient Near East (6 credits). The student may choose from:

130.101 (H) Ancient Near Eastern Civilizations

130.126 (H) Ancient Mesopotamian Civilization

130.135 (H) Ancient Egyptian Civilization

Two of the following 300-level courses (6 credits) will also be required for the major:

130.300 (H) History of Ancient Mesopotamia

130.301(H) History of Ancient Syria-Palestine (first semester)

130.302 (H) History of Ancient Syria-Palestine (second semester)

130.303 (H) History of Egypt

Four 300-level classes (12 credits) offered by the Department of Near Eastern Studies are then required within one of the three following tracks:

1) Art and Archaeology

2) History and Culture

3) Language (Akkadian, Arabic, Ancient Egyptian, Biblical Hebrew, Modern Hebrew, or Sumerian)

N.B. Those majoring also in archaeology cannot choose the Art and Archaeology track.

Three additional courses at any level (including 100-level Freshman Seminars) offered by the Department of Near Eastern Studies are required for the major (9 credits).

A 400-level course, 131.420 (W), a Seminar in Research Methods in Near Eastern Studies, is required of majors (3 credits). The topic of the seminar, which is writing intensive, will vary from year to year, depending on the field of the faculty member teaching the class. This seminar will also be open to non-majors who have taken at least one 100-level Near Eastern Civilization course and one 300-level Near Eastern Civilization course. This seminar is generally offered in the spring semester. Students planning to graduate in December should register for this course in their junior year.

Those seniors wishing to be considered for departmental honors may choose to write a Senior Thesis. A student must maintain a 3.5 GPA in the major (through the junior year) to be eligible for departmental honors. It is advisable for such students to contact a faculty member to supervise the thesis during the spring semester of their junior year. The senior should then register for two semesters of independent study in the senior year.

Graduate Program

The graduate program, the oldest of its kind in the nation, is designed to train professional scholars and teachers in the above-mentioned areas. The courses listed below may be modified in particular years to suit the needs of students currently in residence. Reading and private study under the direction of the faculty are considered as important as work in class. The seminars allow small groups of students and faculty to engage in close study of special problems. As the program is intended to lead to the Ph.D., students are admitted as candidates for the M.A. only in unusual cases.

Requirements for the Ph.D. Degree

Students working full time toward the Ph.D. may expect to do three to four years of course work, after which comprehensive examinations must be written before work on the dissertation begins. The examinations cover a student's major and minor fields of concentration. After passing these examinations, the student, in consultation with the faculty, prepares a dissertation proposal for faculty consideration and then proceeds to write the dissertation.

An ability to read scholarly French and German is necessary, and an examination in one of these must be passed within the first semester of residence at Hopkins. The examination in the other may be delayed not more than one year. Some command of Greek and Latin is necessary to pursue biblical studies.

Financial Aid

The department awards most students admitted to the Ph.D. program who are in need of financial aid a basic annual fellowship covering full tuition and a full stipend for living expenses for up to five years. For some of this period, the department's support may take the form of a teaching assistantship. In addition, the period of support may be extended by the various competitive awards available to advanced students within the university. When appropriate, the department will award travel stipends for graduate students to participate in archaeological excavations in the Near East or visit collections in this country and abroad.

For further information on graduate study in Near Eastern Studies, visit the departmental website at **http://neareast.jhu.edu/**.

Undergraduate Courses

The courses in Near Eastern civilizations listed below are open to all students in the university, as are the elementary language courses. Admission to advanced language courses requires approval by the instructor. Not all listed courses are offered in a given academic year.

Near Eastern Civilizations

130.101 (H) Ancient Near Eastern Civilizations
This course will review important issues in ancient Near Eastern history and culture from the Neolithic era to the Persian period, ca. 9000-330 B.C. Included will be an examination of some of the most momentous changes in human history: the Neolithic agricultural revolution; the emergence of cities, states, and writing; and the formation of vast multiethnic empires. Such cultures as Sumer and Akkad, Egypt, the Hittites, the Bronze and Iron Age societies of Syria-Palestine, and the empires of Assyria, Babylonia, and Persia will be discussed.
Schwartz   3 credits

130.102 (H,S) From Neanderthals to the Neolithic
Emphasizing theories about human biological and cultural development, this course begins with a brief discussion of evolutionary theory and our fossil ancestors, continues with an in-depth survey of Neanderthal morphology and culture, and concludes with an exploration of the mechanisms and results of the shift from hunting

and gathering to farming (Course formerly known as Introduction to Human Prehistory).
S. McCarter   3 credits

130.106 (H) Ancient Empires

A case-study approach to the political, social, and cultural history of one of the ancient Near Eastern states commonly described as an "empire," such as the Akkadian Empire, the Neo-Assyrian Empire, the Neo-Babylonian Empire, or the Achaemenid (Persian) Empire. Individual classes mix a discussion of theoretical issues relevant to the study of ancient empires with close attention to primary sources.
Lauinger   3 credits

130.110 (H,S) Introduction to Archaeology

An introduction to archaeology and to archaeological method and theory, exploring how archaeologists excavate, analyze, and interpret ancient remains in order to reconstruct how ancient societies functioned. Specific examples from a variety of archaeological projects in different parts of the world will be used to illustrate techniques and principles discussed.
Schwartz, S. McCarter   3 credits

130.115 (H,S) Introduction to Near Eastern Archaeology

The archaeology of ancient Near Eastern societies from Neolithic times until the Hellenistic period. Includes ancient Iraq, Iran, Syria, Anatolia, and the Holy Land.
Schwartz   3 credits

130.126 (H) Ancient Mesopotamian Civilization

An introduction to the culture and society of Mesopotamia (ancient Iraq) from 3500 B.C. to 100 B.C. Topics explored will include religion, private and daily life, gender and sexuality, ancient warfare, feasting and eating, conceptions of the afterlife, and other aspects of the social and cultural history of ancient Mesopotamia. The purpose of the course is to provide a general overview, illustrated with passages from ancient texts and visual images, of one of the world's oldest and most fascinating civilizations.
Delnero   3 credits

130.135 (H) Ancient Egyptian Civilization

Introduction to the monuments and culture of Egypt from 3500 B.C. to 100 A.D. From pyramids at Giza to Hellenistic Alexandria, this course surveys in slide illustrated lectures the remains of one of the world's greatest early cultures.
Bryan   3 credits

130.140 (H) Introduction to the Hebrew Bible/ Old Testament

A critical and historical survey of the books of the Hebrew Bible (Old Testament) giving primary attention to the religious ideas they contain and the ancient contexts in which they were composed. Topics include the Academic Study of Religion, Canaanite and Israelite Religion, Patriarchal Religion, the Exodus and Moses, Covenant, Tribalism and Monarchy, the Ideology of Kingship, Prophecy, Priestly Sources, Psalms, Wisdom Literature, and Apocalyptic Thought.
Lewis, McCarter   3 credits

130.177 (H,S) World Prehistory

How and why did our nomadic hunting and gathering ancestors become farmers? What led agricultural societies to build cities, develop writing, religious institutions, wage war, and trade for exotic goods? This course surveys prehistory and ancient history from the origins of human culture to the emergence civilization. Common elements of past human experience, culture, and culture change are emphasized including the origins of anatomically modern humans and their adjustment to a variety of post-ice age environments, shifts from hunting and gathering to agricultural lifeways, and the initial development of the world's earliest cities and civilizations.
Harrower   3 credits

130.300 (H) History of Ancient Mesopotamia (Sumer, Babylonia, Assyria)

Delnero   3 credits

130.301-302 (H) History of Ancient Syria-Palestine, including Ancient Israel

A survey of the history of ancient Syria and Canaan, including ancient Israel.
McCarter   3 credits

130.303 (H) History of Egypt

This lecture and discussion course is a survey of the history of Egypt from 3100 B.C.E. through the 26th Dynasty, ca. 525 B.C.E. All readings will be in English and will combine selections from textual sources in translation with interpretive historical articles. This course counts toward the History requirement for the major.
Bryan, Jasnow   3 credits

130.304 (H) Ancient Cities

A survey of cities in the ancient world from Uruk ca. 3000 B.C. until the conquest of Babylon in 539 B.C. The most important cities from this period will be studied and discussed from a historical, literary, and anthropological perspective. The topics covered include (1) the archaeological and textual evidence for these cities, (2) the depiction of these cities in literary and mythological works, and (3) contemporary theoretical approaches to understanding ancient urbanism.
Delnero   3 credits

130.305 (H,S) Law in the Ancient World

A survey of the legal systems of the ancient Near East and of preclassical Greece and Rome from the earliest known records until the fifth century B.C. Comparison with modern legal concepts.
Lauinger   3 credits

130.306 (H,S) The Origins of Diplomacy

An examination of the early history of diplomacy, through the records of the ancient Near East between the third and first millennium B.C. The course will survey the background to ancient international relations—conceptions of sovereignty and imperialism, attitudes toward war and peace, the force of international law and treaties, and the role of diplomats and negotiation.

Selected diplomatic exchanges will be analyzed, using original documents in translation.

Lauinger   3 credits

130.307 (H) Babylon: Myth and Truth

The ancient city of Babylon is famous throughout the world for its reputation as a city of vice and decadence, as well as for spectacular building achievements like the infamous "Tower of Babel" and the fabled hanging gardens. But how closely does this image of the legendary city correspond to how Babylon really was in antiquity? In this course myths and truths about Babylon will be examined by comparing and contrasting the picture of Babylon that emerges from ancient texts and artifacts from the ancient city itself, with the depiction of the city in sources like the Bible, classical and medieval manuscripts, and in late 20th- and early 21st-century pop culture.

Delnero   3 credits

130.308 (H) Pleasure in Ancient Mesopotamia

The ancient world is commonly thought of as an abstraction of dates, names, and facts about long dead rulers, forgetting that for thousands of years in places like ancient Mesopotamia real people lived and breathed, hoped and dreamed, and had everyday concerns not dissimilar from the concerns of people today. This course will explore one concern that has changed very little: the pursuit of pleasure. By reading translated textual passages from ancient texts that reveal what people did for enjoyment, the full palette of pleasure in ancient Mesopotamia— including feasting, drinking, sexual practices, sports, and other leisure time activities—will be sampled.

Delnero   3 credits

130.310 (H) Mythology of the Ancient World

This course explores the mythology of the ancient Near East from the invention of writing in Sumer in 3000 B.C. until the conquest of Alexander the Great near the end of the first millennium B.C. Mythological texts from Mesopotamia, Egypt, Anatolia, the Levant, and the Bible will be read from a comparative perspective. Special attention is paid to the origin and development of the epic, culminating in the great *Epic of Gilgamesh*, but considerable time is also given to the vast mythological and historical literature, and such diverse genres as love poetry, proverbs, humorous dialogues, omens, and legal and medical texts. All readings are in English translation.

Delnero   3 credits

130.311 (H) Gilgamesh: The World's First Epic Hero

An examination of the development of both the character of Gilgamesh and the composition of epic narrative in ancient Mesopotamia, beginning with the earliest Sumerian Gilgamesh stories of the third millennium B.C. The bulk of the course will consist of a close reading in English of the Akkadian *Gilgamesh* epic, focusing on its concerns with homosocial bonding, human sexuality, and mortality. Some attention will be paid to the influence of *Gilgamesh* on Greek epic, and the reception of *Gilgamesh* in the modern world since its recovery in the late 19th century.

Delnero   3 credits

130.312 (H) Ancient Medicine

A study of medicine in the ancient Near Eastern and Aegean worlds, including an examination of the *practices* of medicine in these ancient societies but with primary emphasis given to *ideas* about health and disease. Readings are selected from primary sources in the writings of ancient Egypt, Mesopotamia, Israel, Greece, and Rome. Topics treated include the sources of our knowledge; the nature of medical practitioners, medical treatment, and surgery; beliefs about disease and the etiology of illness; concepts of contagion and ritual purity. Special attention is given to Hippocratic medicine, the synthesis of Galen, and the rise of humoralism.

McCarter   3 credits

130.313 Incantations, Prayer, Power, and Despair: Religion in the Bible and Its World

The biblical world pulsated with different forms of religious expression. Individual worship, family ritual, priestly regulations, and royal cult jostled with thundering prophets, awestruck poets, and cynical philosophers. Through ancient texts and recent archaeological discoveries, we will investigate the many and often conflicting worlds of biblical religion.

Lewis   3 credits

130.322 (H) Law, Ethics, and Wisdom in Ancient Egypt

Many legal texts survive from ancient Egypt, such as contracts, mortgages, court records, and law codes. There is also a very vigorous tradition of wisdom literature composed by scribal sages, offering ethical and practical guidelines for the conduct of a person's life. In this course, we will read in translation literary texts as well as selected legal documents from the Old Kingdom through the Roman period (ca. 2500 B.C. – 200 A.D.). The goal will be to achieve an understanding of the central concepts of Egyptian law, ethics, and wisdom, and a broad familiarity with the primary evidence for these subjects.

Jasnow   3 credits

130.323 (H) History of Ptolemaic and Roman Egypt

This lecture course is a survey of the history, society, and culture of Graeco-Roman Egypt. We will concentrate on Ptolemaic Egypt (ca. 332-30 B.C.), but will also devote some time to Roman Egypt, especially to the subjects of the decline of paganism and spread of Christianity in Egypt.

Jasnow   3 credits

130.325 (H) Women in Ancient Egypt

A survey of literature and monuments which illustrates the roles of women in Egyptian society. One major focus is the legal status of women through all periods of ancient Egypt (3000 B.C. – 100 A.D.). Included are the few women who ruled Egypt as pharaoh, as well as those whose position as priestesses made them nearly as powerful as the king.

Bryan   3 credits

130.326 (H) Egyptian Religion and Mythology

A survey of the Egyptian religion, including the national temple cults, personal pieties, and funerary cults. Sources

for the various myths of creation and destruction will be read, along with documents relating to temple rituals.
Jasnow   3 credits

130.328 (H) Ancient Egypt within Africa
Recent excavation and research have shed light on several ancient cultures of the Nile and its tributaries. We will look at the available archaeological and textual (all Egyptian) evidence for these societies and their interactions with Egypt between 3500 and 300 B.C. We will also discuss research aims and methods employed now and in the past in Egypt and the Sudan.
Bryan   3 credits

130.329 (H) Ancient Egyptian Art
A survey of Egyptian art as seen in the temples, tombs, funerary, and minor arts of Egypt between 3000 and 100 B.C. Slide lectures will provide a survey of art from the pyramids to Augustus Caesar and will focus on such topics as the principles of Egyptian art; can the term *art* apply to early Egypt? How were artisans trained and what techniques and materials were utilized in their work?
Bryan   3 credits

130.330 (H) Sex and the Garden
A seminar on the history of interpretation of Genesis 2-3, with a focus on the uses of the biblical story of the Garden of Eden in Jewish, Christian, and Muslim traditions. Class attendance and participation are mandatory.
Robbins   3 credits

130.333 (H) Egypt in the Amarna Period
This course surveys the history, art, society, and religion of the period between the reign of Amenhotep III and Tutankhamun, ca. 1400–1320 B.C., a time when a sweeping change in religious notions came to the forefront. Akhenaten, attributed with bringing a type of monotheism to Egypt, dominated the era, but such important other figures as Nefertiti, Horemheb, Ay, and "Tut" were also part of the landscape.
Bryan   3 credits

130.334 (H), Museum Study of Objects from the Eton College Myers Collection
Students will be introduced to studying Egyptian objects through an investigation of some pieces from the Eton College Myers Collection to be on long term loan to the University. Cataloging and research for these objects will be part of the course.
Bryan   3 credits

130.340-341 (H,S) The History of the Religion of Israel
A study of the origins of ancient Israelite religion, its emergence from and continuities with ancient West Semitic religion and culture. Students will be exposed to comparative and historical approaches for reconstructing this time period including the utilization of new sources of knowledge (e.g., Syro-Palestinian archaeology and epigraphy; neighboring ancient Near Eastern religions).
Lewis, McCarter   3 credits

130.343 (H) The Dead Sea Scrolls in English
A survey of the manuscripts found at Qumran and other sites near the Dead Sea.
McCarter   3 credits

130.350 (H) Issues in the Archaeology of the Near East
Selected problems are reviewed within a time span ranging from the Neolithic to the Hellenistic period. The focus is on the reasons for societal change (and societal stasis), with particular reference to transformations in social organization, economy, and ideology.
Schwartz   3 credits

130.351 (H,S) The Emergence of Civilization: A Cross-Cultural Examination
A comparative study of the origins of urban, literate civilizations in five culture areas: Mesopotamia, China, the Indus Valley, Egypt, and Mesoamerica. For each area, we will review the physical setting, the archaeological and textual evidence for the development of states and urban civilization, and theories advanced to explain the rise (and eventual collapse) of these complex societies.
Schwartz   3 credits

130.353 (H,N) Space Archaeology: An Introduction to Satellite Remote Sensing, GIS, and GPS
How and why do archaeologists make such extensive recent use of space technologies? What can satellite imagery tell us about ancient environments and landscapes? How do archaeologists map ancient politics, trade routes, and irrigation systems? This course introduces technologies archaeologists use to map ancient landscapes. These include Geographic Information Systems (GIS) mapping software, advanced Global Positioning System (GPS) receivers, and various types of satellite imagery.
Harrower   3 credits

130.354 (H,S) Archaeological Method and Theory
What questions do archaeologists ask about the ancient past, how do they collect relevant evidence, and how do they arrive at satisfying answers to their questions? This course reviews approaches to method and theory including evolutionary archaeology, culture-historical ar-chaeology, processualist and post-processualist archaeologies, and explores the future of archaeology as a scientific and humanistic discipline.
Harrower   3 credits

130.356 (H) Ancient Magic and Divination
A study of magic and divination in the ancient Near East, focusing on Mesopotamia (ca. 2500–500 B.C.). The decipherment of cuneiform writing revealed a complex world of ancient beliefs and practices: rituals to produce favorable marks on a sheep's liver; observations of the night sky tracking the movements of the "gods of the night"; incantations against witchcraft and evil spirits; handbooks for diagnosing and curing illnesses with herbal remedies and magic. In this course we will explore these and other topics by drawing on texts (in translation), archaeology, iconography, and parallels with ancient Egypt, Greece, Rome, and the Bible.
Delnero   3 credits

130.357 (H,N) Geographic Information Systems in Archaeology
Applications of GIS in archaeology have recently expanded dramatically and GIS has now become an indispensable tool for archaeological research worldwide. This course will introduce the major applications of Geographic Information Systems (GIS) in archaeology. These include the history of GIS in archaeology, air photography and satellite imagery, predictive modeling, hydrological modeling, viewsheds, and least-cost routes. It will grapple with theoretical issues manifest in archaeological GIS including conflicts between environment and social understandings of the ancient past, and will foster discussion of issues that affect outcomes of analyses including spatial scale and boundary delineation choices that can dramatically influence results. Students will learn the basics of ESRI's ArcGIS software.
Harrower   3 credits

130.373 (H) Prophets and Prophecy in the Bible
From thundering voices of social justice to apocalyptic visionaries, biblical prophets have been revered by Jews, Christians, and Muslims for thousands of years. They have inspired civic leaders such Martin Luther King Jr. yet also provided fodder for modern charlatans promising a utopian future. Yet who were these individuals (orators? politicians? diviners? poets?) and what was the full range of their message as set against the Realpolitik world of ancient Israel, Iraq, Egypt, Syria, and Jordan?
Lewis   3 credits

Near Eastern Languages

130.400-401 Introduction to Middle Egyptian
(see 133.600-601 for the description)
Staff   3 credits

130.420 (W) Seminar in Research Methods in Near Eastern Studies
Selected topics within Near Eastern Studies will be examined through class discussion, oral reports, and papers. Students will learn about the wide range of resources available to scholars of the ancient Near East and study the research methodologies employed by them. The topics considered will vary, according to the specialty of the professor teaching the seminar.
Staff

130.440-441 (H) Elementary Biblical Hebrew
Survey of grammar and reading of simple texts. (Credit given only on completion of both semesters.) May not be taken on a satisfactory/unsatisfactory basis.
Staff   3 credits

130.442-443 (H) Reading of Hebrew Prose
Reading of biblical Hebrew prose, especially from the Pentateuch, Joshua, Judges, Samuel, and Kings.
Staff   3 credits

130.444-445 (H) Reading of Hebrew Poetry
An advanced course with readings from the Psalms, Proverbs, and poetical portions of the prophets.
McCarter, Lewis   3 credits

130.500-501 Reading and Research
Staff   3 credits

Graduate Courses
Undergraduates may take these courses only with permission of the instructor.

General

131.600-601 Seminar in Near Eastern History
A three-year history cycle required of all graduate students and forming the core of our graduate program. One year each will be devoted to Egyptian history, Mesopotamian history, and Syro-Palestinian history.
Staff

131.634-635 Seminar in Near Eastern Archaeology
Topic varies but can include the archaeology of Mesopotamia, Syria, or Palestine, or thematic discussions (e.g., on ideology, state collapse, etc.).
Schwartz

131.640 Seminar in Near Eastern Art
Staff

130.650 Seminar in Near Eastern Religion
Topic varies.
Staff

131.653 Space Archaeology: An Introduction to Satellite Remote Sensing, GIS, and GPS
How and why do archaeologists make such extensive recent use of space technologies? What can satellite imagery tell us about ancient environments and landscapes? How do archaeologists map ancient politics, trade routes, and irrigation systems? This course introduces technologies archaeologists use to map ancient landscapes. These include Geographic Information Systems (GIS) mapping software, advanced Global Positioning System (GPS) receivers, and various types of satellite imagery.
Harrower

131.654 Archaeological Method and Theory
What questions do archaeologists ask about the ancient past, how do they collect relevant evidence, and how do they arrive at satisfying answers to their questions? This course will review approaches to method and theory including evolutionary archaeology, culture-historical archaeology, processualist and post-processualist archaeologies, and explores the future of archaeology as a scientific and humanistic discipline.
Harrower

131.657 Geographic Information Systems in Archaeology
Applications of GIS in archaeology have recently expanded dramatically, and GIS has now become an indispensable tool for archaeological research worldwide. This course will introduce the major applications of Geographic Information Systems (GIS) in archaeology. These include the history of GIS in archaeology, air

photography and satellite imagery, predictive modeling, hydrological modeling, viewsheds, and least-cost routes. It will grapple with theoretical issues manifest in archaeological GIS including conflicts between environment and social understandings of the ancient past, and will foster discussion of issues that affect outcomes of analyses including spatial scale and boundary delineation choices that can dramatically influence results. Students will learn the basics of ESRI's ArcGIS software.
Harrower

131.800-801 Independent Reading and Research

131.848-849 Dissertation Research

Assyriology

132.600-601 Elementary Akkadian
Undergraduates admitted to this course earn 4.5 credits per semester.
Staff

132.610-611 Old Babylonian Letters
Lauinger

132.620-621 Legal and Administrative Texts
Lauinger

132.630-631 Literary and Religious Texts
Delnero

132.640-641 Historical Texts
Delnero

132.644-645 Treaties and Diplomacy
Lauinger

132.650-651 Peripheral Akkadian
Includes texts from Amarna, Emar, Ugarit, Boghazkoi, Nuzi, Alalakh, and Elam.
Lauinger

132.660 Old Akkadian
Delnero

132.670-671 Assyrian Dialects
Delnero

132.680-681 Neo-Babylonian
Lauinger

132.690-691 Divination and Ritual Texts
Delnero

132.700-701 Elementary Sumerian
Staff

132.710-711 Advanced Sumerian
Delnero

132.720-721 Sumerian Legal Texts

132.752 Elementary Hittite

132.753 Advanced Hittite

132.800-801 Mesopotamian Seminar
Research and discussion on topics of current interest.
Schwartz, Delnero, Lauinger, Harrower

Egyptology and Coptic

133.600-601 Introduction to Middle Egyptian (Hieroglyphs)
Introduction to the grammar and writing system of the classical language of the Egyptian Middle Kingdom (ca. 2011–1700 B.C.).
Jasnow

133.610-611 Middle Egyptian Texts
Bryan, Jasnow

133.620-621 Hieratic
Jasnow

133.630-631 Old Egyptian
Bryan

133.640-641 Late Egyptian
Jasnow

133.646-647 Demotic
Jasnow

133.648-649 Coptic
Jasnow

133.656 Advanced Demotic
Jasnow

133.700-701 Survey of Egyptian Archaeological Sites
Research and reading on a variety of sites characteristic of Egyptian periods and provincial cultures. Intended to cover the dynastic period and nomes of Egypt in two semesters.
Bryan

133.720-721 Egyptian Art of the Old through Middle Kingdoms
Bryan

133.724-725 Egyptian Art of the Second Intermediate Period and the New Kingdom
Bryan

133.730 Egyptian Art of the Third Intermediate and Late Periods
Bryan

133.735 Egyptian Art of the Ptolemaic and Roman Periods
Bryan

133.750-751 Seminar in Egyptian Art and Archaeology
Bryan

Northwest Semitic Languages

134.602 Wisdom Literature of the Hebrew Bible
A study of the Hebrew text of Qohelet and/or the Book of Proverbs.
Lewis

134.604 The Book of Job
Reading the Hebrew text of the book of Job with attention to philology, textual criticism, and various aspects of interpretation.
Lewis

134.608 The Book of Ezekiel
A rapid reading course aimed at increasing proficiency in reading the Hebrew text of the book of Ezekiel. Various aspects of translation and interpretation will be studied (e.g., grammar, textual criticism, philology) including literary, historical, and theological questions.
Lewis

134.610-611 Historical Hebrew Grammar
Phonology and morphology of biblical Hebrew.
McCarter

134.620-621 Textual Criticism of the Hebrew Bible
An introduction to the ancient witnesses of the biblical text and the principles of textual criticism.
McCarter

134.630-631 Qumran (Dead Sea) Texts
McCarter

134.644 Persian Period Texts from the Hebrew Bible
Readings taken from Second Isaiah, Ezra, Nehemiah, I-II Chronicles, Haggai, Zechariah, etc.
Lewis

134.650-651 Seminar in Hebrew or Northwest Semitic
Subject announced each year.
Lewis, McCarter

134.652 Seminar in Ancient Israelite Religion
Topics include history of scholarship, methodology, representations of deity, the aniconic tradition, solar Yahwism, sacred space, blood rituals, passover, royal cult, family religion, divination, prophecy, incantations, etc.
Lewis

134.656 Comparative Semitics
McCarter

134.700-701 Northwest Semitic Epigraphy
Introduction to epigraphic method and paleography; study of Phoenician, Hebrew, and Aramaic inscriptions.
Lewis, McCarter

134.720-721 Ugaritic
A year long course studying Ugaritic language and literature. The first semester will focus on grammar and translating a representative selection of mythological texts. The second semester will concentrate on ritual texts. The course will also be epigraphic in nature using both conventional and digital techniques.
Lewis

134.740-741 Biblical Aramaic
Grammar and reading of Daniel and Ezra, and as time permits, extrabiblical texts in Imperial Aramaic.
Lewis, McCarter

134.744 Survey of Aramaic Texts
Lewis, McCarter

134.780-781 Biblical Criticism Seminar
Research and discussion on the history of scholarship of the field as well as on topics of current interest.
Lewis, McCarter

Neuroscience

Neuroscience seeks to understand the nervous system and its functioning at levels ranging from molecules interacting with cell membranes to brain systems subserving cognitive functions such as language. Dramatic progress has been made at all levels, and the field continues to grow. On the Homewood campus, researchers study the nervous system at many levels, in the departments of Biology, Biomedical Engineering, Biophysics, Cognitive Science, and Psychological and Brain Sciences and in the Krieger Mind/Brain Institute study the nervous system at many levels. Their presence provides the opportunity for an innovative, interdepartmental program which offers a broad overview of the neuroscience field, as well as more advanced training in one of three areas of concentration.

Cellular and Molecular Neuroscience (CM) focuses on the mechanisms by which information flows within and between cells in the nervous system, and the mechanisms through which the cellular structure of the nervous system develops and is maintained. Topics include the molecular basis of membrane permeability, action potentials, sensory transduction, synaptic transmission, neuronal modulation, mechanisms of drug action, and the molecular basis of genetic disorders of the nervous system.

Systems Neuroscience (ST) seeks to relate brain structure and functioning to behaviors and related physiological processes. Research in this area explores the description and analysis of neural circuits. This includes identifying the brain nuclei and interconnections making up a circuit, identifying and investigating the implicated neurotransmitters, and characterizing the intrinsic and extrinsic factors that modulate the development and adult functioning of the circuit. Topics as diverse as learning and memory, communication, sensory systems, and motivated behaviors (e.g., reproduction, feeding, aggression) are explored from this perspective.

Cognitive Neuroscience (CG) focuses on how cognitive functions, such as vision or language, are implemented by the brain. Drawing upon a variety of techniques for probing the working brain at cognitive and neural levels, including functional neuroimaging, analysis of cognitive impairments in brain-damaged patients, and electrophysiological techniques, research in cognitive neuroscience seeks to relate mental representations and computations to brain mechanisms and processes.

Neuroscience Program Committee

Gregory Ball, Program Chair, Professor, Psychological and Brain Sciences.

Linda Gorman, Director of Undergraduate Studies, Teaching Professor, Psychological and Brain Sciences.

Samer Hattar, Assistant Professor, Biology.

Michael McCloskey, Professor, Cognitive Science.

Brenda Rapp, Professor, Cognitive Science.

Veit Stuphorn, Assistant Professor, Psychological and Brain Sciences, Mind/Brain Institute.

Steven Yantis, Professor, Psychological and Brain Sciences.

Eric Young, Professor, Biomedical Engineering.

Haiqing Zhao, Associate Professor, Biology.

The Neuroscience Program Committee coordinates course offerings, oversees the program's interdepartmental courses, reviews and updates the administration of the program, makes decisions about admission to the B.A./M.S. program, approves proposed research programs and mentors for students in the B.A./M.S. mentored research program, and evaluates the final reports and presentations from the research year.

Undergraduate Programs

The neuroscience major consists of two degree programs: a four-year B.A. based primarily on course work and 6 credits of research; and a five-year concurrent B.A./M.S. involving additional course work and a yearlong intensive laboratory experience. (Under special circumstances, a student may be able to complete the B.A./M.S. program in less than five years.) Both programs are designed to provide rigorous preparation for advanced study in either a Ph.D., M.D. or Ph.D./M.D. programs. All of the mathematics and sciences courses required of premedical students are included in the requirements for the neuroscience major. The concurrent B.A./M.S. program accepts students every spring semester.

Additional information regarding the undergraduate degree and the B.A./M.S. programs is available through our website at http://krieger.jhu.edu/neuroscience. You may also contact our Program Administrator, Ms. Hope Stein, hope.stein@jhu.edu or 410-516-6196.

This curriculum is being reviewed on a regular basis. Please consult our website for the most recent updates, http://krieger.jhu.edu/neuroscience/index.html .

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 48.)

Degree requirements are the same for each concentration, except in the specific advanced courses and the nature of the laboratory research.

- **Optional Introductory Course**

  One of the three following courses are recommended but not required for neuroscience majors; they are intended for freshmen considering the neuroscience major as an introduction to the field.

  Fall: 200.141 Intro to Physiological Psychology or

  050.105 Intro to Cognitive Neuropsychology

  080.105 An Introduction to Neuroscience

- **Neuroscience Sequence (12 credits):**

  These courses are normally completed during the sophomore and junior years. We recommend that students complete these courses in the following sequence:

  080.203 Cognitive Neuroscience (spring)
  080.305 The Nervous System I (fall)
  080.306 The Nervous System II (spring)
  080.250 Neuroscience Lab: A Practical
  Approach (fall/spring)

- **Statistics (3 credits):**

  550.211 Probability and Statistics for the Life
  Sciences (spring)

  Students may substitute 550.111 Statistical Analysis I and 550.112 Statistical Analysis II for 550.211.

- **Advanced Courses (12 credits):**

  Twelve credits from neuroscience or neuroscience-related courses at the 300-level or above. At least nine of the 12 credits must be from the chosen area of concentration, plus three additional credits from a different area. Credits for research may not be applied toward this requirement. 'Advanced/upper level' list of approved courses are posted on our website each semester.

- **Mathematics and Science Courses (49 credits):**

  110.106-107 Calculus I, II (Biological and
  Social Sciences)
  030.101, 105 Introductory Chemistry I and Lab
  030.204, 106 Introductory Chemistry II and Lab
  030.205, 206, 225 Introductory Organic
  Chemistry I (required), II and Lab (II and
  lab are optional)
  171.101-102 or 103-104 and 173.111-112
  General Physics I, II, and Labs

For the cellular and molecular neuroscience concentration:

020.305, 315 Biochemistry and Lab and
020.306, 316 Cell Biology and Lab

For the cognitive neuroscience and systems neuroscience concentration:

either 020.151-152 and 020.153-154 General
Biology I, II, and Lab or
020.305, 315 Biochemistry and Lab and
020.306, 316 Cell Biology and Lab

- **Research (6 credits):**

  Six credits of research, obtained through work in one of the neuroscience laboratories participating in the program. Students are expected to complete a three- to-five-page paper describing the experimental results for each semester of their research.

Requirements for the B.A./M.S. Degree

Students who wish to apply for the B.A./M.S. Program in their junior or senior year must meet the following minimum requirements (prior to applying):

- A minimum 3.5 grade-point average in all required courses for the undergraduate major and cumulative GPA of 3.5,
- Completion of no fewer than three credits of undergraduate research, and,
- Completion of all courses required for the B.A. degree.

- **Statistics (3 credits)**

  All students need to have taken either 550.211 or 550.111 and 550.112. If they have not had these classes, then they will be required to take 200.314 Advanced Statistical Methods. Students may not substitute Advanced Placement credits for this requirement.

- **Advanced Seminars in Neuroscience (6 credits)**

  The Advanced Seminar in Neuroscience is offered in the fall and spring terms.

- **Specialized Courses (12 credits)**

  Degree requirements include 12 credits of additional advanced course work (300-level or above). At least three credits must be at 400-level or above. Courses must be related to the study of neuroscience and ideally focused on the student's concentration of study and area of research. Students may choose courses from the approved list of undergraduate advanced courses. (In addition, up to six additional credits of the Advanced Seminar in Neuroscience, and/or statistics courses, graduate courses and seminars may be taken with the approval of the program director.)

- **Mentored Research (24 credits)**

  During the research year, students will complete a total of 24 credits of mentored research. Students must complete nine credits of research in a spring academic term, six in the summer and an additional nine in the fall.

- **B.A./M.S. Commencement Project (1 credit)**

  After completing the research year, students must register for a one-credit independent study course intended to track the progress and defense of the student's final research project.

Courses

Core Courses

080.203 (N,S) Cognitive Neuroscience
This course surveys theory and research concerning how mental processes are carried out by the human brain. Currently a wide range of methods for probing the functioning brain are yielding insights into the nature of the relation between mental and neural events. Emphasis will be placed on developing an understanding of both the physiological bases of the techniques and the issues involved in relating measures of brain activity to cognitive functioning. Methods surveyed include electrophysiological recording techniques such as EEG, VEP, ERP, single/multiple unit recording, and MEG; functional imaging techniques such as PET and fMRI; and methods that involve lesioning or disrupting neural activity such as WADA, cortical stimulation, animal lesion studies, and the study of brain-damaged individuals. No prerequisites. Co-listed as 050.203 Cognitive Neuroscience: Exploring the Living Brain.
McCloskey, Rapp   3 credits

080.250 (N,S) Neuroscience Lab: A Practical Approach
This course will give students the "hands-on" experience of the interdisciplinary nature of neuroscience. Students will use anatomical, behavioral, and neurophysiological techniques to understand the basic underlying principles of neuroscience. Prerequisites: 080.305 and 080.306, or 200.141 or permission of instructor.
Gorman/Fortune   3 credits

080.305-306 (N) The Nervous System I and II
A half century's research in neuroscience has brought the field to a point where the cell and molecular biology of neurons allows us to understand how the nervous system is put together and how it functions. The Nervous System I and II introduce the fields of cellular, molecular and systems neuroscience by integrating the knowledge that each field contributes to our understanding.

In The Nervous System I, the structural and electrical properties of neurons will be explored in the context of how the auditory system of birds and mammals is organized and how it works to detect sounds, locate their sources, appreciate their content and understand their meaning. In addition, the cellular and molecular biology of synapses will be examined in parallel with the anatomy and physiology of the vertebrate visual system as a way to explain contrast detection, color perception, visual guidance of movement and face recognition.

The Nervous System II uses the functional organization of the somatosensory system as a means to examine mechanisms of neural development. Generation and maturation of neurons, guidance of axons, formation of synapses and the regressive events that shape the adult nervous system will be examined. At the same time we will explore the structure and function of brain regions that allow us to feel pain and temperature, detect vibration, recognize shape and perceive where we are in space. Finally, the single-neuron events that lead to adaptive changes in function will be explored in the context of central nervous system control of movement and of the higher order functions of speech and memory.

These two semesters are designed to be creatively redundant. Essential concepts that bind together all the nervous system will be stressed repeatedly. The goal here is for all students to leave the year's study with their own point of view of how the nervous system works.
Hendry/Hattar/Zhao   3 credits each course

Advanced Courses

The list below represents the advanced courses that are offered by the Neuroscience Program. For a complete list of all available courses, visit **http://krieger.jhu.edu/ neuroscience/courses/index.html**.

080.310 (N) Communication Between Cells: The Synapse as a Model System
All cells inform neighbors of their own activities. That act of communication frequently requires the formation of cell junctions across which information can pass. One of the best studied of the means of communication between cells is the synapse between neurons. This course examines the synapse in depth. both as a means to look at the nature of neuronal communication and as a model for communication across cells of all types. Lectures on the physiology, structure, biochemistry and cell biology of synapses will be used as an introduction to the function of synapses in learning and memory and the effect on synapses of drugs and disease. Cross-listed with Biology. (CM)
Kirkwood, Hendry   3 credits

080.322 (N) Cellular and Molecular Biology of Sensation
Leading scientists in sensory biology from the Johns Hopkins community will present the most current knowledge in the cellular and molecular biology of sensation. A lecture and a student presentation of an exemplar manuscript will be presented each week on a different topic of sensory systems. Meets with AS.020.322 (CM)
Hattar/Hendry   3 credits

080.330 (N,W) Brain Injury and Recovery of Function

This course investigates numerous types of brain injuries and explores the responses of the nervous system to these injuries. The course's primary focus is the cellular and molecular mechanisms of brain injury and the recovery of function. Discussions of traumatic brain injury, stroke, and neurodegenerative diseases, using historical and recent journal articles, will facilitate students' understanding of the current state of the brain injury field. (ST/CM)

Gorman   3 credits

080.340 (N,W) Neuroplasticity

This course will investigate mechanisms associated with changes that occur within the nervous system. Students will use journal articles to discuss current issues related to developmental, adaptive, and restorative neuroplasticity. (ST/CM)

Gorman   3 credits

080.345 (N) Great Discoveries in Neuroscience

This course examines the historical and intellectual context of selected, key advances in neuroscience, how they were made and their impact on understanding the nervous system. Particular attention will be paid to advances in cellular and molecular neuroscience. Among the topics covered will be the discovery of monoamine neurotransmitters and of endocannabinoids, the role of neurotrophins in neural development, and prion-based diseases of the brain. (ST/CM)

Baraban   3 credits

080.352 Primate Brain Function

Neuroscience is approaching the time when it can offer a compelling explanation for how the brain works. This course takes advantage of work done in humans and non-human primates to survey concepts in sensory perception, motor command, and memory mechanisms. Lectures are given by faculty whose research explores these issues. Each subject is explored as a three-lecture sequence: 1) a background lecture that lays out the general principles and overriding questions of the field; 2) an in-depth lecture that covers the most recent scientific literature; and 3) a summary lecture that brings together the major questions and their resolution. (ST)

Hendry   3 credits

080.360 (N) Diseases and Disorders of the Nervous System

This class will use lectures, readings and presentations of filmed clinical examinations to outline the causes and treatments of neurological diseases and disorders. We will begin with diseases of the peripheral nervous system and proceed in steps to examining various forms of mental retardation and a variety of neuropsychiatric disorders. (ST/CM)

McKhann/Hendry   3 credits

080.411-414 (N) Advanced Seminars in Neuroscience

All B.A./M.S. students participate in this three-credit weekly seminar during their last two years, including the research year. The seminar involves student presentations

of research, presentations by guest speakers, and discussion of readings on topics of current interest in the field.

Yoshioka   3 credits

080.850 - 852 Mentored Research in Neuroscience

B.A./M.S. students register for mentored research for three terms (typically the spring and summer terms of the fourth year and the fall term of the fifth year). They receive nine credit hours per semester for research during the fall and spring semesters, and six credit hours for the summer. Letter grade.

Yoshioka   9/6/9 credits
respectively spring/summer/fall

Additional Courses

The courses listed below are offered by the Neuroscience Program, but are not required by the major and do not count toward the major requirements.

080.105 (N) An Introduction to Neuroscience

Our knowledge of brain function from the level of single molecules to human behavior continues to expand at something approaching light speed. That knowledge invades our lives every day. And decisions are made based on that knowledge from every corner of life…from physician to politician and every stop in between. This course is meant to provide a fundamental understanding of how the cells and molecules as well as the regions and systems of the brain work to have you see and hear and move and remember. The course is divided into four sections that progress from the cells of the brain and spinal cord to circuits then systems and finally behaviors. Introduction to Neuroscience is designed for any college student who has an interest in the range of disciplines we call neuroscience.

Hendry   3 credits

080.319 (N,S) Practicum in Language Disorders

This course provides the opportunity to learn about adult aphasias; language disorders which are one of the most common consequences of stroke. You will receive training in Supportive Communication Techniques and work as a communication partner with an individual with aphasia for two hours per week. Three class meetings for orientation and reading assignments will be held on campus; training and practicum will be conducted at a local aphasia support center. Transportation required.

Rapp   1 credit

080.324 Neuroscience Journal Club

Being able to meet with a small group and discuss some key journal articles in a particular area of Neuroscience is one of the experiences that we hope to fulfill with this course. Section themes and topics will be chosen each semester. Classes will consist of reading an assortment of journal articles; both review and primary literature. Students will alternate leading the discussions of the theoretical and practical implications of the papers.

Gorman, TBA   1 credit

Nursing

In 1983, Johns Hopkins University, in affiliation with three Baltimore-based hospitals—Sinai, Church, and Johns Hopkins—formed the Consortium for Nursing Education, which in turn established Johns Hopkins University School of Nursing. The first class of undergraduates was admitted in 1984.

The School of Nursing prepares students for professional nursing practice through an education process that combines academic curriculum with intensive clinical experience. Students work side by side with some of the brightest scholars and graduate and undergraduate students in the world. The outstanding resources of the university provide them with a unique opportunity to develop and grow in the nursing profession. This rare combination of resources and opportunities makes the School of Nursing a leader in nursing education.

Baccalaureate Program

Bachelor of Science in Nursing

The School of Nursing offers an upper-division program leading to a bachelor of science (BS) degree with a major in nursing. This program is accredited by the American Association of Colleges of Nursing (AACN).

Requirements of the Nursing Program

First degree

Students who do not already possess a bachelor's degree and are interested in pursuing a baccalaureate degree in nursing may apply to the 21-month, upper-division Traditional Option. Students transfer to the School of Nursing after successful completion of 60 credits of prerequisite course work from any accredited college or university. Applicants are required to complete the prerequisites listed below. All courses should be completed with a B or better.

Prerequisites – 60 credits

Natural Sciences – 17–23 credits

	credits
Human Anatomy and Physiology (within the past 5 years)	6
Microbiology	3
Chemistry	6–8
Nutrition	2–3

Humanities – 9 credits

English, Writing or Composition	3
Literature	3
Logic, Philosophy, Ethics, Foreign Language, Speech, History of Art or Music, Mathematics	3

Social Sciences – 15 credits

	credits
Intro to Psychology	3
Intro to Sociology	3
Human Growth and Development or Developmental Psychology covering the entire lifespan	3
Anthropology, Economics, Family or Community Sociology, Geography, History, Political Science, or Psychology	6

Statistics – 3 credits

The statistics course should include topics of correlation and linear regression; experimental design such as t-tests, analysis of variance and chi-square. Suggested departments: Psychology, Sociology, Education, Biology and Mathematics. The departments whose statistics courses are more theory-based and lack the experimental design component are Business, Management and Economics.

Electives – 10-16 credits

Electives may be selected from any academic discipline. Credits in studio or performing arts are not acceptable. Only one physical education course will be accepted.

Second degree

Traditional

The Traditional B.S. in nursing option is offered in a 21-month, semester format. The Traditional option begins in the fall of each year. Typically, a student participating in this option has more time for outside activities including working in a hospital or clinical setting, research, involvement with student interest groups such as student government, sports, etc., or taking additional courses. Students are eligible to pursue an internship/externship or work at a hospital such as Johns Hopkins Hospital, during the summer between their first and second years.

Accelerated

The Accelerated BS in nursing option is a 13.5-month option which encompasses all of the components of the Traditional BS in nursing in a concentrated period of time. This option begins in June of each year and ends in July of the following year. The Accelerated student must be able to devote a great deal of time to academics due to the intensity.

Prerequisites

The following courses must be completed at an accredited college or university with a B or better before enrollment:

	credits
Human Anatomy and Physiology (within the past 5 years)	6-8
Microbiology	3
Nutrition	2-3
Human Growth and Development or Developmental Psychology covering the entire lifespan	3
Statistics	3

The statistics course should include topics of correlation and linear regression; experimental design such as t-tests, analysis of variance and chi-square. Suggested departments: Psychology, Sociology, Education, Biology and Mathematics. The departments whose statistics courses are more theory-based and lack the experimental design component are Business, Management and Economics.

Direct Entry to Combined BS/MSN

The Direct Entry to Combined BS/MSN is available for students applying for admission to the baccalaureate program. Students with a previous baccalaureate degree and who have an outstanding academic record, clearly focused career goals, and previous employment or volunteer experience in health care may apply for this program. The Graduate Record Examination (GRE) is only required for the BS/MSN, MSN/MPH, or the MSN/MBA options.

Enhancement Options

Birth Companions

This course focuses on developing initial competence in the Birth Companion role based on the Doula model. The Doula model emphasizes physical, emotional, and informational support to the mother before, during, and after childbirth. Maternal and child health nursing and community health nursing theories and practices are introduced. Group processing of client and birth companion interactions and care management will be held bi-weekly. Seminars with experts in the field, including lactation consultants, social workers, community health educators, and child birth educators will be included.

Community Outreach Program

The Community Outreach Program is an innovative educational curriculum for community-based public health nursing practice. The goals of the project are to increase education in public health nursing practice and to provide a community-based learning experience for students while improving both the delivery of health services to and the health status of the urban Baltimore community. Opportunities for special study credits with selected faculty are available. These offerings provide structured learning experiences while working directly in the community.

Peace Corps Fellows Program

This program offers individuals who have successfully completed Peace Corps service the opportunity to participate in community nursing practice under the supervision of senior community health nursing faculty. This service is outside that required by the nursing courses. Students will be paid a stipend for this service. In addition, an effort will be made to individualize the practice site of the student based on their previous experiences and future career goals.

Master's Programs

Students seeking a Master of Science in Nursing (MSN) may select from a number of highly individualized programs of study, all fully accredited by the American Association of College of Nursing (AACN). These include Adult, Family, or Pediatric Primary Care Nurse Practitioner and Adult Acute/Critical Care Nurse Practitioner; Public Health Nursing; Health Systems Management; Clinical Nurse Specialist including Forensic Nursing and Women's Health; a joint degree program in nursing and public health (MSN/MPH) with Johns Hopkins' Bloomberg School of Public Health; and a joint degree program in nursing and business (MSN/MBA) with the Carey Business School. The MSN/PhD is also available.

PhD Program

The goal of the PhD program is to prepare leaders in the development of nursing science. Graduates will be prepared for careers as investigators conducting empirical research to discover new knowledge that increases understanding of principles and mechanisms underlying human health and responses to health problems.

Additional information may be obtained by calling 410-955-7548 or emailing jhuson@son.jhmi.edu. You can also visit the School of Nursing website at www.nursing.jhu.edu.

DNP Program

The Doctor of Nursing Practice (DNP) program is a practice-focused doctoral program designed to prepare expert nurse clinicians, administrators, and executive health leaders to improve health and health care outcomes. The focus is on innovative and evidence-based nursing practice, applying research processes to decision making, and translating credible research findings to increase the effectiveness of both direct and indirect nursing practice. The DNP is designed for nurses involved in any advanced practice role including but not limited to: clinical nurse specialist, nurse practitioner, nurse midwife, nurse anesthetist, public health practitioner, nurse executive, nurse informatician, and health policy analyst.

Philosophy

The Department of Philosophy offers programs and courses at the undergraduate and graduate levels. The courses cover major periods in the history of Western philosophy and many of the main topics of systematic investigation: epistemology, metaphysics, ethics, aesthetics, philosophy of language, mathematical logic, and philosophy of science.

The undergraduate courses are designed to introduce students to the history of philosophy and its place in Western civilization, to teach them how to read philosophical texts, and to help them think about philosophical problems, including those that arise in other disciplines. Students may major in philosophy or use it as a concentration for an area major in Humanistic Studies. They may also study philosophy along with another subject, either by constructing a double major or by taking courses designed to help them develop philosophical perspectives on their own fields of interest.

The graduate program is intended primarily for those planning to teach philosophy and make their own contributions to it. While the acquisition of a broad background in the history and different systematic fields of philosophy is required, students will have ample opportunity to develop their own special interests.

The Department of Philosophy encourages its students to take advantage of the rich resources of other departments at Johns Hopkins University. As a look at their offerings will show, numerous philosophically important courses are offered by such departments as Political Science (political philosophy), History of Science and Technology (philosophy of science), the Humanities Center (hermeneutic, interpretive, and literary theory), and Cognitive Science.

The Faculty

Peter Achinstein, Professor: philosophy of science, analytic philosophy. (On Leave—June 2010)

Richard Bett, Professor: ancient Greek philosophy, ethics.

Hilary Bok, Associate Professor, Henry R. Luce Professor in Bioethics and Moral and Political Theory: moral philosophy, bioethics, freedom of the will.

Eckart Förster, Professor: metaphysics, history of philosophy, Kant and German idealism.

Steven Gross, Associate Professor: philosophy of language, philosophy of mind, metaphysics.

Yitzhak Melamed, Associate Professor: Early Modern Philosophy, German idealism, metaphysics.

Dean Moyar, Associate Professor: German idealism, social and political philosophy, ethics.

Robert Rynasiewicz, Professor: logic, philosophy of science, history and philosophy of physics.

Meredith Williams, Professor: philosophy of mind, philosophy of psychology, Wittgenstein.

Michael Williams, Krieger-Eisenhower Professor (Chair): theory of knowledge, philosophy of language, history of modern philosophy.

TBA, Duane L. Peterson Chair in Ethics.

Emeriti

Stephen Barker

Jerome B. Schneewind

Joint/Adjunct Appointments

Jeffrey Bub, Professor (Philosophy, University of Maryland, College Park): philosophy of quantum mechanics.

Hent de Vries, Professor (Humanities Center): modern European thought.

Paola Marrati, Professor (Humanities Center): contemporary French thought.

Maria Merritt, Assistant Professor (Bloomberg School of Public Health): bioethics.

Lawrence Principe, Professor (History of Science and Technology): history and philosophy of science.

Andrew Siegel, Core Faculty (Berman Institute of Bioethics).

Undergraduate Programs

(See also General Requirements for Departmental Majors, page 48.)

Philosophy is a discipline of the mind as well as a cluster of closely related subjects. It is an excellent preparation for professional studies such as law and medicine; it provides perspective on other disciplines such as psychology, mathematics, literature, political science, and physics; and it centers on a set of questions that thinking people cannot avoid. At Hopkins it can be studied in a variety of ways.

A number of our courses are designed to provide broad introductions to the subject. Both 150.111 Philosophic Classics and 150.112 Philosophic Problems cover a wide range of topics, the former through the study of some of the major texts of Western thought, the latter by more systematic examination of representative issues. Either one will show a student a variety of approaches to philosophical

problems. The courses 150.201 and 150.205 offer historically oriented introductions to the subject, giving the student a basic grasp of the development of philosophy in two of its major periods. Other courses, such as 150.118 Introduction to Formal Logic, and 150.220 Introduction to Moral Philosophy, are designed for students with an interest in the particular areas they cover. All of these courses are readily available without prior study of philosophy.

The 400-level courses are open to graduate students as well as to undergraduates. Some require no previous course in philosophy. Others presuppose some familiarity with philosophy, such as would be provided by one of the introductory courses. Still others require more specific preparation. A student with questions about whether he/she has the background for a particular 400-level course should consult either the instructor or the departmental undergraduate advisor.

A student who wants to study an area of philosophy not provided for in the regular curriculum or to undertake a special project of writing and research should consult with a faculty member about taking 150.511-512 Directed Study. An undergraduate who has the proper background may enroll in a graduate seminar if the instructor approves.

In addition, opportunities for research assistantships are sometimes available (see 150.521-522). Interested students should make inquiries to the director of undergraduate studies.

Requirements for the B.A. Degree

Philosophy majors must take 11 departmental courses.

A minimum of six courses must be at the 300-level or higher. Of the two general introductory courses, 150.111 Philosophic Classics and 150.112 Philosophic Problems, only one may count toward the major, and only two 100-level courses may count toward the major.

Majors are required to take the "Undergraduate Seminar", preferably in the junior year.

Other courses must be distributed by taking at least one course in each of the five following categories:

• Ancient philosophy

• Modern philosophy

• Logic, philosophy of science, or philosophy of mathematics

• Philosophy of mind, theory of knowledge, philosophy of language, or metaphysics

• Ethics, aesthetics, or political philosophy

The first two categories are normally satisfied by taking Introduction to Greek Philosophy and Introduction to the History of Modern Philosophy.

The student thus has four or five further electives after satisfying the distribution requirements. Well-qualified majors may be admitted to a graduate seminar during the senior year. They should consult their major advisor. Courses in which a grade of D is received may not count toward the major, nor may courses taken pass/fail.

Double Majors

The department encourages linking the study of philosophy with the study of other disciplines. For example, the subject matter and course requirements of the Philosophy and Psychological and Brain Sciences departments are such as to make a double major both practical and intriguing. Similarly, knowledge of literature or the history of art is pertinent to the study of aesthetics; a solid understanding of science is valuable for those interested in the philosophy of science; and students of ethics benefit considerably by combining their work with study of political theory and of the political realities amidst which morality must function. Members of the department will be happy to assist students in planning double majors particularly suited to their interests.

Honors Program in Philosophy

Students with an overall GPA of 3.0 and a Philosophy GPA of 3.5 or higher (or outstanding recommendations from three department members) are eligible for the Senior Honors Thesis Program. In addition to the 10 courses required for the major, successful applicants take two courses, 150.550 and 150.551, using them to write a thesis of about 50 pages under the supervision of a faculty member. The thesis must be completed prior to spring vacation of senior year. If the student withdraws prior to completion of a thesis, a satisfactory/unsatisfactory grade will be awarded.

The grade for the thesis will depend on the thesis itself and an oral examination about it, conducted by the thesis advisor and two other faculty members. Graduation Honors will be awarded to those whose work receives an A- or better. For more information about the Honors Program, consult the departmental major advisor.

Minor in Philosophy

Philosophy minors must take seven departmental courses, which should include the following:

• At least one course in the history of philosophy, either ancient or modern.

• At least one course in two of the following areas:

  1. Logic, philosophy of science, or philosophy of mathematics

  2. Ethics, aesthetics, or political philosophy

3. Systematic studies of problems central to the tradition arising from the work of Frege, Russell, Moore, Tarski, Carnap, and Wittgenstein

4. Either 150.111 Philosophic Classics or 150.112 Philosophic Problems, but not both, may count as one of the seven courses. Neither is a required course.

The Bioethics Program offers an interdisciplinary minor in which philosophy plays a large role. See Bioethics Program for more details.

Graduate Programs

When The Johns Hopkins University was founded in 1876, it was the first university in the United States designed as a center for research and doctoral education. Among its earliest graduate students were Josiah Royce and John Dewey; C. S. Peirce was an early faculty member. The department today continues this tradition, devoting a major part of its effort to preparing graduate students to make original contributions to the field and to pursue careers in college and university teaching.

The department's purpose is to provide opportunities for students to develop special interests within a program that also ensures breadth of knowledge. We offer classes, seminars, and directed study in the history of ancient, modern, and contemporary Western philosophy, and in the systematic areas of epistemology, metaphysics, ethics, philosophy of science, philosophy of physics, philosophy of biology, philosophy of language, philosophy of mind, philosophy of mathematics, mathematical logic, and aesthetics. Philosophy courses are frequently offered in other departments, such as Political Science, German and Romance Languages and Literatures, and Classics, and students are encouraged to take advantage of these opportunities.

The department offers the M.A. and the Ph.D. degrees. The graduate program is designed primarily for those seeking the Ph.D., but under exceptional circumstances students aiming at the M.A. may be admitted.

For full details on the requirements for the Ph.D. program, see the department website at **www.jhu.edu/~phil**.

Program in the History and Philosophy of Science

Graduate students with an interest in the history and philosophy of science receive their Ph.D. from either the Department of Philosophy or the Department of the History of Science and Technology, in accordance with each department's requirements. Students in both departments, however, may apply to enroll in a special program of studies in history and philosophy of science coordinated by the Johns Hopkins Center for the History and Philosophy of Science. Students who fulfill the requirements will be certified by the center as having completed this special program. Further information can be obtained by writing to Professor Peter Achinstein, of the Department of Philosophy.

Program in Political and Moral Thought

Currently inactive except for year long colloquia series.

Admission

In addition to submitting an application, applicants are asked to submit a sample of written work. While an undergraduate major in philosophy is good preparation for graduate study in the department, applications are welcomed from students with other majors whose interests are now turning toward philosophy.

The deadline for those applying both for admission and financial aid is January 15. Awards will be announced by April 1. Inquiries should be addressed to Admissions Chair, Department of Philosophy, The Johns Hopkins University, Baltimore, Maryland 21218. Graduate applications can also be downloaded from the admissions office website.

Financial Aid

All students admitted to the program receive financial assistance. Support is guaranteed for five years provided that a student continues to make satisfactory progress toward completion of the Ph.D. degree. Department fellowships cover tuition and pay a stipend. Outstanding applicants may be nominated for a George Owen Fellowship, which also covers tuition and for which the stipend is higher. All students receive fellowship support for the first two years; no teaching is required. Third- and fourth-year students are supported by teaching assistantships, which carry full tuition and a stipend. Fifth-year students are generally supported through teaching assistantships, though fellowship support may also be available. In practice, the department is often able to offer teaching assistantships to students beyond their fifth year, though this support is not guaranteed. In addition, a generous bequest by a former member of the department, David Sachs, has established the Sachs Fellowship Fund. Sachs Fellowships are dissertation-year fellowships awarded on a competitive basis to outstanding students who are making substantial progress toward completing their dissertations.

Leon Gilbert Barnhart Memorial Fellowship

A fellowship in memory of Leon Gilbert Barnhart, B.A. '67, currently set at $3,000, may be awarded annually to support a student working on a dissertation on one of the topics which most interested Leon Barnhart himself: German philosophy, up to and including current German philosophy, and the history of philosophy more generally.

William Miller Essay Prize

The William Miller Essay Prize is awarded annually for a self-contained essay of outstanding quality in any field of philosophy. The monetary award is open to students in philosophy at the pre-dissertation stage of their graduate work. Submissions should be no longer than 10,000 words. Students may submit only one essay per year. Details are available from the Philosophy Department office.

Undergraduate Courses

Courses offered every year are so marked. Most courses and seminars in the department are offered alternate years. A more detailed list of courses to be offered in a given semester is available in the department office. A student may not take a more advanced course when he/she has earned a D or D+ in a prerequisite course, including a course taken in the first semester of freshman year.

Introductory Courses

150.111 (H,W) Philosophic ClassicsA historical introduction to reading and doing philosophy by way of critically examining selected classic texts in the Western philosophical tradition. Philosophers some of whose ideas will be examined include Plato, Descartes, Hume, Kant, and Nietzsche.
Moyar   3 credits

150.112 (H) Philosophic Problems
An examination of some central philosophical issues, including the nature and limits of human knowledge, reason and religion, and the nature of human freedom.
Staff   3 credits

150.118 (H,Q) Introduction to Formal Logic
The fundamentals of symbolic logic, including truth-functions, quantification theory, and identity; probability and decision theory. No prerequisites.
Staff   3 credits

150.119 (H,Q) Introduction to Inductive Logic
A study of probability and its various interpretations; inductive reasoning and its justification, evidence and paradoxes of confirmation. No prerequisites.
Staff   3 credits

150.120 (H,N) Introduction to Scientific Thinking
A study of the logic of scientific reasoning. What is the "scientific method"? How is it different from non-scientific ones? Do scientific theories describe reality, or are they just useful organizational and predictive devices? What is a scientific explanation? The course examines views on these questions by Descartes, Newton, and more recent scientists and philosophers of science. No previous philosophy or science course is required.
Staff   3 credits

150.190-194 (H) Undergraduate Seminars
Staff 1-3 credits

150.195-199 (H,W) Undergraduate Seminars
Staff   1-3 credits

150.201 (H) Introduction to Greek Philosophy
A survey of the earlier phase of Greek philosophy. Socrates, Plato, and Aristotle will be discussed, as well as two groups of thinkers who preceded them, usually known as the pre-Socratics and the Sophists.
Bett   3 credits

150.205 (H) Introduction to the History of Modern Philosophy
An introduction to early modern philosophy, examining Descartes' Meditations on First Philosophy, Locke's Essay Concerning Human Understanding, Hume's Enquiry Concerning Human Understanding, and selections from Kant's Critique of Pure Reason. We will consider such topics as the relation between philosophy and science, the nature and scope of human knowledge, the nature of the human mind, and the nature of human freedom.
Melamed   3 credits

150.216 (H,N,W) Einstein: Philosopher-Scientist
Einstein is regarded as the single most influential thinker of the 20th century. He is credited with revolutionary changes in our concepts of space, time, and matter introduced by both the special and the general theories of relativity. He was also a leading contributor toward the development of the other major innovation of 20th-century physics, quantum theory, although in the end he rejected the Copenhagen interpretation of Bohr and others. Toward the end of his life, he also became a world figurehead for various social and political movements, such as pacifism and Zionism. This course examines Einstein's life and intellectual development from his early days as a student in Switzerland through his later years as a public figure, critic of quantum theory, and advocate for a unified field theory.
Rynasiewicz   3 credits

150.218 (H,Q) Introduction to Symbolic Logic
An introduction to the basic concepts and techniques of symbolic logic, with considerable emphasis on translating

from English into formal languages, constructing formal proofs, and understanding semantic criteria for validity.
Rynasiewicz   4 credits

150.219 (H) Bioethics
Introduction to a wide range of moral issues arising in the biomedical field—e.g., physician-assisted suicide, human cloning, abortion, surrogacy, and human subjects research.
Bok   3 credits

150.220 (H,W) Introduction to Moral Philosophy
What is the good life? What principles should guide our actions? Can we reach agreement on the answers, as we can with scientific questions? These and related issues are studied in conjunction with explorations of specific moral issues such as abortion, euthanasia, and our obligations to those in dire need.
Staff   3 credits   alternate years

150.235 (H) Philosophy of Religion
Can one prove or disprove the existence of God? What is the relation between reason and faith? Are science and religion at odds with one another? We will consider historically significant discussions of these questions (for example, by Plato, Anselm, Aquinas, Pascal, Hume, and Kierkegaard) as well as important contemporary writings (for example, by Adams, Boyer, Plantinga, and Van Inwagen).
Gross   3 credits

150.240 (H,W) Introduction to Political Philosophy
This course will examine classical and contemporary writings in political philosophy, focusing primarily on the nature of justice and on the justification of democracy.
Moyar   3 credits

150.245 (H) Philosophy of Mind
This is an introduction to the key issues and theories in contemporary philosophy of mind. The focus of the course will be the mind-body problem. It will examine the development of the problem and purported solutions, beginning with behaviorism and the identity theory (that mental states just are brain states) to functionalism and the computational theory of mind. It will also address the problem of consciousness and the nature of self-knowledge of others.
Meredith Williams   3 credits

Interdepartmental

Psychological and Brain Sciences

200.160 Foundations of Mind
An interdisciplinary investigation into the innateness of concepts: perception, number, language, morality, physics discussed. Evidence from animals, patients, infants, brains. Students collect data in sections investigating claims from the readings.
Halberda, Feigenson

Humanities Center

300.153 Philosophy of Religion: An Introduction to Jewish Philosophy
This class will survey some of the major names and themes in Jewish philosophy, situating them within their larger philosophical/historical contexts. Students also will be introduced to general questions in the philosophy of religion. Readings include Philo, Saadiah, J. Halevi, Maimonides, Gersonides, Spinoza, Mendelssohn, Buber, Soloveitchik, and more.
Shuster   3 credits

300.326 Living in Doubts: Skepticism in Philosophy, Literature, and Film
This course examines how literature and film express skepticism, and how these genres influence philosophy. Authors include Descartes, Hume, Sartre, Shakespeare, Fielding, and Proust. Three classic films will be screened.
Fenno

300.330 The Ghost and the Machine
This seminar explores the modern conception with the "ghost in the machine," the "brain in the vat," in view of a conception of the "spiritual automaton" etc. Readings will include Descartes, Spinoza, Bergson, Wittgenstein, Benjamin, Ryle, Dreyfus, Putnam, and Cavell.
de Vries

300.377 Radical Enlightenments: Spinoza's Heretic "Atheism and the Materialist Tradition"
This undergraduate course will introduce one of the major thinkers of the so-called radical Enlightenment, analyze his materialist equation of God and Nature, his conception of philosophy and intuitive knowledge, civil religion and the political order, and discuss the renewed influence of his thought in contemporary debates.
de Vries   3 credits

300.378 What Can a Body Do?
This course will explore different conceptions of the body and its biological, political, cultural, and ethical boundaries. Readings will include Spinoza, Deleuze, Sartre, Levinas, Butler, Nancy.
Marrati

300.383 What Makes Us Desire?
This course will analyze different philosophical and literary conceptions of desire. Readings will include Plato, Pascal, Freud, Proust, V. Woolf, Levinas, Deleuze, and others.
Marrati   3 credits

360.133 Great Books: Western Tradition
This course explores some of the greatest works of the literary and philosophical tradition in Europe and the Americas. These books are lifelong companions, and essential reading for both scientists and humanists. Authors include men and women from ancient times to the present.
Team-taught, faculty vary year to year   3 credits

The Center for Africana Studies

360.340 Power and Racism
Examination of white supremacy and antiblack racism as central dynamics in American political development through readings in philosophy, sociology, political science and critical race theory. Focuses on the role of social constructions of race and racial difference as forms of historic and discursive power that have shaped formal, institutional politics as well as the social relations of power in everyday life. Compares racialized politics in the United States and Brazil.
Hayes

Advanced Courses

Courses numbered 400 or above are for both undergraduate and graduate students.

150.302 (H)Topics in Bioethics
Staff   3 credits

150.401 (H,W) Greek Philosophy: Plato and His Predecessors
A study of pre-Socratic philosophers, especially those to whom Plato reacted; also an examination of major dialogues of Plato with emphasis upon his principal theses and characteristic methods.
Bett   3 credits

150.402 (H) Greek Philosophy: Aristotle
A study of selected major texts of Aristotle.
Bett   3 credits

150.403 (H,W) Hellenistic Philosophy
A study of later Greek philosophy, stretching roughly from the death of Aristotle to the Roman imperial period. Epicureans, Stoics, and Skeptics will be the main philosophical schools examined.
Bett   3 credits

150.405 (H) History of Modern Philosophy: Renaissance through Kant
A critical study of some selected works in the history of philosophy from the Renaissance through Kant.
Staff   3 credits

150.406 (H) History of Modern Philosophy: Kant to the 20th Century
Moyar   3 credits

150.408 Seminar in Schelling's 'System Of Transcendental Idealism'
An in-depth research seminar that will study and attempt to discern the underlying idea of Schelling's 'System of Transcendental Idealism.' Regular attendance is mandatory. Prerequisite: Knowledge of Kant's Critique of Pure Reason.
Förster   3 credits

150.410 (H,W) American Philosophy
Studies of major figures in the history of American philosophy beginning with the 19th century. The course focuses on the development of pragmatism in the work of Peirce, James, and Dewey. Other philosophers, such as Royce and Mead, may also be studied.
Moyar, Michael Williams   3 credits

150.411 (H,W) Studies in the History of Modern Ethics
Studies in the development of philosophical thought about morality. Authors and topics will vary; see the instructor for details. Prerequisite: 150.220 or some acquaintance with moral philosophy.
Moyar   3 credits

150.412 (H) Kant's Critique of Practical Reason
A historical and systematic study of Kant's ethics and philosophy of religion, with special attention to his Critique of Practical Reason.
Förster   3 credits

150.413 (H) Conscience in Action
An examination of moral conscience and its status within theories of practical reason. This course also functions as a survey of the history of Continental ethics, with readings from Rousseau, Kant, Fichte, Hegel, Nietzsche, and Heidegger.
Moyar   3 credits

150.416 (H) The Rationalists
The Rationalists—among them Descartes, Leibniz, and Spinoza—are a group of 17th-century philosophers commonly thought to have believed that we could come to know significant truths about God, nature, and ourselves by reason alone. This course will examine key texts of these philosophers, including the *Meditations*, the *Monadology*, and the *Ethics*. Its emphasis will vary: topics of interest have been the relation between the scientific work and the philosophical views of these philosophers, and the nature and classification of substances.
Michael Williams   3 credits

150.417 (H) Kant's Critique of Pure Reason
An in-depth study of Kant's most important work, one of the great classics of modern philosophy.
Förster   3 credits

150.418 (H) Hermeneutics and Critical Theory
This course provides a critical introduction to two of the most important and influential philosophical schools in 20th-century Europe. The main authors to be discussed are Heidegger and Gadamer (for hermeneutics), Horkheimer and Habermas (for critical theory).
Förster   3 credits

150.419 (H) Kant's *Critique of Judgment*
A close study of both parts of Kant's third *Critique*, Aesthetics and Teleology, and their significance for post-Kantian philosophy.
Förster   3 credits

150.420 (H,Q) Intermediate Symbolic Logic
Includes topics covered in 150.218 but with an introduction to meta-theory.
Rynasiewicz   4 credits offered yearly

150.421 (H,Q) Mathematical Logic
Covers the principal theoretical results about logic, including soundness and completeness proofs, the Löwenheim-Skolem theorem, Gödel's incompleteness theorems, computability and Church's thesis.
Rynasiewicz   3 credits

150.422 (H,Q) Axiomatic Set Theory
Axiomatic development of set theory, including the theory of transfinite ordinals and cardinals. Relative consistency proofs. Independence of the axiom of choice, and of the continuum hypothesis. Implications for the foundations of mathematics. Prerequisite: 150.420 or a sufficient level of mathematics.
Rynasiewicz   3 credits

150.424 (H,Q) Foundations of Probability and Inductive Logic
A study of classical a priori, frequency, subjective, and logical theories of probability and inductive inference; the justification of induction; the concept of evidence. No prerequisites.
 Staff   3 credits

150.429 (H) Topics in Logic
Rynasiewicz   3 credits

150.431 (H) Philosophy of Science
An examination of basic concepts underlying thought and practice in the natural and social sciences, such as scientific methods, the verification of hypotheses, explanation, and the role and status of scientific theories. Readings from philosophers of science of the past and present.
Staff   3 credits   alternate years

150.433 (H) Philosophy of Space and Time
Absolute vs. relational theories of time, space, and motion from Descartes through Einstein. The conventionality of geometry, simultaneity and affine structure. Special problems about time (past, present, future; the direction of time; experience and the passage of time).
Rynasiewicz   3 credits

150.434 (H,N) History and Philosophy of Quantum Physics I
Planck, Einstein, Bohr model, "old quantum theory," correspondence principle, dispersion, BKS theory, Heisenberg's Umdeutung (1925 invention of matrix mechanics) and its development.
Rynasiewicz   3 credits

150.435 (H,N) History and Philosophy of Quantum Physics II
De Broglie, Schroedinger's wave mechanics, equivalence with matrix mechanics, Dirac's transformation theory, Bohr-Einstein debate, von Neumann's formulation, EPR paradox, cat paradox, Bohm's theory, Bell's and other no-go theorems, Aspect experiments, entanglement, and quantum teleportation.
Rynasiewicz   3 credits

150.439 (H) Topics in Philosophy of Science
 Staff   3 credits

150.440 (H) Philosophy of Language: Frege to the Present
This course surveys 20th-century analytic philosophy of language, and focuses on the themes of meaning, understanding, truth, and reference.
Williams   3 credits

150.443 (H) Mental Representation
A look at such questions as: How is thought about the world possible? Do we have representations of the world in our mind or brain? If so, what are they like, and how do they represent things? Prerequisite: 150.245 or some background in philosophy of mind.
Meredith Williams   3 credits

150.444 (H) Philosophy of Mind
Topics will vary from year to year; see instructor.
Meredith Williams   3 credits

150.446 (H) Consciousness
A look at philosophical discussions on such issues as the nature of sensations, introspective knowledge of oneself, and whether consciousness can in principle be explained by science or whether some aspects of it will remain beyond the reach of scientific explanation. Prerequisite: 150.245 or some background in philosophy of mind.
Meredith Williams   3 credits

150.449 (H) Philosophy of Language
An introductory, though rigorous, survey of contemporary analytic philosophy of language. Topics covered include sense, reference, the analytic/synthetic distinction, the indeterminacy of translation, speech act theory, as well as recent work in the theory of meaning.
Gross   3 credits

150.451 (H,W) Ethical Theories
A comparative study of major types of ethical theories.
Staff   3 credits

150.453 (H,W) Contemporary Moral Philosophy
Important topics in contemporary ethical literature, e.g., virtues and vices, moral relativism, moral realism, and neo-Kantian constructivism.
Moyar   3 credits

150.456 (H) Aesthetics
An examination of the more influential theories of aesthetics.
Staff   3 credits

150.458 (H,W) Contemporary Metaphysics
An introductory but rigorous cutting-edge examination of selected metaphysical topics: supposition, abstract entities, necessity and possibility, determinism and freedom, time and consciousness, personal identity. Particular emphasis on the task of metaphysics in relation to the sciences.
Rynasiewicz   3 credits

150.459 (H) Theory of Knowledge
The nature and possibility of human knowledge. Topics will include the concept of knowledge, skepticism, perception, memory, and the objectivity of knowledge.
Michael Williams   3 credits

150.476 (H) Philosophy and Cognitive Science
An examination of some philosophically important foundational issues in the cognitive sciences. Topics covered this year will include modularity (the "Swiss Army knife" view of the mind), innate knowledge, adaptationist hypotheses in psychology, and the computational theory of mind. The first part of the course will provide background for understanding a recent series of exchanges between Steven Pinker (*How the Mind Works*) and Jerry Fodor (*The Mind Doesn't Work That Way*), which will occupy the second part of the course. Other figures read will include Chomsky, Sperber, Carruthers, Tooby and Cosmides, Sterelny, etc., as well as a few selections from Plato, Descartes, Locke, and Leibniz for historical perspective. Cross-listed with Cognitive Science; Psychological and Brain Sciences.
Gross   3 credits

150.511-512 Directed Study
Individual study of special topics, under regular supervision of a faculty member. Special permission is required.
Staff   1-3 credits

150.521-522 Undergraduate Research in Philosophy
Research assistantships to aid in design and execution of various projects.
Staff   1-3 credits

150.550-551 Honors Project
See departmental major advisor.

Graduate Seminars

150.601 Seminar in Plato
A study of selected aspects of Plato's philosophy. The seminar will either examine a few related dialogues comprehensively and in detail, or will focus on some specific theme which can be traced through many different dialogues.
Bett   2 hours

150.602 Seminar in Aristotle
An examination of one or more of Aristotle's major works.
Bett   2 hours

150.603 Seminar in Ancient Greek Skepticism
A study of the major strands of skeptical thinking, and the major forms of opposition to skepticism, in the ancient world.
Bett   2 hours

150.612 Seminar in Early Modern Philosophy
A study of British empiricism, concentrating on one of the following: Locke, Berkeley, Hume.
Michael Williams   2 hours

150.619 Topics in Hegel's Philosophy
Förster, Moyar   2 hours

150.623 Seminar in Contemporary British Philosophy
The materials covered vary from year to year. In some years, the seminar is devoted to Wittgenstein.
Staff   2 hours

150.627 Seminar on Evidence
A study of the concept of evidence and its application to historical cases in the natural and social sciences.
Staff   2 hours

150.631 Seminar in the Philosophy of Logic
Selected topics in logical theory.
Rynasiewicz   2 hours

150.632 Introduction to Formal Logic

150.637 Seminar in Theory of Knowledge
Problems of knowledge and perception.
Michael Williams   2 hours

150.639 Seminar in the Philosophy of Mind
Special topic in the philosophy of mind.
Meredith Williams   2 hours

150.642 Seminar in Ancient Greek Ethics
Bett   2 hours

150.643 Seminar in Problems of Ethical Theory
Staff   2 hours

150.644 Seminar in Contemporary Ethics
Staff   2 hours

150.652 Seminar in the Philosophy of Science
Rynasiewicz   2 hours

150.653 Seminar in Philosophy of Physics
Rynasiewicz   2 hours

150.654 Methodological Foundations of Science
Methodological issues arising in connection with various episodes in science, including the wave-particle debate and theories of the atom.
Staff   2 hours

150.657 Seminar in the Philosophy of Language
Michael Williams, Rynasiewicz   2 hours

150.658 Topics in the Philosophy of Language
Gross   2 hours

150.660 (H) Seminar in Contemporary Philosophical Problems
Staff   2 hours

Interdepartmental

150.820 Methods and Strategies for Aspiring Philosophers
Preparing philosophy graduate students for the impending job market by discussions of, and practicing for, constructing and submitting dossiers, hotel and campus interviews, and giving talks both in and outside one's particular field. Open to all philosophy graduate students, regardless of year and field. No degree credits. Offered sporadically.
Staff   2 hours

300.600 Instances: On Living Here and Now
The seminar is devoted to different historical examples and contemporary formalizations of the privileged, fulfilled, yet fleeting moment (the instant, presence, kairos, durée, Jetztzeit). Readings will include Bergson, Bachelard, Badiou, Hadot, and Heidegger.
de Vries

300.656 The Event and the Ordinary
On the philosophy of S. Cavell and G. Deleuze.
Marrati

300.677 Transcendence and Immanence: Theodor W. Adorno and Gilles Deleuze
Seminar will consist in a systematic confrontation of two important concepts in two influential 20th-century thinkers by way of a close reading of their two major works: Adorno's *Negative Dialectics* and Deleuze's *Differ-*

ence and Repetition. Central topics of discussion will be: transcendence and immanence, the concept of the concept and the task of philosophy, difference and dialectics, materialism and empiricism.
de Vries, Marrati

150.810-811 Independent Study
For dissertation students.
Staff

360.661 The Philosophy of Neurosciences of Emotions
Topics include the role of meaning and intention in the emotions; the nature of the intentional object; Darwinian approaches to the emotions; "natural kinds" and the emotions; and recent neurological approaches to the emotions.
Leys, Williams, Mer

Henry A. Rowland Department of Physics and Astronomy

Johns Hopkins is the nation's first research university. That emphasis on research continues to this day and forms the backbone of the undergraduate and graduate programs in the Department of Physics and Astronomy. The department's research program is focused into four areas of excellence: Astrophysics, Condensed Matter Physics, Elementary Particle Physics, and Plasma Physics. For graduate students interested in these fields, the department offers world-class research opportunities in a friendly and supportive setting. For undergraduates, JHU offers exposure to cutting-edge research combined with a level of personal attention that is typically found only in liberal arts colleges. Nearly all physics majors at JHU work on research projects and many begin as freshmen or sophomores. Details about individual research programs may be found at **physics-astronomy.jhu.edu**.

All research builds upon an established body of knowledge. To be effective researchers, teachers, or professionals, both undergraduate and graduate students must acquire a core knowledge of physics. Our undergraduate and graduate courses are designed to cover the core subjects at the appropriate levels, leading to advanced courses on a variety of specialized topics. As a consequence, students having different backgrounds or different ultimate objectives can select those parts that are most appropriate for them. The selections are made under the guidance of a faculty advisor. The advisor aids the student in making the most efficient use of his or her time and ensures that his or her program contains a reasonable balance among classroom and laboratory, mathematics, seminars, and introduction to research.

The Faculty

N. Peter Armitage, Assistant Professor: experimental condensed matter physics.

Jonathan A. Bagger, Krieger-Eisenhower Professor (Vice Provost): theoretical elementary particle physics.

Bruce A. Barnett, Professor: experimental elementary particle physics.

Charles L. Bennett, Professor: experimental cosmology.

Luciana Bianchi, Research Professor: astrophysics, nearby galaxies, stellar populations, hot stars, UV instrumentation.

William P. Blair, Research Professor: astrophysics, shockwaves, spectroscopy of plasmas.

Barry J. Blumenfeld, Professor: experimental elementary particle physics.

Collin Broholm, Gerhard H. Dieke Professor (Director, Institute for Quantum Matter): experimental condensed matter physics.

Chia-Ling Chien, Jacob L. Hain Professor (Director, Materials Research Science and Engineering Center): experimental condensed matter physics, nanostructured solids.

Chih-Yung Chien, Professor: experimental elementary particle physics.

Gabor Domokos, Professor Emeritus: theoretical elementary particle physics, astroparticle physics.

Gordon Feldman, Professor Emeritus: quantum field theory, theory of elementary particles.

Paul D. Feldman, Research Professor: astrophysics, spectroscopy, space physics, planetary and cometary atmospheres.

Michael Finkenthal, Research Professor: plasma and atomic physics.

Holland Ford, Professor: stellar dynamics, evolution of galaxies, active galactic nuclei, astronomical instrumentation.

Riccardo Giacconi, University Professor: astrophysics.

Andrei V. Gritsan, Assistant Professor: experimental elementary particle physics.

Timothy Heckman, A. Hermann Pfund Professor (Director, Center for Astrophysical Sciences): galaxy evolution, starburst galaxies, active galactic nuclei.

Richard Conn Henry, Professor (Director, Maryland Space Grant Consortium): astronomy and astrophysics.

Brian R. Judd, Gerhard H. Dieke Professor Emeritus: theoretical atomic and molecular physics, group theory, solid state theory.

Marc Kamionkowski, Professor: theoretical particle astrophysics and cosmology.

David Kaplan, Associate Professor: theoretical elementary particle physics.

Chung W. Kim, Professor Emeritus: theory of elementary particles, nuclear theory, cosmology.

Susan Kövesi-Domokos, Professor Emeritus: theoretical elementary particle physics, astroparticle physics.

Julian H. Krolik, Professor: theoretical astrophysics.

Yung Keun Lee, Professor Emeritus: nuclear physics.

Robert Leheny, Associate Professor: experimental condensed matter physics.

Petar Maksimovic, Associate Professor: experimental elementary particle physics.

Nina Markovic, Associate Professor: experimental condensed matter physics.

Tobias Marriage, Assistant Professor: cosmology and astrophysics.

Stephan McCandliss, Research Professor: Experimental Astrophysics; sounding rocket space astronomy in the far UV.

Kirill Melnikov, Associate Professor: theoretical particle physics.

Brice Ménard, Assistant Professor: extragalactic astrophysics, cosmology, large surveys.

H. Warren Moos, Research Professor: astrophysics, plasma physics.

Charles Mattias Mountain, Professor (Director, Space Telescope Science Institute): Star formation in galaxies, capabilities of "second generation telescope."

Stephan Murray, Research Professor: x-ray astronomy.

David A. Neufeld, Professor: theoretical astrophysics, interstellar medium, astrophysical masers, submillimeter astronomy.

Colin A. Norman, Professor: theoretical astrophysics.

Aihud Pevsner, Jacob L. Hain Professor Emeritus: elementary particle physics.

Daniel Reich, Professor and Chair: experimental condensed matter physics.

Adam Riess, Professor: astrophysics, experimental cosmology.

Mark O. Robbins, Professor: theoretical condensed matter physics.

Joseph Silk, Research Professor: cosmology.

Raman Sundrum, Alumni Centennial Professor: theoretical particle physics, including the physics of extra spacetime dimensions, supersymmetry, and nonperturbative phenomena.

Morris Swartz, Professor: experimental elementary particle physics.

Alexander Szalay, Alumni Centennial Professor: theoretical astrophysics, galaxy formation.

Oleg Tchernyshyov, Associate Professor: theoretical condensed matter physics, magnetism.

Zlatko Tesanovic, Professor: theoretical condensed matter physics.

J. C. Walker, Professor Emeritus: condensed matter physics, thin films and surfaces, nuclear physics.

Harold Weaver, Research Professor: solar system science.

Rosemary F. G. Wyse, Professor (Director, Theoretical Interdisciplinary Physics and Astrophysics Center): astrophysics, galaxy formation and evolution.

Nadia Zakamska, Assistant Professor: astrophysics; galaxy formation and evolution.

Adjunct and Visiting Appointments

Ronald J. Allen, Adjunct Professor (Space Telescope Science Institute): spiral structure of galaxies, interstellar medium, radio and optical imaging.

Michael Fall, Adjunct Professor (Space Telescope Science Institute): astrophysics.

Henry Ferguson, Adjunct Professor (Space Telescope Science Institute): observational cosmology, galaxy evolution, dwarf galaxies, space astronomy instrumentation, and calibration.

Michael G. Hauser, Adjunct Professor (Space Telescope Science Institute): cosmology, especially infrared background radiation.

Ann E. Hornschemeier, Adjunct Assistant Professor (NASA Goddard Space Flight Center): high energy and astrophysics.

Gerard Kriss, Adjunct Professor (Space Telescope Science Institute): astrophysics, observations of active galactic nuclei and clusters of galaxies.

Mario Livio, Adjunct Professor (Space Telescope Science Institute): theoretical astrophysics, accretion onto white dwarfs, neutron stars and black holes, novae and supernovae.

Predrag Nikolic´, Adjunct Assistant Professor (George Mason University): condensed matter theory.

Antonella Nota, Adjunct Professor (Space Telescope Science Institute): astronomy.

Cedomir Petrovic, Adjunct Professor (Brookhaven National Laboratory): condensed matter experiment.

Ethan Schreier, Adjunct Professor (President, AUI): astrophysics, active galaxies and jets.

Mark Stiles, Adjunct Professor (NIST): condensed matter theory.

Roeland van der Marel, Adjunct Professor (Space Telescope Science Institute): black holes, cluster of galaxies, dark halos, galaxy structure and dynamics.

Kimberly Weaver, Adjunct Professor (NASA Goddard Space Flight Center): high energy astrophysics.

Robert Williams, Adjunct Professor (Space Telescope Science Institute): novae, emission line analysis.

Joint Appointments

Gregory Eyink, Professor (Applied Mathematics and Statistics): mathematical physics, fluid mechanics, turbulence, dynamical systems, astrophysics.

Michael Falk, Associate Professor (Materials Science and Engineering): theory of systems far from equilibrium: deformation, failure, fracture and friction.

Tyrell McQueen, Assistant Professor (Chemistry): solid state and inorganic chemistry/condensed matter physics.

Jack Morava, Professor (Mathematics): algebraic topology, mathematical physics.

Peter C. Searson, Professor (Materials Science and Engineering): nanostructured materials, nanotechnology in biology and medicine.

Darrell F. Strobel, Professor (Earth and Planetary Sciences): planetary atmospheres and astrophysics.

Research Programs

The department's research program is focused into four areas of excellence: Astrophysics, Condensed Matter Physics, Elementary Particle Physics and Plasma Physics.

Astrophysics

Astrophysical research at Johns Hopkins University had its beginnings with departmental namesake Henry Rowland. Since his day, its subject matter has broadened to include the entire span of modern work, from the solar system to cosmology. Today, Baltimore is one of the principal centers of world astronomy. JHU astrophysicists enjoy close relations with their colleagues at the Space Telescope Science Institute located on the Homewood campus and also collaborate with scientists and engineers at the JHU Applied Physics Lab and NASA Goddard Space Flight Center.

Work in the department's Center for Astrophysical Sciences (CAS) focuses on three areas: developing instrumentation for astronomical observations, particularly from space; observational astronomy from the ground and space; and theoretical astrophysics. Hopkins is one of a small number of universities that builds, flies, and analyzes data from space instrumentation. Examples include:

- JHU is playing a role, working with NASA, on the upcoming WFIRST mission.

- Johns Hopkins is a major partner in the Galaxy Evolution Explorer (GALEX) satellite, which is surveying the entire sky for stars, galaxies, and quasars that are bright in the ultraviolet. Launched in April 2003, GALEX is determining the history of star formation in galaxies at redshifts from 0 to 2, and is identifying 1 million quasars. The GALEX data archive has been developed and managed by JHU astronomers.

- Johns Hopkins is the Principal Investigator institution for the Wilkinson Microwave Anisotropy Probe (WMAP). Launched in June 2001, the WMAP satellite mapped the oldest light in the universe, providing a critical probe of cosmological models—and of the nature of the mysterious dark energy—by making precision measurements of temperature and polarization fluctuations observed in the infant universe.

- JHU has a vibrant rocket program, now aiming to calibrate infrared objects for the benefit of future dark energy measurements and to develop new capabilities for ultraviolet imaging and spectroscopy.

- CAS led the construction of the Advanced Camera for Surveys which was installed in the HST during a shuttle visit in 2002. The Advanced Camera science team at JHU has used the camera to study the evolution of galaxies and clusters of galaxies at high redshift, to study Jupiter and Io, and to search for planets and proto-planetary disks around nearby stars.

- JHU, with CAS oversight, built the Far Ultraviolet Spectroscopic Explorer (FUSE), a satellite for high-resolution spectroscopy. Its primary scientific accomplishments were the measurement of the deuterium abundance in different environments throughout the galaxy, a key parameter in models of Big Bang cosmology, and a wide variety of other studies including the interstellar medium, the extragalactic medium, hot stars, stellar discs, and planets. FUSE is the largest astrophysics project that NASA has ever awarded to a university to develop and operate.

Several members of the faculty are major users of large ground-based telescopes such as Gemini, Keck, Magellan, Arecibo, and IRAM, studying such diverse subjects as the large-scale structure of the universe, galaxy formation and evolution, active galactic nuclei, galaxy clusters, the internal dynamics of galaxies, and stellar populations within our own galaxy.

Hopkins is a member of the Astrophysical Research Consortium (ARC) and a participant in its two major activities. First, ARC is operating Sloan Digital Sky Survey III. This project will probe the nature of Dark Energy, study the evolution of galaxies (including our own Milkyway), and detect many new extrasolar planets. Second, Hopkins owns a share of the ARC 3.5 meter telescope of the Apache Point Observatory in New Mexico. The faculty is also active in the fields of X-ray, infrared and radio astronomy, using the Chandra, XMM Newton, Suzaku, GEMS, Spitzer, Herschel, SOFIA, and

other observatories to investigate a broad range of topics in galactic astronomy, extragalactic astronomy, and cosmology.

Johns Hopkins is a member of both the Large Synoptic Survey Telescope (LSST) consortium and the Pan-STARRS 1 Science Consortium. This consortium is using a special 1.8 m telescope and 1.4 gigapixel camera located at Haleakala, HI, to repeatedly map 75% of the entire sky in five colors. These data are being used to investigate the time domain (including supernovae used to measure dark energy, transiting extra-solar planets, gamma-ray bursts, and potentially hazardous near-earth asteroids). The stacked images are enabling a broad range of studies of the halo of our own Milky Way, distant galaxies, and even the large-scale distribution of dark matter.

Hopkins is developing an instrument to measure the polarization of the cosmic microwave background to determine events in the first few moments of the universe (the Cosmology Large Angular Scale Surveyor) and are playing a lead role in the Atacama Cosmology Telescope, designed to improve on measurements of parameters which describe the early universe and to measure distant, large clusters of galaxies and their environments.

The immense Sloan Digital Sky Survey, GALEX, and Pan-STARRS databases will form the backbone of the Virtual Astronomical Observatory (VAO), a concept pioneered at JHU. When complete, the VAO will link all the major astronomical databases into a seamless user-friendly system that will revolutionize astronomical research. Ongoing VAO work at JHU emphasizes the development of cutting-edge tools for data-mining through collaboration between astronomers and computer scientists, including the new "Data-Scope" project.

Theoretical astrophysical research, by its nature, moves rapidly from topic to topic. Recent studies have included such subjects as the nature of dark matter in the universe, accretion disks, galaxy formation, the evolution and structure of active galactic nuclei, gravitational lenses, interstellar molecules, star formation, pulsars, and the nature of gamma-ray bursts. Working with analytic "pencil-and-paper" calculations and large-scale numerical simulations, astrophysical theorists at JHU are recognized leaders in subjects ranging from the physics of accretion onto black holes to MHD dynamos to interstellar chemistry.

Condensed Matter Physics

Condensed matter physics research in the department spans a wide range of topics, including magnetism, magnetoelectronics, nonequilibrium processes, artificially structured solids, low dimensional solids, low temperature physics, high Tc superconductivity, complex fluids, disordered systems, molecular electronics, quantum computing, and biological physics. In recent years, the program has involved studies of magnetic nanostructures and magnetic/superconducting multilayers, giant magnetoresistance, half-metallic ferromagnets, strongly fluctuating and quantum disordered magnetic systems, heavy fermion systems, liquid crystals, and glassy materials.

Experimental techniques used in these studies involve synchrotron x-ray scattering, ultra-low temperature cryogenics, neutron scattering, magnetotransport measurements, magnetic susceptibility, vibrating sample magnetometry, terahertz and microwave spectroscopies, SQUID magnetometry, dielectric spectroscopy, microrheology, scanning electron microscopy, and transmission electron microscopy. A variety of nanofabrication techniques, as well as laser machining, molecular beam epitaxy, multisource sputtering systems, and single-crystal growth are used for sample fabrication.

Activities in condensed-matter theory are often closely correlated with those of the experimental groups. Field-theoretic methods are employed to study exotic states of matter and quantum critical phenomena in high-temperature superconductors, superfluids, and electrons in high magnetic fields. Computational and analytic tools that span a wide range of length and time scales are used to uncover new behavior in matter as dimensions approach the nanometer scale and to understand the atomic origins of macroscopic behavior, including adhesion, fracture, friction, and the deformation of glassy metals and polymers. Studies in magnetism focus on ground states and excitations of strongly frustrated systems, topological defects in nanoscale ferromagnets, and artificial magnetic arrays.

The Condensed Matter Program encompasses two major interdisciplinary research centers:

- The Institute for Quantum Matter (http://iqm.jhu.edu) combines materials synthesis, spectroscopy, and theory to discover, expose and understand new materials functionality from quantum correlations. The Institute is a collaboration between the Johns Hopkins and Princeton Universities and is funded by the US Department of Energy. IQM scientists are presently exploring materials where interacting atomic spins, rather than forming a magnet, self-organize into an entangled singlet and materials where magnetism and superconductivity intertwine. A state of the art Crystal Growth Laboratory is under development and IQM scientists are develop-

ing new instrumentation for neutron and THz spectroscopies. Enjoying early access to the latest experimental results, the theoretical program employs advanced analytical methods to predict and account for quantum correlated properties in magnets and superconductors. Fundamental materials research at the IQM is conducted with a view towards energy applications.

- Materials Research Science Engineering Center (MRSEC), sponsored by the National Science Foundation, focuses in the area of nanostructured materials and their magnetoelectronic properties. A wide range of novel properties, unattainable in bulk materials, is now being achieved through the manipulation of nanostructures. The MRSEC is an interdisciplinary research effort involving collaboration with several other departments at JHU, and includes synthesis and processing, structural characterization, physical property measurements, theoretical modeling, and prototype device fabrication.

Elementary Particle Physics

The elementary particle physics group engages in experimental and theoretical investigations of the behavior of elementary particles and their interactions. More information about the activities of the group can be found at www.pha.jhu.edu/~morris/jhu_hep.

The experimental group belongs to the CDF Collaboration at Fermilab Tevatron Collider, the BaBar Collaboration at the SLAC PEP-II Collider, and the CMS Collaboration at the CERN Large Hadron Collider (LHC). CDF and BaBar have ceased taking data and are finishing final analyses. CMS is currently taking data and is expected to continue to do so for many years. The group has a long-standing technical expertise in silicon-based precise tracking technology, which is used principally to identify very short-lived particles in high energy collisions. This technological expertise has been leveraged to perform studies (and discoveries) of b-hadrons produced in hadronic collisions at the Tevatron. It has been used to study CP Violation in the B-meson system at the Tevatron and at PEP-II. This experience evolved into our participation in the construction, installation commissioning and operation of the silicon pixel tracking system of the CMS experiment at the LHC.

The CMS experiment is a huge (14,500 metric ton) detector that will study 14 TeV proton-proton collisions at the LHC. Experiments at the LHC are expected to revolutionize the field of particle physics. They will reveal the mechanism by which the W and Z bosons (and probably all other fundamental particles) acquire mass. They will search for physics beyond the Standard Model, and discover or rule out theories ranging from supersymmetry and extra dimensions to new forces of nature. All signs point to major discoveries to be made at the LHC.

In order to best exploit the possibilities of the LHC, the experimental and theoretical particle physics groups at JHU operate in a more highly integrated fashion than has been traditional in the field. Achieving good understanding of new phenomena observed in the difficult environment of the LHC will require the close cooperation of experimental and theoretical physicists.

The theoretical particle physics group at JHU has a strong phenomenological orientation. It possesses considerable expertise in the major extensions/alternatives to the Standard Model: supersymmetry, extra dimensions, and strongly coupled theories. In fact, the most promising strongly coupled theories, those that arise from theories with extra "warped" dimensions, were largely developed at JHU. The group also has a strong interest in the cosmological implications of particle physics ideas and has connections with the experimental cosmology group at JHU.

Plasma Spectroscopy

The plasma spectroscopy program has grown out of the nuclear fusion and astrophysics research. Under grants from the Department of Energy, the plasma spectroscopy group develops far ultraviolet and soft X-ray spectroscopic instrumentation for the diagnostic of Magnetic Fusion Energy (MFE) experiments and applies it to the study of high temperature plasmas. The research covers topics central to the fusion plasma physics, like magneto-hydrodynamic stability, particle and energy transport, as well as atomic physics topics, like the spectroscopy of the highly ionized species relevant to these plasmas.

Complex diagnostic systems, integrating state-of-the-art detectors and X-ray optics, have been developed for leading MFE experiments, like the National Spherical Torus Experiment (NSTX) at the Princeton Plasma Physics Laboratory and the C-Mod tokamak at MIT. The spherical torus is a new and promising path toward economical fusion energy, relying on the achievement of near unity beta (plasma pressure to magnetic pressure ratio), in a tight aspect-ratio configuration. The Johns Hopkins systems enable experiments that cannot be performed by conventional instrumentation, like imaging of peripheral magnetic islands, or determination of the hot plasma resistivity. The plasma spectroscopy group has also an active role

in the NSTX research team, which has the mission of advancing the spherical torus concept toward its assessment as a viable fusion reactor.

Recent research topics of the group include the development of 2-D and 3-D ultrafast imaging techniques in the soft X-ray range, for the study of localized MHD perturbations, like the neo-classical tearing modes. Such perturbations seem to have a profound effect on the stability and confinement properties of high beta plasmas. A new research subject is also the study of turbulence in fusion plasma using focusing, soft X-ray telescopes. Such instruments have been first developed in astrophysics.

The atomic physics packages necessary for retrieving the plasma parameters from the spectroscopic data are developed in collaboration with researchers at the Lawrence Livermore National Laboratory and NIST and bench-marked on various fusion experiments in the U.S. and Europe. Recent international collaborations also include the development of a 2-D Far Ultraviolet imaging system for the measurement of local particle transport in the Large Helical Device, the largest fusion experiment in Japan.

Facilities

The Department of Physics and Astronomy's first facility was Rowland's measuring engine for determining the solar spectrum in the 1880s. Ever since that time the Department has maintained a long and continuous history in instrumentation. In recent decades this has extended to instrumentation for space missions. The Department maintains a Class-1000 clean room for microfabrication and nanofabrication, a high bay lab, professional and student machine shops, and supports a world-renowned Instrument Development Group (IDG) with six full-time engineers and three full-time machinists.

Among the diverse techniques used for studying condensed matter physics are magnetometry/susceptometry, specific heat and transport measurements, atomic force and magnetic force microscopy, X-ray and electron diffraction, terahertz spectroscopy, and neutron scattering at the nearby NIST Center for Neutron Research and at the Spallation Neutron Source, ORNL. A variety of cryostats, He3 refrigerators, and He3-He4 dilution refrigerators together with high temperature ovens, electromagnets, and superconducting magnets allow measurements to be made from 0.05 K to 1100 K and in magnetic fields up to 14 Tesla. Apparatus for the preparation of samples includes two image furnaces for floating zone growth, single-crystal growth vacuum furnaces, box and tube furnaces, arc furnaces, several high vacuum and ultra-high vacuum chambers for thin film fabrication using evaporation, MBE, pulsed laser deposition, sputtering, and focused ion beam (FIB) milling. Also available on campus are cutting-edge transmission electron microscopes and scanning electron microscopes.

In astrophysics, research groups have state-of-the-art laboratories for testing cryogenic transition-edge bolometer detectors with SQUID read-out electronics, and closed-cycle helium crogenics. Recent instrumentation advances include the design and manufacture of large free-standing polarization grids and novel high-bandwith smooth-wall feed horns. Current activities include development of microwave and millimeter-wave instruments for far-infrared and microwave astronomy and cosmology.

The research groups in the department have a wide range of state-of-the-art computer facilities including high performance clusters with over a thousand processors and the largest database at a university—over a petabyte. All undergraduate majors and graduate students have access to high performance workstations.

Undergraduate Programs

The department offers degrees designed for students with a wide range of future career goals. As described below, students can choose to minor in physics, opt for a more flexible B.A. degree in physics, or choose a B.S. program in physics with a focus in any science or engineering discipline. The department also offers a variety of courses and research opportunities in astronomy and astrophysics that provide an ideal preparation for graduate work in those fields. Many recent graduates have gone on to graduate study in physics, astronomy/astrophysics, biophysics, or one of the many engineering disciplines. Others chose professional schools in medicine or law, went into teaching, or entered the work force directly.

The department also offers general interest introductory and intermediate courses aimed at non-majors. Recent general survey courses have included Introduction to Frontier Physics 172.114, Stars and the Universe: Cosmic Evolution 171.118, Subatomic World 171.113, and Physics of the Everyday World 171.115.

At the introductory level there are three two-semester physics sequences designed to meet the needs of a variety of students. General Physics for Physical Science Majors 171.101-102 is a comprehensive one-year sequence in general physics intended for physical science and engineering majors who do not plan to pursue further stud-

ies in the department. This sequence can be started in either semester and is offered in the summer. General Physics for Biological Science Majors 171.103-104 is similar to 171.101-102, but is tailored to students with a biological science or engineering major. General Physics Laboratory 173.111-112 is a co-requisite with any of the above courses. All students who plan to complete more than a year of physics are encouraged take the Classical Mechanics I/Electricity and Magnetism I sequence, 171.105-106, and the associated labs, 171.115-116. This sequence is less comprehensive than the sequences for physical (171.101-102) and biological (171.103-104) science majors, but covers classical mechanics and electricity and magnetism in greater depth and with more mathematical sophistication. Note: Students should be aware that the 171.105-106 sequence alone is not adequate preparation for the physics portion of the MCAT exam.

There are also two year–long intermediate physics sequences from which students may choose (171.201-202 and 171.309-310). Special Relativity and Waves 171.201 and Modern Physics 171.202 provide an in-depth study of the physics of wave phenomena and an introduction to modern topics in physics such as quantum mechanics and statistical physics. Wave Phenomena with Biophysical Applications 171.309 and Biological Physics 171.310 cover similar topics but with an emphasis on their relevance to the biological sciences. Physics majors typically take one of the two sequences (or switch between the two between the fall and spring semesters) during their sophomore year. (Majors who choose 171.309 rather than 171.201 must also take the one-credit course Special Relativity 171.207.) Combined with 171.105-106, these sequences provide an integrated four-semester introduction to physics.

The intermediate and advanced courses treat the various areas of physics in greater depth, and in sufficient variety to broaden the student's background and to provide appreciation of the relation of physics to other scientific areas. Concomitant study of mathematics supplies part of the conceptual framework and the natural language for description of physical phenomena.

Physics majors are strongly urged to supplement the regular course work by participation in seminars and by independent study and research under the guidance of a faculty member. This study may be related to the research program of a faculty member; thus at an early stage the student can experience the satisfaction of activity in the forefront of physics. It is through seminars and such independent study that he or she can best learn what physics is, how physics research is carried out, and whether he or she may wish to continue with graduate study in the field.

Requirements for the B.A. Degree
(See also General Requirements for Departmental Majors, page 48.)

Physics
In the first year the typical student will take one of the introductory physics sequences discussed above, preferably the Classical Mechanics I/Electricity and Magnetism I sequence 171.105-106, along with the corresponding laboratory 173.115-116. In the fall semester of the second year, the student will take Contemporary Physics Seminar 172.203 and either Special Relativity and Waves 171.201 or the combination of Wave Phenomena with Biophysical Applications 171.309 and Special Relativity 171.207. In the spring semester of the sophomore year, the student will take Classical Mechanics 171.204 and either Modern Physics 171.202 or Biological Physics 171.310. During the first two years students are also encouraged to broaden their backgrounds by taking introductory courses in other disciplines, such as Chemistry 030.101.

In the third and fourth years the student will take the required courses Electromagnetic Theory II 171.301 and Quantum Mechanics I 171.303. Additional requirements are Advanced Physics Laboratory 173.308 and either Quantum Mechanics II 171.304 or Statistical Physics and Thermodynamics 171.312. Students who plan to pursue graduate studies in physics or related areas are strongly encouraged to take both of these courses, as well as Topics in Advanced Electromagnetic Theory 171.302, in completing the two elective courses (see below).

In addition to the above core courses, the student is required to take a total of two more courses (at least three credits each) at the 300-level or above. These courses must be in the Department of Physics and Astronomy. None of these courses may be used simultaneously to satisfy either the university distribution requirements or the standard mathematics requirements listed below. Students who wish to continue with graduate study in physics are strongly encouraged to take additional courses within the Department of Physics and Astronomy.

Mathematics
The standard mathematics requirements for all physics majors consist of Calculus I and II 110.108-109, either Linear Algebra 110.201 and Calculus III 110.202 or Honors Multivariable Calculus and Linear Algebra 110.211-212, and Differential Equa-

tions with Applications 110.302. Students with previous calculus experience are urged to place out of Calculus I and II if possible, either through the Advanced Placement examinations or through the placement examinations administered by the Department of Mathematics during the first week of the fall semester. It is recommended that students who intend to continue their study of physics in graduate school take Analytic Methods for Physicists 171.415, Numerical Methods for Physicists 171.416, and/or additional classes in the Department of Mathematics at the 300-level or above, especially Methods of Complex Analysis 110.311. The student may also consider suitable courses in the departments of Computer Science and Applied Mathematical Sciences and Statistics. In particular, it is recommended that the student become proficient in a computer programming language such as Java, FORTRAN, C++, or C, either independently or through course work in the Department of Computer Science.

Language Requirement
There is no language requirement.

B.S. in Physics Degree
Students who plan to continue in science or engineering after graduation, whether in graduate school or in the workforce, may wish to obtain the degree of bachelor of science in physics. This program is designed to supplement the core physics courses with a concentration at an advanced level in a scientific or engineering discipline.

The total number of credits required for the B.S. is 126, rather than 120. The required core course work in physics is the same as for the B.A., as are the mathematics requirements. However, the two electives required for the B.A. are replaced, for the B.S., by five courses at the 200-level or above (at least three credits each). These must be in the departments of Physics and Astronomy, Biology, Biophysics, Chemistry, Cognitive Science, Earth and Planetary Sciences, or Mathematics, or in any of the departments of the School of Engineering. At least four must be taken within a single science department (including Physics and Astronomy) of the Krieger School, or within a single department or program of the Whiting School of Engineering. Considered as a whole, these courses must constitute a coherent and rigorous program of study, whether oriented toward graduate school or the job market. To ensure this, the Director of Undergraduate Studies must approve these courses as satisfactory for the B.S. no later than the registration period for the fall semester of the senior year. None of the electives may be used simultaneously to satisfy either the university distribution requirements or the standard mathematics requirements listed above.

Senior Thesis
Any student majoring in the department may write a senior thesis, based on original research conducted under the supervision of a member of the faculty. Arrangements for this research will be made on an individual basis. The department views the writing of a senior thesis as an excellent capstone experience to an undergraduate education in physics, and encourages all students to consider it.

Minor in Physics
A student may earn a minor in physics by completing one of the introductory physics sequences (171.101-102, 171.103-104, or 171.105-106 and associated lab), Contemporary Physics Seminar 172.203 and four courses offered by the department at the 200-level or above (at least three credits each). It is recommended that these courses include 171.201-202 or 171.309-310.

Donald E. Kerr Memorial Prize
In recognition of Dr. Kerr's work in microwave physics, the department awards the Donald E. Kerr Memorial Prize each year to the most outstanding undergraduate major graduating in physics.

Graduate Programs
Graduate study in physics and astronomy at Hopkins is intended primarily to prepare Ph.D. graduates for careers in teaching and research in physics and astronomy, or in applications such as biophysics, space physics, and industrial research. Entering students may elect to work toward a Ph.D. in physics or a Ph.D. in astronomy and astrophysics. The two programs have somewhat different course requirements (see page 323).

Admission
To obtain admission, a student is expected to submit evidence that he or she has a good chance to succeed. Such evidence will ordinarily consist of transcripts of previous academic work, Graduate Record Examination scores (including advanced physics), letters of recommendation, and, for international students, a Test of English as a Foreign Language (TOEFL) score. Although the department does not admit students who intend to pursue the master's degree exclusively, students in the department and those studying in other departments of the university may elect to receive a master of arts degree in physics. Students from other JHU departments must seek approval from their home department

and from the Department of Physics and Astronomy before beginning their M.A. studies.

Advising

All entering graduate students are assigned to one advisor who works closely with them during the first year, advising them regarding courses of study, helping them to become familiar with the department and to remedy deficiencies in previous work, and generally providing orientation in physics. Part of this program is encompassed in Physics Seminar 172.631-632. In addition, each entering graduate student is assigned a mentor or interim advisor in his or her field of interest until which time the student chooses an official advisor for a thesis project.

During the first year the students will be given opportunities to become acquainted with faculty members other than those in whose classes they are enrolled. They are strongly encouraged to pursue these contacts to find a faculty advisor to whom they can transfer at a mutually agreeable time (usually at the end of their first year), in order to work for a time under his or her supervision and thus to obtain some research experience. A student may engage in several such preliminary research periods before embarking upon his or her dissertation research. A large measure of flexibility characterizes a typical program of study.

Requirements for the Ph.D. Degree

Students must pass preliminary exams that demonstrate mastery of upper-level undergraduate material in classical mechanics, electricity and magnetism, quantum mechanics, and statistical physics and thermodynamics. Students may take each exam each time it is offered and must pass all four exams by February of their second year.

Exams covering electricity and magnetism and quantum mechanics are given at the beginning of the fall term, and exams covering classical mechanics and statistical physics and thermodynamics are given in January, the week before the second term starts. All four exams are given again in May.

After successfully completing these exams, students must pass a preliminary oral examination. This exam is usually taken during the second year, within one semester of passing the preliminary exams. Sometime during the second year or early in the third year, students are expected to link up with an advisor and begin progress toward a thesis. Shortly after doing so, i.e. within about one semester after passing the preliminary oral exam, students must pass a University Graduate Board Oral (GBO) exam in which they demonstrate their general command of physics and/or astronomy and astrophysics. Passage of the GBO should be

accomplished before the start of the fourth year of graduate study.

Course Requirements

Ph.D. in Physics

Students must complete the following courses:
171.415-416 Analytical/Numerical Methods for Physicists
171.601 Theoretical Mechanics
or
171.703 Advanced Statistical Mechanics
171.603-604 Electromagnetic Theory
171.605-606 Quantum Mechanics
173.308 Advanced Physics Lab
or
173.608 Advanced Lab

Ph.D. in Astronomy and Astrophysics

Students must complete the following courses:

171.415-416 Analytical/Numerical Methods for Physicists, or equivalent
171.611 Stellar Structure and Evolution
171.612 Interstellar Medium and Astrophysical Fluid Dynamics
171.613 Radiative Astrophysics
171.615 Galactic Structure and Stellar Dynamics
171.617 Extragalactic Astronomy

They must also complete two semesters drawn from graduate-level optional courses as offered, examples of which include:

171.605-606 Quantum Mechanics
171.614 Astrophysical Spectroscopy
171.618 Observational Astronomy (strongly recommended for students planning to do an observational thesis)
171.626 Statistical Methods for Physics and Astronomy
171.672 Introduction to Plasma Physics and Atomic Processes in Hot Plasmas
171.743-744 Particle Physics and Cosmology
171.746 General Relativity and Cosmology
171.750 Cosmology
171.754 Active Galactic Nuclei
171.755 Fourier Optics and Interferometry
171.756 Astrophysics of Compact Objects
173.608 Advanced Lab
or
270.623 Planetary Atmospheres
270.661 Planetary Fluid Dynamics

Students in both programs must receive at least a B- in each required course, or they will be required to retake the specific course once more and pass it.

Thesis Research and Defense

After the student chooses a thesis advisor, the department forms his/her Thesis Committee consisting of the advisor and two other faculty members (all Thesis Committees contain at least two full-time faculty from the department). These committees function as extended advisory bodies; students have the opportunity to discuss their progress and problems with several faculty. They also conduct one formal annual review of each student's progress.

Research leading to the dissertation can be carried out not only within the Department of Physics and Astronomy, but with appropriate arrangements, either partly or entirely at other locations. Recent dissertation research has been done in the Johns Hopkins Applied Physics Laboratory and Space Telescope Science Institute, as well as at various national laboratories across the country, such as Brookhaven National Laboratory, Stanford Linear Accelerator Center, Fermi National Accelerator Laboratory, and Lawrence Livermore Laboratory.

At the conclusion of thesis research, the student defends the written dissertation before a faculty committee.

Requirements for the M.A. Degree

Students in the department's Ph.D. program, and students in other Ph.D. programs at Johns Hopkins, may apply to fulfill the requirements for the M.A. degree in the Department of Physics and Astronomy.

Course Requirements for the M.A.

Students must master the basic undergraduate material covered by the following courses:

171.204 Classical Mechanics II
171.301-302 Electromagnetic Theory II/Topics in Advanced Electromagnetic Theory
171.303-304 Quantum Mechanics I, II
171.312 Statistical Mechanics and Thermodynamics

Passing the equivalent preliminary written examination satisfies this requirement. Courses taken elsewhere may qualify at the discretion of the Graduate Program Committee.

Students must also complete six one-semester graduate-level (at least three hours/week) courses offered by the Department of Physics and Astronomy. For this purpose, each semester of 171.415-416 (Analytical/Numerical Methods for Physicists) counts as a graduate-level course. In addition, 171.801-802 (Independent Graduate Research) may be substituted for any of the above-mentioned graduate or undergraduate courses. The research course must include an essay supervised and approved by a faculty member of the Department of Physics and Astronomy.

The student must receive a grade of B- or above in each of the courses. The graduate-level courses may be retaken once; the undergraduate courses cannot be repeated. Each preliminary written examination can be taken only three times. The deadline to fulfill all requirements is the date of the Ph.D. thesis defense.

Financial Aid

Teaching assistants are granted full tuition remission, individual health insurance, and an additional academic year salary, supplemented by a research assistantship during the summer. The assistant is expected to help in the teaching of the general physics course and other introductory courses. This is valuable training for any student. Experience in teaching is considered to be an essential part of the Ph.D. program. The normal load is five to eight contact hours per week.

Research assistantships provide an opportunity for acquiring valuable experience in ongoing experimental or theoretical research. The Ellen E. Swomley Endowed Fellowship Fund and the Donald E. Kerr and Barbara Kerr Stanley Fellowship Fund are awarded annually to exceptional students to be used for travel, books, computers, or other expenses associated with studies. The university awards George E. Owen Fellowships on a competitive basis to exceptionally qualified students. Davis Fellowships, with no required duties, are available to exceptional students intending to study astrophysics. The stipend is set equal to that of contemporary NSF predoctoral fellowships.

All fellows and teaching and research assistants in the Department of Physics and Astronomy register as full-time students and thus fulfill their residence requirements while holding appointments. Loans and work-study arrangements are available from the Office of Financial Aid.

Undergraduate Courses

Physics and Astronomy course numbers have three prefixes: 171 indicates a lecture course, 172 a seminar, and 173 a laboratory.

171.101-102 (E,N) General Physics for Physical Science Majors I, II
This two-semester sequence in general physics covers mechanics, heat, sound, electricity and magnetism, optics, and atomic physics. Corequisites: labs 173.111-112, Calculus 110.106-107 or 110.108-109. Prerequisite: A grade of C- or better in Physics I is required for Physics II.
Staff   4 credits   offered yearly/both semesters

171.103-104 (E,N) General Physics for Biological Science Majors I, II
This two-semester sequence is designed to present a standard calculus-based physics preparation tailored to students majoring in one of the biological sciences. The courses treat topics of special interest to biological science majors and cover the relevant material in two semesters. Topics in modern physics and in fluid dynamics, which might not be covered in the first two semesters of the physical science course, will be covered in this course. Corequisites: labs 173.111-112 and Calculus 110.106-107 or 110.108-109. Prerequisite: A grade of C- or better in Physics I is required for Physics II.
Staff   4 credits   offered yearly

171.105 (E,N) Classical Mechanics I
An in-depth introduction to classical mechanics intended for physics majors/minors and other students with a strong interest in physics. This course treats fewer topics than 171.101 and 171.103 but with greater mathematical sophistication. It is particularly recommended for students who intend to take 171.201-202 or 171.309-310. Corequisites: lab 173.115, Calculus 110.108.
Staff   4 credits   fall

171.106 (E,N) Electricity and Magnetism I
An in-depth introduction to classical electricity and magnetism intended for physics majors/minors and other students with a strong interest in physics. This course treats fewer topics than 171.102 and 171.104 but with greater mathematical sophistication. It is particularly recommended for students who intend to take 171.201-202 or 171.309-310. Corequisites: lab 173.116, Calculus 110.109. Prerequisite: A grade of C- or better in Classical Mechanics I
Staff   4 credits   spring

173.111-112 (N) General Physics Laboratory
Experiments are chosen from both physical and biological sciences and are designed to give students background in experimental techniques as well as to reinforce physical principles. Corequisites: 171.101-102 or 171.103-104.
Staff   1 credit   offered yearly/both semesters

171.113 (N) Subatomic World
Introduction to the concepts of physics of the subatomic world: symmetries, relativity, quanta, neutrinos, particles, and fields. The ideas of modern physics rather than the mathematics are emphasized. Intended for nonscience majors.
Staff   3 credits   fall

172.113-114 (N) Introduction to Frontier Physics
Explores modern experimental methods and theoretical ideas in physics.
Staff   1 credit   offered yearly

171.115 (N) Physics of the Everyday World
Introduction to the concepts of physics and their consequences for our commonplace experiences. Examples include moving vehicles, from bicycles to airplanes; waves you can ride, waves you can hear, and waves you can see; kitchen thermodynamics and how your house is heated; colors, textures, and atoms. Intended for non-scientists.
Staff   3 credits   spring

173.115 (N) Classical Mechanics Laboratory
Experiments and activities chosen to complement Classical Mechanics I 171.105 and to introduce students to experimental techniques and statistical analysis. Corequisite: 171.105.
Staff   1 credit   spring

173.116 (N) Electricity and Magnetism Laboratory
Experiments and activities chosen to complement Electricity and Magnetism 171.106 and to introduce students to experimental techniques and statistical analysis. Corequisite: 171.106.
Staff   1 credit   spring

171.118 (N) Stars and the Universe: Cosmic Evolution
Evolution of the universe: from origin in a cosmic explosion to emergence of life on Earth and possibly other planets throughout the universe. Big-bang cosmology, origin and evolution of galaxies, stars, planets, life, and intelligence. Discussions of black holes, quasars, relativity theory. Material largely descriptive, based on insights from physics, astronomy, geology, chemistry, biology, and anthropology.
Staff   3 credits

171.120 (N) Physics of Modern Technologies
This course for non-scientists offers accessible non-mathematical explanations of modern technologies: electric power generation and distribution (AC versus DC), florescent lighting, lasers, computers, the internet, GPS, and student suggested topics.
Staff   3 credits   spring

171.201 (N,E) Special Relativity and Waves
This course continues the introductory physics sequence which begins with 171.105-106. Special theory of relativity, mathematics of waves, harmonic oscillation, forced and

damped oscillators, electromagnetic waves, diffraction, interference. Prerequisites: 171.105-106 (preferred), or 171.101-102, or 171.103-104; Calculus 110.108-109. Corequisite: Calculus 110.202 or 110.211-212.

Staff   4 credits   fall

171.202 (N,E) Modern Physics

This course completes the four-semester introductory sequence which includes 171.105-106 and 171.201. Planck's hypothesis, de Broglie waves, Bohr atom, Schrodinger equation in one dimension, hydrogen atom, Pauli exclusion principle, multi-electron atoms, molecules, conductors and semiconductors, nuclear physics, particle physics, and cosmology. Prerequisite: 171.201 or 171.309.

Staff   4 credits   offered yearly

172.203 (N) Contemporary Physics Seminar

This seminar exposes physics majors to a broad variety of contemporary experimental and theoretical issues in the field. Students read and discuss reviews from the current literature, and describe their findings through oral or written presentation. Prerequisites: 171.101-102, 171.103-104, or 171.105-106.

Staff   1 credit   fall

171.204 (N) Classical Mechanics II

Principles of Newtonian and Lagrangian mechanics; application to central-force motion, rigid body motion, and the theory of small oscillations. Prerequisites: 171.201 or 171.309, Calculus 110.108-109, 110.202.

Staff   4 credits   spring

171.207 (N) Special Relativity

Formalism and interpretation of Einstein's theory of special relativity. Topics include relativistic treatments of kinematics, dynamics, and electrodynamics, and the concept of spacetime. Prerequisites: 171.105-106 (preferred), or 171.101-102, or 171.103-104; Calculus 110.108-109. Corequisite: Calculus 110.202 or 110.211-212.

Staff   1 credit   fall

171.221 (N) Physics of Human Energy Use

Course explores the basic nature of energy and heat, the physical principles underlying how we derive energy from various sources (fossil fuels, nuclear power, solar energy, and others), and the physics governing how much energy is required to heat or cool buildings, propel vehicles, and run industrial processes. Prerequisites: 171.101-102 or 171.103-104 or 171.105-106.

Staff   3 credits   fall

171.301 (N) Electromagnetic Theory II

Static electric and magnetic fields in free space and matter; boundary value problems; electromagnetic induction; Maxwell's equations; and an introduction to electrodynamics. Prerequisites: 171.101-102 or 171.105-106; Linear Algebra and Calculus 110.201-202. Corequisite: Differential Equations 110.302.

Staff   4 credits   offered yearly

171.302 (N) Topics in Advanced Electromagnetic Theory

Topics include electromagnetic waves; reflection and refraction; waveguides; retarded potentials and electromagnetic radiation; relativistic electrodynamics. Prerequisite: 171.301.

Staff   4 credits   offered yearly

171.303-304 (N) Quantum Mechanics I, II

A course intended to familiarize the student with the fundamental aspects of quantum mechanics. Uncertainty relations, Schrodinger equation in one and three dimensions, tunneling, harmonic oscillator, angular momentum, hydrogen atom, spin, Pauli principle, perturbation theory (time-independent and time-dependent), transition probabilities and selection rules, atomic structure, scattering theory. Prerequisites: 171.202 or 309, 171.204, Linear Algebra and Calculus 110.201-202. Corequisite: Differential Equations 110.302.

Staff   4 credits   offered yearly

173.308 (N,W) Advanced Physics Laboratory

The laboratory covers an assortment of foundational experiments in modern physics including cosmic ray muon detection, NMR, nuclear spectroscopy, atomic spectroscopy, and the photoelectric effect. In addition to execution of experiments, data analysis and scientific writing are emphasized.

Staff   3 credits   spring

171.309 (N) Wave Phenomena with Biophysical Applications

This course teaches wave phenomena, primarily through the study of biological probes that depend on the interaction of electromagnetic radiation with matter. Topics include waves and Fourier analysis; standing waves, sound and hearing; diffraction and crystallography; geometrical and physical optics—the physics of modern light microscopy; quantum mechanics—how living things absorb light; NMR and MRI. Prerequisites: 171.101-102, 171.103-104 or 171.105-106; Calculus II 110.109.

Staff   3 credits   fall

171.310 (N) Biological Physics

This course introduces topics of classical statistical mechanics though the study of biological systems. Additional topics include low-Reynolds number hydrodyamics and E&M of ionic solutions, via biologically relevant examples such as diffusion, entropic forces, self-assembly, membrane physics, and nerve conduction. Prerequisites: 171.101-102, 171.103-104 or 171.105-106; Calculus II 110.109.

Staff   3 credits   spring

171.312 (N) Statistical Physics and Thermodynamics

A course for undergraduates that develops the laws and general theorems of thermodynamics from a statistical framework. Topics include thermal radiation, Maxwell-Boltzmann statistics of the ideal gas, real gases, Fermi-Dirac statistics, Bose-Einstein statistics, and phase transitions. Prerequisites: 171.202 or 171.310, Calculus 110.108-109. Recommended: 171.303, Linear Algebra and Calculus 110.201-202.

Staff   4 credits   fall

171.313 (N) Introduction to Stellar Physics
A survey of stellar astrophysics. Topics include stellar atmospheres, stellar interiors, nucleosynthesis, stellar evolution, supernovae, white dwarfs, neutron stars, pulsars, black holes, binary stars, accretion disks, protostars, and extrasolar planetary systems. Practical observational work using the department 20 in. telescope may be included. Prerequisites: 171.202 or 171.309/310 and Calculus 110.108-109.
Staff   3 credits   fall

171.314 (N) Introduction to Galaxies and Active Galactic Nuclei
A survey of galaxies and the universe. Topics include the interstellar medium in our own and other galaxies, the structure of the Milky Way, the Hubble sequence, galaxy dynamics, clusters of galaxies, active galactic nuclei and quasars, the Hubble Law, galaxy formation and evolution, the intergalactic medium, cosmological models, the Big Bang and the early universe. Prerequisites: 171.202 or 171.309/310 and Calculus 110.108-109.
Staff   3 credits   spring

171.321 (N,E) Introduction to Space Science and Technology
Topics include space astronomy, remote observing of the earth, space physics, planetary exploration, human space flight, space environment, orbits, propulsion, spacecraft design, attitude control and communication. Co-listed by departments of Earth and Planetary Sciences, Materials Science and Engineering, and Mechanical Engineering. Prerequisites: Physics 171.101-102 or similar; Calculus 110.108-109.
Staff   3 credits   fall

171.404 (N) General Relativity
Discussion of Einstein's theory of gravitation. Gravity will be discussed first as a field theory. Its relation to the metric will be treated later. The many physical tests of the theory will be discussed in detail. Some tensor theory will be introduced in order to understand the theory in its most general form. Prerequisite: 171.204, 171.301-302, Linear Algebra, and Differential Equations.
Staff   2 credits   spring

171.405 (N) Condensed Matter Physics
A course for undergraduates covering the basic concepts of condensed matter physics: crystal structure, diffraction and reciprocal lattices, electronic and optical properties, band structure, phonons, superconductivity, and magnetism. Prerequisites: 171.304, Linear Algebra and Calculus 110.201-202.
Staff   3 credits   fall

171.408 (N) Nuclear and Particle Physics
The basic properties of nuclei, masses, spins, parity. Nuclear scattering, interaction with electromagnetic radiation, radioactivity, Pions, muons, and elementary particles, including resonances. Prerequisites: 171.304, Linear Algebra and Calculus 110.201-202.
Staff   3 credits   spring

171.409 (N) Topics in Modern Cosmology

171.410 (N) Physical Cosmology
Course provides an overview into modern physical cosmology. The contents of the universe, and the physical principles governing the expansion of the universe, will be studied quantitatively.
Staff   3 credits   spring

171.415 (N) Analytical Methods for Physicists
A selection of analytical methods in applied mathematics most frequently used by physicists: functions of complex variables, series and perturbation methods for solving differential equations, Sturm-Liouville theory and special functions, Fourier series and transforms. Prerequisites: Linear Algebra and Calculus 110.201-202.
Staff   4 credits   fall

171.416 (N,Q) Numerical Methods for Physicists
A selection of numerical methods in applied mathematics most frequently used by physicists: linear problems, numerical integration, pseudorandom numbers, finding roots of nonlinear equations, function minimization, eigenvalue problems, fast Fourier transforms, solution of both ordinary and partial differential equations, Monte Carlo techniques. Prerequisites: Linear Algebra and Calculus 110.201-202.
Staff   4 credits   spring

171.472 (N) Introduction to Plasma Physics and Atomic Processes in Hot Plasmas
Course consists of three parts: an introduction of the basic concepts and approaches to plasma physics, a review of the atomic processes which determine the properties of hot plasmas and a brief overview of major laboratory and astrophysical plasma research today. Part 1 considers fluid and kinetic theories (knowledge of basic undergraduate classical mechanics and electromagnetism an asset); part 2 assumes students have an understanding of quantum mechanics at an introductory level. Course gives general overview of subjects under discussion, in preparation for more advanced courses in these areas offered in coming years.
Staff   3 credits   spring

171.501-502 (N) Independent Research: Undergraduate
Students may register for independent research with a faculty member in the Department of Physics and Astronomy. A research plan should be sent to the director of undergraduate study before the add/drop date that includes project details, the number of hours of effort each week, and the number of credits. This course may not be used for one of the two electives required for a B.A., but one semester of research may be used as one of four focused electives in a B.S. program.
Staff

171.503 (N,W) Senior Thesis
Preparation of a substantial thesis based upon independent student research, supervised by at least one faculty member in Physics and Astronomy. Open to senior departmental majors only. This course may only be taken for credit during one semester. However, students are expected to have engaged in their research project dur-

ing previous semesters through 171.501-502, summer research, etc. This course may not be used as one of the two electives required for a B.A., but can be used as one of the four focused electives in a B.S. program.
Staff   3 credits   offered yearly/both semesters

Cross-Listed

110.407-408 (Q,N) Geometry and Relativity
Staff   4.5 credits

Graduate Courses

Seminars are listed together at the end. All graduate students are expected to attend the Physics Colloquium, a weekly lecture on current research by local and visiting physicists.

171.601 Theoretical Mechanics
The Lagrangian, Hamiltonian, and Hamilton-Jacobi methods of mechanics, with applications to some vibrational and rotational problems. A discussion of classical perturbation theory is included.
Staff   3 hours   fall

171.603-604 Electromagnetic Theory
Theory of the Maxwell equations, with static and dynamic applications, boundary-value problems, guided and free waves, diffraction, scattering, special relativity, electron theory.
Staff   3 hours   offered yearly

171.605-606 Quantum Mechanics
Review of wave mechanics and the Schrodinger equation, Hilbert space, harmonic oscillator, the WKB approximation, central forces and angular momentum, scattering, electron spin, density matrix, perturbation theory (time-independent and time-dependent), quantized radiation field, absorption and emission of radiation, identical particles, second quantization, Dirac equation. Prerequisites: 171.303 and 171.304 or equivalent.
Staff   4 hours   offered yearly

173.608 Advanced Laboratory
The laboratory covers an assortment of foundational experiments in modern physics including cosmic ray muon detection, NMR, nuclear spectroscopy, atomic spectroscopy, and the photoelectric effect. In addition to execution of experiments, data analysis and scientific writing are emphasized.
Staff   6 hours lab   spring

171.611 Stellar Structure and Evolution
The basic physics of stellar structure and evolution will be discussed with emphasis on current research.
Staff   3 hours   alternate falls

171.612 Interstellar Medium and Astrophysical Fluid Dynamics
Physical states of interstellar gas; diagnostics: commonly encountered emission and absorption lines, continuum processes, refraction, dispersion, and scintillation; ionization equilibrium; heating and cooling, multi-phase systems and thermal instabilities; dust physics: optical properties, temperature and ionization; basic equations of fluid mechanics: mass continuity, Navier-Stokes, and equations of state; hydrostatic equilibrium and the Jean's mass; fluid instabilities; shock waves and similarity solutions for blast waves; MHD equations and magnetized equilibria.
Staff   3 hours   alternate springs

171.613 Radiative Astrophysics
A one-term survey of the processes that generate radiation of astrophysical importance. Topics include radiative transfer, the theory of radiation fields, polarization and Stokes parameters, radiation from accelerating charges, bremsstrahlung, synchrotron radiation, thermal dust emission, Compton scattering, properties of plasmas, atomic and molecular quantum transitions, and applications to astrophysical observations.
Staff   3 hours   fall

171.614 Astrophysical Spectroscopy
This course is designed as a complement to Radiative Astrophysics (171.613). It focuses on: atomic and molecular spectroscopy; the calculation of quantum transition rates for both radiative and collisional processes; and applications to various astrophysical environments, including stellar and planetary atmospheres and the interstellar medium. The course will also discuss the various experimental techniques used for spectroscopy across the electromagnetic spectrum, from X-rays to radio, with an emphasis on space instrumentation.
Staff   3 hours   spring

171.615 Galactic Structure and Stellar Dynamics
Potential theory; stellar orbits; equilibrium of collisionless systems; stability of collisionless systems; disk dynamics and spiral structure; galactic rotation and the galactic potential; globular cluster evolution.
Staff   3 hours   alternate springs

171.616 The Universe at High Energies
This course examines the universe from the perspective of the most energetic phenomena, as witnessed primarily by the latest X-ray and gamma-ray observations. Topics covered will include instrumentation, data analysis methods, radiative processes and atomic physics in astrophysical plasmas, stars, white dwarfs, neutron stars, black holes, supernovae, pulsars, accretion, galaxies, active galaxies and quasars, clusters of galaxies, gamma ray bursts, and cosmology. The course will present the latest results from frontier research in the field. Prerequisites: 171.101 and 171.102.
Staff   3 hours   spring

171.617 Extragalactic Astronomy
Establishing the extragalactic distance scale; kinematics of an expanding universe; light element nucleosynthesis; formation of the microwave background. Clusters of galaxies. The Hubble sequence and inventory of internal galactic structures: bulges, disks, star clusters; measure-

ments of distance within the galaxy; stellar kinematics; stellar populations; chemical evolution.
Staff   3 hours   alternate falls

171.618 Observational Astronomy
This course will present the knowledge required for astronomical observations across the entire spectrum. For each wavelength range (gamma rays, X-rays, UV, visible, IR, radio) we will discuss the type of detector used, the range of possible observations, and current open questions. We will also discuss the dominant astronomical and terrestrial sources across the spectrum, and study the differences between ground- and space-based observations.
Staff   3 hours

171.619 Molecular Astrophysics
An advanced graduate level course that emphasizes the importance of molecules in astrophysical environments as diverse as interstellar clouds, circumstellar outflows, cometary comae, and active galactic nuclei. Topics will include the chemistry and photochemistry of astrophysical molecules; molecular excitation; astrophysical masers; interstellar molecular clouds; interstellar shock waves; circumstellar outflows; cometary comae; molecular accretion disks.
Staff   3 hours   spring

171.620 The Local Group of Galaxies
The current understanding of the stellar populations of galaxies that are members of the Local Group will be discussed, together with an emphasis on the implications for galaxy formation and evolution.
Staff   3 hours   spring

171.621-622 Condensed Matter Physics
This sequence is intended for graduate students in physics and related fields. First semester: metals and insulators, diffraction and crystallography, phonons, electrons in a periodic potential, transport. Second semester: advanced topics including superconductivity, magnetism, metal-insulator transitions, low dimensional materials, quantized hall effect.
Staff   3 hours   offered yearly

171.623-624 Introduction to Astroparticle Physics
The course provides an introduction to astroparticle physics, an interdisciplinary subject involving both particle physics and astrophysics. The course is open to advanced undergraduate students by permission of an instructor.
Staff   3 hours

171.634 Topics in Magnetism
This course prepares graduate students for research on the magnetic properties of solids. Basic ingredients and theoretical techniques are introduced through a discussion of magnetic moments in insulators and metals at low concentration. We then consider the statistical physics of interacting local moments and of itinerant magnetic systems. Throughout the course we discuss subjects and materials of current interest including quantum magnetism in low dimensional and frustrated systems, strongly correlated metallic magnets, and coupled spin, charge,

and lattice degrees of freedom in transition metal oxides. Prerequisites: 171.621-622 or equivalent.
Staff   3 hours

171.635 Molecular Simulations: Methods and Applications
Introduction to the methods of Monte Carlo and molecular dynamics. Simulations for a wide range of equilibrium and nonequilibrium applications, including hands-on experience with existing codes. Prerequisites: graduate course in statistical mechanics or approval of instructor.
Staff   3 hours

171.636 Modeling Matter Under Across Multiple Length and Time Scales
This course will begin by introducing standard single-scale methodologies for continuum fluid and solid mechanics, classical and quantum molecular dynamics, and density functional theory. Next, Monte Carlo, kinetic Monte Carlo, Lattice Boltzmann, and related methods for accessing long time and length behavior will be introduced. The final section of the course will describe algorithms that treat different regions of space with different spatial and temporal resolutions. These include standard multigrid methods, and new hybrid methods that treat some regions of space atomistically and others using a continuum description. Prerequisite: 171.621-622 and 171.312 or permission of the instructor.
Staff   3 hours   spring

171.640 Extrasolar Planets
This seminar-style course will cover the ESP inventory and characteristics, techniques for finding ESPs, dependencies on parent stars, debris disks, planet formation theories, ESP outstanding issues, the search for extraterrestrial life, and NASA's ESP plans.
Staff   3 hours

171.650 Methods of Data Intensive Science
Modern science is becoming increasingly dominated by large amounts of data. This course introduces state-of-the-art techniques for the management and analysis of large data sets, including databases, the SQL language and various techniques for data exploration and statistical analysis. The course is appropriate for all natural science disciplines.
Staff   3 hours   spring

171.672 Introduction to Plasma Physics and Atomic Processes in Hot Plasmas
Course consists of three parts: an introduction to the basic concepts and approaches to plasma physics, a review of the atomic processes which determine the properties of hot plasmas, and a brief overview of major laboratory and astrophysical plasma research today. Part 1 considers fluid and kinetic theories (knowledge of basic undergraduate classical mechanics and electromagnetism an asset); part 2 assumes students have an understanding of quantum mechanics at an introductory level. Course gives general overview of subjects under discussion, in preparation for more advanced courses in these areas offered in coming years.
Staff   3 hours

171.701-702 Quantum Field Theory

Introduction to relativistic quantum mechanics and quantum field theory. Canonical quantization; scalar, spinor, and vector fields; scattering theory; renormalization; functional integration; spontaneous symmetry breaking; Standard Model of particle physics. Prerequisites: 171.605-606 or equivalent.

Staff   3 hours

171.703-704 Advanced Statistical Mechanics

The first semester begins with a brief review of basic statistical mechanics and thermodynamics. Then hydrodynamic theory is derived from statistical mechanics and classical treatments of phase transitions, including Ginzburg- Landau theory, are described. The second semester covers renormalization group theories of critical phenomena, the fluctuation-dissipation theorem, and analytic and numerical techniques for studying interacting systems. Prerequisites: 171.303-304 and 171.312 or equivalents.

Staff   3 hours   alternate years

171.731 Experimental Particle Physics

This course is intended for graduate students interested in experimental particle physics, as well as theory students or students from other specialties. Subjects covered in this course are experimental techniques, including particle beams, targets, electronics, and various particle detectors; and a broad description of high energy physics problems.

Staff   3 hours   spring

171.732 Elementary Particle Physics

The physics of the Minimal Standard Model. Topics include gauges theories, quantum electrodynamics, e+e- physics, deeply inelastic scattering, quark model, quantum chromodynamics, weak interactions, Higgs mechanism, Weinberg-Salam theory, neutral heavy mesons and CP violation, physics of neutrinos. Prerequisite: 171.701.

Staff   3 hours

171.746 General Relativity

A comprehensive introduction to differential geometry and Einstein's theory of gravitation. Applications to stellar collapse and black holes, gravitational waves and detectors, and Robertson Walker and inflationary cosmologies.

Staff   3 hours   spring

171.750 Cosmology

Review of basic general relativity, Friedmann solutions; speculations about the early universe, inflation; big bang nucleosynthesis; creation of the microwave background; development of density perturbations; galaxy formation; the intergalactic medium; large-scale structure; dark matter.

Staff   3 hours   alternate years

171.754 Active Galactic Nuclei

Phenomenology of the zoo; samples and search techniques; cosmological evolution of the AGN population; physics of black holes; accretion disks; X-ray and gamma-ray emission mechanisms; pair plasmas; relativistic jets and radio emission; emission lines; broad absorption lines; obscuration, reflection, and unified schemes; host galaxies and fueling.

Staff   3 hours   fall

171.755 Fourier Optics and Interferometry in Astronomy

A course for advanced undergrads and beginning grads covering the principles of optics and image formation using Fourier transforms, and a discussion of interferometry and other applications both in optical and radio astronomy. Topics may include coronagraphs, interferometers, aperture synthesis techniques; and applications to astronomy including high-precision astrometry, high-resolution imaging, and the detection of extrasolar planetary systems.

Staff   3 hours   alternate falls, odd years

171.756 Astrophysics of Compact Objects

A graduate-level course devoted to the physical understanding of black holes, white dwarfs, neutron stars and associated objects. Many astrophysical observations will be discussed where these objects may be relevant including galactic nuclei, quasars, compact X-ray sources and gamma-ray bursts.

Staff   3 hours

171.761 Topics in Condensed Matter Physics

This is an advanced course dealing with current developments in condensed matter and statistical physics.

Staff   3 hours   fall

171.762 Advanced Condensed Matter Physics

This course is designed for graduate students interested in learning the language, techniques, and problematics of modern quantum many-body theory as applied to condensed matter physics. First, some formal tools will be introduced including second quantization, coherent states, functional integrals and diagrammatic method. Next, various physical phenomena of interest will be discussed: superfluidity, superconductivity, magnetism, quantum Hall effect, etc. Prerequisite: a good grounding in quantum mechanics.

Staff   3 hours   alternate years

171.764 Experimental Condensed Matter Physics

This course will be a survey of modern techniques in experimental condensed matter physics and is intended for graduate students interested in this area, but others interested in this topic (especially condensed matter theory students) are encouraged to enroll. Topics include low temperature techniques, transport, the SQUID and other magnetic probes, digital and analog signal processing, scattering (neutron, X-ray, and light), EPR, NMR, data analysis, and Monte Carlo. Sample preparation, including crystal and film growth and lithography will also be covered.

Staff   3 hours   fall

171.783-784 Advanced Particle Theory

Advanced course on the modern theory of fundamental interactions: standard model of strong, electro-magnetic and weak interactions (perturbative aspects of QCD, renormalization group, $SU(2)xU(1)$ vector bosons and the fermion sector, fermion masses, generations, q-problem

limitations of the standard model). Prototype grand unified model (GUT): SU(5). Some of the following topics will also be discussed: Beyond SU(5), supersymmetric models, cosmology and GUTs, superstring phenomenology.
Staff   3 hours   spring

171.801-802 Independent Research: Graduate
Staff

Seminars

172.601-602 Department Colloquium

172.631-632 Physics Seminar
Intended for beginning graduate students. Study of the methods and results of modern physics and other topics of interest. Each student will discuss some phase of the subject.
Staff   1 hour

172.633 Language of Astrophysics
A survey of the basic concepts, ideas, and areas of research in astrophysics, discussing general astrophysical topics while highlighting specialized terms often used compared to physics.
Staff   fall/offered yearly

172.711-712 Intermediate Seminar
A nonspecialized seminar in which second-year graduate students are offered an opportunity to discuss subjects of general interest, supplementing the material of the standard courses and including recent advances in physics.
Staff   1 hour

172.721-722 Hot Topics in Astronomy
Staff   1 hour

172.731-732 Center for Astrophysical Sciences Research Seminar
Staff   1 hour

172.733-734 Astronomy and Astrophysics Research Seminar
Staff   1 hour

172.735 Galaxies Journal Club
Staff   1 hour

172.751-752 Elementary Particle Physics Seminar
Staff   1 hour

172.753-754 Advanced Particle Theory Seminar
Staff   1 hour

172.763-764 Condensed Matter Physics Seminar
Staff   1 hour

172.783-784 Topics in Astrophysics Research
Staff   1 hour

172.787-788 Observational Ultraviolet Astronomy Seminar
Staff   2 hours

Cross-Listed

270.623 Planetary Atmospheres
Staff   3hours

270.661 Planetary Fluid Dynamics
Staff   3 hours

Planetary Science

Planetary science is an interdisciplinary field which at Johns Hopkins University can be studied at the graduate level in the Departments of Earth and Planetary Sciences, Mechanical Engineering, and Physics and Astronomy.

A distinct advantage of studying planetary science at Johns Hopkins is the Space Telescope Science Institute, which is on the Homewood campus and whose facilities are available for thesis research. Exoplanet research at STScI includes studies with Kepler and the Hubble Space Telescope (HST). Future work will involve both the James Webb Space Telescope (JWST) and, eventually, the Terrestrial Planet Finder (TPF). Major initiatives in exoplanet instrumentation are underway. The University and STScI jointly sponsor the Institute for Planets and Life. The Physics and Astronomy Department hosts the Center for Astrophysical Sciences, which has a research staff of approximately 100 Ph.D. scientists. In addition, the University has its Applied Physics Laboratory (APL) which has designed, developed, and launched 64 spacecraft and over 150 space instruments. Currently, the MESSENGER mission to Mercury and the New Horizon mission to Pluto and the Kuiper-belt are operated by APL.

The Faculty

Colin A. Norman, Professor (Physics and Astronomy, STScI)

K. T. Ramesh, Professor (Mechanical Engineering)

Neill Reid, Astronomer (STScI)

Darrell F. Strobel, Professor (Earth and Planetary Sciences, Physics and Astronomy), Principal Professional Staff (APL)

Harold A. Weaver, Principal Professional Staff (APL), Research Professor (Physics and Astronomy)

Graduate Program

Background Requirements

Because planetary science is the application of basic principles from the parent sciences of astronomy, biology, chemistry, geology, and physics to the study of solar system objects and exoplanets, it is important that graduate study in this field be carried out with rigorous training in one or more parent sciences. An undergraduate degree in one of these parent sciences with course work in other basic sciences is the best preparation for graduate study. In addition, three years of undergraduate mathematics is highly desirable. An undergraduate degree in planetary science is not required.

The choice of a department to pursue graduate study in planetary science at Johns Hopkins depends on a number of factors: professional identity (whether the student wants to be known as an astrophysicist, astrobiologist, chemist, geologist, engineer, or physicist, etc.), departmental requirements for the Ph.D., and undergraduate training. Thesis research can be supervised by any professor with interests in planetary science, regardless of the departmental affiliation of either student or professor. Students are encouraged to take courses in astrophysics, astrobiology, chemistry, geology, engineering, physics, and applied mathematics as well as planetary science to gain the comprehensive background necessary for interdisciplinary research in this field.

Research

Current research includes acquisition, analysis, and interpretation of spacecraft data. An active program to study the outer solar system, comets, and exoplanets (and any spectroscopic biomarkers for life) utilizes the Hubble Space Telescope. Currently, an in-depth study of the Saturnian system is being conducted with the Cassini spacecraft. In March 2011, the MESSENGER spacecraft goes into orbit around Mercury to get a fresh perspective on its composition, magnetic field/magnetosphere, and surface. APL has an exceptionally strong planetary science group with over 30 Ph.D. researchers working in diverse areas including surfaces and atmospheres, lunar exploration, geophysics, composition and sampling, and planetary astronomy (mainly comets and asteroids). In the Department of Mechanical Engineering, the research focuses on impact and cratering processes. Recent advances in dynamic failure mechanics are used to provide material models that are appropriate for large-scale planetary impacts on asteroids, Mars, Mercury, and the Moon. At STScI, major ground-based exoplanet studies are undertaken utilizing radial velocity surveys, transit surveys, and adaptive optics to directly image them.

Future spacecraft data are anticipated from the Rosetta Mission, the Lunar Reconnaissance Orbiter, and the New Horizons Pluto Kuiper-belt Mission (arrival at Pluto in July 2015) and JWST. A broad range of fundamental problems in atmospheric chemistry, dynamics, and radiation pertinent to the atmospheres of the giant planets, exoplanets, and their satellites and cometary comas are being pursued observationally, theoretically, and in the laboratory. Development of instrumentation designs for a large exoplanet mission is underway.

Political Science

The programs of the Political Science Department are designed to help students attain a deeper understanding of politics and civic life in its various dimensions. The department encourages students to become sophisticated theoretically and to study politics in global and comparative perspective. We divide the curriculum into American politics, law and politics, comparative politics, political theory, and international relations, and students are encouraged to develop expertise in several of these areas.

The department has 21 faculty members. The undergraduate program offers a broad range of courses about politics and government at local, state, national, and international levels. In addition to taking courses on the Homewood campus, students can do independent research under the guidance of a faculty mentor, take courses at the Nitze School of Advanced International Studies (SAIS) in Washington, D.C., and participate in the Aitchison Public Service Undergraduate Fellowship Program at the Johns Hopkins Washington Center.

The Faculty

Jane Bennett, Professor: political theory, American political thought, ecophilosophy.

Samuel Chambers, Assistant Professor: political theory, feminist and queer theory, cultural politics.

Erin Chung, Charles D. Miller Assistant Professor of East Asian Politics and co-director of the Racism, Immigration and Citizenship Program: comparative politics, East Asian politics, international migration, comparative racial politics.

William E. Connolly, Krieger-Eisenhower Professor: political theory, international relations.

Joseph Cooper, Professor: legislative politics, executive-legislative relations, institutional theory.

Matthew A. Crenson, Professor Emeritus: Urban government, American political development.

Jennifer L. Culbert, Associate Professor: political theory, jurisprudence; law and society, rhetorical theory and theories of interpretation.

Steven R. David, Professor and Vice Dean for Undergraduate Education: international relations, security studies, comparative politics.

Daniel H. Deudney, Associate Professor: international relations, political theory.

Richard E. Flathman, Professor Emeritus and George Armstrong Kelly Professor: political theory, legal philosophy.

Benjamin Ginsberg, David Bernstein Professor and Director of the Washington Center for the Study of Government: American government and politics, political development.

Joel B. Grossman, Professor: constitutional law, law and politics, American politics.

Siba N. Grovogui, Professor: international relations theory, political theory.

Michael Hanchard, SOBA Presidential Professor and co-director of the Racism, Immigration and Citizenship Program: comparative politics, political theory.

Nicolas Jabko, Associate Professor: comparative politics, international political economy, European politics.

Richard S. Katz, Professor: comparative politics (parties, elections, European politics), American politics.

Margaret E. Keck, Professor: comparative politics, international relations (Latin American politics, the environment, social movements).

Renée Marlin-Bennett, Professor: international relations, political economy of information.

Adam Sheingate, Associate Professor: American politics, comparative politics.

Lester Spence, Assistant Professor: black politics, race and politics, urban politics, American political behavior and public opinion.

Steven Teles, Associate Professor: social policy, law and public policy, political analysis.

Kellee S. Tsai, Professor and Vice Dean for Humanities, Social Sciences, and Graduate Programs: comparative politics, political economy of development, Chinese politics, international political economy.

Adjunct Faculty

Robert Freedman, Arab-Israeli politics and Russian politics.

Wayne Smith, International Relations.

Undergraduate Programs

The department offers a broad range of courses in American politics, law and politics, comparative politics, international relations, and political theory. These courses can contribute to two different majors:

Major in Political Science

The major in political science described below is designed for students interested in intensive study

of the institutions, theory, and problems of modern political culture and government.

Major in International Studies

The department offers an interdisciplinary program leading to B.A. or B.A./M.A. degrees in International Studies. This program and its requirements are described under International Studies (see page 256).

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 48.)

In addition to the university distribution requirements, majors must take a total of at least 13 courses in political science and achieve a grade of C or better in each of these courses, including courses taken in the first semester of the freshman year. These 13 courses must include at least one course in each of the following subfields: American politics (AP or LP designation), comparative politics (CP), political theory (PT), and international relations (IR). Students then need to take an additional nine classes in political science for a total of 13 political science courses. Students may count one letter-graded, three-credit independent study course toward the 13 courses required. Internships, which are not letter-graded, do not count toward meeting the requirements of the major.

Outside the department, majors must take at least two courses in the social sciences (Anthropology, Economics, Geography, Psychology, Sociology) and two courses in history (History, History of Art, History of Science and Technology). The Department of Political Science does not award credit for the Advanced Placement examination in government.

Comparative Racial Politics

The undergraduate program in Comparative Racial Politics is designed to introduce undergraduate students to the study of racisms in comparative, cross-spatial perspective. Beginning with an introductory course designed to familiarize students with key concepts and approaches in the examination of racism, students will be able to distinguish the race concept and the practice of racism from the concepts and phenomena such as ethnicity and nationalism.

The curriculum includes two mandatory courses and one elective course. The mandatory courses are Introduction to Ethnic and Racial Politics, and Race and Racism in Comparative Perspective. The elective is a country- or regionally-specific course (Race in the United States, Black Politics, Asian Ameri-can Politics, Race in Latin America, Black Political Thought, and others to be named).

Honors Thesis Program

Seniors also have the opportunity to write a senior research thesis. To be eligible to write this thesis, seniors must identify a faculty sponsor who will supervise the project. Once a faculty sponsor has approved a topic, students must enroll in a three credit independent study during the fall semester of their senior year. If at the end of the fall semester adequate progress has been made and the project warrants further work, the student may enroll in the senior thesis (190.499) which will be worth 6 credits. Students who complete a senior thesis and have a final major GPA (including final semester grades) of 3.7 will be awarded departmental honors. All students may write a thesis, regardless of GPA, provided they have a detailed proposal approved by a faculty member at the beginning of the fall semester of their senior year.

Graduate Program

The graduate program in political science reflects the distinctive strengths of Johns Hopkins University, where graduate education holds a central place in the life of an attractive urban campus of comparatively small size, and where graduate students from several departments in the social sciences and humanities form a vibrant intellectual community. The Hopkins Department of Political Science promotes close interdependence between American politics, comparative politics, law and politics, international relations, and political theory. Our objective is to be a place where most faculty and graduate students are fluent in theory and where many contribute to the global and comparative dimensions of politics. This objective is reflected in the range of the faculty, with most members contributing to more than one field and several engaged actively with colleagues and graduate students in other departments. Our program is designed for graduate students who seek broad training, who are inspired by large questions about politics, and who aspire to develop considerable strength in more than one field. We also encourage students to do some work in allied departments such as. Anthropology, Economics, German and Romance Languages and Literatures, History, the Humanities Center, Philosophy, Public Policy, and Sociology. A broad gauge program speaks to the future teaching responsibilities of students as well as the professional scholarship appropriate to the future. Much political research in the next few decades will study the United States comparatively,

explore connections between contemporary global politics and the durable interests of political theory, and cultivate growing convergences between international relations and comparative politics.

Admission

The department admits approximately 10 to 12 new graduate students each year, selecting them from the approximately 200 applications that it receives annually. The deadline for application for admission to graduate study and the award of financial assistance is January 15. Decisions are made exclusively in late February or early March and announced by March 15. A B.A., B.S., or their equivalent and results of the Graduate Record Examination are required for application. Students whose native language is not English must take the TOEFL examinations or provide other evidence of fluency in English. A broad background in the liberal arts and sciences is preferred. Further information, and the materials necessary to apply for admission and aid, will be sent on request.

Financial Aid

The department ordinarily provides financial aid to all students admitted to the graduate program unless they hold fellowships from sources outside the university. Departmental fellowships cover full tuition and an annual stipend, currently set at $20,000. Assuming satisfactory progress toward the Ph.D., students can normally expect to receive funding for five years. All students receiving financial aid are expected to serve as teaching assistants for one semester of each academic year.

Progress Toward the Ph.D.

The time necessary to obtain a Ph.D. in the department varies according to the preparation individual students bring to the program, the scope and complexity of their dissertation topics, and other factors. Students are encouraged to satisfy the department's foreign language requirement by the time of their comprehensive exams. Doctoral students fulfill the foreign language requirement when they demonstrate successful completion of four semesters of college-level foreign language instruction or its equivalent, or pass a translation test administered by an appropriate faculty member. Most students take their comprehensive examinations in the third year in the program. The Master of Arts degree is offered only to students who have been admitted into the Ph.D. program. For the M.A., the student must complete at least seven one-semester courses at the 300- or 600-level with a grade of B or better, and demonstrate an effective reading knowledge of one approved foreign language.

Requirements for the Ph.D. Degree

The requirements for the Ph.D. are divided between those that must be satisfied by all candidates for that degree and those particular to the subdisciplinary fields into which work in the department is divided.

All candidates for the Ph.D. must satisfy the following requirements:

Course Requirements:

A minimum of 14 semester courses at the 600-level with a grade of B or better.

Comprehensive Examinations in two approved fields:

One major and one minor. The "take-home" comprehensive examination in the major field is two days (16 hours) in length. It is conducted by the members of the departmental faculty whose teaching and research are in the field in question. The comprehensive examination in the minor field is one day (8 hours) in length. Both the major and the minor field are to be chosen from among the five fields of political science into which study in the department is primarily organized: American politics, law and politics, political theory, comparative politics, and international relations. Students may, if they wish, take an optional second minor examination in one of these fields or in a program outside of the Department of Political Science.

In the latter case, the student must devise a coherent program of study in an area related to political science, in consultation with his or her department advisor and faculty from other departments; complete with a grade of B or better a minimum of three courses at the 600-level in the area in question; pass a comprehensive examination prepared and evaluated, in consultation with faculty of the Department of Political Science, by the instructors in those courses.

Dissertation

Preparation of the dissertation will be supervised and must be approved by two members of the faculty, at least one of whom (the dissertation director) must be a member of the Department of Political Science.

Defense

The final examination of the dissertation will take the form of a defense conducted under the rules of the Graduate Board of The Johns Hopkins University.

Fields

The five departmental fields from which students may choose a major are:

- American Politics
- Law and Politics
- Comparative Politics
- International Relations
- Political Theory

Basic expectations, procedures, and requirements concerning work in all these fields are stated below. These are implemented, interpreted, and adjusted in the light of the intellectual orientations and objectives of individual students. It is of great importance that students work closely with their advisors and with the faculty in their major and minor fields in constructing and pursuing their programs.

American Politics

The Department offers both a major and a minor in American politics. In both cases, students will work with at least two faculty members to develop a plan of study that includes recommended course work and other preparation needed to pass a comprehensive exam. Students completing a major are expected to demonstrate a breadth of knowledge sufficient for framing a dissertation in the relevant disciplinary literature and teaching undergraduate courses in the field; students who pursue a minor may focus more narrowly on an area of study in which they demonstrate fluency. These may include, but are not limited to, the following areas of faculty interest:

- American Political Institutions (Congress, Courts, and the Executive)
- Urban Politics
- American Political Development
- Race and Politics
- Political Behavior and Public Opinion
- Public Policy
- American Political Thought
- Political Parties and Elections

In addition, students majoring in the field are strongly encouraged to take both 190.601 Qualitative Research Methods and 190.602 Quantitative Analysis as part of their course of study.

Political Theory

Students majoring in Political Theory will take a comprehensive examination covering the following two subfields:

- Contemporary Political Theory
- History of Political Thought

Each student preparing for a major comprehensive exam will propose six or seven thinkers in the history of thought, six or seven recent or contemporary thinkers, and three or four issue areas. Examination questions are composed in light of the theorists and issues articulated in the exam prospectus.

The minor comprehensive exam in political theory asks the student to select half the number of thinkers required for the major exam and three issue areas.

Preparation for these examinations will be arranged in consultation with relevant faculty.

Students majoring in political theory will also take at least one minor field from American Politics, Law and Politics, Comparative Politics, International Relations, or, after consulting with their advisor, a program of study including courses from outside the Department of Political Science.

Comparative Politics

All students working in this field will become conversant with major substantive and methodological debates in comparative politics, and be able to comment on the key theoretical literature in several of them. They will normally also develop knowledge of at least one world region. We offer core courses in Theories of Comparative Politics, and in both Quantitative and Qualitative Methods, and expect all students to master the materials covered in these courses, as well as others with more specialized topics.

Students will take a comprehensive exam that will test their ability to engage with several areas of theoretical debate in Comparative Politics, and their ability to use comparative examples to support their arguments. Students may focus on (but are not limited to):

- Institutional Theories
- Transnational Relations, Social Movements, and Contentious Politics
- Political Parties, Interest Groups, Representation, and Political Behavior
- Comparative Political Economy
- Comparative Racial Politic
- The Political Economy of Development
- Economic and Political Transitions
- Ideas and Politics

Within the spirit of this division of the overall field, students may propose alternative delineations of thematic subfields.

Students working in specific thematic and substantive subfields within Comparative Politics will be required to demonstrate competence in

methodologies and bodies of theory judged by the faculty to be necessary to quality research and teaching in those subfields.

Students majoring in Comparative Politics will also take a comprehensive examination in at least one minor field from among the following:

• American Politics

• International Relations

• Political Theory

• Law and Politics

They may choose their second minor field from within or from outside the Department of Political Science, including Johns Hopkins' School for Advanced International Studies.

Students minoring in Comparative Politics will take a comprehensive examination in Comparative Politics. Students majoring or minoring in Comparative Politics are required to take 190.625 Theories of Comparative Politics and at least one seminar in quantitative or qualitative methods.

Comparative Racial Politics

The graduate certificate program in Comparative Racial Politics is designed to help train graduate students who are developing empirically based and/or theoretically informed scholarship on citizenship, racism and immigration in contemporary societies, whether in a single national society or cross-spatially. There are three required courses: Nationalism, Comparative Racial Politics, and Immigration, Difference and Citizenship. In addition the student must take one elective from this (preliminary) list:

• Race, research methods and design (public opinion, electoral competition, ethnography)

• Comparative Citizenship

• Regionally specific courses (eg. Europe, Japan, China, Brazil)

International Relations

Students majoring in International Relations will take an examination covering two subfields. The first subfield must be International Politics.

The other subfield is to be determined in consultation with faculty teaching in International Relations. Choices include but are not restricted to:

• International Law and Diplomacy

• International Relations Theory

• International Security Studies

• International Political Economy

Students majoring in International Relations will also take at least one minor field from among the following:

• American Politics

• Law and Politics

• Comparative Politics

• Political Theory

Students may choose a second minor field from within or from outside the Department of Political Science, including Johns Hopkins' School for Advanced International Studies.

Students minoring in International Relations will take a comprehensive examination in International Politics. Students majoring or minoring in International Relations are required to take at least one seminar in political theory or quantitative methods, the seminar to be chosen in consultation with faculty in International Relations.

Undergraduate Courses

The designation after a course name indicates the field within which it falls: American Politics (AP), Law and Politics (LP), Comparative Politics (CP), Political Theory (PT), International Relations (IR).

190.101 Introduction to American Politics (AP)

This course is an introduction to government and politics through the study of the government and politics of the United States. All governments combine coercion and legitimacy. In a stable and legitimate system of government, coercion is hardly noticed by most citizens. Government comes to be seen as a source of benefits. The purpose of this course is to look behind institutions, practices, and benefits to appreciate how, for what, and by whom, we are governed.
Ginsberg   3 credits

190.102 Introduction to Comparative Politics (CP)

An introduction to political institutions and processes with illustrations drawn from selected countries of the world including Great Britain, Japan, Mexico, China, India, Nigeria, and Russia.
Keck   3 credits

191.203 Expository Writing for Political Science and International Studies

This course is designed to teach second- and third-year IS and PS majors how to identify, advance, and critique key forms of scholarly and political argument. Through a variety of scholarly, policy-oriented, and journalistic documents, students will engage sophisticated arguments, analyze them, and formulate counter arguments. The foundations of executing longer-term research projects

will also be surveyed. Strongly recommended for students contemplating writing a senior thesis. Writing Intensive.
Staff   3 credits

190.209 Contemporary International Politics (IR)
An introduction to international politics. Emphasis will be on continuity and change in international politics and the causes of war and peace. The first half of the course will focus on events prior to 1945, including the Peloponnesian War, the European balance of power, imperialism, and the origins and consequences of World War I and World War II. The second half will focus on international politics since 1945, including the origins of the Cold War, the impact of nuclear weapons, the emergence of the Third World, and the effect of the collapse of the Soviet Union on prospects for peace.
David   3 credits

190.213 International Politics (IR)
Intensive analysis of major approaches to international politics (realism, liberalism, Marxism). Topics include anarchy, geopolitics, states, nations, balance of power, hegemony, empire, democratic peace, regimes, nuclear weapons, European Union.
Deudney   3 credits

190.214 Introduction to Racial and Ethnic Politics (AP)
 What do scholars mean when they use concepts of race and ethnicity, and what are the political implications of these concepts in everyday life? One aim of this course is to answer this question. The second aim of this course is to help first-year college students develop familiarity with these concepts and an understanding of how ideas about racial and ethnic difference have impacted the formation of societies, governments, laws, policies, and individuals, even themselves. Comparative in scope, this course will lead students through readings about racial and ethnic relations in countries like Brazil, England, Northern Ireland, and China, often utilizing the United States as a referent. Cross-listed with Africana Studies.
Staff   3 credits

190.221 Political Theory of Gender and Sexuality (PT)
 Feminist theory and queer theory have been important resources for contemporary political thought, at the same time that key issues concerning gender and sexuality have proved central to both political theory and contemporary politics. This course focuses on theories of gender and sexuality through a selective encounter with feminist and queer theories, and it examines political theories that draw from and speak to those other fields. Texts may include: Beauvoir, Sedgwick, Butler, Scott, Warner, Halperin, and Edelman.
Chambers   3 credits

190.228 The American Presidency (AP)
A survey of the historical development of the office and institution of the presidency, with a focus on the contemporary presidency in greater detail: presidential selection and elections, the organization of the White House, and relations with Congress.
Sheingate   3 credits

190.265 Comparative Political Behavior (CP)
An introduction to the study of political behavior, emphasizing electoral behavior in democratic countries.
Katz   3 credits

190.280 Political Persuasion: Classics of Political Thought I (PT)
An introduction to Euro-American political thought through a close examination of six thinkers: Socrates, Machiavelli, Locke, Marx, Whitman, and Foucault.
Bennett   3 credits

190.281 Virtue , Labor, Power: Classics of Political Thought II) (PT)
This is not a class in the history of political thought. Instead, it is an opportunity for selective, circumscribed, but very focused engagement with some of the most powerful and provocative texts in that history. We will read selections from six thinkers (Socrates, Machiavelli, Locke, Marx, Nietzsche, and Foucault), focusing on three themes (virtue, labor, and power). These texts have all profoundly shaped the way we think politics, and they are texts that resonate with our political problematics today.
Chambers   3 credits

190.282 Violence, Law, and the Social Contract: Classics of Political Thought III
Culbert   3 credits

190.301 Global Political Economy (IR)
Examines the intersection of politics and economics in global affairs. Focuses on theoretical approaches to global political economy; institutions of governance of the global political economy; flows of goods, services, capital, and information; and transborder problems.
Marlin-Bennett   3 credits

190.308 Ethics of War (IR)
This is an introduction to U.S. foreign policy, with special emphasis on decision making processes and their agents, principally the executive and legislative branches, and interest groups. Case studies will be limited to the era following World War II.
Grovogui   3 credits

190.310 Global Security Politics (IR)
Intensive examination of contemporary nuclear, space, biological, and information violence capabilities and their interaction with the state-system, non-state actors, limited government, and international governance. Prerequisite: CIP or IP.
Deudney   3 credits

190.315 Asian American Politics (CP)
This course examines issues of political identity, political incorporation, and political participation of Asian Americans. Themes include Asian American panethnicity, the struggle for immigration and citizenship, Asian American electoral politics, political activism and resistance since the 1960s, and the impact of Asian Americans on the politics of race and ethnicity in the United States.
Chung   3 credits

190.320 Politics of East Asia (CP)
Examines some of the central ideas and institutions that have transformed politics in the contemporary world through the lens of East Asia, focusing on Japan, South Korea, Taiwan, and China. Topics include state-society relations, late development, nationalism, democratization, political culture, social movements, and globalization.
Chung   3 credits

190.323 Introduction to International Law (IR, CP)
A limited survey of international law, its sources, and uses in international relations. It has five basic aims: 1) to explore the place, origins, and changing contexts of international law and its instrumentality in international life; 2) to examine the sources of international law, particularly in regard to the different personalities and institutions that influence its development; 3) to survey select international legal dispositions concerning the peaceful resolutions of conflict and the immunities that apply to certain legal subjects; 4) to examine the immunities that apply to certain legal subjects; 5) to examine differing views on the future of international law in light of recent events.
Grovogui   3 credits

190.325 Finding Democracy (PT)
Democracy frequently stands for, equates with, or reduces to, an array of other concepts: majoritarianism, proceduralism, and liberalism; representation, institutions, and rights. This seminar will explore writings in contemporary political theory that seek distinct understandings of democracy and thereby offer alternative approaches to politics and political theory. Texts may include: Rancière, Zizek, Agamben, Honig, Brown, and Mouffe.
Chambers   3 credits

190.326 Democracy and Elections (CP)
An examination of most aspects of democratic elections with the exception of the behavior of voters. Topics include the impact of various electoral systems and administrative reforms on the outcome of elections, standards for evaluations of electoral systems, and the impact of the Arrow problem on normative theories of democratic elections. Prerequisite: 190.101, 190.120, or any course designated CP.
Katz   3credits

190.328 Black Visual Politics
Prerequisite: 190.340 Black Politics.
Spence   3 credits

190.328 International Relations Theory and Practice (IR)
Examines the politics of state systems. The three main Western traditions of international theory—realism, Marxism, liberalism——are explored in depth.
Deudney   3 credits

190.329 National Security in the Nuclear Age (IR)
An examination and analysis of the impact of nuclear weapons on international politics. Emphasis is on nuclear weapons systems, the strategic balance, proliferation, medium nuclear powers, and the theory and practice of arms control. The role of nuclear weapons in traditional concepts of the use of force will be considered.
David   3 credits

190.330 Japanese Politics (CP)
This course introduces students to the major debates and issues of postwar Japanese politics. Topics include nationalism, electoral politics, civil society, and immigration.
Chung   3 credits

190.331 Race and Racism in Comparative Perspective (CP)
Students will learn to utilize qualitative, interpretive methods of comparative politics to examine dynamics of racial and/or ethnic tension in the nation-states of Brazil, Britain France, Germany, and the United States. Readings will emphasize the role of the state, political economy, national culture, racist ideologies and anti-racist politics in the formation, maintenance and transformation of conditions of race-based inequalities. Students will also become familiar with theories and concepts of race and ethnicity, and their relationship to issues of state power, national identity and social policy.
Hanchard   3 credits

190.333-334 Constitutional Law (AP, LP)
A two-semester exploration of the Supreme Court's interpretation of the Constitution and the Court's role in the American political system. The first semester focuses on how the court makes its decisions; on its development and articulation of fundamental principles such as judicial review, federalism, and the separation of powers; and on the powers of Congress and the president. The second semester focuses on issues of civil liberties and civil rights, with major emphasis on the rights of defendants and the criminal justice system; issues of racial, gender, and political equality; the constitutional right of privacy; selected free speech and religious freedom issues; and a final assessment of the policy impact and implementation capacities of the Court. Prerequisite for 190.334 is completion of 190.333.
Grossman   3 credits

190.336 Public Opinion (AP)
This class will analyze the creation of public opinion from the standpoint of racial politics.
Spence   3 credits

190.337 The Constitution and the Criminal Justice System (AP, LP)
Explores how the Constitution has shaped the theory and practice of the American criminal justice system, including arrests, searches and seizure of evidence, interrogation, prosecution, adjudication and plea bargaining, and sentencing. What is a "fair trial?" What is "due process?" What is "equality before the law?" What are "victims' rights?"
Grossman   3 credits

191.338 The American Judiciary: Law, Courts, and Politics (AP, LP)
An exploration of the changing role and function of courts, judges, and lawyers in the American legal systems, and of our increasingly litigious, rights conscious, and adversarial culture. It will address how and why people use the courts to resolve civil disputes, how the courts handle those disputes, and the increasing reliance on alterna-

tive and less formal dispute processing forums. It will also examine the role of courts in the criminal justice system.
Grossman   3 credits

190.339 American Racial Politics (AP)
This class will analyze the creation of public opinion from the standpoint of racial politics.
Spence   3 credits

190.340 Black Politics (AP)
This course is an historical survey of the bases and substance of politics among black Americans and the relations of black politics to the American political system. The sweep of the course covers the period from Emancipation to the present. The intention is both to provide a general sense of pertinent issues and relation over this period as a way of helping t make sense of the present and to develop criteria for evaluating political scientists' and others' claims regarding the status and characteristics of black American political activity.
Spence   3 credits

190.341 Korean Politics (CP)
This course introduces students to the historical and institutional foundations of modern South Korean politics. Topics include nationalism, political economic development, civil society, globalization, and ROK-DPRK relations.
Chung   3 credits

190.343 Nationalism (CP)
Despite the clamor over globalization and regionalization in the contemporary world, nationalism remains a central preoccupation for both political actors and students of politics. Though motivated by questions resonant within the discipline of political science (and the field of comparative politics in particular), this course is designed to familiarize students with key texts and debates in the literatures on nationalism in political science, sociology, history and anthropology. The objective of this course is to provide students with a comprehensive overview of major themes, scholarly approaches and forms of nationalist mobilization in national and cross-spatial perspective. Some of the questions to be addressed in this course are a) what are the roots and routes of nationalism?; b)who are nationalist political actors, and where do they come from?; c) what is nationalism's relation to race, racism and ethnicity d) what is the relationship between various forms of nationalism and contemporary considerations of regionalism and globalization?
Hanchard   3 credits

190.344 (S, W) Seminar in Anti-Semitism (AP)
Cross-listed with Jewish Studies.
Ginsberg   3 credits

190.347 Theories of Political Authority (PT)
Beginning with Plato, and using Nietzsche's History of Metaphysics as a guide, this course analyzes the philosophical foundations of political authority. In addition to works by Plato and Nietzsche, readings will include works by Aquinas, Kant, Mill, Berlin, and MacKinnon.

This class is for juniors and seniors only, and enrollment is limited to 30.
Culbert   3 credits

190.348 Domestic Politics of Contemporary China (CP)
This course examines key issues in contemporary Chinese politics, spanning the period from the Communist Revolution (1949) through the Maoist (1949-1976) and reform eras (1978 to present). Particular emphasis will be placed on contemporary challenges, including the emergence of mass unemployment, gaps in urban-rural incomes, and alternative means of political expression.
Tsai   3 credits

190.351 Punishment and Politics: The Death Penalty in the United States (PT, LP)
Focusing on the issue of capital punishment in the United States, this course examines a number of questions related to the negotiation of law, politics, and morality in modern society: What is the purpose of punishment in our society? What is the proper role of the state in carrying out punishment? Does capital punishment differ from other kinds of punishment? If so, how? Answering these questions, the course explores topics in political theory, constitutional law, legal interpretation, and cultural studies.
Culbert   3 credits

190.354 Politics of Health Policy (AP)
Traces the evolution of the American Health care system, emphasis on the political forces that shape public and private provision of health care in the United States.
Sheingate   3 credits

190.355 Imagining Borders (IR)
What is a border? Why do borders matter? What do borders mean under conditions of globalization? An examination of borders, transborder flows, and networks within and across borders.
Marlin-Bennett   3 credits

190.365 (S) Politics in Europe (CP)
An examination of political institutions and behavior in selected European countries and in the European Union.
Katz   3 credits

190.370 Baltimore: Race and Place (AP)
This course attempts to introduce students to concrete examples of the urban problems that plague cities around the country, but it attempts to do so with respect to a particular city whose distinctive "placehood" reflects, not only its present circumstances, but two centuries of stored up experience. The course will focus on the issue of race in local policy and politics-attempts to avoid it as well as efforts to confront it. Students will be expected to write research papers that rely, at least in part, on information collected outside the library.
Crenson   3 credits

190.372/412 Political Violence (IR)
An examination of the ways in which violence has been used to secure political ends. Topics include terrorism, assassination, genocide, coups, rebellions and war itself.

Students examine what makes types of political violence unique and what unites them.
David   3 credits

190.374 Political Economy of the Information Age (IR)
The advent of the Information Age has been touted as marking a major shift in the nature of the global political economy. This course will critically analyze the politics and policies that enable and constrain the creation of an information economy and the spread of information technologies around the world. The format will be a combination of lecture and seminar.
Marlin-Bennett   3 credits

190.377 Pluralism (PT)
This seminar will explore the theory and politics of pluralism: from Ancient Greek conceptions to the American founding; from liberal political philosophy to radical democracy. Authors may include Madison, Nietzsche, Rawls, Mouffe, Young.
Chambers   3 credits

190.379 Mass Media and Politics (CP, AP)
An examination of broadcast portrayals of politics both in fiction and in journalism and the use of broadcasting by political candidates as inputs to politics, and of the nature of broadcasting systems as an output of politics.
Katz   3 credits

190.380 Law, Morality, and the State (PT, AP)
What is law? How is law related to the state? Does the state have a relationship to morality or a sense of justice? Does law? This course examines how these questions have been posed by various schools of legal thought. Readings will include texts by Austin, Hart, Dworkin, Unger, Fish, MacKinnon, and Cover.
Culbert   3 credits

190.385 Urban Politics and Policy (AP)
An analysis of public policy and policy-making for American Cities. Special attention will be given to the subject of urban crime and law enforcement, poverty and welfare, and intergovernmental relations.
Spence   3 credits

190.389 Seminar on the Institutional Development of Congress and the Presidency (AP)
An examination of the development of the modern Congress and the presidency. Emphasis will be placed on the evaluation of patterns of structure, process, and leadership and their impact on the roles of the Congress in the American political system.
Cooper   3 credits   fall

190.392 Introduction to Latin American Politics (CP)
A survey of political institutions and processes in modern Latin America.
Keck   3 credits

190.394 Understanding Congress (AP)
An examination of the structure, processes, and outcomes of collective action in Congress. Emphasis is placed on the changing character of member and institutional behavior and the changing role of Congress in the constitutional order.
Cooper   3 credits   spring

190.395 Crime and Society (AP)
Contrary to the image most Americans have of their country, the United States is a tough nation with respect to crime. The U.S. has constructed a considerably more harsh criminal justice regime than any of its advanced industrial counterparts. In recent years, America's prisons and jails have held more than one percent of the nation's adults—2.3 million people—with many more on parole, probation or temporarily free on bail awaiting trial. In Western Europe, by contrast, fewer than two-tenths of one percent of the adult populace is behind bars. This enormous discrepancy in incarceration rates is more a function of the relative severity of America's criminal laws than differences between Europe and the U.S. in the actual incidence of serious crime. And, of course, while Western European nations no longer execute convicted criminals, the U.S. remains committed to the use of capital punishment. We will explore these and related issues of crime and punishment in the U.S.
Ginsberg   3 credits

190.397 Why Human Security? (IR)
This course is a survey of the concept of human security: an emerging understanding of global security that stresses global vulnerabilities as counterpoints to traditional notions of national security.
Grovogui   3 credits

190.398 Politics of Good and Evil (PT)
An examination of good and evil through readings of Job, Genesis, Sophocles, Nietzsche, Charles Taylor and William James. A comparison of tragic, theological and secular visions of good and evil. Class presentations and 2 papers.
Connolly   3 credits

190.399 Capitalism and Christianity (PT)
Exploring the history of imbrications between capitalism and Christianity up to and through the contemporary era. What effect does each have on the other in the spheres of faith, investment, consumption and state priorities? How do they interact? Texts include the Gospels, Calvin, Max Weber, Gilles Deleuze, Catherine Keller and William Connolly.
Connolly   3 credits

190.404 Realist IR Theory (IR)
This course undertakes a critical survey of the main concepts and theories of Realism. Readings are a mixture of classic texts and recent social science.
Deudney   3 credits

190.405 Food Politics (AP, CP)
This course examines the politics of food at the local, national, and global level. Topics include the politics of agricultural subsidies, struggles over genetically modified foods, government efforts at improving food safety, and issues surrounding obesity and nutrition policy.
Sheingate   3 credits

190.406 The Executive Branch (AP)
In the 19th Century America was noted for its courts, political parties and representative institutions. Today, America's political parties and representative institutions have declined in importance while the institutions of the executive branch have increased in importance. This seminar will examine the nation's key executive institutions and aspects of executive governance in the U.S. Students will alternate primary responsibility for week's readings. Every student will prepare a 10-15 page review and critique of the books for which they are responsible in class.
Ginsberg   3 credits

190.409 Comparative Politics of Social Movements (CP)
Course examines major approaches to social movement organizations, dynamics, and significance. Case materials come from the U.S., Europe, and Third World examples. Students are expected to write a significant research paper.
Keck   3 credits

190.410 America as a Foreign Country (AP)
A consideration of domestic and foreign perspectives on American exceptionalism—the view that a special destiny is reserved to the United States by reason of its special character as a society and a political system.
3 credits   Crenson

190.411 Environment and Development in the Third World (CP, IR)
A research seminar examining the politics of environmental issues in developing countries, with special focus on Latin America.
Keck   3 credits

190.418, 423, 424, 425 (S) Leon Sachs Visiting Washington Scholars Program (AP)
This program was created in 1985 to bring members of Washington's political "think tanks" to Hopkins as visiting faculty. In 1992 it was renamed in honor of the late Leon Sachs, distinguished faculty member and alumnus of the Department of Political Science.
Staff   3 credits

190.420 Liberal IR Theory (IR)
Intensive survey of major liberal and republican international theories, including constitutionalism, federal union, interdependence, democratic peace, capitalism, international organization, regimes, transnational relations, pluralistic security communities, and civic identity.
Deudney   3 credits

190.421 Issues in International Relations (IR)
Will consider contemporary issues in international relations theory and American Foreign Policy. Students will be expected to read selected texts critically and be prepared to discuss them in class. Requirements include oral presentations, a final exam, and a research paper.
Deudney   3 credits

190.422 Republicanism (IR)
Readings in classical and contemporary texts (Polybius, Machiavelli, Montesquieu, Rousseau, Kant, the Federalist,

Calhoun, world federalism, and nuclear arms control). Focus on security, freedom, and geopolitics, both domestic and international.
Deudney   3 credits

190.434 Advanced Topics in Contemporary Chinese Politics (IR, CP)
This seminar is structured around key thematic concerns in China's domestic politics, including central-local relations, political corruption, increasing regional inequalities/tensions, the role of intellectuals, the rise of quasi-nongovernmental organizations, village elections, obstacles to state sector reform, and other contemporary issues. Prerequisites: 190.348, 190.336, or permission of instructor.
Tsai   3 credits

190.450 Power (IR)
Power is a—if not /the/—key concept of international relations, yet there is no single definition of power that is accepted by all scholars in the field. In this course we will critically examine definitions of power from classic and contemporary works of international relations, political science, and related areas of study.
Marlin-Bennett   3 credits

190.471 Senior Thesis Seminar in Political Science and International Studies
Seminar designed to familiarize majors in political science and international studies with the requirements of writing a senior thesis. Lectures, group work, and writing assignments help students formulate a topic, research the relevant literature, and write the first chapter. Participation in the seminar is required for students writing a senior honors thesis.
Staff   3 credits   fall

190.475 Courts, Politics, and Public Policy (AP)
Examines the causes of American legal change, with particular focus on the role of social movements, and whether and how legal change produces social change. Among the particular cases examined will be civil, prisoners' and women's rights.
Teles   3 credits

190.499 (S) Senior Thesis: Political Science and International Studies
Staff   6 credits   spring

190.501 Political Science Internship

190.505-506 International Studies Internship Program

190.531 Summer Independent Study for Undergraduates

Limited to Political Science students.

190.535-536 Independent Study for Freshmen

190.537-538 Independent Study for Sophomores

190.539-540 Independent Study for Juniors

190.541-542 Independent Study for Seniors

Graduate Courses

190.602 Introduction to Quantitative Political Science
An introduction to measurement and data analysis in contemporary American political science. Measurement topics will include the formation of indices and cumulative scales. Analytic topics will include sampling variations, statistical association and causation, as manifested in contingency tables, and correlation and regression. Emphasis will be on fundamental concepts and assumptions, and on comprehension and evaluation of the scholarly literature. No mathematical prerequisites. Open to undergraduates with permission of instructor.
Katz   2 hours

190.603 Political Data Analysis
An intermediate course in the analysis of quantitative political data, including such topics as multiple regression, factor analysis, multidimensional scaling, and log linear models. Emphasis will be on the practical application and interpretation of these methods in political research. As part of the course requirements, students will be expected to complete a small scale computer data analysis; arrangements to secure data for this project should be made in advance. Recommended for students intending to use quantitative methods in their dissertations. Prerequisite: 190.602 or equivalent.
Katz   2 hours

190.605 Understanding the Supreme Court
Focuses on the institutional role and decision making of the United States Supreme Court as an institution.
Grossman   2 hours

190.608 Comparative Political Economy
Course discusses the interaction of capitalism and democracy. It focuses on rational, institutional, and historical models of political economy across a wide variety of different subject areas.
Blyth   2 hours

190.609 Comparative Constitutional Law
Seminar focusing on the constitutions and constitutional law of selected countries.
Grossman   2 hours

190.611 The Constitution and the International System
Analysis of interaction between the U.S. Constitution and international threats, crises, and institutions. Topics include presidential, congressional, and judicial roles, sovereignty, international law and organizations, the ICC, laws of war, torture, and surveillance.
Deudney/Grossman   3 hours

190.613 Politics of Materialism
Study of philosophies of matter and their implications for politics. How do natural forces, technological objects, biological bodies, or "inorganic matter" affect public life? Readings from Spinoza, Diderot, Marx, Bergson, Driesch, Bakhtin and recent writers in the "New Materialism."
Bennett

190.614 Seminar: Constitutional Theory
An exploration of theories about how the U.S Constitution has been (or ought to be) interpreted.
Grossman   2 hours

190.616 American Political Development
A study of American political institutions, and the "new institutionalism," from a macrohistorical perspective, with a special emphasis on critical periods or events such as the Founding, the rise of political parties, the Progressive era, and the New Deal and the Welfare State.
Sheingate   2 hours

190.618 Nationalism
Despite the clamor over globalization and regionalization in the contemporary world, nationalism remains a central preoccupation for both political actors and students of politics. Though motivated by questions resonant within the discipline of political science (and the field of comparative politics in particular), this course is designed to familiarize students with key texts and debates in the literatures on nationalism in political science, sociology, history, and anthropology.
Hanchard   2 hours

190.620 Women in Dark Times
A survey of female voices—feminist and non-feminist—in political theory. What constitutes political action? What is the relationship of bodies to politics? How is power defined and distributed? Authors include Hannah Arendt, Simone de Beauvoir, Judith Butler, Elizabeth Grosz, Rosa Luxemberg, Saba Mahmood, Catherine McKinnon, Carol Pateman, Patricia Williams, and other contemporary theorists.
Bennett and Culbert

190.624 Poesis Like Politics
This course explores three thinkers-Plato, Heidegger, and Whitman-who imagine politics as a creative act or artistic composition.
Bennett

190.625 Theories of Comparative Politics
This seminar considers the theoretical problems and methods of comparing political processes in different contexts. The implications of various approaches (e.g., functional, macroanalytic, politico-cultural, psychological) will be explored.
Staff   2 hours

190.626 Core Readings on the President and Congress
Seminar will focus on core readings in American politics with emphasis on the president and Congress.
Cooper   2 hours   fall

190.632 The Development of American Political Institutions
This seminar examines the historical development of American political institutions since the Civil War. Particular attention is paid to development and change in political parties, Congress, and the Presidency.
Sheingate and Cooper   2 hours

190.633 Political Violence
What constitutes violence? By what modes of agency is violence expressed? What is the relationship between violence and bodies, violence and representation, violence and social and psychic structures? This course explores different figures of violence and their relationship to politics in the works of Machiavelli, Nietzsche, Fanon, and Adorno.
Bennett and Culbert

190.635 The Institutes and Conventions of Human Rights
A graduate introduction to the origins and evolution of human rights discourses. It aspires to offer a functional knowledge of the foundations and assumptions of contemporary debates over the meanings, implications, and applications of human rights in different regional, socio-political, cultural, and economic contexts.
Grovogui   2 hours

190.645 Immigration, Difference and Citizenship
Hanchard and Chung   2 hours

190.655 Capitalism and Christianity
An exploration of ways in which capitalism and Christianity inform each other, historically and today. Texts will include: The Gospels, Calvin, Locke, Weber, Hirschman, Tawney, Goodchild, and Ralph Reed.
Connolly

190.658 The Political Aesthetics of Thoreau and Whitman
Examination of the works of Henry Thoreau and Walt Whitman, with a focus on the relationship between political, literary, and aesthetic practice.
Bennett

190.649 Sovereignty (1492–1600)
An exploration of the significations, ambiguities, and policy implications of the concept of sovereignty and to examine the applications of sovereignty and sovereign rights in the contexts of relations between "Europe" and other regions of the world during the earlier phase of modern European expansion, conquest, and colonization of other regions of the world.
Grovogui   2 hours

190.650 Reframing Globalization (1945 to present)
This course discusses select dimensions and issues of globalization and related debates: the rising force of transnational corporations in international politics, as well as growing concerns over human rights, the environment, migration, and pandemic diseases. It also explores the relationships between ideology, identity, and interest in the political action and ethics of the various agents and actors of global politics.
Grovogui   2 hours

190.660 State, Empire, and Society (1600–1850)
This second section of the general seminar, Ordering the Universe, explores the effects of conflicts resulting from the Reformation (c.1320–1648), the Counter-Reformation and Inquisition (1480–1834) and the Thirty Years' War (1619–1648) on European conceptions of politics, state, and international relations. A special emphasis is placed on subsequent conventions on the advisability of the use of force in human affairs, with special attention to regional dynamics, the rise of European commercial empires, and the advent of discourses of international law and society.
Grovogui   2 hours

190.663 Rationality and Public Choice
A seminar dealing with three aspects of the problem of rationality in politics. The first topic will be the definition of political rationality. Second will be analysis of some of the theories of politics based on the assumption of rationality. Finally, attention will be directed to some of the empirical research asking whether people are, in fact, rational in politics.
Katz   2 hours

190.664 Neitzsche and his Interlocutors
Texts on Being and becoming by Nietzsche and texts interpreting his most distinctive themes by Heidegger, Deleuze, Strauss, and Jaspers.
Bennett and Connolly

190.666 Political Economy of Development
A seminar that starts with post-war classics in the development literature, including modernization theory and its critics, and the political economy of international finance. The second part examines contemporary debates concerning the role of the state in the development process. The last third turns to developmental concerns at the subnational level, including fiscal decentralization, collective action problems, and the informal sector.
Tsai, Chung   2 hours

190.667 Nations, Imperialism, and Decolonization (1850–1945)
Structured around the historical advent of imperialism and decolonization, this course places special emphasis on the historical contingency of national identity and the connections between particular forms of national identity and imperialism. It also examines the political alienation of colonial peoples from European political forms leading to decolonization. Theoretical perspectives include liberal/modernist, postmodernist, postcolonial, etc.
Grovogui   2 hours

190.670 States, Regimes, and Governmentality
Hanchard   2 hours

190.673 Seminar on Institutional Analysis
This seminar focuses on the major variants of institutional analysis in the political science literature. Agency approaches are distinguished from structural approaches and the premises, claims, and problems of leading examples of each are examined. Emphasis is placed on the manner and success of these various forms of "new institutionalism" in explaining the processes and politics of democratic regimes.
Cooper   2 hours

190.683-684 Research Seminar on Political Parties

Two-semester seminar aimed at the production of a publishable-quality piece of research on political parties. First semester will focus primarily on the literature on political parties and the second will include the place of parties in political theory, the nature of party systems, party organization, and party behavior in both the United States and other countries.

Katz   2 hours

190.692 Politics of Perception

An exploratory seminar juxtaposing classic philosophies of perception to theories of film and electronic media, and both to the structures of "disciplinary society". Bergson, Merleau-Ponty, Foucault, McLuhan, Virilio, and Deleuze.

Connolly

190.693 Sophocles and Kant

What can the Greek tragic tradition teach the Enlightenment and the Enlightenment the tragic tradtion? Texts by Sophocles and Kant will provide focal points, with and responses to each provided by Knox, Nietzsche, Jaspers, B Williams, and others.

Connolly

190.800 Independent Study

190.849 Dissertation Research

Psychological and Brain Sciences

Psychological and Brain Sciences are concerned with understanding the biological and psychological processes underlying animal and human behavior, and with the effects of environmental influences on behavior at all stages of development.

The undergraduate program leading to the baccalaureate degree is intended to provide students with a sound background in psychological and brain sciences and, at the same time, to prepare them for advanced study.

The program for doctoral students in psychological and brain sciences is scientifically oriented and emphasizes research methodology. The broad aims of the graduate program are to train students to become scientists rather than practitioners, and to provide them with the knowledge and skills they need to help solve the problems of contemporary society.

The Faculty

Gregory F. Ball, Professor: biopsychology, behavioral neuroendocrinology, neuroethology.

Susan Courtney, Professor: cognitive neuroscience, working memory, attention, and functional neuroimaging.

Howard Egeth, Professor: perception, memory, cognition, psychology and law.

Lisa Feigenson, Associate Professor: cognitive development, numerical cognition.

Jonathan Flombaum, Assistant Professor: visual perception, attention and coginition.

Eric Fortune, Associate Professor: neural mechanisms of behavior, sensory processing, neuroethology.

Michela Gallagher, Professor: learning and memory, neurobiology of aging.

Justin Halberda, Associate Professor: cognitive development, reasoning, language acquisition.

Peter Holland, Professor: learning, memory, motivation, behavioral ecology.

Amy Shelton, Associate Professor: cognitive neuroscience, spatial cognition, learning, memory, and development.

Veit Stuphorn, Assistant Professor: neurophysiological studies of decision making.

Steven Yantis, Professor (Chair): visual perception, attention, and functional neuroimaging.

Michael Yassa, Assistant Professor: cognitive neuroscience, long-term memory, aging and dementia.

Associate Faculty

Richard Allen, Associate Professor: (Neurology); School of Medicine.

Stephen Drigotas, Teaching Professor and Undergraduate Advisor: social psychology.

David H. Edwin, Associate Professor (Medical Psychology; School of Medicine): clinical and medical psychology.

Linda Gorman, Teaching Professor: Neuroscience.

Jennifer Haythornthwaite, Professor (Psychiatry and Behavioral Sciences; School of Medicine): behavioral medicine.

Paul J. Hofer, Adjunct Associate Professor (U.S. Sentencing Commission, Washington, D.C.): law and psychology.

Chris Kraft, Psychologist and Instructor, Psychiatry and Behavioral Sciences (Johns Hopkins Center for Marital and Sexual Health).

Michele Mazzocco, Professor: Psychiatry and Behavioral Sciences (Kennedy Krieger Institute): developmental learning disabilities.

Jennifer Neemann, Senior Lecturer: clinical psychology and clinical psychology advisor.

Aaron R. Noonberg, Adjunct Assistant Professor (Clinical Practice): forensic psychology, neuropsychology, and behavioral medicine.

Herbert Petri, Adjunct Professor (Department of Psychology, Towson University): motivational processes, neuropsychology of memory.

Lawrence Raifman, Adjunct Assistant Professor (Private Practice and Director of Forensic Services, Springfield Hospital Center): clinical applications of psychology and the law, behavioral finance.

Heather Roberts-Fox, Lecturer: industrial/organizational psychology.

Joint Faculty

Marilyn Albert, Professor and Director at Division of Cognitive Neuroscience; School of Medicine: aging, cognition, memory.

Charles Connor, Professor and Director of the Mind/Brain Institute: neurophysiology of visual perception and object recognition.

Stewart Hendry, Professor (Mind/Brain Institute): primate functional neuroanatomy.

Steven Hsiao, Professor (Mind/Brain Institute): neurophysiology of tactile shape and texture perception.

Alfredo Kirkwood, Associate Professor (Mind/Brain Institute): mechanisms of cortical modification.

Barbara Landau, Dick and Lydia Todd Faculty Development Professor and Chair (Cognitive Science): language acquisition, cognitive

development, spatial representation, acquisition of the lexicon.

Michael E. McCloskey, Professor (Cognitive Science): language, memory, cognitive processes.

Guy McKhann, Professor (Mind/Brain Institute): neurological and cognitive outcomes after coronary artery bypass surgery.

Ernst Niebur, Associate Professor (Mind/Brain Institute): computational neuroscience.

Brenda Rapp, Professor (Cognitive Science): cognitive neuropsychology, attention, reading and writing.

Peter R. Rapp, Senior Investigative Chief (National Institute on Aging, Bayview).

Rudiger Von Der Heydt, Professor (Mind/Brain Institute): perceptual organization in visual cortex.

Emeritus Appointments

Bert F. Green Jr., Professor Emeritus: psychological measurement, quantitative methods, and computer methods.

Facilities

The department's offices and laboratories contain dozens of microcomputers (PCs and Macintoshes) and UNIX workstations used for experimental control and for computational studies, simulation, data analysis, and manuscript preparation.

The F. M. Kirby Research Center for Functional Brain Imaging houses 3.0T and 7.0T Philips research-directed MRI scanners for fMRI studies of human perception, memory, and cognition.

The cognitive psychology and cognitive neuroscience laboratories contain a wide range of computer equipment and special-purpose research equipment, including image-processing and large-format graphics systems, eye-movement monitors, speech recognition and analysis systems, stereoscopic graphic systems, video equipment, and other stimulus-presentation and response-collection devices.

The biopsychology laboratories have all the facilities necessary to conduct modern behavioral neuroscience research, including equipment for behavioral and operant testing, electrophysiology, histology, surgery, neurochemistry, and systems for the analysis and synthesis of audio signals.

Undergraduate Programs

The courses in psychological and brain sciences have four purposes: (1) to acquaint all interested students with a sampling of topics through a variety of introductory and advanced courses; (2) to prepare majors for graduate work in psychology and related disciplines through a program that meets the admission requirements of the outstanding graduate departments in the United States; (3) to offer a distribution of courses for a minor concentration in psychology as well as several fields of concentration for area majors in the social and behavioral sciences; and (4) to provide an honors track designed for exceptional students who want training beyond that provided by the standard undergraduate curriculum.

I. Required Courses Outside the Department:

Calculus (110.106 or 110.108)

or

Linear Algebra (110.201)

Note: Intro to Calculus (110.105) may not be used for this requirement.

Statistical Analysis I (550.111)

Statistical Analysis II (550.112

Note: These courses should be taken as early as possible as they are prerequisites for many psychology courses.

II. Required Courses Within the Department:

Laboratory in the Analysis of Psychological Data 200.207 (fall)

Three introductory-level psychology courses from the following:

200.101 Introduction to Psychology
200.132 Introduction to Developmental Psychology
200.133 Introduction to Social Psychology
200.141 Introduction to Physiological Psychology
200.110 Introduction to Cognitive Psychology
or 050.101 Cognition

Five upper-level psychology courses required:

- 200-level and above, with a minimum of three courses at the 300-level or higher. *Note:* One upper-level course in Cognitive Science may be used to satisfy these course credits with the approval of the director of undergraduate studies. Laboratory in the Analysis of Psychological Data, research, independent study, and internships may not be used to satisfy these course requirements.

Small Group or Individual Experience:

- Three credits of Research, Internship, Independent Study, or a designated seminar course (with an enrollment of 20 students). Courses used to fulfill the five upper-level course requirements may not be used to satisfy this requirement. Students may take 1-3 credits in any given semes-

ter to fulfill this requirement. All students are required to discuss their plans with their faculty advisor before junior clearance.

Distribution Requirements

- 12 additional credits of N, Q, and/or E. (You may use Statistics I and II/Linear Algebra to fulfill this requirement.)
- 18 additional credits of H,N,Q, and/or E

Note: Students who are planning advanced study in psychological and brain sciences are strongly encouraged to engage in psychological research and/or clinical internships.

Restrictions
No courses taken during Intersession or through the School of Eduction and the Carey Business School may be counted toward the requirements for the B.A. degree in Psychological and Brain Sciences (although a limited number of such courses may be counted toward the 120 credits required for graduation). Courses in the Summer at Hopkins daytime program do count toward the requirements for the B.A. in Psychological and Brain Sciences.

Preparation for Graduate Work in Psychology
The Department of Psychological and Brain Sciences provides preparation for graduate training in all areas of psychology, including clinical and counseling. Virtually all psychology graduate programs, including those that provide training in clinical or counseling psychology, expect students to have a strong background in scientific psychology, including statistics. The department encourages students to obtain additional practical experiences outside the classroom, including research in a laboratory and/or an internship in a mental health care setting. These additional experiences are particularly salient to graduate school admission committees.

Honors Program in Psychology
The B.A. degree with honors provides recognition for outstanding achievement in formal course work and research. The requirements for a degree with honors include those for the regular B.A. degree, plus the following:

- A minimum grade point average of 3.5 in psychology courses (exclusive of independent study or research) through the fall semester of the student's junior year.
- A formal application to be submitted to the director of undergraduate studies by March 31 of the student's junior year. The application must include a copy of the student's transcript, a brief

description of the proposed honors research project, and written endorsement of the application by the student's faculty sponsor. The sponsor must have a full-time faculty appointment at Johns Hopkins and either a primary or a joint appointment in the Department of Psychological and Brain Sciences. Admission into the Honors Program is not guaranteed.

- Completion of two 300- or 600-level psychology courses, in addition to those required for the regular B.A. degree. Neither of these can be research or reading courses. These additional courses are not in addition to the 120 credits required for graduation.
- Completion of an independent research project under the supervision of a member of the department's faculty, culminating in a written honors thesis. The student will enroll in 200.519-520 Senior Honors Research during both semesters of the senior year. The honors thesis must be submitted no later than March 31 of the senior year and must be read and approved in writing by two members of the faculty.
- Students considering application to the honors program should begin discussing possible thesis research topics with a faculty sponsor no later than the fall semester of their junior year.

Minor in Psychology
A minor in psychology is available to undergraduates majoring in any department. Students electing to minor in psychology should declare their intention directly to the director of undergraduate studies in the Department of Psychological and Brain Sciences by the end of junior year. The minor requires successful completion of the following:

Three introductory-level psychology courses from the following:

200.101 Introduction to Psychology

200.110 Introduction to Cognitive Psychology or 050.101 Cognition

200.132 Introduction to Developmental Psychology

200.133 Introduction to Social Psychology

200.141 Introduction to Physiological Psychology

Three additional psychology courses, including at least two at the 300- or 600-level.

One additional psychology course at any level.

No more than one research or readings course may count toward the minor. No course from the Carey Business School or School of Education may count toward the minor.

Undergraduate Academic Awards

The Department of Psychological and Brain Sciences offers two undergraduate academic awards. The G. Stanley Hall Prize is awarded for outstanding achievement by an undergraduate in psychology. The Julian C. Stanley Award is given to the psychology major who most closely approximates Dr. Stanley's personal and professional standards of excellence.

Graduate Programs

Master of Arts in Psychology

A student who has been admitted into the Ph.D. program can earn a master of arts degree in partial fulfillment of the requirements for the Ph.D. degree. Normally, candidates for the Ph.D. degree in psychology will qualify for the M.A. degree at the end of their second year, after having completed two area seminars and at least two courses in psychological research design and/or advanced statistics, provided that their performance is of the quality judged satisfactory for the M.A. level. There is no terminal master's program.

Requirements for the Ph.D. Degree

The Department of Psychological and Brain Sciences emphasizes training and experience in the research methods essential to the development of new knowledge in the various fields of psychology. The core program for training doctoral students emphasizes scientific methodology and provides training in both pure research and research related to problems in the everyday world, with emphasis on the ways in which basic research methodology can be adapted to the study of applied problems. Each doctoral candidate is expected to become familiar with both a relatively narrowly defined area and a broad spectrum of knowledge related to the student's topic of specialization.

In addition to general university requirements, the Department of Psychological and Brain Sciences has the following regulations:

Statistics

Most students will take 200.314 Advanced Statistical Methods during the first semester and 200.315 Advanced Research Design and Analysis during the second semester. Students with exceptional statistical training should take two more advanced courses by arrangement with the director of graduate studies.

Proseminars

Proseminars involve more discussion and reading assignments than other graduate seminars. Each student is required to successfully complete both 200.650 Proseminar: Biopsychology and 200.652 Proseminar: Cognitive Psychology. Students are expected to take these proseminars when they are offered, once every other year, alternately.

First-Year Research Report

During the first year, the student, together with the faculty advisor, chooses a research project that will provide extended research experience. Normally, the student designs a study as a larger ongoing project. A project proposal must be submitted by April 15 of the first year; this presents the nature of the problem, reviews the relevant literature, and describes the study in detail, together with the anticipated data, means of analysis, and interpretations. A final report must be submitted by December 15 of the second year; this includes all the information appropriate for published work.

Advanced Examination

Each student must pass an in-depth examination in his/her chosen area. This examination which includes both a written and oral part, is graded by a committee of at least two faculty members. The student must pass the advanced examination by the beginning of the third year.

Advanced Study

Each student with a faculty advisor plans a course of study consisting of intermediate and advanced topical and research seminars.

- **Topical Seminars**

  One or more faculty members lead seminars on topics of special interest, such as cognitive processes, developmental psycholinguistics, neurophysiological aspects of behavior, mathematical psychology, and information processing. Through these seminars a student gets intensive knowledge in particular specialties. Topics vary from semester to semester and are determined by the interests of both faculty and graduate students.

- **Research Seminars**

  Students and faculty engaged or interested in research in particular areas organize these seminars. Participants discuss their own research and other current research in the area.

Teaching Requirement

Teaching requirements are fulfilled by graduate students serving as teaching assistants to members of the department's faculty, in courses taught in the

School of Arts and Sciences. All graduate students are expected to TA a total of four semesters, as follows: second semester–first year students; first and second semester–second year students; first semester–third year students. A committee composed of graduate student representatives participates each semester in the selection of teaching assignments.

Advanced students may apply for a Dean's Teaching Fellowship. A course is proposed by the student and is sponsored by a faculty member. These are highly competitive and prestigious awards. For details please visit **http://krieger.jhu.edu/announcement/deans-teaching-fellowship**.

Literature Review

The literature review should be modeled on articles appearing in professional journals. Ordinarily the review provides a background for the thesis plan, but it may be prepared on a topic other than the one selected for the thesis. It is a separate document and is evaluated by the same committee that evaluates the thesis plan.

Thesis Plan

By the end of the third year or at least one calendar year before receiving the Ph.D. degree, each doctoral candidate must develop a plan for the dissertation research and present the plan before a departmental committee. With the committee's approval, the student then prepares a dissertation.

Dissertation

The dissertation represents the student's finest piece of scholarly work. It establishes the pattern for a research career and the basis for postgraduate employment. The Graduate Board of the University administers the final oral examination, a defense of the thesis. The doctoral dissertation must be in a form suitable for and worthy of publication.

Financial Aid

Financial support packages are available to all doctoral students, with 9-month stipends that are competitive with those of other universities. Financial support includes tuition remission. Summer research assistantships are available in the department.

For further information on graduate study in psychology, contact Academic Program Coordinator, Laura Dalrymple, Department of Psychological and Brain Sciences, 410-516-6175.

Undergraduate Courses

200.101 (S,N) Introduction to Psychology
This course surveys all the major areas of scientific psychology, including the physiological bases of behavior; sensation and perception; learning, memory, and cognition; developmental, social, and personality psychology; and psychopathology.
Drigotas, Holland   3 credits

200.110 (S,N) Introduction to Cognitive Psychology
Introductory survey of current research and theory on topics in cognitive psychology. The course will cover a range of topics in perception, attention, learning, reasoning, and memory, emphasizing relationships among mind, brain ,and behavior.
Stark   3 credits

200.132 (S) Introduction to Developmental Psychology
An introductory survey of human development from the prenatal period through adolescence. The developing child is examined in terms of cognitive, social, emotional, motor, and language development.
Staff   3 credits

200.133 (S) Introduction to Social Psychology
An introductory survey of social psychology. Topics include social perception, social cognition, attitudes, prejudice, attraction, social influence, altruism, aggression, and group behavior.
Drigotas   3 credits

200.141 (S,N) Introduction to Physiological Psychology
A survey of neuropsychology relating the organization of behavior to the integrative action of the nervous system.
Gorman   3 credits

200.159 Freshman Seminar: Evolutionary Psychology
In this course we discuss the principles of evolutionary psychology, which is the idea that the mind can be understood as an adaptation to our ancestral environment by means of natural selection.
Egeth   3 credit

200.207 (S,Q,W) Laboratory in Analysis of Psychological Data
Laboratory in the fundamental methods of data collection and analysis in experimental and differential psychology. Pre- or corequisite: 550.112 Statistical Analysis.
Egeth   3 credits

200.208 (S,N) Animal Behavior
This introductory course examines the basic principles of animal behavior. Topics include orientation, migration, communication, reproduction, parent-offspring relations, ontogeny of behavior, and social organization. The evolution and adaptive significance of behavior will be emphasized.
Ball, Holland   3 credits

200.211 (S,N) Sensation and Perception
This is an introductory course surveying present knowledge about how our sensory and perceptual systems function to enable us to see, hear, taste, smell, and feel. The course will use a lecture and demonstration format.
Yantis   3 credits

200.212 (S) Abnormal Psychology
A survey of the major syndromes of psychological disorders. Research and theory about the mechanisms, development, and diagnosis of psychopathology are emphasized.
Noonberg   3 credits

Intermediate Courses

Intermediate courses are open to all students who have satisfied the stated prerequisites or who have the permission of the instructor. Many of them are conducted as seminars, and all encourage informal discussion and independent work.

200.204 (S) Human Sexuality
This course will focus on the biological, psychological, and social dimensions of human sexuality including sexual relationships, sexual functioning, gender, sexual orientation, the commercial sex industry, and HIV/STD issues.
Kraft   3 credits

200.214 (S,N) Brain Myths and Folk Psychology
This course examines popular facts about the brain and cognition, exploring the origins, how they are perpetuated in the media, and the empirical data that support or refute the claims.
Shelton   3 credits

200.301 (S,H) The History of Psychology
A survey of leading figures, schools, and systems in the history of psychology. The course will emphasize the development of experimental psychology in late 19th-century Germany and its establishment in America at Johns Hopkins, Harvard, Chicago, and Columbia. Special topics will include the development of clinical and applied psychology and psychological testing.
Hofer   3 credits

200.303 Introduction to Learning Disabilities
This course will focus on theories and research relevant to the study of learning disabilities (LD), as contrasted with studies of acquired disorders. The premise of this course is that LD is biologically based rather than a result of instructional deprivation or other societal factors. We will discuss the historical context through which the construct of a "learning disability" emerged, and explore contributions to the study of LD from diverse fields (medicine, cognitive psychology, developmental psychology, and educational psychology). We will consider LD in general, and reading, writing, and mathematics disabilities specifically. Note that this is not a course on how to diagnose or remediate learning disability, although these topics will be discussed in the context of relevant research.
Mazzocco   3 credits

200.306 Psychology in the Workplace
Industrial-organizational (I-O) psychology is the scientific study of the workplace. Rigor and methods of psychology are applied to issues of critical relevance to business, including talent management, coaching, assessment, selection, training, organizational development, performance, and work-life balance.
Fox   3 credits

200.307 Introduction to Clinical Psychology
This course is a survey of the field of clinical psychology. Accordingly, the primary objectives of the course are: (1) to familiarize students with the history of clinical psychology as a field, including the roles in which clinical psychologists serve and settings in which they work, as well as "hot topics" of current debate in the field; (2) to orient students to the range of theoretical orientations which guide how clinical psychologists approach their work, including assessment, prevention/intervention, and research; (3) to highlight controversies in assessment and treatment as well as emphasize critical thinking in clinical psychology; and (4) to clarify students' interests and goals within the mental health field, generally, and clinical psychology, in particular, including client populations and research questions of interest to individual students.
Neemann   3 credits

200.308 (S,N) Neurobiology of Learning and Memory
This course is an advanced survey of the scientific study of learning and memory. An interdisciplinary approach is used to integrate the state of the field across levels from the cellular-molecular basis of synaptic plasticity to functional circuitry implicated in learning to memory systems in the brain. The course is designed to provide a deep understanding of the outstanding issues and current debates in learning and memory research with a specific emphasis on animal models. This is an interactive lecture/seminar course with active student participation.
Yassa   3 credits

200.309 (S) Evolutionary Mechanisms of Human Behavior
This course examines the evolution of human adaptive behaviors. In particular it examines evolutionary contributions to behaviors concerned with problems of survival, such as mating strategies, parenting, and group living.
Petri   3 credits

200.312 (S,N) Imaging the Human Mind
Survey of neuroimaging research contributing to understanding abilities that may be uniquely human (language, reasoning, emotion). Physical, physiological, theoretical bases of methods, applications in normal adults, development, aging, psychiatric/neurological disorders.
Courtney   3 credits

200.314 (S,Q) Advanced Statistical Methods
Topics in applied probability and statistical inference; analysis of variance; experimental design. Prerequisite: one statistics course. Intended for graduate students in psychology.
Yantis   3 credits   fall

200.315 (Q,S) Advanced Research Design and Analysis
Advanced topics in the analysis of data from psychological research, including design of multi-way experiments and complex analysis of variance. Prerequisite: 200.314 or equivalent.
Shelton   3 credits

200.317 Interpersonal Relationships
This course will investigate interpersonal processes ranging from attraction and courtship to relationship functioning and distress. Prerequisite: 200.133. Open to Psychology and Behavioral Biology majors only.
Drigotas   3 credits

200.325 (S) Law and Psychology: Clinical Applications
An introduction to the legal standards governing criminal forensic psychology assessments, e.g., competence to stand trial, criminal responsibility, mitigation of death penalty, negation of *mens rea*, and other criminal law forensic applications.
Raifman   3 credits

200.326 (S) Law, Psychology, and Public Policy
An introduction to applications of psychological research in policy analysis. Special emphasis is given to the use and misuse of psychology in Supreme Court advocacy and decision making in the areas of children's rights, adult sexuality, and educational and employment opportunity. In addition, research into the trial process and jury decision making is reviewed, with the aim of identifying possible reforms to improve the truth-seeking function of the courts. Prerequisite: permission of instructor.
Hofer   3 credits

200.327 Personality and its Measurements
This course is an intensive writing advanced psychology seminar that will address personality organization as constructed traits, dispositions, and situation by trait interactions. Idiographic vs. nomothetic issues will be addressed, as will be approaches to test construction including empirical versus dynamic test construction, the problems with response sets, and the benefits of sophisticated construct validation procedure. Major tests and strategies including, but not limited to, "the big five" and its controversies as well as the MMPI, MCMI, and PAI will all be addressed in terms of test construction and interpretation.
Neemann   3 credits

200.328 (S,W) Theory and Methods in Clinical Psychology
A critical examination of the methods of observation, description, reasoning, and inference that underlie the clinical practice of psychology and psychiatry. Prerequisite: 200.131. Senior psych majors only.
Edwin   3 credits

200.329 (S,N,W) Brain, Communication, and Evolution
This course investigates neural, hormonal, and evolutionary influences on communication between animals and considers these in the context of communication between people.
Ball   3 credits

200.333 (S) Advanced Readings in Social Psychology
This seminar is designed as an advanced course in social psychology. Students read and discuss primary articles in social psychology regarding topics such as aggression, social cognition, helping, attitudes, relationships, and intergroup behavior. The course is designed for upper-level psychology majors. Prerequisite: 200.133.
Drigotas   3 credits

200.336 (S) Foundations of Mind
An interdisciplinary investigation into the origins of human knowledge. For case studies including depth perception, number, morality, explores evidence from developmental psychology, cognitive neuroscience, philosophy, animal cognition and behavior. Data collection in weekly section meeting.
Feigenson, Halberda   3 credits

200.343 (S,N) Motivation
Current biological, behavioral, and cognitive research and theory concerning the motivation of behavior are examined. Both human and non-human animal research is reviewed. Topics include the role of genetics, arousal, biological regulatory systems, incentives, expectancies, attributions, social processes, and self-actualization in the generation of behavior.
Petri   3 credits

200.344 (S,N) Behavioral Endocrinology
An examination of the effects of hormones on behavior in non-human and human animals. Topics will include the effects of hormones on sexual differentiation, reproductive behavior, parental behavior, homeostasis and biological rhythms, regulation of body weight, learning and memory.
Ball   3 credits

200.355 (S) Psychology of Decision Making: Behavioral Finance
This course will apply insights from cognitive psychology decision-making research to the stock market. Beginning in the 1970s, finance decisions were guided by belief in the efficient markets theory, which assumes that the stock market correctly prices stocks, benefiting from the wisdom of aggregate marketplace by incorporating all (publicly available) information. Behavioral finance, drawing from research results in cognitive psychology, has offered an analysis of marketplace anomalies to suggest that human heuristics (mental shortcuts people take when making decisions) are crucial in explaining stock market behavior. The course investigates whether investors can beat the market benchmarks by exploiting marketplace investor sentiment?
Raifman   3 credits

200.368 Sleep, Dreams, and Altered States of Consciousness
Sleep, dreaming, and arousal to waking represent three very different states of consciousness which differ dramatically both psychologically and physiologically. This course focuses on cognitive, psychological, physiological, and biological aspects characterizing each of these states and other selected altered states (e.g., states related

to drugs, dissociation, anxiety, and meditation). Actual physiological recordings of sleep states will be reviewed, and the student will learn to how to evaluate these. The circadian rhythms, ontogeny, and evolution of these sleep-wake states will also be covered. Understanding of these states will be used to develop some of the scientific concepts of human self-awareness or consciousness.
Allen   3 credits

200.370 (S,N) Functional Human Neuroanatomy
Lecture/computer course examines the structure and basic organizational principles underlying the function of human and other mammalian nervous systems. Students acquire an understanding of central and peripheral nervous systems. Prerequisite: 200.141.
Courtney   3 credits

200.376 (S,N) Psychopharmacology
Designed to provide information about how drugs affect the brain and behavior. The course focuses on the interaction of various classes of drugs with the individual neurotransmitter systems in the brain. A brief historic review is followed by a discussion of clinical relevance.
Gorman   3 credits

200.386 Animal Cognition
We will examine relations between brain, mind, and behavior in nonhuman animals, focusing on topics such as learning, memory, attention, decision making, navigation, communication, and awareness. We will take a variety of approaches, including behavioral, computational, evolutionary, neurobiological, and psychological perspectives. Although mostly we will be considering birds and mammals, the occasional insect or person will creep in. Suggested prerequisite: a course in animal behavior, cognitive psychology, or systems neuroscience.
Holland   3 credits

200.387 The Social Brain/The Visual Brain
We tend to feel that we are thinking the hardest in social situations. In contrast, we barely feel the complicated processing that produces our vivid and salient visual experiences; in fact, we cannot even access most of this processing directly. This course will explore the relationship between visual perception and social cognition, especially the ways that the visual system supplies crucial raw materials for more elaborate social processing, and the ways that our social agendas may, in turn, influence vision. Topics will include what we find physically attractive in mates (and why); the quick formation of social impressions; the neural, cognitive, and evolutionary basis of aesthetic perception; and the extent to which perception might be socially constructed (i.e. whether vision can be influenced from the 'top-down'). All readings will come from primary scientific literature, and students should have some experience reading this kind of material. Limited to Juniors, Seniors, and graduate students.
Flombaum   3 credits

200.501-502 Freshman Psychological Research
S/U grading only.

200.503-504 Sophomore Psychological Research
The student chooses some research problem with the advice and approval of a faculty member.
Staff

200.505-506 Freshman Psychological Readings

200.507-508 Sophomore Psychological Readings
With approval of a faculty member, a student may make arrangements to undertake a program of independent reading on topics not covered in courses.
Staff

200.510 Psychological Internship
Students work in a mental health care delivery or educational institution under the sponsorship of a full-time faculty member.
Staff

200.511-512 Junior Psychological Research

200.513-514 Senior Psychological Research
The student chooses some research problem with the advice and approval of a faculty member.
Staff

200.515-516 Junior Psychological Readings

200.517-518 Senior Psychological Readings
With approval of a faculty member, a student may make arrangements to undertake a program of independent reading on topics not covered in courses.
Staff

200.519-520 Senior Honors Research
Seniors working on the honors thesis enroll with the approval of the undergraduate coordinator.
Staff

200.536 Independent Research, Summer
Credits are assigned at the discretion of the instructor.
Staff

200.537 Psychological Internship, Summer
Staff

Graduate Courses

Psychology Colloquium
Reports of research by advanced students and invited speakers. These meetings do not carry course credit, but all graduate students are expected to attend.

Proseminars
A general review of the science of psychology is supplied through two required seminars (200.650, 200.652) covering current areas of research in the department. These seminars provide graduate students with a background in the methods, findings, and issues presently being explored.

200.650 Proseminar: Biopsychology
This seminar will discuss the organization of behavior as it is related to the integrative action of the nervous system, ranging in topics from single nerve cells to adaptive behavior as exhibited by the entire organism. An intensive analysis of the topics covered will be placed in the context of a broad perspective emphasizing the functional relevance of the systems under consideration.
Ball, Courtney, Fortune, Gallagher, Holland, Stuphorn, Yassa   2 hours

200.652 Proseminar: Cognitive Psychology
A survey of classical and modern theory and research in the areas of sensation, perception, human performance, memory, and cognition.
Courtney, Egeth, Feigenson, Flombaum, Halberda, Shelton, Yantis, Yassa   2 hours

Topical Seminars
Topical seminars are open to all graduate students with permission of the instructor. Several seminars are offered each term, and in each case some specialized topic from the more general field is selected for study, depending on the interests of the students and faculty. The same seminar may be offered each year with different topics.

200.601 Information Processing
Special topics in perception, memory, and thinking.
Egeth   2 hours

200.609 Vision and Brain
This seminar will study the brain mechanisms of vision as revealed by neurophysiology, functional brain imaging, and cognitive neuropsychology.
Yantis   2 hours

200.610 Brain and Cognition
This seminar will review the neural basis of cognition and behavior using evidence from neurophysiology, functional brain imaging, and cognitive neuropsychology.
Yantis   2 hours

200.611 Cognitive Neuroscience
Survey of current issues in cognitive neuroscience, emphasizing the logic by which data from neuroimaging, neuropsychology, neurophysiology, and behavior can be integrated.
Courtney, Yantis   2 hours

200.614-615 Graduate Seminar in Functional Neuroimaging
Gmeindl   2 hours

200.622 Neurobiology of Learning and Memory
Advanced study of neurobiological mechanisms of cognitive processes in animals.
Gallagher, Holland   2 hours

200.640 Review of Recent Literature in Biopsychology
Each semester students read and critique a recent book in biological psychology.
Staff   2 hours

200.642 Neural Circuits and Behavior
This course will consider defined multisynaptic pathways in the vertebrate nervous system that mediate behaviors such as reproductive behavior and communication.
Ball   2 hours

200.644 Behavioral Ecology
This course will examine the relationships between ethology, ecology, and the theory of natural selection. Topics include feeding behavior, social organization, sex and mate choice, life history strategies, communication, decision making, and optimality theory.
Staff   2 hours

200.661 Topics in Psychological and Brain Sciences
An introduction to postdoctoral activities (e.g., grant applications, journal article submission, meeting presentations, the politics of psychology and American science) for Ph.D. candidates in psychology.
Yantis   2 hours

200.662 Career Development in Psychological and Brain Sciences
Covers a wide range of topics for professional career development including ethics, grantsmanship, course development, interviews, etc. Second and third year graduate students only
Shelton   2 hours

200.670 Advanced Seminar in Vision
This seminar will cover advanced topics in vision from the perspectives of several disciplines. Topics include human visual psychophysics, perception and cognition, and computational vision.
Egeth, Yantis   2 hours

Research Seminars
Research seminars, offered yearly, are designed for students engaged in research in the particular areas named by the seminars and may be taken only by permission of the instructor. All students in a given seminar are expected to contribute to the presentation and discussion of research.

200.802 Research Seminar in Behavioral Endocrinology
Staff   2 hours

200.810 Research in Psychology
Students plan and execute original research under guidance of advisors. Results are usually prepared in a form suitable for publication.
Staff

200.811 Research Seminar in Human Performance
Egeth   2 hours

200.816 Research Seminar in Learning
Holland   2 hours

200.817 Research Seminar: Working Memory and Prefrontal Cortex
Discussion of the current literature on the cognitive neuroscience of working memory and the role, organization, and other cognitive functions of prefrontal cortex.
Courtney   2 hours

200.820 Directed Readings and Research
Guided independent readings and research in special fields.
Staff

200.821 Research Seminar in Behavioral Neuroscience
Ball   2 hours

200.825 Research Seminar in the Neurobiology of Learning and Memory
Gallagher   2 hours

200.828 Research Seminar in Perception and Attention
Yantis   2 hours

200.830 Readings in Psychology
Guided independent readings in special fields.
Staff

200.840 Research Seminar: Neural Systems of Memory and Attention
Staff

200.848 Current Advances in Psychological and Brain Sciences
Staff   2 hours

200.849 Teaching Practicum
All candidates are required to obtain special experience in various aspects of undergraduate teaching.
Staff

200.850 Advanced Teaching Practicum
All candidates will get the opportunity to actually teach a section of an intermediate undergraduate course for an entire semester.

Public Health Studies

Public Health combines a prevention orientation with a population perspective in pursuit of better health for all members of society. Public health professionals deal with critical large-scale issues such as access to health care; chronic disease control; mapping, predicting, and containing outbreaks of infectious disease; as well as researching factors that contribute to health outcomes such as gender, poverty, and education. Public Health has close ties with medicine through research, clinical practice, and formulating policy.

The Public Health Studies Program offers undergraduates a major that links them to the world of public health through core courses taken on the Homewood campus, as well as electives taken at the Johns Hopkins Bloomberg School of Public Health (JHSPH).

Core course work at Homewood includes Fundamentals of Epidemiology, Environment and Your Health, Fundamentals of Health Policy and Management, Biostatistics, Social and Behavioral Health, as well as a year of Biology and Calculus I. Students will select additional public health coursework from a range of options that include the natural sciences, health economics, medical anthropology, disparities in health and access to health care, the history of science and medicine, and demography. The major is flexible and easily adapted to further course work in the natural sciences and historically about two-thirds of Public Health Studies majors complete the premedical core curriculum.

Public Health Studies majors beginning with the class of 2013 also complete the Public Health Applied Experience as part of their undergraduate degree requirements. This involves a supervised, hands-on experience working with public health professionals. The goal of the applied experience requirement is to ensure that students have practical public health exposure in a clinical, research, or community setting.

The Johns Hopkins Bloomberg School of Public Health is the oldest and largest school of public health in the United States. Although its primary function is to serve as a graduate school, seniors majoring in public health studies take a semester's worth of courses there in fulfilling their B.A. degree requirements. Many students get involved in ongoing research projects at JHSPH such as developing malaria vaccine, investigating hospital patient safety protocols or assessing the links between poverty and poor health.

Available course work at JHSPH includes the following areas: health education, environmental health sciences, epidemiology, health finance and management, health policy, human genetics, immunology and infectious diseases, international health, maternal and child health, mental health, nutrition, occupational medicine/health protection and practice, population studies, toxicology, and tropical medicine, among others.

An honors option is available to Public Health Studies majors with a major GPA of 3.3. Public Health Honors students work in a research capacity under the supervision of a JHU faculty member and with the guidance of the Director of the Public Health Studies program. Students register for 280.495 Honors in Public Health Seminar in the fall and 280.499 in the spring. Interested students should discuss their plans with the Director of the Public Health Studies program in the spring of their junior year.

The Public Health Studies office is located in the 3505 North Charles Building second floor, adjacent to the Homewood campus. Public Health Studies advisors may be consulted about the various courses, careers, and graduate programs in public health on a walk-in basis or by appointment. Information can also be obtained by emailing phstudies@jhu.edu or at http://krieger.jhu.edu/publichealth.

B.A./M.H.S and B.A./M.S.P.H

The Bachelor of Arts/Master of Health Sciences (BA/MHS) and Bachelor of Arts/Master of Sciences in Public Health (BA/MSPH) programs are a coordinated academic collaboration between the Krieger School of Arts and Sciences and the Johns Hopkins Bloomberg School of Public Health. It enables talented and committed Public Health Studies Program majors to complete a BA and master's degree from the School of Public Health in five to six years.

The Department of Environmental Health Sciences, Department of Epidemiology and Department of Mental Health will consider JHU undergraduates majoring in Public Health Studies for admission to the BA/MHS program. The Department of Environmental Health Sciences also offers a BA/MSPH in Occupational and Environmental Hygiene. The Department of Health Policy and Management offers a BA/MSPH in Health Policy.

Public Health Studies students apply for early admission during their junior year. Admitted students must complete the BA degree before formally

enrolling in the graduate school, but up to 16 of the public health credits earned inter-divisionally toward the BA may also apply toward the MHS or MSPH degree. In addition, students in this program will receive co-advising from both schools to optimize their academic experience.

The Faculty

Program Director

Kelly Gebo, M.D., M.P.H.; Associate Professor (Medicine, Epidemiology)

Associate Director

James Goodyear, Ph.D.; Senior Lecturer (Public Health Studies Program)

Academic Advisors

Lisa Folda, M.H.S.
Mieka Smart, M.H.S.

Joint Appointments

Miriam Alexander, Assistant Professor (Population and Family Health Sciences); Director General Preventive Medicine Residency Program

David Bishai, Professor (Population, Family and Reproductive Health); Coordinator, Health Economics @ Hopkins

Lee Bone, Associate Professor (Health, Behavior and Society)

Lynda Burton, Associate Professor, Adjunct (Health Policy and Management)

Lawrence Cheskin, Associate Professor, (Health, Behavior and Society); Director, Johns Hopkins Weight Management Center

Carolyn Furr-Holden, Assistant Professor, (Mental Health); Director, DIVE Studies Laboratory

Kelly Gebo, Associate Professor, (Infectious Disease); Director of Undergraduate Public Health Studies Program

Thomas LaVeist, Professor (Health Policy and Management); Director Hopkins Center for Health Disparities Solutions

Philip Leaf, Professor (Mental Health); Director, Center for the Prevention of Youth Violence

Darcy Phelan, Assistant Scientist (Epidemiology)

Donald Steinwachs, Professor (Health Policy and Management); Director, Health Services Research and Development Center

James Tielsch, Professor (International Health); Associate Chair for Academic Programs. (International Health, Global Disease Epidemiology and Control Program)

Michael Trush, Professor (Environmental Health Sciences) Deputy Director, Johns Hopkins Center

for Urban Environmental Health; Director Community Outreach and Education Core

Barry Zirkin, Professor (Biochemistry and Molecular Biology)

Public Health Studies Program Advisory Board

The Public Health Studies Program Advisory Board reviews the progress and status of the Public Health Studies Program. Members provide advice and guidance on issues that are vital to a successful program, such as faculty appointments, curriculum reviews, utilization of university resources, and new funding opportunities.

Steven David, Professor (Political Science); Vice Dean for Undergraduate Education (Zanvyl Krieger School of Arts & Sciences)

James Yager, Professor (Environmental Health Sciences, Toxicology); Senior Associate Dean for Academic Affairs; Edyth H. Schoenrich Professor in Preventive Medicine (Bloomberg School of Public Health)

KSAS Representatives

Richard Cone, (Advisory Board Chair), Professor (Biophysics)

Andy Cherlin, Professor (Sociology)

Adam Sheingate, Associate Professor (Political Science)

Stephen Shore, Assistant Professor (Economics)

JHSPH Representatives

John Groopman, Professor (Environmental Health Sciences) Chair; Anna M. Baetjer Professor in Environmental Health Sciences

Ellen MacKenzie, Professor (Health Policy and Management) Chair; Fred and Julie Soper Professor in Health Policy and Management

James Tielsch, Professor (International Health); Associate Chair for Academic Programs. (International Health, Global Disease Epidemiology and Control Program)

Marie Diener-West, Professor (Biostatistics); Chair, Master of Public Health Program

One designated Public Health Studies Alumni serves a 2 year term on the committee.

Requirements for the B.A. Degree
All requirements must be taken as graded credits.

Required Courses at Homewood

AS 110.106/108 Calculus I	4
AS.280.335 The Environment and Your Health	3
AS 280.340 Fundamentals of Health Policy and Management	3

AS 280.345 Biostatistics in Public Health   4
AS 280.350 Fundamentals of Epidemiology 3

Choose two semesters of Biology + one lab
AS 020.151/161 General Biology I + lab   9-10
AS 020.152/162 General Biology II + lab
AS 020.305/315 Biochemistry + lab   10-12
AS 020.306/316 Cell Biology + lab

Two (2) Introductory level Social Science courses. Please see the PHS checklist online for further details.

A minimum of four (4) courses must be selected from the following list to show depth in the field of public health. One of these 4 courses must be one of the starred courses to satisfy the core competency in the social and behavioral area.

AS 100.333 Global Public Health Since WWII
AS 180.289 Economics of Health
AS 190.354 Politics of Health Policy
AS 190.405 Food Politics
AS 230.225 Population Health and
    Development
AS 230.341 Medical Sociology*
AS 270.360 Climate Change: Science and Policy
AS 280.215 Understanding Behavior Change:
    Theory and Application*
AS 280.320 Seminar on Baltimore Health and
    Wellbeing
AS 280.360 Clinical and Public Health
    Behavior Change*
AS 280.375 Cultural Factors of Public Health*
AS 280.380 Introduction to Global Health
AS 280.399 Practicum in Community Health
    Care

Satisfies the core competency in social and behavioral health.

Applied Experience
Public health studies majors will complete one (1) applied clinical or community-based experience. A minimum of 80 hours of applied work is required along with a synthesizing assignment. Additional information about this requirement is posted on our website http://krieger.jhu.edu/publichealth.

PHS Majors Electives
In order to satisfy requirements for the major, students must complete four (4) additional 3-or-more credit courses at Homewood. These may NOT be labs, independent research, special studies, or classes taken S/U. Students must complete one of the two categories listed below.

Category I: Natural Sciences—4 courses from the N/NE/E/Q/QS area designations (any level)

Category II: Humanities—4 courses from the H area designation

Requirements at JHSPH
Fifteen (15) units of courses are taken at the Johns Hopkins Bloomberg School of Public Health in the student's fourth year. This is the equivalent to 10 Homewood credits. Within the 15, students must create an 8 unit concentration in one particular area, topic, or department. Other courses may be taken in any department. These courses may not be independent research/special study, taken S/U or online.

Other General Requirements
Four (4) writing intensive courses (12 credits)

General electives as needed to bring the total number of credits to 120

Courses

280.101 (S) Introduction to Public Health
The field of public health spans a broad range of disciplines and professions. The objectives of this course include familiarizing students with the U.S. public health model; providing a working knowledge of the tools and methods used in public health practice and research; increasing awareness of social and cultural factors embedded in current public health issues; and exposing students to the range of fields and occupations that fall within public health. Experts, primarily from the Bloomberg School of Public Health, will serve as guest lecturers.
Alexander/Kahan   3 credits   spring

280.111 (S) Urban Health and Advocacy
This is a student driven exploration of a wide range of psychosocial issues facing the poorest residents in urban centers. The coursework will include weekly assigned readings, lively discussions, and experiential activities. Students will increase their awareness of health issues facing the poor and of the utility of advocacy in the health field.
Smart   2 credits   fall

280.120 (S) Lectures on Public Health and Wellbeing In Baltimore
An introduction to Urban Health with Baltimore as a case study: wellbeing, nutrition, education, violence and citywide geographic variation. Lectures by JH Faculty, local government/service providers and advocates.
Leaf   1 credit   spring

280.157 (H,S) From Tropical Disease to Global Health
Freshman Seminar. It inquires into the origin of the idea of tropical disease as a legacy of European conquests and colonization in tropical latitudes, as well as a function of shifting paradigms within history of science and the rise of international health
Goodyear   3 credits   summer

280.215 (S) Understanding Behavior Change: Theory and Application
This course begins by exposing students to a variety of theories of behavior change—why and how we do it, and why we often don't. From there they use this knowledge to develop a communication campaign designed to encourage changing a behavior among their peers. They will gain the skills necessary to analyze a problem, develop a campaign strategy, create persuasive materials, and implement and monitor that campaign. Some elements of impact evaluation will also be covered in this course.
Folda   3 credits   fall

280.222 (Q,S) Applied Geographic Information Systems In Public Health
Course provides an Introduction to GIS and presents its utility in public health. Provides exposure to GIS as a tool for describing the magnitude of health problems, and for supporting health decision-making. Course topics include a historical overview of the intersection between geography and public health; current epidemiological use of GIS; and experiential learning (thematic mapping of health needs observed in the field); and GIS applications in identifying public health problems.
Smart   3 credits   summer

280.320 (S) Seminar on Public Health and Wellbeing in Baltimore
Seminar combines lectures from 280.120 with additional readings and discussion to more deeply address urban health issues.
Leaf   3 credits   spring

280.335 (N) The Environment and Your Health (Required Course)
This course surveys the basic environmental health sciences (toxicology, risk assessment), current public health issues (hazardous waste, radon, water-borne diseases), and emerging global health threats (global warming, ozone depletion, sustainability).
Trush   3 credits   fall

280.340 (S) Fundamentals of Health Policy and Management (Required Course)
This course will provide an overview of health policy in the United States with an emphasis on medical care policy and fundamentals of managing health services organizations. Through lectures and small-group discussions, students will develop a framework for analyzing health care policy problems and gain familiarity with current issues including managed care, Medicare, and the uninsured. Management implications will be explored, and students will learn current thinking regarding "best practices" in managing and improving health services organizations,

including leadership development, strategic planning, resource management, process improvement, and monitoring performance indicators. Students will be evaluated on the basis of a midterm exam, final paper, and two to three short take-home assignments.
Steinwachs/Burton   3 credits   spring

280.345 (Q) Biostatistics in Public Health (Required Course)
Using problem-based learning focusing on public health topics, students learn to describe and summarize data, make inferences regarding population parameters, and test hypotheses. Students use linear regression to describe continuous outcomes and logistic regression to predict proportions with a statistical analysis package, but prior computing experience is not required. Instruction is by lectures and laboratory sessions, with evaluation based on examinations, problem sets, and projects. Prerequisite: 4 years of high school mathematics.
Zeger   4 credits   fall

280.350 (Q) Fundamentals of Epidemiology (Required Course)
This course introduces principles and methods of epidemiologic investigation of both infectious and noninfectious diseases. Some of the methods by which properly conducted studies of distribution and dynamic behavior of disease in the population can contribute to an understanding of etiologic factors, modes of transmission, and pathogenesis of disease are illustrated. Instruction is by lectures, laboratory problems, and seminar discussions.
Phelan   3 credits   spring

280.360 (S) Clinical and Public Health Behavior Change
This course explores the theory and practice of changing the health behaviors of individuals, and the public health and medical impact of doing so. Theoretical concepts are integrated with practical clinical applications, especially in the areas of diet and fitness. Skill building in persuasive, health-related communication will be included in smaller group discussions.
Cheskin   3 credits   spring

280.375 (S) Cultural Factors in Public Health
This course covers the influence of culture on health policy, management and practice. It also provides background in disparities in health in the US. Guest speakers include health care providers, managers, and policy-makers.
LaVeist   3 credits   spring

280.380 (S) Introduction to Global Health
Introduces approaches used by various countries In solving their health and medical care problems, and the role of major international health organizations. Analyzes some of the current important issues in global health.
Tielsch   3 credits   fall

280.399 (S) Practicum in Community Health Care
Students will participate in community-based health services intervention programs, working with community leaders and health interventionists from the schools of

Medicine and Public Health. Classroom presentation. Paper required.

Bone, Goodyear   3 credits   fall

280.495 (S,W) Honors in Public Health Seminar
Using lectures, oral presentations, and writing assignments, this seminar is designed to assist Public Health Studies majors in writing a senior thesis. Students will formulate their topics, develop research skills, address issues of professional ethics, and begin drafts of their final projects. Participation in this seminar is required for students pursuing honors in PH studies.

Gebo   3 credits   fall

280.499 (S,W) Honors in Public Health Studies
Restricted to public health studies majors. Consult public health advisor for procedure. Prerequisite: 280.495.

280.501 & 502 and 280.570 & 590 Internship in Public Health
Restricted to public health studies majors. Consult the public health studies advisor for procedure.

280.507& 508 and 280.576 and 280.596 Independent Study in Public Health
Restricted to public health studies majors. Consult the public health advisor for procedure.

280.505-506 & 280.571 and 280.597 Independent Research Fresh/Sophs
Consult the public health studies advisor for procedure.

280.511-512 and 280.572 and 280.598 Independent Research Jrs/Srs
Consult the public health studies advisor for procedure.

280.519-520 Public Health Practice
Specialized training course/experience for students who have been selected to become members of the PEEPs (Preventative Education and Empowerment for Peers), a peer education group based out of the Center for Health and Wellness. The experience will focus on knowledge, skill and application of college health issues including: health promotion theory, body image, sexual health, alcohol and other drugs, and stress management. Skills include program planning, listening, communication, assertiveness, facilitation and presentation.

Gwinn/Goodyear

A sample of public health-related courses offered regularly on the Homewood campus follows. Not all courses are offered every semester. Please refer to departmental listings for more complete information.

Anthropology

070.248 (H,S) Medical Anthropology
Han   3 credits

Earth & Planetary Science

270.107 (N) Introduction to Sustainability
Parker   3 credits

270.360 (N) Climate Change: Science & Policy
Szlavecz   3 credits

Economics

180.252 (S) Economics of Discrimination
Morgan   3 credits

180.289 (S) Economics of Health
Bishai   3 credits

180.390 (S,W) Health Economics & Developing Countries
Gersovitz   3 credits

History

100.333 (H,S,W) Global Public Health Since World War II
Galambos   3 credits

History of Science and Technology

140.105 (H,S) History of Medicine: Antiquity through the Scientific Revolution
Fissell   3 credits

140.106 (H,S) History of Medicine: 18th–20th Centuries
Fissell, Todes   3 credits

Philosophy

150.219 (H, W) Introduction to Bioethics
Bok   3 credits

Political Science

190.405 (S,W) Food Politics
Sheingate   3 credits

195.477 (S, W) Introduction to Urban Policy
Newman   3 credits

195.478 (W) Urban Policy Internship
Newman   3 credits

Psychological and Brain Sciences

200.132 (S) Introduction to Developmental Psychology
Staff   3 credits

200.133 (S) Introduction to Social Psychology
Drigotas   3 credits

Sociology

230.150 (S) Issues in International Development
Agarwala   3 credits

230.225 (S) Population, Health and Development
Becker   3 credits

230.341 (S) Medical Sociology
Staff, Bloomberg School of Public Health   3 credits

Public Policy

Effective August 2012, the MPP Program will become part of the Bloomberg School of Public Health. For the latest information please visit IPS.jhu.edu.

Graduate Program

Master of Arts in Public Policy

The Master of Arts in public policy (MPP) is a two-year multidisciplinary degree that equips students with the analytical skills required to understand public problems and develop policy responses. The program is small by design, affording students extensive opportunities to interact with faculty in classes, seminars, research and teaching assistantships, student thesis research, and through academic and career advice. Distinctive elements include:

- Location within a university-based research institute, providing opportunities to work on public policy research and technical assistance projects;
- A balance of quantitative and non-quantitative courses, both of which emphasize analytic thinking; and
- Enrichment through the involvement of scholars and practitioners from overseas.

The Faculty

David M. Altschuler, Principal Research Scientist; Adjunct Associate Professor (Sociology and Mental Hygiene): juvenile crime and the justice system, juvenile aftercare and parole, drug control policy.

Sen. Benjamin Cardin D-MD, Distinguished Lecturer; Maryland: the legislative process, domestic social policy.

Carey Borkoski, Assistant Director, MPP; Instructor (Health, Policy and Management– Bloomberg): economics and data analysis.

Michael Giandrea, Senior Lecturer: statistics.

Nancy Hall, Senior Lecturer; Senior Advisor, Maryland Association of Nonprofit Organizations: nonprofit management.

Sandra J. Newman, Professor of Public Policy (Sociology and Health Policy and Management): housing policy, policy analysis, urban and social welfare policy.

Marion W. Pines, Senior Fellow; Director of Sar Levitan Center for Social Policy Studies: program design and implementation, at-risk youth strategies, social welfare policy, education reform, employment strategies, service integration model for families.

Lester M. Salamon, Principal Research Scientist; Founding Director, IPS; Director, Center for Civil Society Studies; Professor (Political Science): alternative instruments of government action, social welfare policy, nonprofit sector U.S. and overseas, human capital investment policy.

Marsha Schachtel, Senior Fellow: urban studies and urban planning.

Eric Seigel, Journalist-in-Residence: media and public policy.

Curt Ventriss, Visiting: ethics.

Joint Appointments

John J. Boland, Professor Emeritus and Lecturer (Geography and Environmental Engineering): environment and public utility economics, water resource management, and environmental policy.

Andrew J. Cherlin, Professor (Sociology): family sociology, urban sociology, demography.

Matthew A. Crenson, Professor (Political Science): urban government and politics, political origins of American welfare policy.

Ruth Faden, Professor (Health Policy and Management); Director of Law, Ethics, and Health program: ethics and health policy management.

Bernard Guyer, Professor and Chair (Maternal and Child Health Policy): maternal and child health policy, childhood injury prevention, child development, childhood immunization.

Robert Moffitt, Professor (Economics, Population and Family Health Sciences): labor economics, public finance, and population economics.

Vicente Navarro, Professor (Health Policy and Management): welfare state, globalization, social policy.

Donald Steinwachs, Professor (Health Policy and Management).

Requirements for Admission

Applicants must have the equivalent of an American B.A. degree and typically must score 600 or higher on the verbal and quantitative sections of the Graduate Record Examination (GRE). In addition to college undergraduate performance and GRE scores, the Admissions Committee considers relevant work and community experience, the personal statement, career goals, and letters of recommendation, which should include those from former professors. Students should consult the Graduate Admissions section of this catalog for additional information. International students whose native language is not English must take the Test of Eng-

lish as a Foreign Language (TOEFL), and have the results submitted directly to the university. Hopkins requires a a minimum score of 600 (paper-based), 250 (computer-based), and 100 (Internet-based). A score of 600 or better is preferred.

Requirements for the M.A. Degree

Degree requirements consist of a set of core analytical courses, a set of substantive policy courses in an area of specialization, and an internship, and the opportunity to write a thesis.

Core Courses

Each student is required to take the following core courses:

195.603 Applied Microeconomics for Policymaking
195.605-606 Statistical Analysis for Policymaking
195.607 The Policy Process
195.608 Policy Tools of Government
195.609 Policy Analysis for the Real World
195.611 Introduction to Program Evaluation
(Various) Research Design and Methods
195.610 Values, Ethics, and Public Policy

The courses emphasize analytical thinking throughout the curriculum, from applied statistics and microeconomics to the policy process and policy implementation. It embeds those skills in the concept of citizenship, linking questions of ethics and values to policymaking. Courses are designed to prepare students for involvement in the critical decision-making required in the development of public policy in the private, public and nonprofit sectors. Students usually take four courses in each of four semesters, plus an internship in the summer between their first and second years, for a total of 17 courses. The program consists of nine core courses, five electives, and the internship. Students also have the opportunity to write a master's thesis.

Substantive Courses

In addition to the required core courses, students are required to select either a substantive field of policy or a particular analytic area for special focus. A minimum of four courses is required in this concentration. Courses are drawn from the MPP and the extraordinary array of electives available in JHU's schools and departments. Students may choose course offerings from the graduate School of Public Health, the Krieger School of Arts and Sciences, the Nitze School of Advanced Interna-

tional Studies (SAIS), the Whiting School of Engineering, the Carey Business School, and the School of Education. Note: MPP students are limited to a maximum of four SAIS courses during their course of study at the Johns Hopkins University.

Policy Practicum

All students are required to intern in a public or private agency for a minimum of 300 hours. The purpose of the internship is to give students real-world experience as a policy professional. Students work with faculty to develop a placement consistent with their own career objectives. Throughout the internships, students remain in touch with their faculty advisors.

The B.A./M.A. Program

Each year the MPP program accepts a limited number of Hopkins undergraduate students into its B.A./M.A. program in public policy. Students take core policy courses on the Homewood campus in their senior year and fulfill an area of concentration requirement in a fifth year at Hopkins. The program is rigorous and requires a GPA of at least 3.0, strong writing skills, and a demonstrated interest in public policy issues. Because of the demands of the program, students must complete virtually all requirements for their undergraduate major before beginning their senior year.

Financial Aid

The Institute for Policy Studies awards partial tuition scholarships to entering master's students based on merit. Awards are generally renewed for the second year of study if academic performance is satisfactory.

Research and teaching assistantships are available for qualified students to work for research faculty in the Institute for Policy Studies. Assistantship assignments are decided after the student has accepted the offer to study at The Johns Hopkins University and after interviews have been conducted with selected faculty members. Pay averages $14-16 an hour; students usually work 15-20 hours a week, depending on their schedule and the needs of the project. Students who are interested in being considered for an assistantship are urged to apply for the federal work-study program through the Financial Aid Office.

Various loan programs for graduate students are also available. Information and application materials may be obtained from the Financial Aid Office.

Courses

195.477 (S,W) Introduction to Urban Policy
This seminar surveys key urban policy challenges and opportunities faced by U.S. cities. Course topics include a critical analysis of the continuing viability of cities in the context of current economic and demographic dynamics, fiscal stress, governance, economic development, poverty and race, drugs, homelessness, federal urban policy, and survival strategies for declining cities. Enrollment is limited to ensure a true seminar format.
Newman   3 credits

195.603 Applied Microeconomics for Policymaking
The goal of this course is to communicate the basic principles of microeconomics by emphasizing applications to the solution of public problems. Students examine how markets operate and how they fail. This includes an analysis of the reasons for government intervention. Public vs. private goods, the problem of externalities, the pricing of public goods, and related issues will be addressed. The course provides the student with elements of a theoretical framework useful in addressing policy problems.
Borkoski

195.605-606 Statistical Analysis for Policymaking
This course sequence over two semesters teaches the application of statistical techniques commonly used in policy analysis and decision analysis including measures of central tendency, correlation, analysis of variance, and multivariate analysis. The course uses actual policy problems to demonstrate applications of techniques.
Giandrea

195.607 (W) The Policy Process
This course examines the influence of political and organizational factors on the various stages of the policy process including problem identification, developing alternative responses, assessing the political feasibility of alternative responses, generating political support, budgeting and resource allocation, and implementing policy decisions through both public and private institutions.

195.608 Tools of Government
The course focuses on the instruments available to government to achieve its policy and program objectives (e.g., regulation, grants-in-aid, purchase of service contracting, loan guarantees, direct payments, procurement, vouchers). Students learn that the choice of instrument affects the operation of programs and the success with which they meet their objectives. Attention focuses on the challenges of managing the complex public-private collaborations from either direction.
Salamon

195.609 (W) Policy Analysis for the Real World
This course teaches students to think analytically and to apply analytic thinking to policy problems. Students work through several real-world problems primarily in social, urban, and health policy, to master the essential steps of any policy analysis: identifying the problem, assessing the available evidence, specifying goals and constraints, and examining policy alternatives. Course goals also include understanding some of the major policy debates of the day, and communicating in a simple, clear, and direct way.
Newman

195.610 Values, Ethics and Public Policy
Including the philosophical bases of public action, notions of responsibility of individuals to society, and alternative forms of citizen action, from political participation to voluntary service.
Ventriss

195.611 Introduction to Program Evaluation
This course provides the student with an introduction to the use of qualitative and quantitative evaluations for social programs. The course reviews rationale for evaluation and its use in budgeting, policy assessments, research and development, and program improvement. The course addresses cost-benefit analysis, experimental and quasi-experimental designs, selection bias, and methods of overcoming problems. The course includes an introduction to use of cost-benefit analysis. Students undertake a critical review and reanalyze data from existing evaluations.
Staff

195.621 Internship
The internship usually takes place during the summer between the two years of the program. It involves placement in a public or private agency in the U.S. or another country, and preparation of a paper that takes a critical look at the relationship between on-the-job experience and concepts learned in class, and an example of a written product produced on the job.
Borkoski

195.640 Policy Implementation
There is an "art" to leading and a "science" to managing systems. This course explores principles for managing the implementation of policies in public or nonprofit organizational settings as well as principles for evaluating the management/implementation of proposed or ongoing operations. Students examine policy implementation at the federal, state, or local level.
Pines

195.650 Quantitative Approaches to Public Policy
This course will be of interest to graduates and advanced undergraduates who wish to advance their quantitative skills. Topics will include simple and multiple regression models, different functional forms, the use of dummy, interactive, quadratic, and lagged terms in regression analysis, simple time series models, models that employ panel data sets, limited dependent variable models, and instrumental variables estimation. We will examine the practical application of these models, rather than formal proofs of the assumptions behind them. Understanding is reinforced by the use of statistical software to analyze policy problems. To further reinforce this methodology,

students also research and formally present an empirical paper.

195.652 Social Policy: Special Topics Seminar

195.654 Social Policy
This course provides a historic, theoretical, and programmatic overview of U.S. social policy. The primary objectives are to understand current social policy within the broader historic context of policy evolution since 1900; provide an overview of the key theoretical, philosophic, and ideological principles on which U.S. social policy is based; examine key dimensions of major current policies, including welfare, employment, child welfare, public housing, and social services; and explore methodological and analytic methods used to determine the effectiveness of selected policies and programs. An interdisciplinary approach is used: economics, political science, history, sociology, public administration, and law.

195.680 Seminar on the Press and Public Policy
This seminar brings in prominent journalists and other members of the media to discuss how the media influences government decisions, big and small.
Staff

195.682 Writing for the Op-Ed Page
The object of this one-credit course is to learn how to use policy skills in ways instructive not only to fellow experts but to a general audience. Good writing opens paths to excellence and influence. You will be required to write 600-800-word pieces due at every class session.

195.683 Applied Evaluation Seminar

195.685 Adolescents, Crime, and Justice
Should adolescents who "break the law" be punished and held accountable or be provided services and treatment; is it possible to pursue all these objectives; how should adolescent drug use be handled; does the age of an offender matter in terms of how the police, prosecution, judiciary, and corrections respond; what justifies the detention or incarceration of adolescents; what should be the purpose of "confinement" and how should "reentry" figure in; should adolescents who commit particular crimes be subject to capital punishment; and what should be done about adolescents who have gang involvement? These are some of the public policy questions that are examined and debated.
Altschuler

195.687 Management Systems for Nonprofit Organizations
This course provides an overview of the key management systems nonprofit leaders use to run their organization. A substantial portion of the course focuses on financial management. Additional topics include data collection, human resource management systems, and IT systems.
Hall

195.689 Writing for Mass Media
This course is designed to allow future policy-makers to develop and sharpen their skills in writing advocacy, analytical and explanatory pieces for a general audience. The focus of the course will be on marshalling supportive facts and writing clear, concise prose on matters of public importance in formats that include letters to the editor and op-ed page pieces.

195.695 Special Topics
Special topics courses may be offered in such areas as state and local finance, the macroeconomic context of policy, issues in comparative urban policy, citizen action in community development, and other areas.
Staff

195.800-801 Master's Thesis
Each student has the opportunity to prepare a thesis applying the analytical tools of policy studies to some facet of their policy area of concentration. Theses will be expected to reach a quality level that could pass peer review for publication in leading policy studies journals.
Staff

195.825-826 Independent Study
Special readings course for master's students in policy studies only. This course may also be taken in conjunction with an undergraduate course in another department to enhance or supplement existing courses in a student's field of concentration. This course requires the consent of the student's advisor.
Staff

Research Methods
Students take one of several courses offered in research design and methods. These courses provide an introduction to basic methods to undertaking research and teach students to select and design a research project.

180.351 Labor Economics
This course covers the important elements of labor economics. The course begins with a discussion of what labor markets are and the determinants of the supply of and demand for labor. The course then covers special topics of policy interest such as the existence of labor shortages, the effects of the minimum wage on employment, the effects of tax policy on labor supply and demand, investments in education and training, the effects of welfare policy on labor supply and demand, the effects of international trade on labor demand, worker mobility, pay and productivity, the labor effects of outsourcing, the role of trade unions, unemployment, and income inequality. We also discuss labor issues that arise during the semester such as proposed changes in trade, overtime, and immigration rules.

Sociology

Founded by James Coleman, the Department of Sociology has had a distinguished and productive record during its more than five decades of existence. Despite its small size, it ranks as one of the major Sociology departments in the nation according to the latest surveys. The department is strong in the sociology of education, social structure and personality, family, social policy, cross-national research, sociology of development, race and gender, sociology of immigration, and world-systems studies. Its graduates teach and conduct research in many of the major universities in the nation and abroad.

The Sociology Department at Hopkins is among the smallest of the major graduate training centers in the United States. We presently have twelve full-time faculty members and forty pre-doctoral students. The intimacy afforded by such numbers has allowed us to design a unique environment for graduate study. The term "research apprenticeship" probably best characterizes our structure and philosophy. Graduate training at Hopkins rests upon a careful blend of formal instruction, faculty-directed individual study, and supervised as well as self-initiated research experience. This balance has been a strength of the department since its inception in 1959. The social climate is informal, and the mix of students and faculty, both drawn from a wide variety of geographic and social backgrounds, constitutes a rewarding intellectual community.

We believe that a small department need not be narrow. The interests of the faculty are diverse and the requirements of the department flexible. The department is particularly strong in three broad substantive areas, these being Comparative and International Development, the Sociology of Human Development, and Sociology of Education. The department's Program in Cross-National Sociology and International Development and its Program on Social Inequality, with which students can affiliate at their discretion, coordinate activities in the first two areas, and several faculty share an interest in the third. We also retain our long-standing commitment to rigorous preparation in quantitative research methods. Other interests represented in our core faculty include the family, demography, urban sociology, race and ethnic relations, economic sociology, political sociology, the sociology of intelligence, and world systems analysis

The research and training opportunities available in the department are further enriched by the active participation of a distinguished part-time faculty. These faculty have their primary appointments in social science research institutes located on the Homewood Campus or in the School of Hygiene and Public Health, which offers first-rate programs in population and demography, mental health and mental hygiene, and health care organization, to name but a few. More detailed information can be found on our website at **www.soc.jhu.edu**.

The Faculty

Rina Agarwala, Assistant Professor: international development, social demography, gender, labor, class, inequality, globalization, political sociology, social movements.

Karl L. Alexander, John Dewey Professor of Sociology (Chair): sociology of education, social stratification.

Joel D. Andreas, Assistant Professor: Post 1949 Chinese society, transitions to and from socialism, industrial democracy, education and class reproduction.

Pamela R. Bennett, Assistant Professor: racial and ethnic inequality, racial residential segregation, education, and social demography.

Andrew J. Cherlin, Benjamin H. Griswold III Professor of Public Policy: sociology of the family, demography, social policy.

Stefanie A. DeLuca, Associate Professor: sociology of education, sociology of neighborhoods, life course studies.

Doris R. Entwisle, Research Professor: sociology of human development, socialization of cognitive behavior, methods in social science research.

Lingxin Hao, Professor: sociology of the family, immigration, education, social inequality, public policy, and quantitative methodology.

Ho-Fung Hung, Associate Professor: sociology of world-system analysis and comparative-historical sociology.

Melvin L. Kohn, Professor: social structure and personality, cross-national comparative analysis, social class and stratification, sociology and social psychology of work.

Katrina Bell McDonald, Associate Professor: sociology of the family, race, social class, gender/ethnic identity.

Katherine Newman, Professor: James B Knapp Dean of the Krieger School of Arts & Sciences.

Stephen B. Plank, Associate Professor: sociology of education, stratification, statistical and research methods.

Beverly J. Silver, Professor: historical sociology, world-systems analysis, labor and social movements, political sociology, international development.

Emeritus

Edward L. McDill, Professor Emeritus: sociology of education, social psychology of adolescence, deviant behavior.

Adjunct/Lecturers

David M. Altschuler, Adjunct Associate Professor (Institute for Policy Studies): de-institutionalization and community-based services, delinquency and criminal justice, voluntary organizations and philanthropy, social policy.

Joyce Epstein, Research Professor (Center for Social Organization of Schools): sociology of education, evaluation research, social psychology.

Kelly Gebo, Adjunct Assistant Professor (School of Medicine): medical sociology and mental health.

Stephen Harris, Lecturer (Public Defender for the State of Maryland, retired): criminal justice and corrections.

Huei-ying Kuo, Sr Lecturer: Asian studies in sociology.

James McPartland, Research Professor (Center for Social Organization of Schools): sociology of education, race relations, formal organizations.

Sandra J. Newman, Adjunct Professor (Institute for Policy Studies): policy analysis/public policy, urban sociology.

Magda von der Heydt, Senior Lecturer: stratification/mobility, race/ethnic/minority relations.

Joint Appointments

Bloomberg School of Public Health

Emily Agree, Associate Professor: gerontology, demography.

Nan M. Astone, Associate Professor: demography, urban poverty, adolescence.

Stanley Becker, Professor: population and family health science, couples and reproductive health.

William W. Eaton, Professor: epidemiology of schizophrenia, research methods, sociology of mental disorders.

Margaret E. Ensminger, Professor: poverty, medical sociology, issues of transition over the life course.

Thomas A. LaVeist, Professor: medical sociology, mortality, health services, aging.

Lori Leonard, Associate Professor: global health, anthropology, ethnography, reproductive health, adolescents, women's health.

Vicente Navarro, Professor: health and social policy, international health, health care policy.

Katherine Clegg Smith, Assistant Professor: medical sociology, qualitative methodology, mass communication/public opinion.

Amy Ong Tsui, Professor: population, demography, fertility, family planning.

Undergraduate Programs

Major in Sociology

The undergraduate sociology major provides students with a grounding in sociological theory, methods, and social statistics. Beyond the core requirements, elective courses are offered on a range of important sociological themes including gender, families, race and ethnicity, immigration, social structure and personality, education, health care, labor and social movements, comparative and international development, macro-historical and global social change. For more details, please visit **www.soc.jhu.edu/undergrad-prog.html**.

Requirements for a B.A. Degree

(See also General Requirements for Departmental Majors, page 48.)

The requirements for a major in sociology are as follows:

- Core Curriculum: 230.101 Introductory Sociology, 230.205 Introduction to Social Statistics, 230.202 Research Methods for the Social Sciences, 230.213 Social Theory, and either 230.322 Quantitative Research Practicum or 230.323 Qualitative Research Practicum or 230.325 Comparative and Historical Sociology Research Practicum.

- Six elective courses in Sociology, at least four of which must be numbered 300 or above.

- Three elective non-Sociology courses carrying an "S" designation in at least two other departments or programs are required. These may be at any level.

Core curriculum courses may not be taken pass/fail, and four of the five must be passed with a grade of C or better (a grade of C- is permissible for one, but only one, core curriculum course). A grade of C or better is required of all elective courses.

Foreign language study through the intermediate level is required for the two certificate programs and for the Senior Honors Program (see below). Foreign language study is not required of other majors, but is strongly encouraged, especially for students considering graduate or professional study.

Certificate Programs

Sociology majors may concentrate in one of the department's two main areas of expertise. The certificate Program in Cross-National Sociology and International Development (PCSID) is intended to serve

undergraduate students with a special interest in the development of Third World regions and the social issues and problems arising out of growing global integration. The program focuses on issues of social inequality, stratification, and social change from a global, comparative, and historical perspective.

The certificate Program in Social Inequality (PSI) is intended to serve undergraduates with an interest in the role of social institutions such as the family, schools, and work in generating and mitigating inequality. The focus is on race, class, and gender in the U.S. context.

Additional requirements for students pursuing a certificate:

- Three of the six Sociology elective courses and two of the major's three required elective courses outside Sociology must have a focus relevant to the certification program theme.
- Foreign language through the intermediate level (equivalent of two years).

Senior Honors Program

The entrance requirements for the honors program are (1) a 3.5 GPA in all Sociology core curriculum courses and at least two 300-level elective courses in sociology by the end of the junior year. Additionally, by the end of the senior year, foreign language study through the intermediate level (equivalent to two years) is required.

The honors program requires completion of an honors thesis under the supervision of a department faculty member and enrollment in the year-long Senior Honors Program (230.502). These requirements are in addition to the requirements for the major.

Students interested in pursuing one of the certificate programs or the Senior Honors Program MUST declare their intention to their faculty advisor by the end of their junior year. Additionally, all prerequisites for these programs MUST be fulfilled by the end of the junior year.

Alpha Kappa Delta Honor Society

AKD is an open, democratic, international society of scholars dedicated to the ideal of Athropon Katamanthanein Diakonesein or "to investigate humanity for the purpose of service." AKD seeks to acknowledge and promote excellence in scholarship in the study of sociology, the research of social problems, and such other social and intellectual activities as will lead to improvement of the human condition.

There are more than 50,000 lifetime members and over 500 chapters of the society. These are persons with academic records showing excellence in sociology.

AKD chapters are important in the academic, professional, and social lives of student and faculty members. They provide opportunities for initiating and sharing activities in keeping with the purposes of the society. Our local chapter affords the opportunity for faculty, graduate students, and undergraduate students to interact informally and to plan together events to enrich the intellectual and social life of the department.

To be eligible for membership, majors must have at least junior year standing, an overall GPA of at least 3.0 and a sociology GPA of at least 3.5, and have taken at least four courses in Sociology.

Election to Alpha Kappa Delta is without regard to race, creed, or national origin. For more information, interested students should contact the AKD faculty chapter representatives: Karl Alexander (karl@jhu.edu) or Katrina McDonald (kmcdon@jhu.edu) or Stephen Plank (splank@jhu.edu).

James S. Coleman Award

This award was established by the Department of Sociology in 1994 in honor of Dr. James S. Coleman, first chair of the department. The award is for outstanding academic achievement by a senior majoring in sociology and is presented at graduation.

Graduate Program

The department's graduate program is oriented toward the training of Ph.D.'s in sociology. Requirements for the Ph.D. are organized around a core curriculum, research apprenticeship experience, a one-semester teaching assistantship, and a dissertation. Beyond these requirements, students are free to tailor their graduate training under the supervision of their advisors. For those who request it, the M.A. degree is granted to students who have successfully completed at least one year in full-time residence and the core curriculum. This degree is granted as part of the doctoral training sequence.

Admissions

Applicants should have a broad background in social science, especially sociology, economics, and psychology. Training in mathematics is encouraged. Applicants must submit scores on the GRE verbal and quantitative examinations, official transcripts of college work, three letters of recommendation, a statement of purpose, and a sample of written work. International applicants must also submit TOEFL scores.

Requirements for the Ph.D. Degree

Core Curriculum

The core curriculum consists of the following eight courses:

- Introduction to Social Statistics (230.600)
- Research Design (230.601)
- Social Theory: Theories of Society (230.602)
- Contemporary Social Theory (230.603)
- Regression Analysis (230.604)
- Sociological Analysis (230.643) and Proseminar (230.608), which is a pass/fail course that must be taken by all first-year students;
- A third course in quantitative/qualitative methods (beyond 230.600 and 230.604) selected from among the following options:
  a. Categorical Data Analysis (230.605)
  b. Seminar on Panel Data Analysis (230.615)
  c. Seminar on Limited Dependent Variables Analysis (230.622)
  d. Confirmatory Factor Analysis and Linear Structural-Equations Modeling (230.631)
  e. Qualitative Research Methods (230.649)
  f. Macro-Comparative Research Methods (230.650)

With the exception of the pass/fail Proseminar, all core curriculum courses must be passed with a grade of B- or higher.

Electives

In addition to the core curriculum outlined above, the student must complete nine elective courses, up to four of which may be taken outside the department. At least five of the nine electives must be regular courses, including cross-listed courses, that carry Departmental credit. "Regular courses" are those with numbers in the 300 range, the 400 range, and the 600 range, excluding the Proseminar and the Dissertation Seminar. This means that up to four of the nine electives may be fulfilled by a combination of: 1) exemptions granted by the Graduate Standards and Development Committee; 2) courses taken outside the department that are permissible under the Handbook rules (and taken with the Departmental advisor's approval); 3) and directed research and independent study courses within the Department.

Elective courses allow students to tailor the curriculum to their personal needs. Students ideally will take advantage of the opportunity to become acquainted with the range of expertise and research styles represented on the faculty while also studying intensively in areas of personal interest.

Teaching Assistantships (230.811)

As part of their preparation for future academic work, graduate students are required to serve as a teaching assistant for at least one semester.

Foreign Language

One of the requirements for the Ph.D. degree in sociology at Johns Hopkins University is a reading knowledge of a language other than English, and no student is exempt from this requirement. For a language to be eligible the student must show that 1) a body of social scientific literature exists in the language, or 2) the student needs to use this language to carry out dissertation fieldwork or archival research for the dissertation. The language test will evaluate comprehension of a social science document.

Residence

The university requires a minimum of two consecutive semesters of full-time residence. However, the department recommends at least six semesters of full-time residence for completion of the Ph.D. During the first six semesters the student is expected to complete the core curriculum and electives, and participate in at least two different faculty-led research projects. By the end of the fourth year in the program, the student is expected to have written a dissertation proposal, and have defended it successfully before the appropriate examining committees.

Research Apprenticeship (230.804) and Research Assistantship (230.801)

Students are required to develop practical research expertise through professional-level participation (data analysis, literature searches/reviews, non-routine data processing or coding, preparation and refinement of research instruments, and data/file management) in two different research projects under the supervision of two different investigators. The first research certification is earned by satisfactorily completing a Research Apprenticeship, which is required during the student's first year of full-time graduate study in the department. A second research certification is earned by satisfactorily completing a minimum of one semester as a Research Assistant on a research project different from your Research Apprenticeship and supervised by a faculty member. The standard for certification is substantial research accomplishment as judged by the faculty supervisor.

Trial Research Paper (TRP 230.815, 230.816, 230.817)

The Trial Research Paper (TRP) affords students the experience of planning and executing a research project that leads to a scholarly paper. The TRP is expected to be a serious, complete work of scholarship, suitable for conference presentation or journal submission. Whether or not the topic of the TRP is similar to that of the eventual dissertation, we believe all students will benefit from going through this exercise before planning for the dissertation.

Dissertation

The student must propose and conduct original research that is presented in a dissertation suitable for publication, in whole or in part. The department administers an oral examination that must be passed before the student is allowed to defend before a university dissertation committee. The student must then either defend the dissertation proposal at a University Graduate Board preliminary oral examination, or the completed dissertation at a Graduate Board final oral examination.

Special Programs

The department offers two special programs that coordinate activities in its two areas of concentration. Doctoral students may affiliate with one or both of these programs at their discretion. These programs function as fields of doctoral specialization within the Department of Sociology.

Program in Cross-National Sociology and International Development (PCSID)

This program focuses on cross-national, comparative research and on long-term, world-scale social change. The goal of the program is to give students knowledge of the various theoretical perspectives in these areas, coupled with experience in data collection and analysis, and the acquisition of expertise in one or more substantive fields.

Many students conduct their dissertation research abroad on issues such as urbanization, labor migration, regional development, social structure and personality, health policies, and the informal economy. Comparative and historical research on long-term social structural change is also encouraged.

Requirements for the program include four courses: 230.611 Seminar on Comparative and World-Historical Sociology, and three electives chosen from an approved list. The four courses count toward the nine elective courses required for the Ph.D. All must be taken in the department.

Program on Social Inequality (PSI)

The focus of the department's Program on Social Inequality is on the causes and consequences of social inequality for individuals' lives, the social processes that sustain it, and how social policies can reduce it. These questions are addressed in terms of class, gender, race, ethnicity, and immigration status/citizenship.

The program is designed to train students in the sociological analysis of social inequality among individuals and groups. This training includes course work in areas such as social stratification, the sociology of the family, the sociology of education, sociology of immigration, social structure and personality, social policy, and research design and methods. It also includes research experience with faculty members who are studying aspects of social inequality.

Requirements of the program include the Seminar in Social Inequality (230.612) and three other electives at the 300 level or above and taught by PSI affiliated faculty.

Joint Program: Doctorate in Sociology and Master's in Applied Mathematics and Statistics

The Department of Sociology (Krieger School of Arts and Sciences), and the Department of Applied Mathematics and Statistics (Whiting School of Engineering), sponsor a joint program leading to a Ph.D. in sociology and an M.A. or M.S.E. in applied mathematics and statistics. The purpose of the joint program is to offer Sociology doctoral students an opportunity to acquire advanced statistical knowledge and applied research skills.

Interested Ph.D. students in Sociology can apply to this joint program after being admitted to the Sociology Ph.D. program but no later than the start of their third academic year. Students are permitted to take courses before applying to the program, but must officially apply after completing no more than three of the required AMS core courses. The deadline for submitting applications for the joint program is February 1 for fall applicants and September 15 for spring applications. They should first discuss their intention with the faculty advisor and the Sociology statistical coordinator. Applying students should submit to the AMS Department the abbreviated application, two new letters of recommendation that focus on the evaluation of the student's quantitative abilities, and a completed proposed master's program. The Sociology Department will forward materials required from the student's current file (copies of three original recommendation letters, copy of application to Ph.D. program, GRE and TOEFL scores, personal statement, and current transcript)

to the AMS Department. The completed application must be approved by the chair of the Sociology Department and the Admissions Committee of the Applied Mathematics and Statistics Department.

Students who are interested in the joint program should first discuss it with their faculty advisor and then must obtain the permission of the statistical coordinator for the Department of Sociology. For more information, please visit **www.soc.jhu.edu/ jointprogram.html**.

Facilities

Each resident graduate student is provided office or desk space to conduct his or her studies and research. In addition, the department has a computer lab with a network of computers and printers for graduate student use. Close working relationships exist with the Center for Social Organization

of Schools and the Institute for Policy Studies, which provide excellent opportunities for research training. (For further information, see Research, Information and Academic Centers, page 593.)

Financial Aid

The department strives to provide five years of financial aid for all students who are in good academic standing. Eligibility for financial aid in the fifth year ordinarily requires successful oral defense of the dissertation proposal by September 1, following their fourth year in the Ph.D. program.

The department has a number of assistantships that are awarded each year to graduate students in the Ph.D. program. Opportunities are also available for graduate students to work as salaried research assistants with members of the Sociology faculty and staff at associated research centers.

Undergraduate Courses

230.101 (S) Introductory Sociology
The course will introduce students to the discipline of Sociology (the scientific study of human social life). Students will learn about the major theoretical approaches in the field as well as the diverse research methods used in sociological investigations. These tools will be applied to a wide variety of specific topics studied by sociologists, including family and work, as well as the dynamics of class, gender, race and ethnic inequalities within and across countries.
Staff   3 credits

230.109 (S,W) Freshman Seminar: Hot Topics in Education
This course examines current school reform initiatives, and controversies surrounding them, through a sociological lens.
Alexander   3 credits

230.112 (S,W) Freshman Seminar on Race and Education in the U.S.
The goal of this course is to explore issues of race and ethnicity in American education. We begin by studying the landmark Supreme Court case, Brown V. Board of Education, and related school segregation and resegregation issues. Through lectures, discussions, and films, students will become familiar with various sociological lens through which the educational issues facing blacks, Asians, Latinos, and American Indians are analyzed.
Bennett   3 credits

230.114 (S) Labor and Globalization
Themes include the impact of global processes such as immigration and capital mobility on the nature of work and employment in different parts of the world, and how local protest has shaped global social change.
Silver   3 credits

230.150 (S) Issues in International Development
This course will provide an undergraduate level introduction to the study and practice, as well as the successes and failures, of international development. Students will be introduced to the various theoretical frameworks used to explain underdevelopment. Students will also explore the practice of development since the 1950s by examining specific strategies employed in Latin America, South Asia, East Asia, and Africa. Using a variety of country-specific case studies, students will have the opportunity to apply the theoretical and practical frameworks learned in the class to assess the successes and failures of real-life cases. Freshman and sophomore only.
Agarwala   3 credits

230.199 (S) Criminal Justice and Corrections
An overview of the criminal justice system including court watching and riding with a police officer. Class includes guest visits, field trips, and term projects.
Harris   3 credits

230.202 (S,W) Research Methods for the Social Sciences
Formerly 230.302
The purpose of this course is to provide a sound introduction to the overall process of research and the specific research methods most frequently used by sociologists and other social scientists.
Hao   3 credits

230.203 (S) Introduction to Latin American Societies
This course is designed as an introduction to Latin America's societies for beginners, providing a survey of Latin America through its historical, economic, social, and political dimensions. We will analyze the pre-columbian civilizations and the legacy of colonialism to understand the origins of the multiethnic societies and then focus

on the contemporary development. For the first part of the semester we are going to analyze the process chronologically, the second part the course is organized thematically. We focus on class structure, race, ethnicity and social movements. This course will offer background information to build a solid foundation for further specialization in a region or a theme.

Heydt-Coca   3 credits

230.205 (S,Q) Introduction to Social Statistics

This course will introduce students to the application of statistical techniques commonly used in sociological analysis. Topics include measures of central tendency and dispersion, probability theory, confidence intervals, chi-square, ANOVA, and regression analysis. Hands-on computer experience with statistical software and analysis of data from various fields of social research.

McDonald   4 credits

230.213 (S,W) Social Theory

This course provides an introduction to the classical sociological theories of Marx, Weber, and Durkheim. The goals are to become familiar with important theories about how society works and to apply them to analyzing current social issues.

Andreas   3 credits

230.225 (S) Population, Health and Development

This course will cover the major world population changes in the past century as well as the contemporary situation and projections for this century. Topics include rapid population growth, the historical and continuing decline of death and birth rates, the mortality transition, increases in contraceptive use, population aging, urbanization, population and the environment and the demographic effects of HIV/AIDS

Becker   3 credits

230.302 (S) Class, Stratification, and Personality

An intensive examination of the research literature on the relationships of social class and social stratification with personality. The course will examine the links between people's positions in the class structure and the stratification hierarchy of their society and their more proximate conditions of life, particularly their job conditions, and how these conditions, in turn, affect (and are affected by) such basic dimensions of personality as intellectual flexibility, self-directedness of orientation, and feelings of well-being or distress. The research has been conducted principally in the United States, Japan, Poland when it was socialist, Poland and Ukraine during their transitions from socialism to nascent capitalism, and (in the instructor's current research) China during its very different transformation. Open only to juniors and seniors.

Kohn   3 credits

230.304 (S) Social Organization and Social Control in Schools

We will ask: "How do arrangements of tasks, rewards, roles, and opportunities in schools affect student learning, behavior, and sense of attachment?" and "In what ways are social control processes in schools related to the demands and dynamics of other institutions, particularly the family and the labor market?" Before addressing these questions, we will define social organization and social control, and describe the forms (both intended and unintended) they take in schools.

Plank   3 credits

230.307 (S) Sociology of Latin America

This course will offer an overview of Latin America's reality through its economic, social, political and cultural dimensions. Latin American development will be analyzed as a historical process determined by intertwined internal socio-economic factors, however, within the constraints of the world economy.

Heydt-Coca   3 credits

230.309 (S) Segregation and Social Inequality

This course provides an In-depth study of residential, school and occupational sex segregation, along with their relationships to inequality. Questions regarding residential segregation are featured prominently in the course, with the city of Baltimore often serving as the site in which our readings find real world expression. School and occupational sex segregation, while less prominent in the course, illustrate the relationship between social separations(by race and gender) and inequality across several social economic and demographic domains, Topics include the early residential organization of race (among blacks, white and immigrants) the legal history of segregation, its causes, and its relationship to social mobility, health, crime, mortality and other outcomes. Introduction to Sociology (230.101) is helpful but not required.

Bennett   3 credits

230.310 (S,W) Becoming an Adult: Life Course Perspectives on School, Work, and Family Transitions

While students may already be personally familiar with the subject matter, the course examines the sociological and psychological dimensions of this demographically dense period known as the transition to adulthood. Emphasizes life course theories of human development through readings of empirical work on adolescence, the transition to college, early employment, and early family formation. Attention is paid to the ways class, gender, race, and nationality influence the pathways, choices, and outcomes of young people. A statistics/sociology background is helpful but not required.

DeLuca   3 credits

230.313 (S,W) Space, Place, Poverty, and Race: Sociological Perspectives on Neighborhoods and Public Housing

Is a neighborhood just a grouping of individuals living in the same place, or do neighborhoods have collective meanings and impacts on children and families? We will capitalize on research methodologies used to define and describe neighborhoods and their effects on economic and educational outcomes. These include case studies, census data, surveys, quasi/experimental data. Focus is on how research measures neighborhood effects and incorporates community-level processes into models of social causation (e.g., social capital/control, community

efficacy, civic engagement). Also examined: patterns in residential mobility, segregation, and preferences within black and white populations; development of housing policy in the U.S.; programs to determine how neighborhoods affect issues of social importance. Statistics and public policy background is helpful but not required.

DeLuca   3 credits

230.314 (S) International Development

Recent and long-term trends in the distribution of wealth, status, welfare and power will be analyzed in light of theories of national and international development.

Silver   3 credits

230.316 (S) The African-American Family

This course is an examination of sociological theories and studies of African-American families and an overview of the major issues confronting African-American family life. The contemporary conditions of black families are explored, as well as the historical events that have influenced the family patterns we currently observe. Special attention will be given to social policies that have evolved as a result of the prominence of any one perspective at a given point in time.

McDonald   3 credits

230.318 State and Society Relations in Modern India

This course examines the complex, at times conflicting, relationship that has emerged between Indian seats of power from above and Indian expressions of society from below. Attention will be placed on the period between 1947 to the present.

Agarwala   3 credits

230.320 (S,W) Education and Inequality: Individual, Contextual, and Policy Perspectives

This course examines classic and current debates in the sociology of education. Topics covered include the function and purpose of schooling in modern society; inequality and social mobility (as affected by labor market returns to school and the institutional mechanisms that affect status, such as tracking); social interactions in the classroom and student achievement; racial differences in achievement: the effort vs. ability debate; schools as organizations in the larger societal context; the function of community colleges; and the school-to-work transition. The relevance of education research to policy-making and school reform is emphasized throughout the course.

DeLuca   3 credits

230.321 (S,W) Revolution, Reform, and Social Inequality in China

This course explores various aspects of social inequality in China during the Mao Zedong and the post-Mao reform eras. We will examine inequality within villages, the rural/urban divide, urban inequality, education and health policies, and gender and ethnic relations. Each of these issue areas will be tackled analytically, but the aim is also to understand what it was/is like to live in China during and after the Mao era.

Andreas   3 credits

230.322 (S,Q) Quantitative Research Practicum

This course provides "hands-on" research experience applying sociological research tools and a sociological perspective to problems of substance. Quantitative methods will be emphasized, as applied to census data, survey data, and/or archival data. Students will design and carry out a research project and write a research report. Prerequisite: Introduction to Social Statistics (230.205).

Plank   3 credits

230.323 (S,W) Qualitative Research Practicum

This course provides "hands-on" research experience applying sociological research tools and a sociological perspective to problems of substance. Qualitative observational and/or interviewing methods will be emphasized. Students will design and carry out a research project and write a research report. Prerequisite: Introduction to Social Statistics (230.205).

DeLuca   3 credits

230.324 (S) Gender and Development

This course employs a comparative perspective to examine the gendered impact of international development experiences and policies. Students will discuss the historical evolution of how the concept of gender has been constructed, conceptualized, and integrated into international development theory and practice. The course will also examine how greater attention to gender issues has challenged the assumptions behind the theoretical frameworks and the policy prescriptions guiding international development. In particular, we will examine structural theories of poverty reduction, individual theories of power, and processes of stratification at the household and family level. Specific issue areas will include globalization, class and work, political participation, and social movements.

Agarwala   3 credits

230.325 (S) Comparative and Historical Sociology Research Practicum

This course provides 'hands on' research experience in comparative and historical sociology. Sociological research tools and perspectives will be used to analyze social structure, conflict and change. This course is suitable for both majors and non-majors, and fulfills the 'research practicum' requirement for Sociology majors.

Silver   3 credits

230.332 (S) Race, Racism, and Racial Privilege

This course will examine the concepts of race, racism, racial privilege in contemporary America, and the West in general. Examples from other countries will be integrated as well. Historical contexts such as the colonialism, the Civil War and Reconstruction, the Civil Rights movement, and the post-Civil Rights era will help to provide an understanding of the social, political, economic, and cultural forces processes that have constructed and shaped the concepts of race and the racialized subject over time.

McDonald   3 credits

230.333 (S,W) Quality and Inequality in American Education

The tension between quality and equality in American education, as developed in the various writings of James S. Coleman, will be the focus of this course. Major works to be considered will include *The Adolescent Society*, *Equality of Educational Opportunity*, *Youth in Transition*, *Trends in School Segregation*, and *Public and Private High Schools*.
Alexander   3 credits

230.337 (S) Global Crises: Past and Present

This course compares the social, political and economic dynamics of the contemporary global crisis with that of earlier ones. Special attention will be paid to the Great Depressions of the 1930s and that of the late 19th century.
Silver   3 credits

230.341 (S) Medical Sociology

This course introduces students to medical sociology, which is the application of the sociological perspective to health and health care.
Staff, Bloomberg School of Public Health   3 credits

230.343 (S) Political Sociology of Latin America

This course provides an overview of Latin America through its historical, economic, social, and political dimensions. Emphasis will be given to the analysis of social structures: class, race and ethnicity, and the contemporary social movements. The course begins with an overview of the pre-Columbian civilizations and colonial legacies that gave rise to the multiethnic societies and the ethnic conflicts which characterize contemporary Latin America.
Heydt-Coca   3 credits

230.346 (S) Contemporary Economic Sociology of Latin America

Latin American development will be analyzed as a historical process that is driven by intertwined internal socio-economic factors and constraint by the world economy. The inclusion of these countries in the world economy since the colonial times fostered the formation of outward oriented economies based on primary export commodities. After a short period of inward-oriented development, the new global order fostered a reorientation of the national economies toward global markets. The new developmental model led to downsizing of the state, and the reconfiguration of social structures. The course will focus on the analysis of the economic developmental patterns starting in the middle of the 19th century. Finally, in the second half of the semester, we will analyze in depth the contemporary neoliberal approach to development. Globalization is the force that drives economic, social and political processes in Latin America. The course will include case studies as well the social conflicts generated by the increasing polarization of the society.
Heydt-Coca   3 credits

230.353 (S) Global Social Change

This course introduces students to issues of global social change, with a particular focus on the challenges of international development and the contemporary globalization process. Specific themes include world income inequality and global poverty, the rise of supranational organizations (e.g. WTO and EU) and their relations with sovereign states, anti-globalization activism, the rise of China and India in the global economy, and the origins as well as consequences of the current global economic crisis, among others. Lectures will be aided by documentary films and other multi-media materials.
Hung   3 credits

230.354 (S) Trust and Collective Efficacy: Fragile Resources

Trust is often cited as necessary to the successful functioning of small groups, formal organizations, and democratic society. Collective efficacy (social cohesion combined with shared expectations for control of public space) is a related concept. This course will consider theories and empirical evidence regarding trust and collective efficacy, as well as claims about other mechanisms that can secure mutually beneficial cooperation. Case studies from education and neighborhood ecology will be considered.
Plank   3 credits

230.365 (S) Labor and Globalization

The course will focus on the ways in which contemporary processes of globalization (including the current crisis) are transforming the nature of work and employment, using a wide range of local case studies from Africa, Asia, Europe, Latin America and North America. Themes include changes in business organization that impact labor (e.g., automation, outsourcing, subcontracting) and the role of inter- and intra-national labor migration. We will also look at present-day forms of workers' protest (open and hidden, local and transnational) and how these are shaped by and are shaping global social change.
Silver   3 credits

230.388 (S) Sociology of the Family

Sociological perspectives on contemporary family life, including marriage and divorce, cohabitation, single parenthood, same sex partnerships, children's well being, balancing work and family responsibilities, domestic violence, and government policy toward families.
Cherlin   3 credits

230.415 (S,W) Social Problems In Contemporary China

In this course we will examine contemporary Chinese society, looking at economic development, rural transformation, urbanization and migration, labor relations, changes in class structure and family organization, health care, environmental problems, governance, and popular protest. The course is designed for both graduate and undergraduate students. Undergraduates must have already completed a course about China at Hopkins and must obtain the instructor's permission to join the class.
Andreas   3 credits

230.421 (S,W) Revolution, Reform, and Social Inequality in China

This course explores various aspects of social inequality in China during the Mao Zedong era and during the post-Mao reform era. We will examine inequality within villages, the rural/urban divide, urban inequality, education

policies, and gender and ethnic relations. Each of these issue areas will be tackled analytically, but the aim is also to understand what it was/is like to live in China during and after the Mao era.
Andreas   3 credits

230.500 (S) Independent Study
Staff

230.501 (S) Research Assistantship
Staff   2 credits

230.502 (S) Senior Honors Program
The requirement for the seminar is an honors thesis, due at the end of the second semester. The thesis may be a piece of research that the student does independently, or it may be a thoughtful and critical review of the work in a selected area.
Staff   3 credits

230.505 Independent Study (Summer)
Staff   3 credits

230.506 Independent Research
Staff

230.508 Internship
Staff

230.509 Independent Study (Intersession)
Staff   3 credits

230.510 Tutorial in Criminal Justice
Harris   3 credits

Cross-Listed

195.477-478 Introduction to Urban Policy: Seminar and Internship
This is a six-credit, one-semester undergraduate course on urban problems and policy in the U.S. The weekly seminar considers the major challenges and opportunities facing cities, and the effectiveness of urban and related policies. Students also work at part-time internships in the City Council, a government agency, or community organization in Baltimore. Course requirements include two term papers—one for the seminar portion of the program, the other for the internship. Admission is by permission of the instructor. Undergraduates must take the seminar and internship concurrently. Graduate students may take the seminar only.
Newman   3 credits (seminar)   3 credits (internship)

Graduate Courses

230.600 Introduction to Social Statistics
This course will introduce students to the application of statistical techniques commonly used in sociological analysis.
McDonald

230.601 Research Design
This course is designed to support and foster the ability of students to think *critically, theoretically, and empiri-

cally *about issues in the design of sociological research. There are four main areas we will focus on in the course: 1) Understanding causal inference and the objectives of social science; 2) Learning the types of validity in research designs; 3) Becoming familiar with the elements of research design, such as treatment, observation and assignment; 4) Comparing and contrasting experimental and quasi-experimental designs and their applications for the study of social processes and social problems. The course will give a general overview of sociological research designs, but we will critically examine research in a few specific areas, such as education and urban sociology, for the sake of consistent, coherent examples. Sociology/Statistics background is helpful, but not required.
DeLuca

230.602 Social Theory: Theories of Society
Intensive readings from classical theorists (Marx, Weber, and Durkheim) form the core of this course. Various critics and elaborators of modern social theory are also studied, ranging from representatives of the Frankfurt School to postmodern and feminist social theorists. Emphasis is placed on exploring the utility of social theory for formulating important sociological questions and conceptualizing social research.
Silver

230.603 Contemporary Social Theory
This course explores several important traditions in contemporary social theory, including structural-functionalism, interactionism, exchange and rational choice, post structuralism, discourse and narrative analysis, and the efforts of recent theorists to extend, synthesize and supplement Marx and Weber's explanations of inequality, group conflict, and macro-level social change, including world systems analysis.
Andreas

230.604 Regression Analysis
A seminar in multiple regression (least squares and alternative estimation procedures) with a focus on sociological problems and software applications. Extensions to hierarchical linear models will be included. Graduate students should have completed 230.600 or the equivalent. Undergraduates only admitted with instructor's permission, and 230.205 or equivalent. Prerequisite: 230.205, 230.600 or equivalent.
Plank

230.605 Categorical Data Analysis
This course provides the students with a set of statistical tools to understand and interpret social science research dealing with categorical dependent variables and to prepare students to apply these models in their own research. The models covered in the course include logit, probit, and Poisson models. The selected topics include multi-level models and measurement models.
Hao

230.606 Categorical and Panel Data Analysis
This course introduces the main tools of categorical and panel data analysis. Part I (the first six weeks) introduces models for dichotomous, multiple-category, and count

dependent variables, including logit, probit, multinomial logit, ordered logit, Poisson, and negative binomial models. Part II (week7) covers procedures for constructing longitudinal data and multiple imputations for cross-sectional and longitudinal data. Part III (last six weeks) introduces discrete-time models for panel data analysis along three lines: continuous vs. categorical dependent variables, random vs. fixed-effects models, and static vs. dynamic models. This course uses the statistical package Stata.
Hao

230.607 Labor in the World System

This is an intensive reading seminar on working class formation from a comparative, historical and global perspective, including theoretical and empirical (case study) readings on changes over time in labor process, labor markets, and labor movements. We will build on a range of local case studies to establish spatial and temporal patterns, and discuss the connections between these global patterns and the dynamics of historical capitalism.
Silver

230.608 Proseminar in Sociology

Individual one-hour presentations by faculty members will introduce students to the faculty's substantive interests and research styles.
Department Chair

230.609 Dissertation Seminar

A semester-long course designed to facilitate graduate students' formulation of a dissertation proposal. This course is designed for advanced graduate students actively preparing their dissertation proposals.
Staff

230.610 Seminar on Cross-National Comparative Research

A critical examination of the research literature in this domain, with special attention to the logic of cross-national comparative analysis and to the methods used for assuring comparability of concepts and indices in cross-national research.
Kohn

230.611 Seminar on Comparative and World-Historical Sociology

In this seminar we will read key texts in comparative sociology. The topics covered are cross-national sociology, comparative national development, comparing world-systems, the modern world-system, globalization, and social movements.
Silver

230.612 Seminar on Social Inequality

This seminar attempts a broad survey of sociological theorizing and research on social stratification and the role of social institutions in generating and mitigating inequality.
Alexander

230.614 Seminar on the Family

A discussion-oriented seminar focused on major recent writings on the family, in both the developed and developing nations.
Cherlin

230.617 Seminar on Immigration

In-depth reading and discussion of theories and research on immigration to the U.S. Theoretical issues include international migration, immigration, and assimilation. Research topics include the impact of U.S. immigration laws on immigrant inflows and stocks, self-selection of immigrants, the impact of immigration on the native-born population, and the adaptation of the first and second generations. The course focuses on immigration since 1965 and its related controversies and debates.
Hao

230.623 Hazard Models and Causal Inference

This course covers hazard models (also called survival analysis), treatment effects models such as propensity score analysis, censored regression models, and statistical approaches to address endogeneity. It is offered in alternate years with 230.606 Categorical and Panel Data Analysis.
Cherlin

230.625 Seminar on International Development

This seminar offers a graduate-level introduction to the theoretically guided study of national development. The first part of the course analyzes the development theories that dominated the first four decades of the development effort. The second half of the course examines more recent perspectives that have attempted to fill the intellectual void left by the demise of the development paradigm. Throughout the seminar, discussions and readings will focus on the intellectual history of the development theories: what are the relevant questions to ask and what are the appropriate units of analysis for the study of social and political change? What forces have propelled transformations across the world? What explanatory power do the theories hold for our future?
Agarwala

230.626 World Systems Analysis

Selected topics in the study of long-term, world-scale social change.
Silver

230.630 Research on International Development

Research-oriented seminar on selected topics in international development. Course work will include various activities including the writing of review essays, critical analysis of key texts, symposium participation, and the collection and incorporation of new evidence related to specific theses on global inequality and development.
Silver

230.631 Confirmatory Factor Analysis and Linear Structural-Equations Modeling

Non-mathematical introduction to the use of these advanced methods for dealing with measurement error and causal modeling. Emphasis will be given to examining underlying assumptions and critically evaluating the advantages and disadvantages of these methods. Participants will be expected to do analyses using own data or data provided by the instructor. Prerequisites: some knowledge of multiple regression analysis, some familiarity with computers.
Kohn

230.632 Research on International Development II
Research-oriented seminar on selected topics in international development. Course work will include various activities including the writing of review essays, critical analysis of key texts, symposium participation, and the collection and incorporation of new evidence related to specific theses on global inequality and development.
Silver

230.635 PCSID Research Seminar
Working seminar focusing on new research in the field of comparative and world-historical sociology. Restriction: Sociology graduate students or permission of instructor.
Silver

230.643 Sociological Analysis
An intensive analysis of a wide range of sociological studies, designed to acquaint the student with how sociologists deal with important theoretical issues, using a variety of methods and sources of data. Particular attention will be paid to the logical coherence of the studies and to the fit between data and interpretation.
Kohn

230.649 Qualitative Research Methods
This course provides in-depth familiarity with qualitative research methods, including ethnographic research, participant observation, and intensive interviewing. Alternative conventions in the elaboration of narratives are also explored. The course includes the application of relevant methods. Open to advanced undergraduates with permission of instructor.
McDonald

230.650 Macro-Comparative Research Methods
The course examines methods of studying long-term, large-scale social change. Both qualitative and quantitative methods are covered.
Silver

230.651 Politics and Society
This seminar surveys key texts that treat essential problems of political sociology including the rise of the modern state, the relationship between political and economic power, the nation-state model and nationalism, ideology and political contention, collective identity and action, the origins and nature of liberal democracy, and gender and the state.
Andreas

230.652 Macrocomparative Research Methods II
The course examines methods of studying long-term, large-scale social change. Time and space in social science research, narration and explanation, statistical and historical approached.
Silver

230.655 Seminar on Sociology of Education
Topics are selected to enable students to understand and extend or revise current theories and measurements of school effects. Topics may include the social organization of schools and classrooms, estimation of cumulative school impact; techniques for examining the interaction of school, individual and family characteristics; definition and measurement of nonacademic outcomes of schooling, formulation of factors which condition the influence of school desegregation; elaboration of attainment models; comparison of within- and between-school models; and study of school, family, and peer group influence processes.
Alexander, Bennett, DeLuca, Plank

230.657 Race, Segregation and Social Inequality
This course undertakes an in-depth study of racial residential segregation and its relationship to social and economic inequality. Students will explore the history of residential segregation in the United States, its patterns and causes, as well as its social, economic, and demographic consequences. In doing so, students will gain insight into racial and ethnic inequality across several social, economic, and demographic domains.
Bennett

230.660 Social Structure and Personality
An intensive examination of the research literature on the relationships of position in the social structure (particularly the class structure and the social-stratification hierarchy) with personality, based primarily on research conducted by the instructor and his collaborators in the United States, Japan, Poland when it was socialist, Poland and Ukraine during their transitions from socialism to nascent capitalism, and (currently) China during its very different transformation.
Kohn

230.800 Independent Study
Students may request instructors to arrange reading or research courses fitting particular needs and interests.
Staff

230.801 Research Assistantship
Staff

230.802 Dissertation Research
Staff

230.804 Research Apprenticeship
Staff

230.810 Dissertation Fellowship Semester
Staff

230.811 Teaching Assistantship
Staff

230.815 Trial Research Paper I
Staff

230.816 Trial Research Paper II
Staff

230.817 Trial Research Paper III
Staff

Theatre Arts and Studies Program

The program offers a comprehensive approach to the arts of acting, directing, playwriting, and theatre history, along with the fundamentals of technical direction, play production, play analysis, and theatre management.

For those students who intend to prepare for a career in the theatre, the courses offered are taught exclusively by established professionals, with experience on Broadway, in the best of regional theatres, and in many countries of the world.

For those students not focused on a career in theatre arts, the courses offer a broader perspective, an understanding of societal traditions and culture, and an appreciation for the arts, whether theatrical, literary, musical, or visual. Students pursuing careers in medicine, engineering, law, international relations, science, and others have been challenged and enriched by the school's courses in theatre arts.

For those who seek careers in the arts, the acting and directing workshops, playwriting courses, and independent study opportunities provide rigorous training in acting and other theatre crafts, as well as an appreciation for and an understanding of the history of dramatic arts, its cultural significance, and the industries it has produced.

Located in the program's home, the historic Merrick Barn, The Johns Hopkins University Theatre provides a vehicle for the fulfillment of student lab requirements. The University Theatre produces several plays each year in the Barn and occasionally in the Meyerhoff Auditorium at the Baltimore Museum of Art, which adjoins the Homewood campus. Classes are also held in the Barn.

Director

John Astin, Visiting Professor (Dramatic Arts), Writing Seminars: acting, directing, theatre history, production and management.

The Faculty

John T. Irwin, Decker Professor in the Humanities, Writing Seminars: criticism and poetry in the theatre.

Richard A. Macksey, Professor, The Humanities Center, History of Science and Technology: theatre history and criticism.

Ronald Walters, Professor, History: American cultural and social history.

Visiting Appointments

Margaret (Peg) Denithorne, Instructor: acting, directing, theatre history.

James Glossman, Instructor: directing, acting, theatre management, theatre history.

Marc Lapadula, Visiting Assistant Professor, Writing Seminars: playwriting.

Joseph Martin, Instructor: theatre history, dramaturgy.

Michael Quattrone, Instructor: acting, theatre history.

William Roche, Instructor: technical direction, theatre crafts, theatre management.

Krista Smith, Instructor: acting, directing.

Requirements for a Minor in Theatre Arts

- One semester of study in the Writing Seminars: Introduction to Fiction and Poetry Writing I: Telling it Straight (220.105).

- One semester of a drama course in the departments of English, Classics, Film and Media Studies, German and Romance Languages. (Course must be approved by the student's minor advisor or by the director.)

- One course in Theatre History: The Dramatic Event (300.333), Comic Relief: Comedy and Catharsis (300.308), Dramatic and Narrative Poetry Workshop (220.310), History of Modern Theatre and Drama (225.345), Critical Moments in 20th Century Radical Theatre (225.322), or any other approved Theatre History course.

- Contemporary Theatre and Film: An Insider's View (225.300).

- Acting and Directing Workshops I and II (225.301 and 225.302).

- At least one from among any of the following:
  – Acting and Directing Workshop III (225.303).
  – Acting and Directing Workshop IV (225.304).
  – Directing Seminar (225.307).
  – Any Writing Seminars playwriting course.
  – Play Production and Stage Management (225.309).
  – Technical Direction for the Theatre (225.314).
  – Acting Workshop: Chekhov and O'Neill (225.312).
  – Any Theatre History course approved or not used above.

Courses

225.300 (H) Contemporary Theatre and Film: An Insider's View
An introduction to the performing arts, including an overview of theatre history, acting styles, and the interaction of art and society. A personal view from inside.
Astin   3 credits

225.301 (H) Acting and Directing Workshop I
An introduction to the fundamentals of acting through exercises, Shakespearean sonnets, improvisation, and work on scenes from established plays, based on the teachings of Stanislavsky, Greet, Boleslavsky, Michael Chekhov, Clurman, and Meisner. This course also includes a brief survey of major playwrights. Eight plays will be read, analyzed, and employed in scene work.
Astin   3 credits

225.302 (H) Acting and Directing Workshop II
The Sanford Meisner repetition exercises are introduced. They, along with the Uta Hagen exercises, form the basis of Workshop II, which also includes an introduction to affective memory and building a character through the "reality of doing." Substantial out-of-class time must be spent on reading, rehearsals, and exercises. Prerequisite: completion of first workshop.
Astin, Denithorne   3 credits

225.303 (H) Acting and Directing Workshop III
Continuation of the Meisner exercises, as the student learns to tap the sources of emotional preparation. Improvisation and its uses in working on specific roles. Increased emphasis on preparation and the various approaches to it. Further work with the text and voice. Directing students will begin to direct actors.
Astin   3 credits

225.304 (H) Acting and Directing Workshop IV
An advanced class for actors who have gained some control over their instruments and are ready for character work and full performances. Work will be coordinated with productions in which the actor performs and in which the directors direct. Play analysis, characterization, fullness of performance, diction, accents, and other elements of building a performance are covered. Prerequisite: Workshop III.
Astin   3 credits

225.307 (H) Directing Seminar
Fundamentals of mounting, casting, and staging the play; various theories of directing; students must commit to a practical lab. It is understood that students have a working familiarity with acting fundamentals.
Glossman   3 credits

225.308 (H) Shakespeare in Performance
A hands-on workshop in performing Shakespeare, including work on voice, diction, content, and the use of analysis to complement the actor's intuitive feeling for verse, with a goal of both poetry and sense in the result.
Glossman   3 credits

225.309 (H) Play Production and Stage Management
Students will learn the basics of producing a play, including play selection, budgeting, organization, and management of the staff during both the pre-rehearsal and rehearsal periods. The second half of the semester will detail the job of the stage manager and relationships with crew, producer, director, and actors. Students will be expected to participate in lab activities outside of class hours.
Astin, Staff, and Visitors   3 credits

225.310 (H) Stagecraft
A hands-on approach to the technical and theoretical elements of production. Meets in the Merrick Barn Scene Shop.
Roche   3credits

225.311 (H) Advanced Scene Study
Classes and scenes tailored to the needs of the actors. Some rehearsal will take place during school hours. It is expected that substantial out-of-class time be spent on rehearsals and exercises.
Astin   3 credits

225.312 (H) Acting Workshop in Chekhov and O'Neill
Using the plays of Anton Chekhov and Eugene O'Neill, this workshop applies the acting fundamentals from Workshops I and II in both preparation and scene work as the student employs the basics in order to build a character for the stage. Play analysis is included. Prerequisite: Workshop II or Workshop I and permission.
Astin, Glossman   3 credits

225.313 (H) The Story Of Theatre—An Introduction To Drama and Performance.
An exploration of world theatre from the Greeks to modern times, including the major playwrights and their plays, performance styles throughout the ages, and the surrounding social and cultural contexts. Limit 30.
Staff   3 credits

225.314 (H) Technical Direction for the Theatre
An introduction to technical direction, including pre-production and production with an overview of materials, tools, rigging and safety, together with design and its implementation.
Roche   3 credits

225.320 (H) Performance
In addition to class time, the advanced student is given a major assignment in a production. The student must be prepared to spend considerable hours outside class in rehearsal and preparation. Permission required.
Denithorne, Astin   4 credits

225.321 (H) The Actor/Director/Playwright Lab—A Collaborative Workshop
Student actors, directors, and playwrights will explore their respective crafts with emphasis on process and individual artistic growth. Participants in the class will also collaborate on the creation of new material for the stage. Prerequisite: at least one course in acting, directing, or

playwriting. Permission required. Contact instructor at 6-0618.

Denithorne   3 credits

225.324 (H,W) Adaptation for the Stage
For aspiring playwrights, dramaturgs, and literary translators, this course is a workshop opportunity in learning to adapt both dramatic and non-dramatic works into fresh versions for the stage. Students with ability in foreign languages and literatures are encouraged to explore translation of drama as well as adaptation of foreign language fiction in English. Fiction, classical dramas, folk and fairy tales, independent interviews, or versions of plays from foreign languages are covered.

Martin   3 credits

225.325 (H,W) The New American Theatre
Emphasizes powerful new trends within American theatre, bringing together an important circle of playwrights, directors and theorists. Mamet, Bogart, Shepard, Fornes, Parks, Bogosian, S. Hanley, Wallace, August Wilson, Kushner, and Ruhl. The course terminates with group presentations and casebooks.

Martin   3 credits

225.326 (H,W) Three Giants Of Theatre: Ibsen/Strindberg/Brecht
This course explores the wide ranging works of three giants of the modern drama that shaped, and then reshaped, the 20th-century theatre. The roots of both the conventions of today's theatre and contemporary innovative work lie with these writers. We will also explore putting scenes on their feet utilizing the acting approaches of Stanislavsky, Vakhtangov, and Brecht. Plays include Peer Gynt, The Wild Duck, The Ghost Sonata, The Dream Play, Threepenny Opera, Mother Courage, and others, with theatre theory excerpts from Brecht and Antonin Artau.

Martin   3 credits

225.327 (H,W) Theatre History and Dramatic Traditions I
Draws upon plays and performance from classical antiquity to the Middle Ages, in East and West. Part one will cast a light on modern theatre by tracing these older traditions and "structures" in major works by modern playwrights, directors, and artists.

Martin   3 credits

225.344 (H,W) Theatre History and Dramatic Traditions II
Traces the evolution of the drama and performance from Shakespeare up to the 20th-century, with a special emphasis on comic and tragic traditions—and the new "hybrid" forms which emerged in the modern age. Shakespeare, Webster, Moliere, Racine, and Commedia dell'Arte, alongside Bond, Brecht and other moderns.

Martin   3 credits

225.345 (H,W) History of Modern Theatre and Drama
Designed to impart a deepened appreciation and understanding of today's theatre by surveying the major playwrights, historical movements, and theatre practices of the 20th-century. The course also seeks to help students understand theatre's relationship to the societal and political power structure of each era and to introduce students to great dramatic literature in its intended form, which is performance.

Denithorne   3 credits

225.346 (H) Creative Improvisation
An exploration of the imagination and the senses using basic techniques of improvisation. Exercises, conflict resolution, ensemble building, and theatre games. Texts: Spolin, Johnstone, LaBan and Feldencreis. Open to all students.

Denithorne   3 credits

225.375 (H) Critical Moments in 20th-Century Radical Theatre
An in-depth examination of selected significant events in 20th-century American radical theatre.

Walters, Astin   3 credits

225.520 (H) Independent Study: Special Projects in Theatre
Special projects created for and tailored to the individual theatre student. Permission required.

Astin

The Humanities Center

300.333 (H) The Dramatic Event
An eclectic tour of theatrical spaces, forms, and texts from Athens to the present. Interpretation through performance with comparative study of dramatic and cinematic representation. Comic and tragic perspectives.

Macksey   3 credits

The Writing Seminars

220.139 (H) Introduction to Playwriting Workshop
Students tackle the rough magic of writing—and rewriting—for the stage through a practical examination of the basic principles of dramatic action, character, and language. Analysis of works by past masters (e.g., Shakespeare, Molière, Ibsen), as well as contemporary practitioners like Vogel, Churchill, and Guare, supplement writing exercises and assignments.

Lapadula   3 credits

220.303-304 (H) Advanced Playwriting
Intensive workshop development of one play. Repeatable for credit with permission of instructor. Year course, though first semester may be elected separately.

Lapadula   3 credits

220.310 (H) Dramatic and Narrative Poetry Workshop
Intensive practical training in writing blank verse for plays and longer narratives, with models taken from Elizabethan plays and from modern dramas by W.B. Yeats, T.S. Eliot, Maxwell Anderson, etc., and from long narrative poems such as Wordsworth's *The Prelude.*

Irwin   3 credits

Program for the Study of Women, Gender, and Sexuality

The Program for the Study of Women, Gender, and Sexuality (WGS) promotes interdisciplinary scholarship on women, gender, sexuality, and related issues. The program coordinates a wide array of course offerings for both undergraduate and graduate students. It incorporates non-Western intellectual traditions where gender and sexuality are discussed in relation to class, ethnicity, and race in everyday life, political organization, and situations of violent conflict. The program also provides opportunities for intellectual exchange across disciplines by sponsoring lectures, symposia, seminars, and workshops for faculty and students alike. Through both interdisciplinary and specialized courses, students are encouraged to develop critical and comparative approaches to the study of gender and associated topics; race, class, and violence being among them.

Courses in the program are taught by prominent faculty members from many disciplines and are cross-listed through a variety of departments. New courses are added each year. Recent offerings have included Feminist and Queer Theory, The Poetics and Politics of Sex, and seminars that incorporate non-Western perspectives on religion and sexuality. WGS also offers a Seminar/Practicum, where students combine volunteer work in a local social service agency with a seminar that explores the connections between social justice and academic inquiry. Each of these courses is offered on a regular basis. Together, they form the basis of a flexible minor. More generally, the minor—which is open to students from any department—aims to help integrate work undertaken across a broad range of offerings in the humanities, sciences, and social sciences.

A sample of cross-listed courses follows. Not all courses are offered every semester. Complete information regarding the Program for the Study of Women, Gender, and Sexuality courses appears in the departmental listing of the School of Arts and Sciences fall and spring schedules.

Director: Paola Marrati

Sam Chambers, Professor (Political Science).

Jennifer Culbert, Professor (Political Science).

Veena Das, Krieger-Eisenhower Professor (Department of Anthropology and Humanities).

Hent de Vries, Professor (Humanities and Philosophy).

Jonathan Ellen, M.D., Professor (Pediatric Medicine).

Aaron Goodfellow, Visiting Assistant Professor (Anthropology).

Lori Leonard, Professor (Health, Behavior and Society, Bloomberg School of Public Health).

Paola Marrati, Professor (Humanities and Philosophy).

Katrin Pahl, Professor (German and Romance Languages).

Todd Shapard, Professor (History).

Dimitrios Yatromanolakis, Assistant Professor (Classics).

Minor

The requirements for the minor consist of six one-semester courses chosen from offerings cross-listed with the Program for the Study of Women, Gender, and Sexuality. At least two of these courses must be drawn from the humanities division and social science divisions, respectively. In addition, it is suggested that minors take two of the four core courses, but only one is required. In the recent past, the core courses have been Feminist and Queer Theory, Gender and Health, The Poetics and Politics of Sex, and The Body of Islam. Students must check with the most recent course catalog for a description of the courses constituting the core. Two introductory 100- or 200-level courses may be counted toward the minor. With approval, students may elect to apply two semesters of independent study to fulfill the minor requirements. Courses counted toward the minor can also be used to meet university distribution requirements. Students electing to minor in the Program for the Study of Women, Gender, and Sexuality may declare their intention to the program at any time, but they are encouraged to seek advice about course selection early in their academic careers.

Courses

Please refer to departmental listings for more complete information. Some of these courses are offered on an irregular basis.

Africana Studies

362.175 Remembering the Black Power Movement
362.320 African Americas and American Medicine
362.457 Richard Wright and Modernism: Philosophy, Literature, Politics

Anthropology

070.327 Poverty's Life: Anthropologies of Health and Economy
070.351 Political Life of Gender
360.403 The Family in Economic and Anthropological Discourse
070.661 Anthropology of Cultures and Relatedness

Art History

010.317 The Face of God (and other Body Parts)
010.344 From Virgin to Venus. Venetian painting and the Invention of Art

Behavioral Biology

290.420 Origins of Human Sexual Orientation and Variation

Biophysics

250.351 Reproductive Physiology

Classics

Economics

180.252 Economics of Discrimination
180.289 Economics of Health

English

Film and Media

German and Romance Languages and Literatures

213.377 Mermaids and Water Sprites
213.648 The Multilingual Culture of Weimar Berlin

History

100.219 The Chinese Cultural Revolution
100.498 Colloquium: History of Family and Gender in the United States
100.765 Problems in Women's History
100.766 Problems in Women's History

History of Science and Technology

Humanities

300.303 Early Modern Women Writers: Poetry of the European Renaissance
300.335 Proust and Philosophy
300.363 Reading Judith Shakespeare: Women Playwrights of Early Modern England
300.383 What Makes Us Desire

Interdepartmental

360.208 Re-Writing Women in Mexico
360.233 Feminist and Queer Theory
360.262 Gender, Sexuality, and Law
360.376 The Body of Islam
360.457 Gender and Health

Near Eastern Studies

130.331 The Politics of Sexuality in the Bible and Ancient Near East
130.330 Sex and the Garden
130.325 Women in Ancient Egypt

Political Science

191.352 The Body Politic
190.613 Politics of Materialism
190.620 Women in Dark Times
190.638 Contentious Politics
190.647 Black Political Thought

Psychology and Brain Sciences

200.204 Human Sexuality

Sociology

230.324 Gender and Development
230.614 Seminar on the Family

The Writing Seminars

The Writing Seminars exists for those students who want to combine imaginative writing with scholarship in the general context of the humanities.

The Faculty

John Barth, Professor Emeritus: fiction.
Glenn Blake, Senior Lecturer: fiction.
Tristan Davies, Senior Lecturer: fiction.
John T. Irwin, Decker Professor in the Humanities: criticism and poetry.
Matthew Klam, Assistant Professor: fiction.
Brad Leithauser, Professor: fiction.
Alice McDermott, Richard A. Macksey Professorship for Distinguished Teaching in the Humanities: fiction.
Jean McGarry, Professor (Co-chair): fiction.
Mary Jo Salter, Andrew W. Mellon Professor in the Humanities (Co-chair): poetry.
Dave Smith, Elliott Coleman Professor of Poetry: poetry.
Greg Williamson, Senior Lecturer: poetry.

Visiting Appointments

Wayne Biddle, Visiting Associate Professor: nonfiction.
Ann Finkbeiner, Visiting Associate Professor: science writing.
Marc Lapadula, Visiting Assistant Professor: playwriting/screenwriting.

Undergraduate Programs

Writing Seminars 220.105-106 Introduction to Fiction and Poetry Writing is a prerequisite for all majors and others who want to take advanced courses in writing.

Requirements for a B.A. Degree (through the class of 2014)

(See also General Requirements for Departmental Majors, page 48.)

Students choose a genre concentration: fiction, poetry, generalist.

- Two Introductory courses (200-level); both may be taken in the selected genre.
- One Intermediate course (300-level) in the selected genre.
- One Advanced Workshop (400-level) in the genre.
- One Readings course (400-level) in the genre.
- One Writing Seminars course beyond IFP outside the selected genre.
- A total of 8 courses beyond 220.105-106.

In addition, students must take:
- Two semesters of Introduction to Fiction and Poetry (220.105 and 106).
- Four semesters of literature.
- Two semesters of philosophy (The Writing Seminars strongly recommends that its majors select at least one course from the following: Philosophic Classics, Philosophic Problems, Introduction to Greek Philosophy, or Introduction to History of Modern Philosophy).
- Two semesters of history (may include one course in History of Art or History of Science and Technology. Majors are encouraged to take at least one semester of History of Occidental Civilization).
- Demonstrate competence in a foreign language through the intermediate college level.

Requirements for a B.A. degree

(Class of 2015 and later. Optional for class of 2012–14)
- Two semesters of Introduction to Fiction and Poetry (220.105 and 106).
- Four semesters of English literature or other literature with adviser's approval.
- Two semesters in the Department of Philosophy. It is strongly recommended that at least one be selected from either Philosophic Classics or the department's introductory courses. Philosophy courses from other departments maybe used with adviser's approval.
- Two Semesters in the Department of History. Majors are encouraged to take at least one semester in the History of Occidental Civilization. May include one course from History of Art or from History of Science and Technology.
- Demonstrated competence in a foreign language through the intermediate level. Any language requirement waived by exam must be documented on transcript or in the Advising Office before the checklist will be accepted.

Beyond IFP 1 and 2 (220.105 and 106) in the major:
- One semester of Introduction to Fiction.
- One semester of Introduction to Poetry.
- One semester of fiction at the 300-400 level.
- One semester of poetry at the 300-400 level.
- One advanced writing workshop.
- Three elective semesters beyond IFP within the department.

Requirements for an Undergraduate Writing Seminars Minor (through the class of 2013)

A minor in The Writing Seminars is available only to selected undergraduate students (up to and including the class of 2013) who apply to the department's director of undergraduate studies. The requirements for a minor are:

- Two semesters of Introduction to Fiction and Poetry (220.105 and 106).
- One semester of English literature.
- One semester of history.
- One semester of philosophy.
- Demonstrated competence in a foreign language through the intermediate level.
- Five semesters (total) beyond IFP in The Writing Seminars.

Graduate Programs

The Writing Seminars offers a master of fine arts (M.F.A.) in fiction and poetry. Students admitted to the M.F.A. program enroll in two years of course work and produce a substantial manuscript in the form of a novel or collection of fiction or poetry. M.F.A. candidates are chosen on the basis of a manuscript, college transcripts, GRE scores, and appropriate letters of recommendation that testify to the student's ability and willingness to undertake serious study in the literary arts. Since all students receive financial aid in the form of full tuition and a teaching assistantship, applicants must be able to demonstrate aptitude for college teaching.

The program requires two full years of residency in Baltimore. Students enroll each semester in two courses: a writing workshop in poetry or fiction and a second course in craft or literature taught within the department. Poets study with Dave Smith, John T. Irwin, and Mary Jo Salter. Fiction writers take courses with Alice McDermott, Jean McGarry, Brad Leithauser, and Matthew Klam. At the end of the first year, students present half of their theses for faculty review. Successful completion of this work is a requirement for continuation in the second year.

The M.F.A. degree in The Writing Seminars is designed for students committed to the study and practice of literary writing at the highest level of accomplishment. Approximately five poets and five fiction writers will be admitted annually. Our pedagogy emphasizes genre-informed discussions, faculty conferences, independent readings, and interactions with visiting writers. Culminating in a book-length thesis, this immersion in literary study is designed to inculcate the habits and skills necessary for a productive writer's life.

Students applying to the M.F.A. program should have a bachelor's degree. All must demonstrate competence in a foreign language at the second-year college level.

M.A. in Writing about Science

Writing about Science is a two-semester program leading to a master of arts degree. The program requires workshops in which student writing is criticized for form and substance, and the production of a thesis in the form of a long essay or series of articles. All students take Science Stories, a weekly series of conferences with scientists engaged in research. Students interview, analyze and write accounts of these reports.

Science-writing students focus on developing stories and on presenting the science clearly, accurately, and seamlessly. Students enroll in three courses per semester. Elective courses can be chosen from, among others, the sciences, public health and the history and philosophy of science. Internships can be arranged. Some tuition remission and teaching assistantships are available.

Undergraduate Seminars

Permission is required for all courses unless otherwise indicated.

220.105 (H,W) Introduction to Fiction and Poetry: Telling It Straight

A course in realist fiction and traditional verse, with readings in Eudora Welty, Vladimir Nabokov, Henry James, Robert Frost, Paul Fussell, John Gardner, Seamus Heane, and Gwendolyn Brooks. This first course for writers is a study of forms of short fiction and metered verse. Students compose short stories and poems; includes practice of critical attention to literary models and workshop of student writing. IFP 105 must be taken before 220.106, IFP II, Telling It Slant. Permission not required. Section limit: 17.

Blake and Teaching Fellows   3 credits

220.106 (H,W) Introduction to Fiction and Poetry: Telling It Slant

The second half of IFP, a course in counter-traditional anti-realist fiction and free verse (Emily Dickinson, Virginia Woolf, Elizabeth Bishop, Franz Kafka, Italo Calvino, and William Carlos Williams). This course will follow the format of 220.105, IFP I, described above, and should be taken after the completion of 220.105. Limit 17.

Blake and Teaching Fellows   3 credits

220.108 (W) Introduction to Fiction and Nonfiction I
A course in realist fiction and nonfiction, with readings by Eudora Welty, Vladimir Nabokov, Henry James; George Orwell, Beryl Markham and Truman Capote. Students compose short stories and essays with attention to literary models. IFN I can be substituted for IFP I. Permission not required. Limit 17.
Simpson   3 credits

220.200 (H) Introduction to Fiction
A study in the reading and writing of short narrative with focus on basic techniques of subject, scene, beginnings and endings. Students do weekly sketches, present story analyses, and write a complete story for workshop critique. Parallel readings from such masters of the form as Henry James, James Joyce, Ivan Turgenev, and others. IFP 105 and 106 required for admission. Limit: 15.
Blake, Davies, Klam   3 credits

220.201 (H) Introduction to Poetry
A study of the fundamentals and strategies of poetry writing. This course combines analysis and discussion of traditional models of poetry with workshop critiques of student poems and student conferences with the instructor. Admission requires successful completion of both IFP 105 and 106. Limit: 15.
Irwin, Smith, Salter, Williamson   3 credits

220.202 (H,W) Introduction to Nonfiction: Matters of Fact
A first course in nonfiction writing, emphasizing how facts can be woven into narrative forms to portray verifiable, rather than imagined, people and events. Students read and discuss model works, then write frequent papers to refine their own style. Limit: 15.
Biddle   3 credits

220.203 (H,W) Introduction to Science Writing
Science writing translates science to nonscientists. Students read, interview scientists, organize, write initial drafts, then revise, with practice under journalistic pressures of deadlines and verification. Background in science is useful but not essential. Limit: 15. Permission not required.
Finkbeiner and Teaching Fellows   3 credits

220.204 Introduction to Dramatic Writing: Film
An examination of the screenplay as a literary text and blue-print for production. Professional screenplays will be critically analyzed, with focus on character, dialogue, plot development, conflict, pacing, dramatic foreshadowing, the element of surprise, text and subtext, and visual storytelling. Students write one complete script. Limit: 15.
Lapadula   3 credits

220.205 (H) Introduction to Dramatic Writing: Plays
Students study conventions and strategies of writing for the stage through examination of the basic principles of dramatic action, character, and language. Analysis of works by dramatic masters (e.g., Shakespeare, Moliere, Ibsen), as well as contemporaries such as Vogel, Churchill,

and Guare, with writing assignments and critiques of student writing. Limit: 15.
Lapadula   3 credits

220.303 Intermediate Dramatic Writing: Plays
Intensive workshop development of one play by each student. Repeatable for credit with permission of instructor. Limit: 15.
Lapadula   3 credits

220.316 (H,W) Intermediate Non-Fiction: Opinion Writing
The study of exposition and argument in literary prose, with exposure to journalistic practices. Instructor will assign topics on which students write essays subsequently discussed in class and critiqued for style, grammar, coherence, and effectiveness. Limit: 17.
Staff   3 credits

220.319 (H,W) Intermediate Non-Fiction: Non-Fiction and Non-Fact
A study of differences between accuracy and truth in nonfiction writing. Students discuss mutually correct but incongruent biographies, incompatible news reports, hoaxes, fictitious memoir, and class writing assignments chosen to elicit disparate statements of fact. Limit: 15.
Biddle   3 credits

220.320 Intermediate Poetry: Poetics
A study of how to read poetry closely and how to write critical prose about it. Readings in the course may include: TS Eliot, Robert Frost, John Crowe Ransome, WH Auden, Robert Lowell, Randall Jarrell and others. Limit: 15.
Salter, Smith, Williamson   3 credits

220.322 (H) Intermediate Fiction: Modernist Stories
A study of stories with a realist (Joyce), poetic (Virginia Woolf), or fantasist (Kafka) formal structure, with consideration of how the standard elements of fiction (story, point-of-view, tone, character, endings) function in each. Students will also write their own stories. Limit: 15.
Klam, Leithauser, McGarry   3 credits

220.323 (H) Intermediate Fiction: Describing in Fiction: Colette, Kawabata, Woolf, and Nabokov
Close study of the role in narration of descriptive writing. Readings in Colette, Kawabata, Woolf, Proust. Limit: 15.
McGarry   3 credits

220.324 (H) Intermediate Fiction: Landscape and Setting
Students will write sketches and stories. Limit 15
McGarry   3 credits

220.325 (H) Intermediate Fiction: Story and Plot
The study of plot, with questions, both practical and theoretical, inevitably raised by the short story form. Readings in Chekhov, James, O'Connor, Cheever, Joyce, and Hemingway. Limit: 15.
Davies, Klam, McGarry   3 credits

220.326 Intermediate Fiction: Point of View in Short Fiction

Emphasis in writing assignments to develop concision and economy, with close attention to setting, pace, point of view. Reading will include James, Chekhov, Kafka, Hemingway, Cheever, Borges, Flannery O'Connor, Malamud and Updike. Limit: 15.

Davies, Klam, Leithauser   3 credits

220.327 (H) Intermediate Fiction: Characters

A study of fictional persons in works by Fitzgerald, Joyce, W.C. Williams, and Rilke. Students write sketches and compose at least one complete story. Limit: 15.

Davies, Klam, McGarry   3 credits

220.328 (H) Intermediate Fiction: Narrative Voice

How do writers find a "voice" to narrate their stories? We will examine sources for fictional voice. Students will practice many modes—realist and experimental—of placing characters in the world of the story. Limit 15

McGarry   3 credits

220.329 (H) Intermediate Fiction: Forming the Short Story

Readings in the first hundred years of the short story in the Western tradition. Authors may include Hoffmann, Kleist, Pushkin, Gogol, Turgenev, Maupassant, James, Chekhov, and Wharton. Numerous pastiches will be assigned. Limit: 15.

Davies   3 credits

220.331 (H) Intermediate Fiction: Forms of Fiction

A course in such forms of fiction as romance, confession, anatomy, novel, and short story. Students write sketches and three stories. Limit: 15.

Davies   3 credits

220.333 Intermediate Fiction: The Anatomy

A workshop with readings in encecyclopedic fictional forms. Authors will include Petronius, Robert Burton, and Joyce. Numerous sketches to be assigned including the exploration of digital media. Limit: 15

Davies   3 credits

220.335 (H) Intermediate Fiction: Fiction and Fact

A workshop in the use of fact in fiction, its limits and responsibilities. Special attention will be paid to the anatomical form. Readings will include famous examples of the form as well as writings in contemporary metaphysics. Three fictions will be required. Limit 15

Davies   3 credits

220.337 Intermediate Dramatic Writing: Film

An intensive workshop focusing on enhancing original characterization, plot development, conflict, story, pacing, dramatic foreshadowing, surprise, text and subtext, act structure, and visual storytelling. Students present sections of his/her "screenplay-in-progress" for class discussion. Limit: 15.

Lapadula   3 credits

220.338 Intermediate Fiction: Image and Text

A study of book composition and design. Emphasis on combinations of writing and digital photography, with attention to aesthetic principles and production. Requirements include, but are not limited to, creation of a prose-and-image semester project. Darkroom access is limited to students who have completed 371.146, Basic Black and White Photography. Limit: 15. Cross-listed with Art.

Davies   3 credits

220.339 (H,W) Seminar: Science Stories

The course's model is the scientific press conference. Scientists from different fields talk about their research. Students interview scientists and write short articles. Emphasis is on identifying and structuring a story. Limit 15.

Finkbeiner   3 credits

220.343 (H, W) Intermediate Fiction: Contemporary Asian and American Fiction

An introduction to Asian American literature through study of major novels in the field. Selected novelists include Frank Chin, Ronyoung Kim, Maxine Hong Kingston, Jumpa Lahiri, Chang-rae Lee, Bette Bao Lord, Bharatl Mukherjee, and Amy Tan. Class discussion will mainly center on the content and literary artistry of the novels. Students will be given the opportunity to interpret and reflect on these works in writing; and to try their hand at producing stories or essays, by focusing on subjects of interest from within a broad range of issues concerning race and ethnicity in America. This is a reading and writing intensive course.

Staff   3 credits

220.344 (H,W) The Short-Short Story

A consideration of the short-short story. Students will weekly present in this short-short story form. We will read the following anthologies: Short shorts, Flash fiction, Micro fiction and Sudden fiction. Limit: 15

Blake   3 credits

220.368 (H) Intermediate Fiction: Contemporary American Fiction

This seminar will examine how three schools of American fiction address the fate of linear narrative in the late 20th-century.

Blake   3 credits

220.373 Intermediate Fiction: The Art of the Novel: The Fractured Love Story

This seminar will examine how three schools of American fiction address the fate of linear narrative in the late twentieth century. Ford Madox *The Good Soldier*. Kawabata's *Snow Country* and E.M. Forster's *Howard's End*. We'll study these narratives to see how "love gone bad" structures plot and offers ideal material for psychological exploration. Students will write textual analyses and two short stories.

Staff   3 credits

220.377 (H) Intermediate Poetry: Forms I

A consideration of a variety of poetic forms and conventions, analysis and discussion of characteristic approaches,

with a balance of workshop of student poems. Admission requires completion of Introduction to Poetry. Limit: 15.
Salter, Williamson   3 credits

220.378 (H) Intermediate Poetry: Forms II
An extension of Forms I and a careful reading of eight to 10 contemporary poets and writing imitations of their work. Prerequisite: 220.377. Limit: 15.
Williamson   3 credits

220.380 (H) Intermediate Poetry: Dramatic and Narrative Forms
The study and writing of blank verse for plays and longer narratives, based upon such models as Elizabethan plays, modern dramas by T.S. Eliot, Maxwell Anderson, etc., and long narrative poems such as Wordsworth's *The Prelude*. Limit: 15.
Irwin   3 credits

220.384 (H,W) Intermediate Non-Fiction: I, Me, Mine: American Autobiography
A study of the evolution of non-fiction prose composing an individual's life-story, with readings from Benjamin Franklin to Malcolm X and beyond. Not a workshop course. Limit: 15.
Biddle   3 credits

220.386 (W) Intermediate Nonfiction: Science as a Social Activity
An analysis of knowledge as "value-free" or essentially political, raising practical issues for writing about science and technology. We will discuss the effects of commerce, secrecy, government oversight, press coverage, and other social forces on scientific pursuits.
Biddle   3 credits

220.388 (H,W) Intermediate Non-Fiction: Science and Society
A study of the political and economic context of science and technology. Topics include moral responsibility, conflict of interest, government oversight, secrecy, and press coverage. Not a workshop course. Limit: 15.
Biddle   3 credits

220.390 Intermediate Poetry: Modernist Poetry
The works of Stevens, Crane, Williams, Pound, H.D., Eliot, Stein, Moore, Oppen. The philosophical bases; the entwined courses of art, music, and criticism; the influence of French, Provencal, Chinese, and other poetry. A portrait of an era's flashpoints: expatriation, Pound's anti-Semitism and fascist leanings, boom and bust, technology and progress, wartime, Spengler's Decline of the West, Franier's The Golden Bough, the Harlem Renaissance. Limit: 25.
Staff   3 credits

220.397 Intermediate Poetry: The Lyric Form
A study of the lyric form from image to contemporary song with emphasis on the form's brevity, personal speaker, and rhythmic character. May be taught as a read-ings course in the history of the lyric, as a workshop in writing lyric forms, or as a combination of both. Readings will vary from instructor to instructor, as will required writing. Limit: 15.
Irwin, Salter, Smith, Williamson   3 credits

220.398 Intermediate Poetry: Survey
Staff   3 credits

220.400 (H) Advanced Poetry
The capstone course in poetry writing. Consideration of various poetic models in discussion, some assigned writing, primarily workshop of student poems. Students will usually complete a "collection" of up to 15 poems. Completion of Introduction to Poetry required for admission. Limit: 15.
Irwin, Salter, Smith, Williamson   3 credits

220.401 (H) Advanced Fiction
The capstone course in writing fiction, primarily devoted to workshop of student stories. Some assignments, some discussion of literary models, two or three completed student stories with revisions. Completion of Intermediate Fiction is required for admission. Limit: 15.
Klam, Leithauser, McDermott, McGarry   3 credits

220.402 (H) Readings in Fiction: Novels of Vision: Virginia Woolf and Yasunari Kawabata
We will read Woolf's "The Waves," "To the Lighthouse" and "Between the Acts" along with Kawabata's "Snow Country," "Thousand Cranes," "Sound of the Mountain" and "Beauty and Sadness," examining ways in which east and west use descriptive modes of story-telling. Limit: 15
McGarry   3 credits

220.403 Readings in Contemporary Poetry: The Branch Will Not Break
Confession, place, myth, and image are the four compass points of American poetry best embodied in the work of James Wright. With the work of Wright at the center of the compass, we will read the Selected Poems of four major living poets and discover how these directions and forces play out over the course of a career. Limit: 15
Staff   3 credits

220.404 (H)Readings in Fiction: Narrative Design
A readings course in the novel studying works by Jane Austen, Honore de Balzac, Ivan Turgenev, Henry James, Thomas Mann, Joseph Conrad, and Elsa Morante. Students keep a notebook of critical responses to the novels and write a final paper. Limit: 25.
McGarry   3 credits

220.405 (H) Readings in Poetry: 14th-Century Alliterative Poetry
A course in the poetry of the 14th-century alliterative revival in which students will read and study Middle English works such as *Patience, Cleanness, Pearl, Gawain and the Green Knight*, and *Piers Plowman*. Limit: 15.
Irwin   3 credits

220.406 (H,W) Readings in Fiction: Hard-Boiled Fiction and Film Noir

Students read six novels by Hammett, Chandler, Cain, Burnett, and Woolrich and view seven films made from these novels by Huston, Hawks, Wilder, Dmytryk, Richards, Walsh, and Farrow. Cross-listed with Film and Media Studies. Limit: 15. Lab fee $40.

Irwin   3 credits

220.407(H) Readings in Fiction: The 20th Century

A survey study of novels, novellas, and short stories written by world writers in translation. Readings and course make-up vary from instructor to instructor, as do requirements for student writing. Limit: 20.

Blake, Leithauser, Davies   3 credits

220.408 (H) Readings in Poetry: Introductory Anglo-Saxon

Introduction to the Anglo-Saxon language and Anglo-Saxon poetry in works such as *The Battle of Maldon*, *The Seafarer*, *The Wanderer*, *Widsith*, and *The Dream of the Road*. Limit: 15.

Irwin   3 credits

220.409 (H) Readings in Fiction: Faulkner, Fitzgerald, and Hemingway

An examination of the fiction of three American modernist masters in the context of the early 20th-century movement in the verbal and visual arts. Not a workshop course. Limit: 15.

Irwin, Smith   3 credits

220.410 (H) Readings in Poetry: Four Women Poets

A study of technique and strategy in the poetry of Emily Dickinson, Marianne Moore, Elizabeth Bishop, and Amy Clampitt. Not a workshop course. Limit: 20.

Salter   3 credits

220.411 Readings in Poetry: Sex and Death in Contemporary American Poetry

Between sex and death the body has a varied wild life in American poetry. In a survey of contemporary work this seminar will consider the life of the body, its relationship to the imagination and the kaleidoscopic world of the senses. Reading erotic poems, elegies, poems of sickness and health, and of age and youth, we will find an intimate politics of the body. Students will read and respond critically to American poems written over the last forty years.

Staff   3 credits

220.412 Readings in Poetry: Eliot, Crane, and Stevens

An examination of the poetry of Eliot, Crane, and Stevens in the context of the modernist movement in the verbal and visual arts. Not a workshop course. Limit: 15.

Irwin   3 credits

220.413 Readings in Fiction: Contemporary American Fiction

A survey study of novels, novellas, and short stories by American writers from 1945 to the present. Readings and course make-up vary from instructor to instructor, as do requirements for student writing. Limit: 20.

Blake, Davies, Leithauser   3 credits

220.414 Readings in Poetry: Contemporary Poetry

A study of poetry written since 1945 in the English language, ordinarily by poets from Canada, the Caribbean Islands, England, Ireland, Scotland, and the United States. This is not a workshop course but may require some poems written in imitation of the poems read in class. Limit 25.

Smith   3 credits

220.416 Readings in Fiction: Five from the Fifties

Through short stories, novels, essays, and letters, we will examine five American writers who were emerging or thriving in the middle of the 20th century: Cheever, O'Connor, Salinger, Stafford and Updike. Limit 15

Leithauser   3 credits

220.421 Readings in Poetry: Poetry of War

A study of modern war poetry, especially of the two World Wars, including work by W.B. Yeats, Rupert Brooke, Wilfred Owen, W.H. Auden, Louis MacNeice, Randall Jarrell, Henry Reed, Richard Wilbur, Anthony Hecht. Some poetry concerning other conflicts, from the Trojan War to the war in Iraq, will also be addressed. What is the role of poetry in responding to political events? Students will write critical papers as well as poems.

Salter   3 credits

220.501-502 Independent Study

Prerequisite: permission of individual faculty member. Ordinarily no more than one independent study course may be counted among the eight Writing Seminars courses presented for graduation.

220.507-508 (H) Honors Thesis

For selected undergraduate majors. By invitation only.

220.509-510 Practicing Journalism

This internship is given in conjunction with local media and must be taken on a satisfactory/unsatisfactory basis. It covers many aspects of the operation of a metropolitan newspaper or magazine or TV station. Admission is competitive.

1 credit

220.513-514 Internship: Teaching of Writing

Teaching writing to students in public or private elementary, middle, junior high or high schools. Interns, under supervision of a professional teacher, teach and assist in teaching a course in the writing of fiction or poetry or a combination of both. Interns make up writing assignments, critique student writings, lead workshops, conduct free writing exercises in class, and comment on students' works.

220.570 Intersession Independent Study

220.572 Intersession Practicing Journalism

220.574 Intersession Internship: Teaching of Writing

220.594 Summer Practicing Journalism

220.596 Summer Internship: Teaching of Writing

220.598 Summer Independent Study

Graduate Seminars

220.603 Readings in Fiction: 20th-Century World Literature: First Person

A study of technical and thematic questions such as how "personal" voices are constructed; how reliable they are; what kinds of stories they can tell, and how well they can tell them. Students write an analytic paper and a first person narrative. Readings include Gertrude Stein, *The Autobiography of Alice B. Toklas*; James Joyce, *Portrait of the Artist as a Young Man*; Ford Madox Ford, *The Good Soldier*; Marcel Proust, *Swann's Way*.

McGarry

220.610 Readings in Fiction: Alternatives to Realism

We will look at three strains of non-realistic fiction: surreal fiction (readings to include Franz Kafka and Kobo Abe), supernatural fiction (Henry James, M.R. James, Edith Wharton, Sylvia Townsend Warner), and early science fiction (H.G. Wells, Robert Louis Stevenson).

Leithauser

220.611 Readings in Fiction: Faulkner, Fitzgerald, and Hemingway

A study of the major writings of Faulkner, Fitzgerald, and Hemingway with the corpus of each writer's work being treated as oblique psychobiography.

Irwin

220.612 Readings in Fiction: Poe, Borges

We will look at three strains of non-realistic fiction: surreal fiction (readings to include Franz Kafka and Kobo Abe), supernatural fiction (Henry James, M.R. James, Edith Wharton, Sylvia Townsend Warner), and early science fiction (H.G. Wells, Robert Louis Stevenson).

Irwin

220.613-614 Workshop in Writing about Science

A seminar in the writing of factual prose about scientific matters, whether for the general reader or for professional scientists as audience. Weekly writing, editing, and reading assignments. Prerequisites: approved writing samples.

Finkbeiner

220.620 Techniques of Poetry: Forms

A study of the kinds of poetry written in English, with attention to historical context and strategies of application. Requirements include, but are not limited to, assignments, class presentations, and a semester project.

Irwin, Salter, Smith

220.621 Techniques in Fiction: A Writer's Journal

A study of published writers' journals as examples of work in progress, record keeping and memoir, and as deliberately crafted works of art. Students will write specimen pages in each mode. (James, Chekhov, Kafka, Woolf, Rilke, et al.) Open to undergraduates with permission. Limit: 15.

Leithauser, McGarry

220.623-624 Fiction Workshop

Discussion and critique of fiction manuscripts by students enrolled in the M.F.A. program. Some assignments possible. Limit: 10.

Leithauser, McDermott, McGarry

220.625-626 Poetry Workshop

Discussion and critique of poetry manuscripts by students enrolled in the M.F.A. program. Some assignments possible. Limit: 10.

Irwin, Salter, Smith

220.627 Techniques of Fiction: Characters

Close study of fictional characters as constituted by physical features: face, clothing, gestures and attributes; internal features: personality, ideals, habits; and by social forces: class, religion, education, ethnic group, historical period. We will also consider where authors find their characters, and what stylistic techniques are used to bring these "people" forward with a minimum of strain. We will further consider the constraints fictional form imposes on the creation of characters, limiting what an author may say, wants to say, and is able to say. Readings in Fitzgerald, Joyce, Williams and Rilke, Lukacs, Forster and Aristotle. Limit: 10.

McGarry

220.628 Techniques of Fiction: Landscape and Setting

We will study physical setting in fiction (landscape, weather, houses, furniture, and other objects) in terms of its role in narration and its special techniques. We will read writers who aimed—in the course of telling their stories—to evoke a particular region, class, and era. Readings in Cheever, Taylor, Munro, Merwin, Waldie; Ruskin, Valery, and Wolfflin.

McGarry

220.629 Readings in Poetry: Contemporary Poetry

A study of American and/or British poetry written after 1945 with discussion of aesthetic movements, historical and contextual, and the character of evolution and practices in poetic structures. Readings vary. Limit: 10.

Smith

220.630 Readings in Poetry: Poetic Modernism: Eliot, Crane, and Stevens

Readings in the poetry and prose of Eliot, Crane, and Stevens with attention paid to origins and effects of the Modernist movement in the arts. Limit: 10.

Irwin

220.631 Readings in Poetry: The Modern Sonnet

A study of some of the masters of the sonnet, in both its traditional and more innovative incarnations, in the 20th and 21st century. Poets discussed may include Robinson, Frost, Wiley, Auden, Millay, Cummings, Owen, Bogan, Bishop, Lowell, Merrill, Heaney, Muldoon, others. Students will write imitations as well as their own sonnets or sonnet sequence.

Salter

220.633 Readings in Contemporary Poetry: Walcott, Heaney and Brodsky

A study of three poets—friends, and Nobel laureates—who broadened the contemporary idiom in English. Born outside the U.S., each of these poets has strong American connections (particularly an indebtedness to Robert Frost), but each employs themes and language beyond American culture. Some younger poets they have influenced (Maxwell, Muldoon, Schackenberg) will also be read.

Salter, Smith

220.634 Forms of Poetry: Syllable and Stress

A work in modern uses of poetic forms, from ballads to syllabics to free verse. Readings may include Dickinson, Moore, Lowell, Clampitt, others.

Salter, Smith

220.636 Techniques of Fiction: Varieties of Viewpoint

Readings in writers who develop what might be called "disparate outlooks," including possibly Halldor Laxness, Sylvia Townsend Warener, Gabriel Garcia Marquez, Italo Calvino, Kinglesy Amis, and John Cheever. Limit 10

Leithauser

220.639 Techniques of Fiction: The Short Novel

A study of the novella form of fiction that is longer than short story but shorter than a novel in the attempt to iso-late characteristics and define the form. Readings include 10 novellas. Students write one novella in the course of the semester. Limit: 10.

McDermott

220.640 Readings in Poetry: The Longer Poem

A study of poems motivated primarily by narrative strategy and structure that requires book-length shape. Readings vary but may include Anglo-Saxon and later epics, romances, Milton, Wordsworth, Baudelaire, Whitman, Eliot, Williams, Frost, Warren, Walcott, Irwin, Muldoon, Ondaatje, (Ann) Carson, Voigt, Dove, and others. Short papers accompany class presentation and a seminar project is required. Limit 10.

Smith

220.641 Readings in Poetry: The Lesser and Greater Lyric

A study of short poems, primarily in the English tradition, with emphasis on what lyric form is and has been, what work a lyric may and may not do, and considerations of varieties within the unequivocally dominant shape of the contemporary poem. Readings vary but may focus upon poems defined as image, elegy, ode, verse, monologue, dialogue, prose, and rap. Short papers accompany class presentation and a seminar project is required. Limit: 10.

Smith

Whiting School of Engineering

Engineering education at Johns Hopkins began with the establishment on an engineering school in 1913. Throughout its history, the Whiting School has maintained close ties with the Krieger School of Arts and Sciences, which has led pioneering education and research since the Faculty of Philosophy was assembled in 1876. The Whiting School of Engineering provides its students with an education and research environment that fosters a lifetime ability to create and apply new knowledge and to contribute to their professions.

The Whiting School offers 10 ABET-accredited programs in engineering leading to the bachelor of science degree: biomedical engineering, chemical and biomolecular engineering, civil engineering, computer engineering, computer science, electrical engineering, engineering mechanics, environmental engineering, materials science and engineering, and mechanical engineering. The school also offers B.S. and B.A. degrees in applied mathematics and statistics as well as B.A. degrees in computer science and general engineering.

Our commitment to advanced study and research yields outstanding programs that lead to master's and doctoral degrees. In the descriptions that follow, each department lists its faculty and their research, research facilities, graduate programs, and the elementary and advanced courses they offer. More details can be obtained from the departmental websites, through the Whiting School homepage at **www.wse.jhu.edu**.
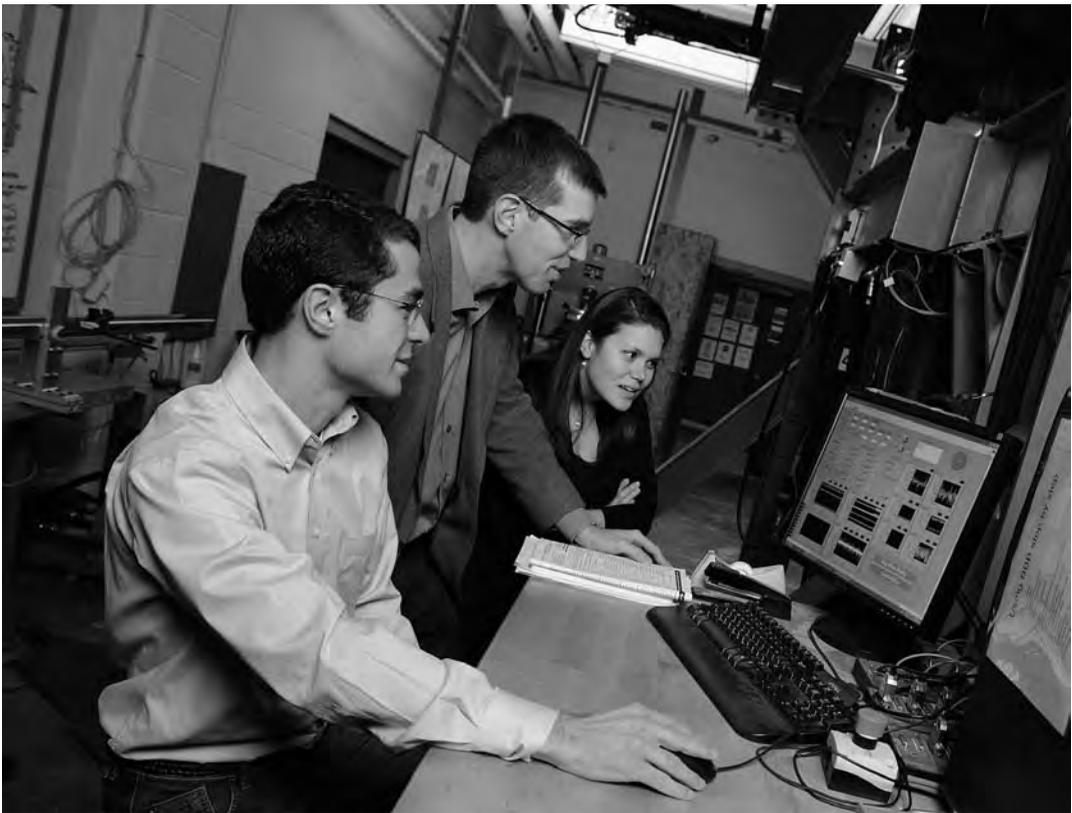
Applied Mathematics and Statistics

The Department of Applied Mathematics and Statistics (**www.ams.jhu.edu**) is devoted to the study and development of mathematical disciplines especially oriented to the complex problems of modern society. A broad undergraduate and graduate curriculum emphasizes several branches of applied mathematics: *Probability*, the mathematical representation and modeling of uncertainty; *Statistics*, the analysis and interpretation of data; *Operations Research*, the design, analysis, and improvement of actual operations and processes; *Optimization*, the determination of best or optimal decisions; *Discrete Mathematics*, the study of finite structures, arrangements, and relations; and *Scientific Computation*, which includes all aspects of numerical computing in support of the sciences.

Probability and Statistics is treated in the curriculum as a single general area, dealing in a unified way with theory and methodology for probabilistic representation of chance phenomena, applications of stochastic modeling to physical and social sciences, formulation of statistical models, fitting of statistical models to data, and interpretation of data. *Operations Research and Optimization* represents a second general area, dealing in unified fashion with the application of optimization theory, mathematical programming, computer modeling, stochastic modeling, and game theory to planning and policy problems such as scheduling, allocation of resources, and facility location. *Discrete Mathematics* includes the traditional themes of graph theory and combinatorics, as well as newer topics arising from modern technological and theoretical developments. The fourth general area, *Computational and Applied Mathematics*, covers topics pertaining to computing, numerical analysis, advanced matrix analysis, and mathematical modeling.

In its fundamental role of representing applied mathematics at Johns Hopkins University, the Department of Applied Mathematics and Statistics is complemented by the Department of Mathematics, with its differing emphasis. Located in the School of Engineering, the Department of Applied Mathematics and Statistics fulfills a special integrative role, stemming in part from the affinity of engineers for applied mathematics and in part from the increasing need for interaction between science and engineering. The mathematical sciences, especially the mathematics of modeling, provide a common language and tools through which engineers can develop closer alliances and cooperation with other scientists.

The department's degree programs include foundational and introductory course work drawing from all areas of the curriculum, along with specialized course work in areas such as probability, statistics, operations research, and optimization. Students, in consultation with their advisors, may develop challenging individual programs. The department emphasizes mathematical reasoning, mathematical modeling, abstraction from the particular, and innovative application, all in a problem-oriented setting. The aim is to prepare graduates for professional careers in the mathematical sciences and related areas, in academic institutions as well as in governmental, industrial, and research organizations.

The undergraduate major in applied mathematics and statistics leads to the B.A. and B.S. degrees. The graduate program leads to the M.A., M.S.E., and Ph.D. degrees. In addition, under a combined bachelor's/master's program, exceptionally able undergraduates may be admitted early to simultaneous graduate work.

The Faculty

David Audley, Senior Lecturer and Executive Director, Financial Mathematics Master's program: financial mathematics, term structure models, fixed income derivatives, and quantitative portfolio strategies.

Beryl Castello, Lecturer: operations research, optimization, facility location, inventory modeling.

Gregory L. Eyink, Professor: mathematical physics, fluid mechanics, turbulence, dynamical systems, partial differential equations, nonequilibrium statistical physics, geophysics and climate.

James A. Fill, Professor: probability, stochastic processes, random structures, and algorithms.

Donniell E. Fishkind, Associate Research Professor: combinatorics, graph theory, matrix analysis.

Donald Geman, Professor: image analysis, statistical learning, bioinformatics.

Youngmi Hur, Assistant Professor: wavelets and other multiscale data representation methologies, statistical applications of wavelet representations, applied harmonic analysis, approximation theory.

Bruno Jedynak, Associate Research Professor: statistical modeling, computer vision, applications to road detection, face detection, skin detection, registration of brain MRI, langage modelling and bioinformatics.

Nam Lee, Assistant Research Professor: probability theory, stochastic processes, and their applications.

Tim Leung, Assistant Professor: financial mathematics, credit risk, employee stock options, stochastic control, optimal stopping.

Daniel Q. Naiman, Professor (Chair) and Director, Financial Mathematics Master's Program: statistics, computational probability, bioinformatics.

Carey E. Priebe, Professor: statistics, image analysis, pattern recognition.

Daniel P. Robinson, Assistant Professor: optimization, numerical analysis, matrix analysis, complementarity problems.

Edward R. Scheinerman, Professor and Vice Dean: discrete mathematics, graph theory, social networks, random methods, partially ordered sets.

Fred Torcaso, Lecturer: stochastic processes, asymptotics, and partial differential equations.

John C. Wierman, Professor: probability, statistics, discrete mathematics, percolation theory, stochastic processes.

L**aurent Younes,** Professor**:** mathematical imaging, shape theory and applied differential geometry, computational probability, statistics.

Joint, Part-Time, and Visiting Appointments

Gregory Chirikjian, Professor (Mechanical Engineering): computational structural biology, applied mathematics, robotics.

John Goutsias, Professor (Electrical and Computer Engineering).

Benjamin F. Hobbs, Professor (Geography and Environmental Engineering): energy and environmental systems and economics.

Pablo Iglesias, Professor (Electrical and Computer Engineering).

Takeru Igusa, Professor (Civil Engineering).

S. Rao Kosaraju, Edward J. Schaefer Professor (Computer Science): design of algorithms, parallel computation, pattern matching, robotics computational geometry.

Scott Levin, Assistant Professor (Emergency Medicine, School of Medicine).

David Marchette, Lecturer (Naval Surface Warfare Center).

Michael I. Miller, Professor (Biomedical Engineering).

Jerry L. Prince, Professor (Electrical and Computer Engineering): multi-dimensional signal processing, medical imaging, computational geometry.

James C. Spall, Principal Professional Staff (Applied Physics Laboratory, System Identification and Modeling Group).

Facilities

The department is located in Whitehead Hall. Office space and liberal access to computing facilities are provided to resident graduate students. A Reading/Commons Room provides the opportunity for informal discussions among faculty and graduate students. The university's Milton S. Eisenhower Library maintains an excellent collection of literature in the mathematical sciences, including all of the important current journals.

Undergraduate Programs

The undergraduate major in applied mathematics and statistics may serve as preparation for employment as an applied mathematician, for graduate study in applied mathematics or related areas, or as a general quantitative training for a career in business, medicine, or other fields. An undergraduate major in applied mathematics and statistics takes an individually tailored program of courses within the department and in the Department of Mathematics (calculus, and perhaps further courses such as differential equations, analysis, complex variables, topology, and modern algebra) and electives in science and engineering. By suitable choice of electives, heavy concentration in a specific field of engineering is possible.

In order to develop a sound program suited to individual needs and interests, the student should consult regularly with the faculty advisor. Additional advisory information, including information about the areas of focus described below, may be obtained from the department office.

With the advice and consent of the faculty advisor, each student constructs an individualized program meeting the requirements below. A written copy of the program should be on file with the faculty advisor, with whom it can be revised and updated from time to time.

Bachelor's Degrees

Departmental majors can earn either the B.A. or the B.S. degree by meeting the general requirements of the School of Arts and Sciences or of the School of Engineering, respectively, the general university distribution requirements, and the departmental requirements. (See General Requirements for Departmental Majors and Writing Requirement in this catalog.)

All courses used to meet the following departmental requirements must be passed with grade of C- or higher:

1. Calculus I, II, and III: The courses 110.106-107 or 110.108-109 can be used to satisfy the Calculus I and II requirements. The courses 110.202

or 110.211 satisfy the Calculus III requirements. Advanced placement is acceptable as well.

2. Two courses in linear algebra and differential equations. These two courses must, collectively, touch both areas. There are two ways to meet this two-course requirement: (a) 110.201 or 110.212 for linear algebra, and 110.302, 110.417, 550.386, or 550.391 for differential equations; or (b) 550.291 for an introduction to both linear algebra and differential equations, and an additional course in linear algebra or differential equations chosen from among the following: 550.385, 550.386, 550.391, 550.692, and 110.417.

3. A course in computing emphasizing numerical/scientific computing: 500.200, 530.106 (taken prior to Fall 2007), 550.281, 550.385, 550.386, 570.210, 580.223, 550.413 (taken Fall 2009 or later) or 550.400 (taken Fall 2008 or later) is acceptable. (Other courses may be substituted with advisor's approval.)

4. A course in discrete mathematics: 550.171, 550.371, 550.471, or 550.472 is acceptable.

5. At least five approved 3- or 4-credit Applied Mathematics and Statistics courses numbered 300 or higher, including an optimization course, typically 550.361, and two courses in probability and statistics, chosen from 550.310, 550.311, 550.420, and 550.430. (Either 550.310 or 550.311 [but not both] can be used for this purpose.) Any course used to satisfy the requirements 1–4 above can be used to meet this requirement. More advanced courses may be substituted with advisor's approval. One course in Introduction to Real Analysis (110.405 or higher), Advanced Algebra I (110.401), or Differential Equations with Applications (110.302) may be used toward the total of five courses. Students may choose to write a senior thesis, but the thesis (550.501) does not count toward the five-course total.

6. Courses coded (Q) totaling 40 credits, of which at least 18 credits must be in courses numbered 300 or higher. (Courses used to meet the requirements above may be counted toward this total.)

7. For the B.S. degree, at least 12 credits coded (N). Laboratory courses that accompany (N) courses may be used in reaching this total. (Courses used to meet the requirements above may be counted toward this total.)

8. A sequence of three approved courses in an area of application (outside the department). At least one of these courses must be quantitatively oriented and be at the 300-level or above. Appropriate fields include, but are not restricted to, biology, biomedical engineering, chemistry, civil engineering, computer science, earth and planetary sciences, economics, electrical engineering, mechanical engineering, physics, psychology, sociology, and systems analysis for public decision making.

Requirements 1–8 together constitute a minimal core program, allowing maximum flexibility in planning degree programs. Students often are able to complete a second major during a four-year program or to proceed to the department's combined bachelor's/master's degree program.

It is highly recommended that students attempt to develop a coherent program of study (see below) or at least take additional departmental courses, in order to establish a broad foundation for a career as an applied mathematician. Of particular importance are additional courses in optimization (550.362), stochastic processes (550.426), statistics (550.413, 550.432, 550.433, 550.434), numerical methods (550.382), dynamical systems (550.391), mathematical modeling and consulting (550.400), scientific computing (550.385, 550.386), and investment science (550.442). Students planning to continue to graduate school in an applied mathematics program are encouraged to consider taking one or more graduate-level courses in probability (550.620, 550.621), statistics (550.630, 550.631), optimization (550.661, 550.662), combinatorics (550.671), graph theory (550.672), numerical analysis (550.681), or matrix analysis (550.692).

Areas of Focus

The department advises students to observe that there are some general areas into which many of our courses fall, and students will benefit from choosing courses carefully from these specific areas in order to pursue a more coherent program of study. These areas and some of the courses within these areas are as follows:

Probability. Students will take
- 550.420 (550.310/311 may *not* be substituted),
- 550.426, and
- one additional course in probability or statistics at the 400-level (or higher) or Introduction to Real Analysis 110.405 (or higher).

Statistics. Students will take
- 550.430 (550.310/311 may *not* be substituted), and
- two of the following courses: 550.413, 550.432 through 550.438.

Optimization. Students will take
- 550.361, and
- two of 550.362, 550.453, and 550.463.

Discrete Mathematics. Students will take
- either 550.471 or 550.472, and
- one additional course from 550.371, 550.471, 550.472, and 550.463.

Scientific Computing. Students will take
- two of 550.385, 550.386, and 550.433.

Financial Mathematics. Students will take
- three of 550.427, 550.442, 550.444, 550.445

Capstone Experience
Students may elect to complete a capstone experience. This consists of taking 550.400 Modeling and Consulting in the fall of their senior year followed by a senior thesis (550.501) during the spring. An oral presentation based on the thesis is required.

Honors
To earn departmental honors, undergraduate majors must earn a GPA of 3.5 or higher in their applied mathematics and statistics courses and do one of the following:
- complete the courses in one of the areas as described above,
- complete a capstone experience as described above, or
- complete the department's combined bachelor's/master's program.

Minor in Applied Mathematics and Statistics
The minor in applied mathematics and statistics should be attractive to students majoring in a variety of disciplines, in both the School of Engineering and the School of Arts and Sciences. The minor provides formal recognition of the depth and strength of a student's quantitative knowledge beyond the minimal requirements of his/her major.

The requirements of the minor in applied mathematics and statistics are the following:
- Completion of an approved program of study containing at least 18 credits in courses coded (Q). The first two courses in calculus (110.106-107 or 110.108-109 or their equivalents) may not be used to fulfill this requirement.
- Among the courses comprising the 18 credits, there must be (a) at least four courses in the Department of Applied Mathematics and Statistics (each of these must be a 3- or 4-credit course); (b) at least three 3- or 4-credit courses at the 300-level or above, of which at least two must be in the Department of Applied Mathematics and Statistics; and (c) an approved semester course based on a high-level computer language (500.200,

550.385, 550.386, 550.400 taken Fall 2008 or later, 550.413 taken Fall 2009 or later, 570.210, 580.223 or 600.107), or one course which requires one of these courses as a prerequisite.
- The grade in each course counted in fulfillment of requirements for the minor must be at least a C-.
- Students may not count all 3 courses, 550.310/311, 550.420, and 550.430 toward minor requirements.
- A student wishing to complete a minor in applied mathematics and statistics may obtain more information from the Applied Mathematics and Statistics Department office.

The W. P. Carey Minor in Entrepreneurship and Management
Offered by the Center for Leadership Education, the minor in entrepreneurship and management focuses on business and management from a multidisciplinary viewpoint, with a quantitative emphasis. The program offers students a diversified learning experience that emphasizes the concepts, practices, and skills necessary for effective leadership as managers and entrepreneurs in the public and private sectors.

Graduate Programs
A wide variety of advanced courses, seminars, and research opportunities is available in the Department of Applied Mathematics and Statistics. In addition to graduate programs in probability, statistics, operations research, optimization, discrete mathematics, and scientific computation, advanced study is possible in interdisciplinary topics in cooperation with other departments, particularly the departments of Biostatistics, Computer Science, Economics, Geography and Environmental Engineering, Health Services Administration, Mathematics, and Sociology. A graduate student in the Department of Applied Mathematics and Statistics may thus develop a program that suits his/her individual interests and objectives.

Various elements of the graduate program are summarized below. Further information is available from the department office.

Admission
To be admitted to an advanced degree program in the department, an applicant must show that he/she has the basic intellectual capacity and has acquired the skills necessary to complete the program successfully within a reasonable period of time. A faculty committee evaluates each applicant's credentials; there are no rigid requirements.

Prospective applicants should submit transcripts of previous academic work, letters of recommen-

dation from persons qualified to evaluate the applicant's academic performance and potential for graduate study, a letter describing anticipated professional goals, and Graduate Record Examination (GRE) scores. Foreign students must submit scores from the Test of English as a Foreign Language (TOEFL). Foreign students applying for teaching assistantships are encouraged to submit scores from the Test of Spoken English (TSE).

Most applicants have undergraduate majors in quantitative fields such as mathematics, statistics, engineering, or a field in the physical sciences, but any major is permitted. Regardless of the major, completion of a program in undergraduate mathematics at least through advanced calculus and linear algebra is essential to begin the normal graduate program.

Requirements for the Master's Degree in Applied Mathematics and Statistics

Students may work toward either the master of arts (M.A.) degree or the master of science in engineering (M.S.E.) degree in applied mathematics and statistics, or the master of science in engineering (M.S.E.) degree in financial mathematics (described in the next section). Both masters degrees in applied mathematics and statistics ordinarily require a minimum of two consecutive semesters of registration as a full-time resident graduate student.

To obtain departmental certification for the master's degree, the student must:

- Complete satisfactorily at least eight one-semester courses of graduate work in a coherent program approved by the faculty advisor. All 600- and 700-level courses are satisfactory for this requirement. Most 400-level courses are also acceptable. For courses used toward the degree, all grades must be C or higher, at most two grades can be below a B-, and the overall average grade point average in these courses must be at least 3.0.

- Meet one of the following two options: (a) submit an acceptable research report based on an approved project; or (b) complete satisfactorily two additional one-semester graduate courses, as approved by the faculty advisor.

- Demonstrate a working knowledge of the utilization of computers in applied mathematics and statistics.

In consultation with the faculty advisor, a candidate for the master's degree plans a complete program of proposed course work and submits it in writing for departmental approval. This should be done early in the first semester of residence.

Doctoral students in other departments may undertake concurrently a master's program in Applied Mathematics and Statistics. Application forms and information are available in the department office.

Requirements for the Master's Degree in Financial Mathematics

The department offers an M.S.E. degree in Financial Mathematics. The structure of this program is summarized below. More detailed information about this program may be found on the department's website at **www.ams.jhu.edu/financialmath/masters.html**.

Full-time students in this program are expected to attend courses for three semesters beginning in the fall semester, a summer internship after the spring semester of their first year, and return for a second fall semester.

For departmental certification for this degree, the student must complete the following courses or approved substitute courses with program approval:

- Core financial mathematics requirements (4 courses): 550.442 Investment Science, 550.444 Mathematical Modeling of Securities and Financial Markets I, 550.445 Mathematical Modeling of Securities and Financial Markets II, and 550.448 Financial Engineering.

- Core applied mathematics requirements (5 courses): 550.427 Stochastic Processes in Finance, 550.433 Monte Carlo Simulation and Reliability, 550.413 Applied Statistics and Data Analysis, 550.439 Time Series Analysis, and 550.461 Optimization in Finance.

- Electives (3 courses): One in Applied Mathematics and Statistics, one course in Financial Mathematics, and one additional course with prior program approval.

- Topics in Financial Mathematics Seminar.

- Computing requirement (includes the Topics in Financial Computing Workshop).

- Communication skills requirement (includes the Communications Skills Practicum).

- Summer Internship

For courses used toward the degree, all grades must be C or higher, at most two grades can be below a B-, and the overall average grade point average in these courses must be at least 3.0.

Requirements for the Bachelor's/Master's Program

Highly motivated and exceptionally well-qualified undergraduates may apply for admission to the combined bachelor's/master's program in applied mathematics and statistics. Interested students should apply no later than fall semester of their junior year.

The requirements for this program consist of those for the bachelor's and master's programs, as well as:

- At least two consecutive semesters of full-time residence after admission to the program.
- Satisfactory completion of at least 145 course credits.

As part of the application for admission to this program, a student submits a current transcript and a complete proposed program of course work which will meet the requirements. Application forms and information are available in the department office.

Requirements for the Ph.D. Degree

The objective of the department's Ph.D. program is to produce graduates who are broadly educated in applied mathematics and statistics and who can work at the current frontiers of their chosen specialized disciplines. The introductory phase of graduate study acquaints the student with a spectrum of topics, provides an opportunity to fill gaps in his or her background, and affords a close view of the doctoral research process and of potential research areas and advisors. Continuation to advanced study and dissertation research is based upon favorable evaluation of preparedness and potential. The progress of students is evaluated at the end of every semester. The culmination of the program is the doctoral dissertation, representing an original and significant contribution to knowledge in applied mathematics.

In addition to fulfilling the university requirement of a minimum of two consecutive semesters of registration as a full-time resident graduate student, the student must accomplish the following to obtain departmental certification for the Ph.D.:

- Pass the Introductory Examination, normally offered immediately before each semester.
- Pass the Ph.D. Candidacy Examination. This oral examination is normally taken in the third year of residency. The scope of the exam will be governed by a syllabus prepared by the student with the help of the student's mentor or advisor.
- Pass the Graduate Board Oral Examination, normally taken in the third year of residence.
- Complete satisfactorily a one year elective course (or the equivalent) in some area of application of applied mathematics and statistics.
- Acquire teaching experience under the supervision of the faculty.
- Demonstrate a working knowledge of the utilization of computers in applied mathematics and statistics.

- Complete a program of original research and its clear exposition in a written dissertation. The dissertation must be approved by at least two faculty readers and be certified by them to be a significant contribution to knowledge and worthy of publication in scholarly journals. The candidate defends the dissertation in a public examination held under the auspices of the department.

Additional details on these items may be found at the department's website.

Course Program

The most common way for students to gain the knowledge and skills to succeed in the Ph.D. program is through course work. In consultation with his or her advisor, each student will develop a program of proposed course work. The relevant courses for the Ph.D. are of three types: basic graduate-level courses, additional specialized courses appropriate to the student's field of research, and an elective one year course selected to broaden the student in applied mathematics. To promote a well-rounded education and record, all full-time graduate students are expected to enroll in an appropriate number of courses for their stage in the program. Students are required to enroll in and attend 550.600, the Applied Mathematics and Statistics Department Seminar, every semester. Grades of B- or better (or equivalent level of performance in pass/fail courses) are expected of all department Ph.D. graduate students in their course work.

Basic Courses: All students are encouraged to master basic material in:

- probability (550.620), statistics (550.630), and stochastic processes (550.426);
- optimization (550.661, 550.662);
- numerical and matrix analysis (550.681, 550.692); and
- discrete mathematics (550.671, 550.672).

Normally, a student will have completed at least eight basic courses by the end of the fourth semester of residence.

Specialized Courses: Each student takes advanced courses appropriate to the proposed area of dissertation research. Sample programs in the areas of probability/statistics, operations research/optimization, discrete mathematics, scientific computation, and numerical analysis are given online at the department's website, but a student with different goals is free to propose an appropriate program meeting the approval of the research advisor.

Elective Courses: A *one-year* graduate course (or the equivalent) in a field distinct from the student's specialized area is required. This is a minimal requirement. Students are encouraged to take more than two semesters of elective course work, either covering one area in depth or covering two areas. Typical areas in other departments are biology, econometrics, mathematical economics, mathematical ecology, computational geometry, systems theory, health systems, mathematics, facility location, psychometrics, and physics. These courses may complement or supplement the student's previous experience, but if a student has no previous experience in an area some elementary course work may be necessary as a prerequisite to acceptable graduate level courses. Although students are strongly encouraged to take the elective courses outside the department, with the approval of the advisor they may be chosen within the department, provided they are 600- or 700-level courses in a field clearly distinct from the student's specialized area.

Financial Assistance

A limited number of teaching and research assistantships providing full tuition and a competitive academic year stipend are available to qualified full-time Ph.D. candidates. Furthermore, the following special fellowships are awarded:

- The Rufus P. Isaacs Fellowship, named in honor of a late member of the faculty acclaimed for his contributions to operations research.

- The Charles and Catherine Counselman Fellowship, generously endowed by Hopkins alumnus Charles Counselman.

In addition, summer employment opportunities are often available within the university and in the Baltimore-Washington corridor.

Undergraduate Courses

Prospective students are invited to discuss with individual instructors the aims and prerequisites of their courses; formal prerequisites are listed to indicate the level and type of background expected and may be waived by the instructor for a student with suitable alternative preparation.

550.100 (E,Q) Introduction to Applied Mathematics and Statistics
A seminar-style series of lectures and assignments to acquaint the student with a range of intellectual and professional activities performed by applied mathematicians and statisticians. Problems arising in applied mathematics and statistics are presented by department faculty and outside speakers. Prerequisite: one semester of Calculus.
Staff   1 credit

550.103 (Q) Mathematics and Politics
Examining interesting problems from the world of politics including apportionment, resource allocation, voting, and conflict, this course is designed for humanities and social science students who enjoy solving logic puzzles.
Scheinerman   4 credits

550.111 (Q,E) Statistical Analysis I
First semester of a general survey of statistical methodology. Topics include descriptive statistics, probability models, random variables, expectation, sampling, the central limit theorem, classical and robust estimation of location, confidence intervals, hypothesis testing, two-sample problems, introductory analysis of variance, introductory nonparametric methods. Three lectures and a conference weekly. Some use of computing with the Minitab statistical package, but prior computing experience not required. Prerequisite: four years of high school mathematics. Students who may wish to undertake more than two semesters of probability and statistics should consider 550.420-430.
Fishkind, Lee, Torcaso   4 credits

550.112 (Q,E) Statistical Analysis II
Second semester of a general survey of statistical methodology. Topics include least squares, regression and analysis of variance, correlation, nonparametric methods, analysis of categorical data, contingency tables and chi-square tests, the likelihood concept, and Bayesian inference. Students who may wish to undertake more than two semesters of probability and statistics should strongly consider the 550.420-430 sequence.
Fishkind, Lee, Torcaso   4 credits

550.122 (Q) Chance and Risk
The course will help students develop an appreciation of probability and randomness, and an understanding of its applications in real life situations involving chance and risk. Applications, controversies, and paradoxes involving risk in business and economics, health and medicine, law, politics, sports, and gambling will be used to illustrate probabilistic concepts such as independence, conditional probability, expectation, and variance. The course is intended primarily for humanities and social science majors. There is no prerequisite beyond high school mathematics; in fact, the course is not open to students who have taken two semesters of calculus.
Wierman   3 credits   spring

550.150 (Q,E) Introduction to Contemporary Applied Mathematics
A survey course aimed at developing, in an accessible way for non-mathematicians, an appreciation for practical mathematical thinking, while exposing students to vari-

ous ways in which mathematics is used to solve real-world problems. The course presents topics from a variety of application areas, including management science, statistics and data analysis, information coding and transmission, social choice and decision making, and the study of size and shape.

Castello   4 credits

550.171 (Q) Discrete Mathematics

Introduction to the mathematics of finite systems. Logic; Boolean algebra; induction and recursion; sets, functions, relations, equivalence, and partially ordered sets; elementary combinatorics; modular arithmetic and the Euclidean algorithm; group theory; permutations and symmetry groups; graph theory. Selected applications. The concept of a proof and development of the ability to recognize and construct proofs are part of the course. Prerequisite: four years of high school mathematics.

Castello, Fishkind, Scheinerman, Torcaso   4 credits

550.211 (Q) Probability and Statistics for the Life Sciences

This is an introduction to statistics aimed at students in the life sciences. The course will provide the necessary background in probability with treatment of independence, Bayes theorem, discrete and continuous random variables and their distributions. The statistical topics covered will include sampling and sampling distributions, confidence intervals and hypothesis testing for means, comparison of populations, analysis of variance, linear regression and correlation. Analysis of data will be done using Excel. Prerequisite: Calculus I.

Jedynak   4 credits

550.230 (Q) Introduction to Biostatistics

A self-contained course covering various data analysis methods used in the life sciences. Topics include types of experimental data, numerical and graphical descriptive statistics, concepts of (and distinctions between) population and sample, basic probability, fitting curves to experimental data (regression analysis), comparing groups in populations (analysis of variance), methods of modeling probability (contingency tables and logistic regression). Prerequisite: 3 years of high school mathematics.

Staff   4 credits   summer

550.251 (Q,E) Mathematical Models for Decision Making: Deterministic Models

This course is an introduction to management science and the quantitative approach to decision making. Our focus will be on deterministic models, in which we assume that all problem parameters are known with certainty. The covered topics may include Linear and Integer Programming, Network Models, Inventory Models (Stationary Demand), Nonlinear Programming, Goal Programming, and Dynamic Programming. We emphasize model development and case studies, using spreadsheets and other computer software. The applications we study occur in manufacturing and transportation systems, as well as in finance and general management.

Prerequisites: One semester of calculus.

Castello   4 credits   spring

550.252 (Q,E) Mathematical Models for Decision Making: Stochastic Models

This course is an introduction to management science and the quantitative approach to decision making. Our focus will be on the formulation and analysis of stochastic models, where some problem data may be uncertain. The covered topics may include Project Scheduling, Decision Analysis, Time Series Forecasting, Inventory Models with Stationary or Nonstationary Demand, Queuing Models, Discrete-Event Simulation, and Quality Management. We emphasize model development and case studies, using spreadsheets and other computer software. The applications we study occur in variety of applications.

Prerequisites: One semester of calculus.

Castello   4 credits   fall

550.291 (Q,E) Linear Algebra and Differential Equations

An introduction to the basic concepts of linear algebra, matrix theory, and differential equations that are used widely in modern engineering and science. Intended for engineering and science majors whose program does not permit taking both 110.201 and 110.302. Prerequisites: one year of calculus, computing experience.

Castello, Hur, Torcaso   4 credits

550.303 (E, Q) Differential Equations

The aim of this course is to present the formulation, solution, and qualitative understanding of differential equations of various types that are used to model real-world phenomena. Topics include first-order, second-order and higher-order differential equations, series solutions, Laplace transforms, systems of equations, numerical methods, and nonlinear equations. Prerequisite: Calculus II.

Eyink, Torcaso   4 credits   spring

550.310 (Q,E) Probability and Statistics for the Physical and Information Sciences and Engineering

An introduction to probability and statistics at the calculus level, intended for engineering and science students planning to take only one course on the topics. This course will be at the same technical level as 550.311. Students are encouraged to consider 550.420-430 instead. Combinatorial probability, independence, conditional probability, random variables, expectation and moments, limit theory, estimation, confidence intervals, hypothesis testing, tests of means and variances, goodness-of-fit. Prerequisite: one year of calculus. Recommended corequisite: multivariable calculus. Students cannot receive credit for both 550.310 and 550.311. Students cannot receive credit for 550.310 after having received credit for 550.420 or 550.430.

Fishkind, Geman, Jedynak, Torcaso   4 credits

550.311 (Q,E) Probability and Statistics for the Biological and Medical Sciences and Engineering

An introduction to probability and statistics at the calculus level, intended for students in the biological sciences planning to take only one course on the topics. This course will be at the same technical level as 550.310. Students are encouraged to consider 550.420-430 instead. Combinatorial probability, independence, conditional probability, random variables, expectation and moments,

limit theory, estimation, confidence intervals, hypothesis testing, tests of means and variances, and goodness-of-fit will be covered. Prerequisite: one year of calculus, Corequisite: 110.202 recommended. Students cannot receive credit for both 550.310 and 550.311. Students cannot receive credit for 550.311 after having received credit for 550.420 or 550.430.

Fishkind, Geman, Jedynak, Torcaso   4 credits

550.361-362 (Q,E) Introduction to Optimization

An introductory survey of optimization methods, supporting mathematical theory and concepts, and application to problems of planning, design, prediction, estimation, and control in engineering, management, and science. Study of varied optimization techniques including linear programming, network-problem methods, dynamic programming, integer programming, and nonlinear programming. Prerequisites for 550.361: one year of calculus, linear algebra, computing experience. Prerequisites for 550.362: 550.361 and multivariable calculus. Appropriate for undergraduate and graduate students without the mathematical background required for 550.661.

Castello, Fishkind, Robinson   4 credits   361 fall; 362 alternate springs

550.371 (Q,E) Cryptology and Coding

A first course in the mathematical theory of secure and reliable electronic communication. Cryptology is the study of secure communication: How can we ensure the privacy of messages? Coding theory studies how to make communication reliable: How can messages be sent over noisy lines? Topics include finite field arithmetic, error-detecting and error-correcting codes, data compressions, ciphers, one-time pads, the Enigma machine, one-way functions, discrete logarithm, primality testing, secret key exchange, public key cryptosystems, digital signatures, and key escrow. Prerequisites: 550.171 (110.204 with permission of instructor), linear algebra, computing experience.

Fishkind, Scheinerman, Torcaso   4 credits spring

550.385 (Q,E) Scientific Computing: Linear Algebra

A first course on computational linear algebra and applications. Topics include floating-point arithmetic, algorithms and convergence, Gaussian elimination for linear systems, matrix decompositions (LU, Cholesky, QR), iterative methods for systems (Jacobi, Gauss–Seidel), and approximation of eigenvalues (power method, QR-algorithm). Theoretical topics such as vector spaces, inner products, norms, linear operators, matrix norms, eigenvalues, and canonical forms of matrices (Jordan, Schur) are reviewed as needed. Matlab is used to solve all numerical exercises; no previous experience with computer programming is required. Prerequisites: Calculus III and 550.291 or approved alternative (e.g., 110.201).

Fishkind, Hur, Robinson   4 credits   fall

550.386 (Q,E) Scientific Computing: Differential Equations

A first course on computational differential equations and applications. Topics include floating-point arithmetic, algorithms and convergence, root-finding (midpoint,

Newton, and secant methods), numerical differentiation and integration, and numerical solution of initial value problems (Runge–Kutta, multistep, extrapolation methods, stability, implicit methods, and stiffness). Theoretical topics such as existence, uniqueness, and stability of solutions to initial-value problems, conversion of higher-order/non-autonomous equations to systems, etc., will be covered as needed. Matlab is used to solve all numerical exercises; no previous experience with computer programming is required. Prerequisites: Calculus III and 550.291 or approved alternative (e.g.,110.201).

Eyink   4 credits   spring

550.391 (Q,E) Dynamical Systems

Mathematical concepts and methods for describing and analyzing linear and nonlinear systems that evolve over time. Topics include boundedness, stability of fixed points and attractors, feedback, optimality, Liapounov functions, bifurcation, chaos, and catastrophes. Examples drawn from population growth, economic behavior, physical and engineering systems. The main mathematical tools are linear algebra and basic differential equations. Prerequisites: multivariable calculus, linear algebra, computing experience.

Castello, Eyink, Scheinerman   4 credits   fall

550.400-401 (Q,E) Mathematical Modeling and Consulting

Formulation, analysis, interpretation, and evaluation of mathematical models. Synthesis of ideas, techniques, and models from mathematical sciences, science, and engineering. Case studies to illustrate basic features of the modeling process. Project-oriented practice and guidance in modeling techniques, research techniques, and written and oral communication of mathematical concepts. Prerequisites: probability, statistics, and optimization at the 300-level or higher.

Castello, Naiman, Torcaso   4 credits

550.413 (Q,E) Applied Statistics and Data Analysis

An introduction to basic concepts, techniques, and major computer software packages in applied statistics and data analysis. Topics include numerical descriptive statistics, observations and variables, sampling distributions, statistical inference, linear regression, multiple regression, design of experiments, nonparametric methods, and sample surveys. Real-life data sets are used in lectures and computer assignments. Intensive use of statistical packages such as S+ to analyze data. Prerequisite: 550.112 or equivalent.

Naiman   4 credits

550.420 (Q,E) Introduction to Probability

Probability and its applications, at the calculus level. Emphasis on techniques of application rather than on rigorous mathematical demonstration. Probability, combinatorial probability, random variables, distribution functions, important probability distributions, independence, conditional probability, moments, covariance and correlation, limit theorems. Students initiating graduate work in probability or statistics should enroll in 550.620. Prerequisite: one year of calculus. Recommended corequisite: multivariable calculus.

Fill, Wierman   4 credits   fall

550.426 (Q,E) Introduction to Stochastic Processes
Mathematical theory of stochastic processes. Emphasis on deriving the dependence relations, statistical properties, and sample path behavior including random walks, Markov chains (both discrete and continuous time), Poisson processes, martingales, and Brownian motion. Applications that illuminate the theory. Prerequisite: 550.420 and linear algebra.
Fill, Torcaso, Wierman   4 credits   spring

550.427 (Q) Stochastic Processes in Finance
A development of stochastic processes with substantial emphasis on the processes, concepts, and methods useful in mathematical finance. Relevant concepts from probability theory, particularly conditional probability and conditional expection, will be briefly reviewed. Important concepts in stochastic processes will be introduced in the simpler setting of discrete-time processes, including random walks, Markov chains, and discrete-time martingales, then used to motivate more advanced material. Most of the course will concentrate on continuous-time stochastic processes, particularly martingales, Brownian motion, diffusions, and basic tools of stochastic calculus. Examples will focus on applications in finance, economics, business, and actuarial science. Prerequisite: 550.420.
Leung, Wierman   4 credits

550.430 (Q,E) Introduction to Statistics
Introduction to the basic principles of statistical reasoning and data analysis. Emphasis on techniques of application. Classical parametric estimation, hypothesis testing, and multiple decision problems; linear models, analysis of variance, and regression; nonparametric and robust procedures; decision-theoretic setting, Bayesian methods. Prerequisite: 550.420 or approved alternative.
Jedynak, Naiman, Priebe   4 credits   spring

550.431 (Q,E) Statistical Methods in Imaging
Cross-listed with 580.466. Denoising, segmentation, texture modeling, tracking, object recognition are challenging problems in imaging. We will present a collection of statistical models and methods in order to address these, including the E.M. algorithm, Maximum Entropy Modeling, Particle filtering, Markov Random Fields, and Belief Propagation. Prerequisites: 110.202, 550.310 or equivalent.
Jedynak   3 credits   spring

550.432 (Q,E) Linear Statistical Models
The general linear model in matrix terms. Techniques of applications, with use of statistical computer packages. Multiple regression, polynomial regression, stepwise regression, multicollinearity, reparametrization, normal correlation models and analysis; basic and multifactor analysis of variance, fixed and random effects. Prerequisites: 550.430, 550.291 or approved alternative.
Naiman, Torcaso   3 credits

550.433 (Q,E) Monte Carlo Simulation and Reliability
The Monte Carlo method has proven to be an indispensable tool in any area of application involving stochastic modeling. The purpose of this course is to expose students to important ideas that arise when we employ the Monte Carlo approach. In the process, several key topics at the interface between numerical analysis, computing, probabilistic modeling, and statistics are covered, including: uniform random number generation, non-uniform random number generation, techniques for variance reduction, importance sampling, design of simulation experiments, Markov chain methods, applications to system reliability, and applications to error estimation for statistical methods. Prerequisites: 550.430, computing experience.
Lee, Naiman   4 credits

550.434 (Q) Nonparametric and Robust Methods
Statistical methodology without strict parametric model assumptions. Exploratory data analysis; linear rank statistics; tests of independence, symmetry, location differences, scale differences, and regression alternatives; chi-square and Kolmogorov–Smirnov goodness-of-fit tests; association analysis; order statistics; nonparametric confidence intervals; nonparametric analysis of variance; influence curves; robust estimation of location and regression parameters. Some use of statistical computer programs. Prerequisite: 550.430.
Priebe   3 credits

550.435 (Q,N) Bioinformatics and Statistical Genetics
Biological research has evolved to the point where complex quantitative tools are playing an ever increasing role. The aim of this course is to survey various computational and statistical methodologies that have been put into play in the analysis of biological data to better understand biological phenomena. A large spectrum of biological applications used to motivate the choice of topics. Probabilistic methods, as well as algorithmic ideas related to the assembly, alignment, and matching of DNA sequences, will be developed, and statistical inference methods for making genotype to phenotype connections will be presented. Prerequisites: 550.310, 550.311 or equivalent.
Naiman   3 credits

550.436 (Q,E) Data Mining
Data mining is a relatively new term used in the academic and business world, often associated with the development and quantitative analysis of very large databases. Its definition covers a wide spectrum of analytic and information technology topics, such as machine learning, artificial intelligence, statistical modeling, and efficient database development. This course will review these broad topics, and cover specific analytic and modeling techniques such as advanced data visualization, decision trees, neural networks, nearest neighbor, clustering, logistic regression, and association rules. Although some of the mathematics underlying these techniques will be discussed, our focus will be on the application of the techniques to real data and the interpretation of results. Because use of the computer is extremely important when "mining" large amounts of data, we will make substantial use of data mining software tools to learn the techniques and analyze data sets. Prerequisite: 550.310 or equivalent. Recommended prerequisite: 550.413.
Jedynak   4 credits

550.437 (Q,E) Statistical Learning with Applications
Statistical modeling and inference, inductive learning and information theory together provide a cohesive framework for machine perception, which amounts to building a data-description machine converting physical measurements (images, molecular counts, etc.) to interpretations or descriptions. Recurring themes include quantifying uncertainty, estimating generalization error, Occam's razor, the bias/variance dilemma and small-sample learning. Various problems in computational vision and computational biology will be analyzed in this context, including visual tracking, object recognition, cancer diagnosis, neural decoding and learning molecular networks. Prerequisites: 550.310 or 550.311 as well as some additional exposure to probability and statistics, e.g., 550.420 and/or 550.430.
Geman   3 credits

550.438 (Q,E) Statistical Methods for Computer Intrusion Detection
This course will give an introduction to the data and methodologies of computer intrusion detection. The focus will be on statistical and machine learning approaches to detection of attacks on computers. Topics will include network monitoring and analysis, including techniques for studying the Internet, and estimating the number and severity of attacks; network-based attacks such as probes and denial of service attacks; host-based attacks such as buffer overflows and race conditions; malicious code such as viruses and worms. Statistical pattern recognition methods will be described for the detection and classification of attacks. Techniques for the visualization of network data will be discussed. The book will be supplemented with readings of various articles. Prerequisite: 550.310 or 550.311, or equivalent.
Marchette   3 credits

550.439 (Q,E) Time Series Analysis
Time series analysis from the frequency and time domain approaches. Descriptive techniques; regression analysis; trends, smoothing, prediction; linear systems; serial correlation; stationary processes; spectral analysis. Prerequisites: 550.310, 550.311 or equivalent calculus-based probability course, 110.201 or 550.291 and mathematical maturity.
Lee, Torcaso   4 credits

550.440 (Q) Stochastic Calculus
Introduction to stochastic integration, stochastic differential equations, and the Ito calculus. Emphasis will be on underlying ideas rather than rigorous development. Stochastic processes, Brownian motion, conditional expectation, martingales, Ito and Stratonovich integrals and their calculus, stochastic differential equations, some applications to finance, stochastic flow systems, or other areas should be provided. Prerequisites: 550.420; stochastic processes recommended, but not required.
Torcaso   3 credits

550.442 (Q,E) Investment Science
Intended for upper-level undergraduate and graduate students, this course offers a rigorous treatment of the subject of investment as a scientific discipline. Mathemat-ics is employed as the main tool to convey the principles of investment science and their use to make investment calculations for good decision making. Topics covered in the course include the basic theory of interest and its application to fixed-income securities, cash flow analysis and capital budgeting, mean-variance portfolio theory, and the associated capital asset pricing model, utility function theory and risk analysis, derivative securities and basic option theory, portfolio evaluation. The student is expected to be comfortable with the use of mathematics as a method of deduction and problem solving. Prerequisites: one year of calculus, an introductory course in probability and statistics (such as 550.310, 550.311 or its equivalent). Some familiarity with optimization is desirable but not necessary.
Naiman, Tzitzouris   4 credits

550.444 (Q,E) Modeling and Analysis of Securities and Financial Markets I
This course will develop the mathematical concepts and techniques for modeling cash instruments and their hybrids and derivatives. Prerequisites: 110.302, 550.420.
Audley   4 credits   fall

550.445 (Q,E) Modeling and Analysis of Securities and Financial Markets II
Advances in corporate finance, investment practice and the capital markets have been driven by the development of a mathematically rigorous theory for financial instruments and the markets in which they trade. This course builds on the concepts, techniques, instruments and markets introduced in 550.444. In addition to new topics in credit enhancement and structured securities, the focus is expanded to include applications in portfolio theory and risk management, and covers some numerical and computational approaches.
Audley   4 credits   spring

550.446 (Q,E) Risk Management Analysis and Hedging
This course applies advanced mathematical techniques to the measurement, analysis, and management of risk. The focus is on financial risk. Sources of risk for financial instruments (e.g., market risk, interest rate risk, credit risk) are analyzed; models for these risk factors are studied and the limitation, shortcomings and compensatory techniques are addressed. Prerequisite: 550.444
Audley   4 credits   spring

550.447 (Q,E) Advanced Portfolio and Investment Theory
This course focuses on modern quantitative portfolio theory, models, and analysis. Topics include intertemporal approaches to modeling and optimizing asset selection and asset allocation; benchmarks (indexes), performance assessment (including, Sharpe, Treynor and Jenson ratios) and performance attribution; immunization theorems; alpha-beta separation in management, performance measurement and attribution; Replicating Benchmark Index (RBI) strategies using cash securities / derivatives; Liability-Driven Investment (LDI); and the taxonomy and techniques of strategies for traditional management: Passive, Quasi-Passive (Indexing) Semi-

Active (Immunization & Dedicated) Active (Scenario, Relative Value, Total Return and Optimization). In addition, risk management and hedging techniques are also addressed. Prerequisites: 550.442 or 550.444.
Audley   4 credits   fall

550.448 (Q,E) Financial Engineering

This course focuses on structured securities and the structuring of aggregates of financial instruments into engineered solutions of problems in capital finance. Topics include the fundamentals of creating asset-backed and structured securities—including mortgage-backed securities (MBS), stripped securities, collateralized mortgage obligations (CMOs), and other asset-backed collateralized debt obligations (CDOs)—structuring and allocating cash-flows as well as enhancing credit; equity hybrids and convertible instruments; asset swaps, credit derivatives and total return swaps; assessment of structure-risk interest rate-risk and credit-risk as well as strategies for hedging these exposures; managing portfolios of structured securities; and relative value analysis (including OAS and scenario analysis). Prerequisites: 550.442, or 550.444 or permission of instructor.
Audley   4 credits

550.453 (Q,E) Mathematical Game Theory

Mathematical analysis of cooperative and noncooperative games. Theory and solution methods for matrix games (two players, zero-sum payoffs, finite strategy sets), games with a continuum of strategies, N-player games, games in rule-defined form. The roles of information and memory. Selected applications to economic, recreational, and military situations. Prerequisites: multivariable calculus, probability, linear algebra.
Castello   4 credits   alternate springs

550.457 (Q,E) Topics in Operations Research

Study in depth of a special mathematical or computational area of operations research, or a particular application area. Recent topics: decision theory, mathematical finance, optimization software.
Staff   3 credits

550.461 (Q,E) Optimization in Finance

A survey of many of the more important optimization methods and tools that are found to be useful in financial applications. Prerequisites: 550.442 or 550.444.
Tzitzouris   4 credits   fall

550.463 (Q,E) Network Models in Operations Research

In-depth mathematical study of network flow models in operations research, with emphasis on combinatorial approaches for solving them. Introduction to techniques for constructing efficient algorithms, and to some related data structures, used in solving shortest-path, maximum-volume flow, and minimum-cost flow problems. Emphasis on linear models and flows, with brief discussion of non-linear models and network design. Prerequisites: 550.361 or 550.661.
Fishkind   4 credits

550.471 (Q) Combinatorial Analysis

Counting techniques: generating functions, recurrence relations, Polya's theorem. Combinatorial designs: Latin squares, finite geometries, balanced incomplete block designs. Emphasis on problem solving. Prerequisites: linear algebra, one year of calculus.
Fishkind, Scheinerman   4 credits   fall

550.472 (Q) Graph Theory

Study of systems of "vertices" with some pairs joined by "edges." Theory of adjacency, connectivity, traversability, feedback, and other concepts underlying properties important in engineering and the sciences. Topics include paths, cycles, and trees; routing problems associated with Euler and Hamilton; design of graphs realizing specified incidence conditions and other constraints. Attention directed toward problem solving, algorithms, and applications. One or more topics taken up in greater depth. Prerequisite: linear algebra.
Fishkind, Scheinerman   4 credits   spring

550.480 (E,Q) Shape and Differential Geometry

The purpose of this class is to provide an elementary knowledge of the differential geometry of curves and surfaces, and to place this in relation with the description and characterization of 2D and 3D shapes. Intrinsic local and semi-local descriptors, like the curvature or the second fundamental form will be introduced, with an emphasis on the invariance of these features with respect to rotations, translations, etc. Extension of this point of view to other class of linear transformations will be given, as well as other types of shape descriptors, like moments or medial axes. Prerequisites: Calculus III and linear algebra.
Younes   3 credits

550.484 (Q,E) Introduction to Wavelet and Fourier Analysis

Wavelets are a relatively new mathematical tool that is introduced to provide an answer to the main shortcoming of the Fourier transform: the fact that it does not represent localized data very well. Wavelets have become a popular tool in signal processing, statistics, and many other areas of applications. This course will introduce wavelet analysis along with basic Fourier analysis. Some simple examples of applications of wavelets will also be discussed. Matlab will be used for all computational examples and homework. Prerequisites: 110.202, linear algebra, some basic computer programming experience.
Hur   3 credits

550.486 (Q,E) Asymptotic Methods

Methods for obtaining approximate analytical solutions to ordinary differential equations and difference equations. Topics vary depending on the instructor, but the course is likely to cover local analysis, asymptotic approximation, expansion of integrals, Laplace's method, Watson's Lemma, perterbation theory, summation of series, multiple scale analysis. Prerequisites: Calculus I and II and an introductory course in differential equations (550.291 or 550.303).
Torcaso   4 credits

550.491 (Q,E) Applied Analysis for Engineers and Scientists

This course will cover techniques and applications of differential and integral analysis that are important for advanced work in engineering and science, including partial differential equations and transform methods. Prerequisites: Calculus 1, 2, 3, and either 550.291 and 500.303, or 110.201 and 110.302.

Eyink   4 credits   fall

550.493 (E,Q) Mathematical Image Analysis (an Introduction to Functional Analysis)

The course introduces a few of the basic concepts of functional analysis and of the calculus of variations, and describes how they apply to low level image processing (denoising, deblurring, contour extraction, image transforms). We will define Hilbert and Banach spaces, orthogonal bases, the notion of duality, and discuss the choice of an appropriate space for images. This will induce linear and nonlinear image smoothing methods, and the Chan-Vese's segmentation algorithm. We will also discuss the extraction of local information from images, including the SIFT and other feature extractors, windowed Fourier and continuous wavelet transforms, and an introduction to orthogonal wavelet transforms. Prerequisites: Calculus III (110.202 or equivalent), linear algebra (110.201 or equivalent).

Younes   3 credits

550.500 Undergraduate Research

Reading, research, or project work for undergraduate students. Pre-arranged individually between students and faculty. Recent topics and activities: percolation models, data analysis, course development assistance, dynamical systems. Offered each semester.

Staff   1-3 credits

550.501 Senior Thesis

Preparation of a substantial thesis based upon independent student research, under the pre-arranged supervision of at least one faculty member in Applied Mathematics and Statistics. Offered each semester.

Staff   1-3 credits

550.505 Applied Mathematics Pedagogy

Opportunity for students to participate in the teaching of applied mathematics under the supervision of a departmental faculty member. Instructor permission required.

Staff   2 credits

550.510 Readings in Actuarial Mathematics

Independent reading of mathematical topics pertinent to the insurance industry and actuarial profession. Arranged individually between students and faculty. Possible topics: risk theory, financial mathematics, mathematical demography, survival models, forecasting.

Fill, Wierman

Graduate Courses

550.600 Applied Mathematics and Statistics Department Seminar

A variety of topics discussed by speakers from within and outside the university. Required of all resident department graduate students. Offered each semester.

Staff   1 hour

550.620 Probability Theory I

Probability as a mathematical discipline, including introductory measure theory. Axiomatic probability, combinatorial probability, random variables, conditional probability, independence, distribution theory, expectation, Lebesgue-Stieltjes integration, variance and moments, probability inequalities, characteristic functions, conditional expectation. Prerequisites: 110.405 and 550.420, or equivalents.

Fill, Leung, Torcaso, Wierman   4 hours   fall

550.621 Probability Theory II

Probability at the level of measure theory, focusing on limit theory. Modes of convergence, Poisson convergence, three-series theorem, strong law of large numbers, continuity theorem, central limit theory, Berry-Esseen theorem, infinitely divisible and stable laws. Prerequisites: 550.620, 110.405, or equivalents.

Fill, Leung, Torcaso, Wierman   3 hours   spring

550.626 Stochastic Processes II

Measure-theoretic treatment of stochastic processes, focusing on continuous parameter processes. Brownian motion and diffusion, renewal processes, continuous-time martingales, stationary processes. Existence and construction, structure, sample path behavior, and asymptotic properties. Prerequisites: 550.426, 550.621.

Fill, Wierman   3 hours

550.630 Statistical Theory I

The fundamentals of mathematical statistics. Distribution theory for statistics of normal samples; exponential statistical models; sufficiency principle; least squares, maximum likelihood, and UMVU estimation; hypothesis testing, the Neyman-Pearson lemma, likelihood ratio procedures; the general linear model, the Gauss-Markov theorem, multiple comparisons; contingency tables, chi-square methods, goodness-of-fit; nonparametric and robust methods; decision theory, Bayes and minimax procedures. Prerequisite: 550.420 or 550.620.

Naiman, Priebe, Younes   4 hours   fall

550.631 Statistical Theory II

Advanced concepts and tools fundamental to research in mathematical statistics and statistical inference: asymptotic theory; optimality; various mathematical foundations. Prerequisite: 550.630.

Naiman, Priebe, Younes   3 hours   spring

550.632 Multivariate Statistical Theory

Theory of statistics when data are in the form of multivariate observations. The multivariate normal distribution; Wishart distributions; inference on means, Hotelling's T2; multivariate linear models; regression, ANOVA; infer-

ence on covariances; classification and discrimination; principal components; canonical correlations; canonical variables. Prerequisites: 550.630, 550.692.
Naiman, Priebe   3 hours

550.633 Time Series Analysis
Time series analysis from the frequency and time domain approaches. Descriptive techniques; regression analysis; trends, smoothing, prediction; linear systems; serial correlation; stationary processes; spectral analysis. Prerequisites: 550.630, 550.692.
Naiman, Priebe   3 hours

550.634 Nonparametric and Robust Inference
Distribution-free statistics; asymptotic relative efficiency of tests; U-statistics; linear rank statistics; one-sample, two-sample, and general regression problems; concepts of robust and adaptive estimation; M-, L-, and R-estimates; nonparametric density estimation. Prerequisite: 550.630.
Staff   3 hours

550.635: Topics in Bioinformatics
A "readings" course organized around research articles in the recent bioinformatics and computational biology literatures. In this term, the choice of papers will favor work on inferring phenotype from genotype, and modeling signaling networks, based on gene microarrays bearing the expression levels of thousands of transcripts, and on properties of proteins, such as predicting active sites and detecting harmful mutations. One major objective is to prepare students to comfortably read articles which involve extensive mathematical and statistical modeling as well as techniques from pattern recognition and machine learning. Most papers will be presented by the students. In addition, student expositions will be preceded by "tutorials" by the instructor on various aspects of statistical learning, modeling and prediction, such as properly estimating generalization error in cancer classification and avoiding over-fitting in learning networks of molecular interactions. Prerequisites: A course in Statistics is required; some previous exposure to machine learning or pattern recognition is recommended. The course is suitable for prepared seniors through doctoral students in both the life sciences and engineering.
Geman   3 hours

550.640 Machine Learning
This course will focus on theoretical and practical aspects of statistical learning. We will review a collection of learning algorithms for classification and regression estimation, including linear methods, kernel methods, tree-based and boosting methods; we will also discuss unsupervised methods for linear and nonlinear data reduction and clustering. We will introduce fundamental concepts of the theory of model selection and validation: bias/variance dilemma, penalty methods, and some measures of complexity; the course will also include standard validation algorithms, like cross-validation and bootstrap. Prerequisite: 550.430.
Younes   3 hours

550.643 Graphical Models
This course describes how models based on networks encoding the conditional dependency structure between random variables, also called graphical models, can be used to design multivariate probability distributions. A special focus will be made on important particular cases, like Markov Chains, Bayesian networks or Markov Random Fields. We will also discuss parametric estimation and inference problems, and issues arising when some of the variables cannot be observed. Prerequisites: 550.420 or equivalent, 550.430 or equivalent.
Younes   3 hours

550.651 Financial Mathematics
Advanced introduction to no-arbitrage derivatives pricing theory. Fundamental theorems of asset pricing, equivalent martingale measures, dynamic hedging and the martingale representation theorem. Stochastic models for pricing equity, fixed income, and credit-linked derivatives. Stochastic control with application to portfolio optimization. This course assumes a working familiarity with Brownian motion, and stochastic differential equations (e.g. Ito's lemma.) Prerequisite: 550.427, 550.440, 550.426 or 550.621.
Leung   3 hours

550.661 (Q,E) Foundations of Optimization
Study of the fundamental theory underlying linear and nonlinear optimization. Unconstrained optimization, constrained optimization, saddlepoint conditions, Kuhn-Tucker conditions, linear programming, the simplex algorithm, post-optimality, duality, convexity, quadratic programming. Prerequisites: multivariable calculus, linear algebra. Corequisite: 110.405.
Robinson   4 hours   fall

550.662 Optimization Algorithms
Design and analysis of algorithms for linear and nonlinear optimization. The revised simplex method, the primal-dual algorithm, algorithms for network problems, first- and second-order methods for nonlinear problems, quadratic programming techniques, and methods for constrained nonlinear problems. Prerequisite: 550.661.
Robinson   4 hours   spring

550.663 Stochastic Search and Optimization
An introduction to stochastic search and optimization, including discrete and continuous optimization problems. Topics will include the "no free lunch" theorems, beneficial effects of injected Monte Carlo randomness, algorithms for global and local optimization problems, random search, recursive least squares, stochastic approximation, simulated annealing, evolutionary and genetic algorithms, machine (reinforcement) learning, and statistical multiple comparisons. Prerequisites: graduate course in probability and statistics and knowledge of basic matrix algebra.
Spall   2 hours   alternate springs

550.664 Modeling, Simulation, and Monte Carlo
Concepts and statistical techniques critical to constructing and analyzing effective simulations; emphasis on generic principles rather than specific applications. Topics include

model building (bias-variance tradeoff, model selection, Fisher information), benefits and drawbacks of simulation modeling, random number generation, simulation-based optimization, discrete multiple comparisons using simulations, Markov chain Monte Carlo (MCMC), and input selection using optimal experimental design. Prerequisites: basic matrix algebra and a graduate course in probability and statistics. Familiarity with some programming language such as Matlab, C, C++, or FORTRAN.
Spall   2 hours   fall

550.671 Combinatorial Analysis
An introduction to combinatorial analysis at the graduate level. Meets concurrently with 550.471. See 550.471 for course description. Prerequisites: one year of calculus, linear algebra.
Fishkind, Scheinerman   4 hours   fall

550.672 Graph Theory
An introduction to graph theory at the graduate level. Meets concurrently with 550.472. See 550.472 for course description. Prerequisite: linear algebra.
Fishkind, Scheinerman   4 hours   spring

550.681 Numerical Analysis
Mathematical formulation and analysis of numerical algorithms. Brief review of topics in elementary numerical analysis such as floating-point arithmetic, Gaussian elimination for linear equations, interpolation and approximation. Core topics to be covered: numerical linear algebra including eigenvalue and linear least-squares problems, iterative algorithms for nonlinear equations and least-squares problems, and convergence theory of numerical methods. Other possible topics: sparse matrix computations, numerical solution of partial differential equations, finite element methods, and parallel algorithms. Prerequisites: multivariable calculus, linear algebra, computing experience. Corequisite: 110.405.
Robinson   4 hours   spring

550.692 Matrix Analysis and Linear Algebra
A second course in linear algebra with emphasis on topics useful in analysis, economics, statistics, control theory, and numerical analysis. Review of linear algebra, decomposition and factorization theorems, positive definite matrices, norms and convergence, eigenvalue location theorems, variational methods, positive and nonnegative matrices, generalized inverses. Prerequisites: linear algebra, multivariable calculus, 110.405.
Fill, Fishkind, Robinson   4 hours   fall

550.693 Turbulence Theory
An advanced introduction to turbulence theory for graduate students in the physical sciences, engineering and mathematics. Both intuitive understanding and exact analysis of the fluid equations will be stressed. Prerequisites: previous familiarity with fluid mechanics would be helpful but not required.
Eyink   3 hours

550.694 Turbulence Theory II
This course will continue the theoretical investigation of fluid turbulence, directly following on from 550.693.

Topics to be considered are turbulent vortex dynamics, Lagrangian dynamics, and special topics such as wall-bounded turbulence, free shear flows, two-dimensional and quasigeostrophic turbulence, MHD turbulence, etc. Prerequisite: 550.693.
Eyink   3 hours

550.695 Advanced Parameterization in Science and Engineering
This course will present an overview of topics in science-based parameterization, including dynamics, probability, and other applied mathematical methods. These concepts will be presented in a unified format, with some emphasis on scientific computing. Specific topics include: basic probability, statistical dynamics (moment hierarchies, Liouville/forward equations, path-integral methods), asymptotic closure (homogenization, Chapman-Enskog), closure techniques without any separation of scales (nonlinear Galerkin & weighted residuals, algebraic closures, PDF-based closures, down-scaling), uncertainty quantification (variance & other measures of uncertainty, Bayesian estimation, ensemble methods), hybrid methods.
Eyink   3 hours

550.700 Master's Research
Reading, research, or project work for master's-level students. Arranged individually between students and faculty. Offered each semester.
Staff   1-3 hours

550.720 Topics in Probability and Stochastic Processes
Advanced topics chosen according to the interests of the instructor and graduate students. Recent topics: Brownian motion, diffusion theory, point processes, random walk; convergence rates for Markov processes, infinite particle systems, reversible Markov chains.
Fill, Wierman   2-3 hours

550.721 Percolation Theory
Percolation models are infinite random graph models with applications to critical phenomena, with the phase transition corresponding to a critical probability value. Possible topics: critical probability bounds and exact values, application of lattice theory and stochastic ordering to percolation models, critical exponents, first passage times, AB percolation, multi-type percolation.
Wierman   2-3 hours

550.722 Poisson Convergence
Development of methods for proving convergence to a Poisson limiting distribution. Stein-Chen and coupling methods. Applications to discrete mathematics, e.g., random graphs and random permutations.
Wierman   2-3 hours

550.723 Markov Chains
Recent advances in computer science, physics, and statistics have been made possible by corresponding sharply quantitative developments in the mathematical theory of Markov chains. Possible topics: rates of convergence to stationarity, eigenvalue techniques, Markov chain Monte Carlo, perfect simulation, self-organizing data structures,

approximate counting and other applications to computer science, reversible chains, interacting particle systems.
Fill   2-3 hours

550.730 Topics in Statistics
Advanced topics chosen according to the interests of the instructor and graduate students. Recent topics: applications of differential geometry to statistics, large deviation theory; semiparametric models; mixture models, spatial point processes, nonparametric smoothing, and exploratory data analysis techniques.
Naiman, Priebe, Spall   2-3 hours

550.731 Case Studies in Applied Statistics
The course presents students with theoretical backgrounds with a variety of application areas and types of data where statistical methods and related theoretical developments ought to have significant impact in the near future. Prerequisite: 550.430 or equivalent.
Naiman   2-3 hours

550.735 Topics in Statistical Pattern Recognition
This course will cover topics in classifier design and dimensionality reduction from a statistical perspective.
Priebe   2-3 hours

550.747 Topics in Financial Mathematics
This course is only open to students enrolled in the MSE in Financial Mathematics program. Advanced topics chosen according to the interests of the instructor and graduate students. The course will focus on recent research articles in the financial mathematics literature.
Audley   2-3 hours

550.750 Topics in Operations Research
Advanced topics chosen according to the interests of the instructor and graduate students. Recent topics: probabilistic analysis of algorithms, scheduling theory.
Staff   2-3 hours

550.760 Topics in Optimization
Advanced topics chosen according to the interests of the instructor and graduate students. Recent topics: integer programming, complementarity problems, optimization software, linear programming in combinatorial optimization, mathematical programs with equilibrium constraints.
Robinson   2-3 hours

550.761 Advanced Linear Programming
Further theory and applications of optimizing a linear function subject to linear constraints. An advanced algorithmic or theoretical topic (for example, nonsimplex methods), and/or an advanced modeling or application topic (for example, the use of linear programming in treating Markov decision chains, or stochastic programming) are studied in depth. Prerequisite: 550.661.
Staff   2-3 hours

550.762 Advanced Nonlinear Programming
Theory and applications of optimizing a nonlinear function subject to linear or nonlinear constraints. Duality theory, convex analysis, and nonlinear sensitivity analysis; applications of these techniques to special classes of problems such as geometric programs and location problems. Prerequisites: 110.405, 550.661.
Robinson   2-3 hours

550.764 Optimization of Functionals
Examination from a unified point of view of topics in infinite-dimensional optimization such as the calculus of variations, optimal control theory, and approximation theory. Applications in the physical sciences, engineering, and statistics. Prerequisites: 110.405, 550.661.
Staff   2-3 hours

550.765 Numerical Methods for Optimization
Advanced topics in the design and analysis of numerical methods for solving optimization problems. Algorithms include gradient methods, conjugate direction techniques, quasi-Newton methods, feasible direction methods, and successive quadratic programming. Issues of matrix factorization and updating, data storage, line searches, convergence, efficiency, and numerical stability. Prerequisites: 550.662, 550.681.
Robinson   2-3 hours

550.770 Topics in Discrete Mathematics
Advanced topics chosen according to the interests of the instructor and graduate students. Recent topics: random graph theory, Ramsey theory, partially ordered sets, matroid theory, random structures and algorithms, fractional graph theory, graphs on surfaces.
Scheinerman   2-3 hours

550.771 The Probabilistic Method
One of the most powerful tools currently applied in combinatorics. The course covers the basic method, with applications to graph theory, combinatorics, and especially algorithm design.
Staff   2-3 hours

550.790 Topics in Applied Mathematics
Advanced topics chosen according to the interests of the instructor and graduate students. Recent topics: numerical approximation and ordinary differential equations, functional analysis.
Eyink   2-3 hours

550.791 Neural Networks and Feedback Control Systems
Course is introduction to two related areas: neural networks (NNs) and feedback systems. Course considers important theory and applications for NNs and considers modern control systems, especially with stochastic effects. Prerequisites: matrix theory, differential equations, and a graduate course in probability and statistics.
Spall   2 hours

550.800 Dissertation Research
Reading, research, or project work for advanced graduate students. Arranged individually between students and faculty. Offered each semester.

550.803 Financial Computing Workshop
Intersession course restricted to students enrolled in the Financial Mathematics M.S.E. program.

550.805 Communications Practicum
Intersession course restricted to students enrolled in the Financial Mathematics M.S.E. program.

Seminars

Discussion of new results in the specified research area based on journal articles, research monographs, and current research. Each week a participant in the seminar will present a lecture. Organized by advanced graduate students with the sponsorship of an Applied Mathematics and Statistics faculty member.

550.810 Probability and Statistics Seminar

550.865 Optimization and Discrete Mathematics Seminar

Courses by Category

Courses may be selected from five categories within the department.

Probability and Statistics

550.111-112 Statistical Analysis I, II
550.122 Chance and Risk
550.211 Probability and Statistics for the Life Sciences
550.230 Introduction to Biostatistics
550.310 Probability and Statistics for the Physical and Information Sciences and Engineering
550.311 Probability and Statistics for the Biological and Medical Sciences and Engineering
550.413 Applied Statistics and Data Analysis
550.420 Introduction to Probability
550.426 Introduction to Stochastic Processes
550.430 Introduction to Statistics
550.431 Statistical Methods in Imaging
550.432 Linear Statistical Models
550.433 Monte Carlo Simulation and Reliability
550.434 Nonparametric and Robust Methods
550.435 Bioinformatics and Statistical Genetics
550.436 Data Mining
550.437 Statistical Learning with Applications
550.438 Statistical Methods for Computer Intrusion Detection
550.439 Time Series Analysis
550.440 Stochastic Calculus
550.493 Mathematical Image Analysis
550.620-621 Probability Theory I, II
550.626 Stochastic Processes II
550.630 Statistical Theory I
550.631 Statistical Theory II
550.632 Multivariate Statistical Theory
550.633 Time Series Analysis
550.634 Nonparametric and Robust Inference

550.635 Topics in Bioinformatics
550.640 Machine Learning
550.664 Modeling, Simulation and Monte Carlo
550.720 Topics in Probability and Stochastic Processes
550.721 Percolation Theory
550.722 Poisson Convergence
550.723 Markov Chains
550.730 Topics in Statistics
550.731 Case Studies in Applied Statistics
550.735 Topics in Statistical Pattern Recognition
550.810 Probability and Statistics Seminar

Optimization and Operations Research

550.150 Introduction to Contemporary Applied Mathematics
550.251 Mathematical Models for Decision Making: Deterministic Models
550.252 Mathematical Models for Decision Making: Stochastic Models
550.361-362 Introduction to Optimization
550.453 Mathematical Game Theory
550.457 Topics in Operations Research
550.463 Network Models in Operations Research
550.661 Foundations of Optimization
550.662 Optimization Algorithms
550.663 Stochastic Search and Optimization
550.750 Topics in Operations Research
550.760 Topics in Optimization
550.761 Advanced Linear Programming
550.762 Advanced Nonlinear Programming
550.764 Optimization of Functionals
550.765 Numerical Methods for Optimization
550.865 Optimization and Discrete Mathematics Seminar

Discrete Mathematics

550.171 Discrete Mathematics
550.371 Cryptology and Coding
550.471 Combinatorial Analysis
550.472 Graph Theory
550.671 Combinatorial Analysis
550.672 Graph Theory
550.770 Topics in Discrete Mathematics
550.771 The Probabilistic Method

Computational and Applied Mathematics

550.291 Linear Algebra and Differential Equations
550.303 Differential Equations
550.385 Scientific Computing: Linear Algebra
550.386 Scientific Computing: Differential Equations
550.391 Dynamical Systems
550.480 Shape and Geometry
550.484 Introduction to Wavelet and Fourier Analysis
550.486 Asymptotic Methods
550.491 Applied Analysis for Engineers and Scientists

550.493 Mathematical Image Analysis

550.693 Turbulence Theory

550.694 Turbulence Theory II

550.695 Advanced Parameterization in Science and Engineering

550.681 Numerical Analysis

550.692 Matrix Analysis and Linear Algebra

550.693 Turbulence Theory

550.790 Topics in Applied Mathematics

550.791 Neural Networks and Feedback Control Systems

Financial Mathematics

550.427 Stochastic Processes in Finance

550.442 Investment Science

550.444 Modeling and Analysis of Securities and Financial Markets I

550.445 Modeling and Analysis of Securities and Financial Markets II

550.446 Risk Management Analysis and Hedging

550.447 Advanced Portfolio and Investment Theory

550.448 Financial Engineering

550.461 Optimization in Finance

550.651 Financial Mathematics

550.747 Topics in Financial Mathematics

550.803 Financial Computing Workshop

550.805 Communications Practicum

Combined Areas, Research, and General

550.103 Mathematics and Politics

550.400-401 Mathematical Modeling and Consulting

550.500 Undergraduate Research

550.501 Senior Thesis

550.505 Applied Mathematics Pedagogy

550.510 Readings in Actuarial Mathematics

550.600 Applied Mathematics and Statistics Department Seminar

550.700 Master's Research

550.800 Dissertation Research

Biomedical Engineering

Faculty and students in the Department of Biomedical Engineering have been breaking new ground in biomedical research for over 45 years, and we strive to continue this history of innovation and discovery every day. Some examples of biomedical engineering include instrumentation and systems for use in medical environments, health care delivery systems, therapeutic and prosthetic devices such as artificial organs and orthopedic implants, and the application of quantitative methods and engineering-based modeling to basic research in the biological sciences.

The Department of Biomedical Engineering offers three programs of study to prepare students to work in this area: an undergraduate program leading to a bachelor's degree with a choice of B.S. or B.A., a master's degree program, and a doctoral degree program.

Research in the department focuses on several general areas: biomaterials, biomedical imaging systems, biomedical sensors and instrumentation, cardiovascular systems physiology, molecular and cellular engineering physiology, systems neuroscience, theoretical and computational biology, cell and tissue engineering, and nanobiotechnology.

The Faculty

Soumyadipta Acharya, Assistant Research Professor: biomedical instrumentation, medical device innovation, neuroprosthetics, brain machine interfaces, computational neuroscience.

Angelo Homayoun All, Assistant Professor: spinal cord injury, stem cells, electrophysiology, imaging.

Robert H. Allen, Associate Research Professor: design, education, biomechanics, birth mechanics.

Joel S. Bader, Associate Professor: bioinformatics, computational biology, systems biology, synthetic biology.

Michael A. Beer, Assistant Professor: genomics and computational molecular biology.

Jennifer H. Elisseeff, Associate Professor: tissue engineering, biomaterials, cartilage regeneration.

Harry R. Goldberg, Assistant Professor, Assistant Dean School of Medicine: interactive simulations, virtual classrooms.

Warren L. Grayson, Assistant Professor: tissue engineering, stem cells, bioreactors, biomaterials and orthopaedics.

Jordan J. Green, Assistant Professor: cellular engineering, nanobiotechnology, biomaterials, controlled drug delivery and gene delivery.

Joseph L. Greenstein, Assistant Research Professor: cell biology, cardiac electrophysiology and excitation-contraction coupling, ion channels, calcium signaling in microdomains, biophysically detailed mathematical modeling.

Eileen Haase, Lecturer: Freshmen Modeling and Design, System Bioengineering Laboratory I and II, Cell and Tissue Engineering Laboratory, Molecules and Cells, BME Teaching Practicum.

Daniel Herzka, Assistant Professor: cardiac magnetic resonance imaging, self-navigation, open-ended imaging, fast imaging, high resolution imaging, applications of MRI in cardiac electrophysiology, kinematic imaging, and fetal imaging.

Xiaofeng Jia, Research Associate: clinical neuro-engineering—peripheral nerve, cardiac arrest and hypothermia.

Richard J. Johns, University Distinguished Service Professor: industrial liaison.

Rachel Karchin, Assistant Professor: computational molecular biology, bioinformatics, genetic variation.

Scot C. Kuo, Associate Professor: cell motility and mechanics, nanoscale biophysics, laser-based bioinstrumentation, advanced multiphoton and confocal microscopy.

Andre Levchenko, Associate Professor: intracellular signal transduction, cell engineering, cancer research.

Xingde Li, Associate Professor: endomicroscopy technologies, nanobiophotonics and molecular imaging, early detection (cancer, cardiovascular diseases, wound healing).

Feilim Mac Gabhann, Assistant Professor: computational modeling of growth factor-receptor networks, personalized medicine, individualized medicine, experimental studies of interindividual variation, therapeutic cardiovascular remodeling, novel methods for data visualization and automated image analysis, computational models of virus-host interactions.

Elliot McVeigh, Professor (Chair) (Bessie Massey Professor and Director): imaging.

Michael I. Miller, Professor (The Herschel and Ruth Seder Chair in Biomedical Engineering): computational anatomy, medical imaging, image understanding.

Niranjan Pandey, Research Associate: angiogenesis, cancer, metastasis, peptide drugs, drug discovery.

Aleksander S. Popel, Professor: physiological flows and molecular transport, microcirculation, cell mechanics.

J. Tilak Ratnanather, Assistant Research Professor: computational anatomy, biomedical imaging, numerical analysis, mathematical biology of the cochlea.

Murray B. Sachs, University Distinguished Service Professor: auditory neurophysiology and psychophysics.

Sridevi Sarma, Assistant Professor: closed-loop deep brain stimulation, control theory, computational neuroscience and large-scale optimization.

Lawrence P. Schramm, Professor: spinal cord injury and regeneration, neural regulation of the circulation.

Reza Shadmehr, Professor: human motor control and learning in health and disease, functional imaging of the brain, human neurophysiology, computational and theoretical neuroscience.

David Sherman, Research Associate: quantitative and clinical neurophysiology; EEG; seizure detection; signal processing; instrumentation.

Artin A. Shoukas, Professor: systems analysis of circulatory systems, systems physiology.

Jeffrey H. Siewerdsen, Associate Professor: medical imaging, image-guidance, flat-panel imagers, cone-beam CT, volume imaging, MRI, image science, imaging performance, radiation therapy.

Alexander A. Spector, Research Professor: biosolid mechanics, cell mechanics and biophysics, membrane mechanics, mechanotransduction, molecular motors, mathematical and computational modeling.

Web Stayman, Research Associate: imaging physics, 3D image reconstruction, novel imaging systems, image-guided interventions and diagnostic imaging.

Nitish V. Thakor, Professor: medical instrumentation, medical micro and nanotechnologies, neurological instrumentation, signal processing, and neural prosthesis.

Natalia Trayanova, Professor: computational cardiac electrophysiology and electro-mechanics, mechanisms of arrhythmogenesis and cardiac anti-arrhythmia therapies, cardiac dyssynchrony and resynchronization, development of cardiac models from imaging modalities.

Leslie Tung, Professor: functional electro-physiology of cultured cardiac cell networks, cardiac arrhythmias, analysis of multicellular structure, stem cell-derived cardiac cells.

Fijoy Vadakkumpadan, Assistant Research Professor: patient-specific whole-heart modeling, ex vivo image-based cardiac modeling, image-based cardiac shape analysis, computational methods for brain surface mapping.

Rene Vidal, Associate Professor: computer vision (camera sensor networks, recognition of human activities, dynamic scene analysis, structure from motion), biomedical imaging (processing of high angular resolution diffusion imaging, registration and segmentation of diffusion MRI, segmentation and fiber tracking of cardiac MRI, interactive medical image segmentation), machine learning (generalized principal component analysis, manifold learning and clustering, classification of dynamical systems), signal processing (consensus on manifolds, distributed optimization, compressive sensing).

Xiaoqin Wang, Professor: neurophysiology of the auditory cortex, neural mechanisms of speech perception and learning, computational neuroscience.

Raimond L. Winslow, Professor (The Raj and Neera Singh Professor of Biomedical Engineering): computational cell biology, systems biology, cardiac electrophysiology.

Kevin J. Yarema, Associate Professor: metabolic glycoengineeing, glycobiology, systems biology of glycosylation, carbohydrate-based cancer drug design and delivery, cellular responses to static magnetic fields.

Youseph Yazdi, Assistant Professor: medical instrumentation, medical device design, translation and commercialization of medical devices, biophotonics, optical spectroscopy.

Eric D. Young, Professor: auditory neurophysiology, neural modeling, sensory processes.

David T. Yue, Professor: Ca^{2+} signaling experiments and modeling, as related to basic mechanisms and neuronal/cardiovascular disease; Ca^{2+} ion channels; calmodulin/Ca^{2+} channel decoding of channel nanodomain Ca^{2+} signaling; Ca^{2+} channel modulation; genetically encoded Ca^{2+} sensors; electrophysiology; fluorescence resonance energy transfer (FRET) imaging; confocal multiphoton, and total internal reflectance fluorescence (TIRF) imaging of Ca^{2+}-related signaling; biophysics; molecular biology; biochemistry.

Kechen Zhang, Assistant Professor: theoretical neuroscience, computational neuroscience, neural computation.

Joint, Part-Time, and Visiting Appointments

Mohamad E. Allaf, Associate Professor (Urology): laparoscopic and robotic surgery.

Andreas G. Andreou, Professor (Electrical and Computer Engineering): bioelectronics, integrated micro and nano devices for the life

sciences, natural and synthetic sensory systems, neural computation.

Isaac N. Bankman, Assistant Professor (Applied Physics Laboratory): biomedical signal and image processing.

Ronald D. Berger, Professor (Department of Medicine, Division of Cardiology): mechanisms of sudden cardiac death, new modalities of ablation therapy, device development, signal processing.

Dan E. Berkowitz, Professor (Anesthiology and Critical Care Medicine): molecular mechanisms of cardiovascular deconditioning in rodent models of microgravity, vasoregulatory dysfunction associated with obesity, diabetes, the role of leptin in vasoregulatory changes.

Paul A. Bottomley, Professor (Radiology): magnetic resonance imaging and spectroscopy, medical imaging.

Jeff W.M. Bulte, Professor (Radiology): stem cells, cell therapy, imaging, nanotechnology, in vivo diagnostics.

Charles C. Della Santina, Associate Professor (Otolaryngology–Head & Neck Surgery): electrical stimulation of the inner ear for restoring balance function, neurophysiology, vestibular function testing.

Andrew S. Douglas, Vice Dean for Faculty (Whiting School of Engineering) and Professor (Mechanical Engineering): nonlinear solid mechanics, soft tissue mechanics, mechanics of active materials.

Paul A. Fuchs, Professor (Otolaryngology): biophysics of sensory hair cell, regulation of ion channel expression.

Peter L. Gehlbach, Associate Professor (Ophthalmology): microsurgerical tools, angiogenesis, antiangiogenesis, viral vectors, oxidative injury as they apply to diseases of the retina and vitreous, microsurgerical tools, angiogenesis, antiangiogenesis, viral vectors, oxidative injury.

Donald Geman, Professor (Applied Mathematics and Statistics): statistical learning, visual recognition, computational genomics.

John Goutsias, Professor (Electrical and Computer Engineering): complex interaction networks, biochemical reaction system modeling and analysis, computational systems biology.

Edith D. Gurewitsch, Associate Professor (Gynecology and Obstetrics): birth simulation, birth mechanics, mechanical birth injury, shoulder dystocia, obstetric brachial plexus injury, human subjects testing.

Henry R. Halperin, Professor (Medicine): cardiovascular medicine, MR compatible devices.

Justin Hanes, Professor (Ophthalmology): drug and gene delivery, biomaterials synthesis, particle transport through biological barriers.

Kalina Hristova, Associate Professor (Materials Science and Engineering): biomolecular materials, biomembranes, biosensor development, signal transduction across biological membranes.

Steven S. Hsiao, Professor (Neuroscience): neurophysiology of the central nervous system.

Pablo A. Iglesias, Professor (Electrical and Computer Engineering): computational biology, models of cellular signal transduction, directed cell motility, cell division, control systems.

Bruno Jedynak, Associate Research Professor (Applied Mathematics and Statistics): statistical models in image processing, language processing, genomics and neuroscience.

David W. Kaczka, Assistant Professor (Anesthesiology and Critical Care Medicine): respiratory mechanics, mechanical ventilation, patient monitoring, mathematical modeling of physiological system, signal processing, image processing.

David A. Kass, Professor (Cardiology): molecular pathophysiology of heart failure and hypertrophy, pathobiology of cardiac dyssynchrony and resynchronization, cardiac stress regulation by phosphodiesterase 5, nitric oxide synthase uncoupling, structure-function of sarcomeric proteins to cardiac mechanics, heart failure with preserved ejection fraction.

A. Jay Khanna, Associate Professor (Orthopaedic Surgery): spine surgery, minimally invasive, musculoskeletal imaging, image guidance for surgery, MRI, biomechanics, clinical outcomes.

Konstantinos Konstantopoulos, Professor (Chemical and Biomolecular Engineering): cell adhesion and microfluidics, nanoscale mechanics, receptor biochemistry, quantitative modeling and functional genomics.

Albert C. Lardo, Associate Professor (Medicine): cardiovascular MRI, cardiovascular CT, image guided therapy.

Jonathan S. Lewin, Professor (Radiology): interventional MRI, intraoperative MRI, neuroradiology.

Hai-Quan Mao, Associate Professor (Materials Science and Engineering): nanomaterials, electrospinning, nanofibers, biomimetic matrix, stem cell expansion and differentiation, nerve regeneration, micellar nanoparticle, therapeutic delivery, biodegradable polymers.

Richard A. Meyer, Professor Emeritus (Neurosurgery): neural mechanisms of pain and itch.

Robert E. Miller, Associate Professor (Pathology Informatics): clinical laboratory instrumentation, laboratory information systems.

Lloyd B. Minor, Provost and Senior Vice President for Academic Affairs and Professor (Otolaryngology): vestibular neurophysiology.

Wayne Mitzner, Professor (Environmental Health Sciences, Program in Respiratory Biology and Lung Disease): modeling lung function, lung structure-function interactions, mechanical aspects of lung disease.

Carey E. Priebe, Professor (Applied Mathematics and Statistics): statistics, image analysis, nonparametric estimation.

Jerry L. Prince, Professor (Electrical and Computer Engineering): multi-dimensional signal processing, medical imaging, computational geometry.

Lewis H. Romer, Associate Professor (Anesthesiology and Critical Care Medicine, Cell Biology, and Pediatrics, and the Center for Cell Dynamics): tissue engineering the micro-vasculature, extracellular matrix as an instructive environment, biophysics and biochemistry of matrix assembly, interactions between tyrosine kinases and Rho family GTPases in cell matrix adhesion, mechanochemical coupling in cell-matrix adhesion signaling, harnessing stem and progenitor cells for microvascular restitution.

Richard D. Schulick, Professor (Surgery, Oncology, Gynecology and Obstetrics): immunotherapy of colon and pancreas cancer.

Mark J. Shelhamer, Associate Professor (Otolaryngology): sensorimotor adaptation, nonlinear dynamics, vestibular and oculomotor modeling, space flight adaptation, traumatic brain injury.

Sean Sun, Associate Professor (Mechanical Engineering): biological force generation, molecular motors, cell motility, statistical mechanics of soft condensed materials.

Benjamin M.W. Tsui, Professor (Radiology): molecular imaging including SPECT, PET and CT, anatomical and physiological models of humans and small animals, simulation of imaging systems and processes, quantitative image reconstruction methods, image quality assessment.

Jennifer E. Van Eyke, Professor (Cardiology): proteomics, mass spectrometry, cardiac disease, biomarker discovery, technology development.

Tza-Huei (Jeff) Wang, Associate Professor (Mechanical Engineering): micro/nanoscience and technology, BioMEMS, single molecule manipulation and detection.

Thomas B. Woolf, Professor (Physiology): molecular dynamics calculations, membrane biophysics, computational neurosciences.

Laurent Younes, Professor (Applied Mathematics and Statistics): statistical properties of Markov random fields, image analysis, deformation analysis—shape recognition.

Program Directors

Professor Reza Shadmehr and Professor David Yue are the co-directors of the BME PhD Program. The director of the master's degree program is Professor Kevin Yarema. The director of the undergraduate program is Professor Leslie Tung.

Facilities

The center of gravity for the Department of Biomedical Engineering is the Traylor, Ross and Broadway research buildings on the campus of the School of Medicine. This location favors a close association with other basic medical science programs and provides access to the clinical environment of one of the nation's top-ranked hospitals. The Homewood campus houses the Whitaker Biomedical Engineering Institute. The Whitaker Institute was established as a vital link between the School of Medicine and the Whiting School of Engineering. The vision of the institute is of an integrative research and education enterprise that provides leadership in moving biomedical engineering to the forefront of biomedical science and practice.

The general facilities of the Department of Biomedical Engineering include seminar rooms that allow broadcasting throughout the university, physiology teaching laboratories, a microfabrication laboratory, a cell and tissue teaching and research laboratory, a student instrumentation laboratory, and a fully staffed mechanical shop.

Each of the faculty members listed above further maintains a well-equipped laboratory for research in his/her area of interest. A wide variety of equipment in these laboratories is available to students as their interests draw them into active participation in research.

The profoundly interdivisional nature of biomedical engineering education at Johns Hopkins provides students with a wide range of general university facilities. These include the Human Stem Cell Core facility, the Institute for Basic Biomedical Sciences Microscope Core facility, the Tissue Microarray Core facility, the Flow Cytometry Core Facility, the Genetics Resources Core Facility, and the Transgenic Core Laboratory, the Welch Medical Library at the School of Medicine, the Eisenhower Library at the Homewood campus, the university

computing facility, the Medical School Computing Center, and the Medical School's Microcomputer Laboratory.

Undergraduate Programs

The mission of the undergraduate programs is to provide state-of-the-art biomedical engineering education to students in order that they may continue their education in graduate, medical, and professional schools or pursue careers in industry. To this end, our responsibility is as much to the future as it is to the present. Through a strong research and educational environment, we strive to empower our students to explore and define their own frontiers as well as instill the ethical principles that will foster rewarding professional endeavors.

The biomedical engineering program normally leads to the bachelor of science (B.S.) degree and requires at least 129 credits. The B.S. program is recommended for students who plan careers in engineering or who plan to attend graduate school in engineering. If a student wishes to take a more flexible program with less emphasis on engineering, a B.A. program is also available. Either the B.S. or the B.A. program can meet the needs of a student who plans graduate study in a nonengineering area.

The undergraduate program (B.S.) in biomedical engineering, which is accredited by the Accreditation Board for Engineering and Technology (ABET), provides a strong foundation in mathematics, engineering, and science. The program emphasizes preparation for advanced study in an area related to biomedical engineering and is broad enough to accommodate students who plan graduate work in biology, medicine, engineering, biophysics, physiology, or biomedical engineering.

Thus, the program objective of the undergraduate program is to educate students majoring in biomedical engineering who will attain the following upon or within a few years of graduation:

- will be successful in attaining entry into graduate (M.S. or Ph.D. Degree Programs) or professional schools (medical, dental, veterinarian, business, public health, law), or
- will be successful in attaining employment in jobs that utilize biomedical engineering or a related field.

Each student plans a curriculum suited to his/ her goals, with the assistance of a faculty advisor. Upon completion of the B.S. in biomedical engineering, students will demonstrate the abilities to:

- apply knowledge of mathematics, science, and engineering. They will learn to apply knowledge of advanced mathematics (calculus, differential equations, linear algebra, statistics) to problems at the interface of engineering, biology and medicine; apply knowledge of life sciences (biology, physiology and medicine) to problems at the interface of engineering, biology and medicine; apply knowledge of natural sciences (chemistry and physics) to problems at the interface of engineering, biology and medicine; apply principles of engineering to problems at the interface of engineering, biology and medicine; and mathematically model and simulate biological systems using computers.

- design and conduct experiments, as well as analyze and interpret data. They will formulate hypotheses for experiments, including those on living systems; devise procedures for experiments, including those on living systems; collect and validate data using appropriate equipment; display, describe, summarize and interpret experimental results in a lab report; relate the experimental results to previous work, including the interaction between living and non-living materials and systems; and practice lab safety.

- design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. They will identify a desired need and define the biomedical engineering problem to be solved, determine the constraints to the problem and assess the successful likelihood for different approaches, undergo the design process of creation, synthesis and integration and evaluate success of the design to meet the desired need.

- function on multidisciplinary teams. They will understand team goals and complementary role and expertise of each team member, share opinions and viewpoints with other team members and assume and fulfill individual responsibilities within a team.

- identify, formulate, and solve engineering problems. They will conceptualize the engineering problem, formulate a solution to the problem and solve problems using experimental, mathematical and/or computational tools.

- understand professional and ethical responsibility. They will understand the guidelines for ethical and responsible use of human subjects and data for research, understand the guidelines for ethical and responsible use of animals for research, understand professional and ethical standards in the workplace and properly reference the work of others.

- communicate effectively. They will synthesize, summarize and explain technical content in a written report and synthesize, summarize and explain technical content in an oral presentation.
- understand the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. They will understand the contributions that biomedical engineers can play in academia, industry, and government and understand how biomedical engineering solutions are of benefit inside and outside the U.S.
- recognize the need for, and gain an ability to engage in life-long learning. They will use library resources, professional journals and Internet effectively, update technical literacy to understand contemporary issues, and recognize the need for self-assessment.
- comprehend contemporary issues. They will understand recent developments in biomedical engineering, understand differing viewpoints in academia, government, industry, and business and gain the ability to search and critically evaluate scientific literature.
- use the techniques, skills, and modern engineering tools necessary for engineering practice. They will gain proficiency in computer simulations and mathematical analysis tools, create mathematical models, develop laboratory skills applied to living systems, and utilize data acquisition systems. The program also encourages individual study and research and gives academic credit for them. Students are welcome to work in laboratories on the Homewood campus or at the Medical Institutions in East Baltimore.

Bachelor of Science in Biomedical Engineering

Students seeking the B.S. degree are encouraged to focus their studies on one of five subspecialties that incorporates traditional engineering disciplines and biomedical applications. See the Biomedical Engineering Undergraduate Advising Manual for specifics on focus areas, lists of recommended mathematics and engineering electives, limitations on credits for courses with overlapping material, and the design content of engineering courses.

Requirements for the B.S. Degree

(See also General Requirements for Departmental Majors, page 48.)

The B.S. degree in biomedical engineering requires 129 credits. The courses listed below must either be taken or passed by examination for advanced credit. Engineering, science, and mathematics courses may not be taken satisfactory/unsatisfactory. No more than 6 credits of engineering, science, or mathematics courses in which a grade of D was received may be counted.

Basic Sciences (22 credits):

- General Physics I and II with Labs
- Introductory Chemistry I and II with Labs
- Organic Chemistry I

Mathematics (24 credits):

- Calculus I, II, III
- Linear algebra
- Differential equations
- At least one additional semester of advanced statistics/probability

Humanities and Social Sciences (18 credits):

These courses should form a coherent program, relevant to the student's goals, with at least one course at the 300-level or higher. They should include:

- One course in which ethical and social issues related to technology are discussed.
- At least two semesters of (W) courses (see Writing Requirement, page 44).

Biomedical Core Knowledge (35 credits):

- What do biomedical engineers do?
  580.111 Biomedical Modeling and Design
  580.202 BME in the Real World
- Molecular and cellular biology
  580.221 Molecules and Cells
- Creating, analyzing, and simulating a linear or nonlinear system model from knowledge of the real biological system
  580.222 Biomedical Systems and Controls
    – Analysis of biological control systems
  580.223 Biomedical Models and Simulations
    – Analysis of systems described by linear and nonlinear ordinary differential equations
- Fundamental thermodynamic principles in biology
  580.321 Statistical Mechanics and Thermodynamics
- Engineering analysis of systems-level biology and physiology
  580.421 Systems Bioengineering I: Cells and Cardiovascular Systems
  580.423 Systems Bioengineering Lab I
  580.422 Systems Bioengineering II: Neural Systems
  580.424 Systems Bioengineering Lab II
  580.429 Systems Bioengineering III: Genes to Organs

Focus Area (21 credits):

Building on the foundation of this core curriculum, each student is required to take a cohesive sequence of advanced engineering encompassing one of four Biomedical Engineering focus areas. A student's choice of focus area is made before the start of the junior year and is based on their experience with the Biomedical Engineering Core and their answers to the questions given below:

Systems Biology—"Do you want to focus on understanding at a fundamental level how biological systems work?"

Sensors, Micro/Nano Systems, and Instrumentation—"Do you want to build things that facilitate research or clinical medicine?"

Cell/Tissue Engineering and Biomaterials—"Do you want to create replacement cells, tissues, and organs?"

Computational Bioengineering—"Do you want to focus on the use of mathematical theory or computers to solve complex biological and medical problems?"

Imaging—"Do you want to develop new imaging technology to reveal how biological systems work or diagnose disease?"

Courses in a focus area must be taken for a total of 21 or more credits. Please refer to **www.bme.jhu.edu /academics/undergrad.htm** for applicable courses designed for each focus area by faculty members with research interests appropriate to the area; all faculty members are active participants in shaping the undergraduate curriculum.

Design (6 credits)
Among the technical elective courses offered, at least 6 credits must come from an approved list of design options. There are many combinations of courses, programs and independent study opportunities to satisfy this requirement. This is discussed in detail in the Undergraduate Handbook. Please refer to **www. bme.jhu.edu/academics/undergrad.htm**.

Computer Programming (3 credits)

General Electives (6 credits)
Student may choose at least two courses from any area. Many students will place prerequisite courses under this heading or use this area appropriate to his/her interests and approved by the Biomedical Engineering advisor. For example, a student interested in neuroscience might take Development Biology and/or Molecular and Cellular Neuroscience.

Bachelor of Arts in Biomedical Engineering

(See also General Requirements for Departmental Majors, page 48.)

The B.A. in biomedical engineering requires 120 credits. The courses listed below must either be taken or passed by examination for advanced credit. See the Biomedical Engineering Undergraduate Advising Manual for lists of recommended courses, acceptable course substitutions, and limitations on credits for courses with overlapping material.

Basic Sciences (22 credits):
• General Physics I and II with Labs
• Introductory Chemistry I and II with Labs
• Organic Chemistry I

Mathematics (20 credits):
• Calculus I, II, III
• Linear algebra
• Differential equations

Humanities and Social Sciences (24 credits):
These courses should form a coherent program, with at least 9 credits chosen from one department, including at least one 300-level course.
• At least four semesters of (W) courses.
• At least two semesters of a modern foreign language.

Biomedical Core (35 credits)
• Biomedical Engineering Modeling and Design
• BME in the Real World
• Molecules and Cells
• Biomedical Systems and Controls
• Biomedical Models and Simulation
• Statistical Mechanics and Thermodynamics
• Systems Bioengineering I
• Systems Bioengineering II
• Systems Bioengineering Lab I
• Systems Bioengineering Lab II
• Systems Bioengineering III

Other Electives:
At least 19 additional credits (12 credits for premedical students counting Intermediate Organic Chemistry and Lab) are needed to complete the 120 credit requirement for the BA Degree. A course in which the use of computers in computer programming is strongly recommended.

Graduate Programs

Master of Science in Engineering

The master's degree program is designed for students who wish to pursue careers in research and development, or as a step toward Ph.D. or M.D./Ph.D. education. The program, which is designed to be completed in two years, consists of core courses, elective courses, and a thesis project. The project may be basic research in a laboratory or practical engineering, related to patient monitoring or other clinical problems.

Admission and Financial Aid

Students with undergraduate degrees in engineering are eligible to apply. Exceptional students with degrees in basic sciences may also apply, but would normally have to take a number of courses to overcome deficiencies in their curriculum.

All students have the potential to receive full tuition support by obtaining a position in a research laboratory. Research assistantships are usually advertised by various laboratories in the institution to carry out specific research and development projects. Students without a research assistantship are expected to pay full tuition independently. Fellowships are also awarded to the top students in the program.

Applications for admission are due by the appointed deadline (usually in mid-January).

For more information and to apply online, go to **www.bme.jhu.edu/academics/masters**.

Requirements for the M.S.E. Degree

Each student will take a minimum of 24 credits of courses at the 400-level or higher and complete a thesis. Students fulfill the course requirement by taking two courses in the Systems Bioengineering sequence (580.421, 580.422 or 580.429) and other advanced engineering, math and science courses. (JHU undergraduates waive the SBE sequence and take 8 credits from advanced engineering, math or science.) Students will also fulfill a minor teaching requirement by providing support to one of three lab-based undergraduate courses and six core lecture courses each semester. Additionally, all students must complete a thesis based on a research problem requiring application of quantitative or applied engineering principles to biomedical engineering.

B.S./M.S.E. Program

Students enrolled in the B.S. program in biomedical engineering may pursue a combined B.S./M.S.E. degree that can be completed in five years. Students should apply in their junior year and adhere to the published deadlines and application requirements. (The only exception is that biomedical engineering undergraduates do not need to take the GRE.) Course work should be carefully structured so as to fulfill all the requirements for the B.S. as well as the M.S.E. degree in a timely and coordinated manner. Students are advised to make an early start toward their master's thesis. The M.S.E. program grants partial tuition fellowship awards on the basis of academic merit. Research assistantships are usually advertised by various laboratories in the institution to carry out specific research and development projects. Fellowships are also awarded to the top students in the program.

Master of Science in Engineering in Innovation and Design

The Center for Bioengineering Innovation and Design (CBID), housed in the Department of Biomedical Engineering, focuses on the design aspect of Biomedical Engineering. This exciting program gives students opportunities to design, develop, build, and test devices that solve some of the most pressing problems facing clinicians today.

The mission of CBID is to:

- Improve human health by developing medical devices that solve important clinical problems

- Educate a new generation of medical device engineers and fellows

- Facilitate technology transfer and industry collaboration

We have programs for both undergraduate and graduate students. Undergraduate students at Hopkins Homewood campus may become involved in our BME Design Teams where they will work with fellow undergraduate students in coming up with ideas for new devices, developing prototypes, researching intellectual property, writing business plans, and presenting their designs to fellow students, faculty, and outside advisors.

CBID has a new one-year masters program that allows students to work closely with physicians at Johns Hopkins' School of Medicine to first identify problems and then design and build products to solve these problems. This non-research based graduate program will award a Masters of Science in Engineering in Bioengineering Innovation and Design and runs from June through May.

Incorporated in all the BME design curriculum is a focus on technology commercialization. All students, graduate and undergraduate, will interact with clinical and corporate sponsors and have experiences that promote the development of their leadership, communications, and marketing skills, thus helping to ensure our graduates' professional success.

Please see our website for more information on our programs: **http://cbid.bme.jhu.edu**.

Ph.D. in Biomedical Engineering

Biomedical Engineering (BME) has emerged as one of the most exciting interdisciplinary research fields in modern science. Biomedical engineers apply modern approaches from the experimental life sciences in conjunction with theoretical and computational methods from the disciplines of engineering, mathematics and computer science to the solution of biomedical problems of fundamental importance. The Biomedical Engineering Graduate Program of the Johns Hopkins University is designed to train engineers to work at the cutting edge of this exciting discipline.

The cornerstone of the Program is our belief in the importance of in-depth training of students in both life sciences and modern engineering. In-depth training in life sciences is achieved in one of two ways. Typically, incoming PhD students enroll in the first year basic sciences curriculum of the Johns Hopkins University School of Medicine. That is, they learn human biology with the medical students. This is a unique and intensive curriculum covering a broad range of topics including molecules and cells, human anatomy, immunology, physiology and neuroscience. Students choosing this option typically devote their entire first academic year to these courses. This curriculum is an excellent way to build a broad and solid foundation in the life sciences. Alternatively, students may elect alternative life sciences curricula. These curricula have been carefully designed to provide training in areas of the life sciences that are appropriate to each of the program's research areas. This option is of particular value to students who enter the program having a strong background in the life sciences. In-depth training in engineering, mathematics and computer science is achieved through elective courses that are taken in the second year.

All students are admitted with full fellowship. This covers tuition and provides a modest stipend for the duration of their PhD. Because the students are fully funded, they can choose to perform their dissertation in essentially any laboratory in the University (subject to the approval of the Program directors). A special program with the NHLBI of the NIH allows students to also choose from research laboratories at the NIH.

Students typically do research rotations during the summer before start of the first academic semester, during the first year (typically as they are taking medical school courses), and during the following summer year. They are expected to choose a research laboratory before the start of the second academic year.

Emphasis is placed on original research leading to the doctoral dissertation. The research is usually experimental in nature, and students are expected to learn biological experimental techniques; nevertheless, experiment or theory can be emphasized in the research as desired by the student.

Program Directors

Professor Reza Shadmehr and Professor David Yue are the co-directors of the BME PhD Program.

Requirements for Admission

The Program accepts applications for the PhD program until December 15 of each year. We typically recruit students in five areas: Computational Biology, Imaging, Tissue Engineering, Neural engineering, and MNCP (molecular, neural, and cardiac physiology). The program is unique in that it offers the BME student the strengths of one of the best medical schools in the world. If you wish to combine engineering with cutting edge research in medicine, this may be the program for you.

In their first year, our students have the option of taking many of the same courses as the medical students, including human anatomy, molecules and cells, and genes to society. In their second year, our students take advanced engineering courses. Therefore, students that apply to our program need to not only have a strong background in engineering and mathematics, but also sufficient background in chemistry (including organic chemistry) and biology (at least two introductory courses).

The admission process is by committee. The applicant should specify which area they are interested in, and write about the kind of research they are considering. The faculty in each area vote and rank the applicants. The final pool of applicants is ranked and voted on by the entire faculty.

All accepted students receive a full fellowship. The fellowship covers tuition and provides for a monthly stipend. In this way, the students are free to choose from almost any research lab in the university. To facilitate this process, students do two or more rotations during their first year and typically choose a lab by the end of the summer of their first year.

About one third of our incoming students are international students. A short list of these students is formed by committee and the top candidates are interviewed by phone. Like all admitted students, international students receive full financial aid as well as a monthly stipend. They too have the freedom to choose from any lab.

Applications should be complete when submitted. In order to be considered a complete application we must have:

- A completed online application form.
- Official transcripts from each college or university attended—Sealed, official transcripts or certified records of all university (undergraduate and graduate) study must be submitted. If you have attended more than one institution, transcripts from each must be included with your application.
- **Official Graduate Record Examination**—scores (GRE)/MCAT scores will be acceptable, and can be arranged through the Office of Graduate Affairs (address provided below). The GRE code for applying to graduate programs at the Johns Hopkins School of Medicine is 5316.

    The BME Ph.D. program does not rely heavily on the GRE exam in making admissions or financial aid decisions. Research experience, course grades, and recommendations carry more weight. However, because the GRE score is part of the application and does affect admissions decisions in some cases, foreign applicants who took the GRE in its electronic form, in a country where the electronic test is no longer offered, are advised to retake the exam in its paper form. Applications will be considered regardless of which form of the exam was taken.
- **Three letters of recommendation**—These letters should come from faculty members who are acquainted with you and your academic work. These letters should be sealed and comment on your aptitude and promise for independent research.
- **Personal Statement**—a typewritten statement (one page maximum) indicating the basis of your interest in graduate study and your career objectives. Included should be a discussion of any research experience you have had.

Applicants for admission must fulfill the following course prerequisites:

- one year of college level biology (may include quantitative biology or physiology)
- one semester of organic chemistry
- differential equations

If you are interested in applying and do not have the prerequisite courses, you may want to submit your application with an explanatory note indicating you have made/will make arrangements to take the prerequisites before you would matriculate, if your application is accepted. In the past, applicants have taken the prerequisites at their present schools, local community colleges, etc. Courses taken at any accredited college or university are acceptable.

Each applicant must have received a BA or BS degree or its equivalent prior to matriculation. A Masters degree is not required for admission to our program.

All written correspondence and supporting documents should be sent directly to:

The Office of Graduate Affairs
The Johns Hopkins School of Medicine
1830 E. Monument St., Suite 2-107
Baltimore, MD 21205-2196
410-614-3385 phone
410-614-3386 fax
grad_study@jhmi.edu

Processing—The Ph.D. Program admissions committee will not consider any application until it is complete. Once an application has been received the applicant will be notified if supporting materials are missing.

Interview—The admissions committee will review completed applications and invite applicants to come to Johns Hopkins for a personal interview with faculty. Applicants from North America must come for an interview to be considered for admission. In the case of overseas applicants, for whom such a trip is not possible, a small number of telephone interviews will be conducted. The final admissions decisions will be made from the pool of interviewed applicants. Interviews are generally conducted in March.

Acceptance—Applicants will be notified by end of March of the outcome of their application. An offer of admission from the program will include a yearly stipend, full tuition and paid medical and dental insurance. This applies to every accepted applicant, regardless of citizenship or national origin. Those offered admission will be asked to let us know their decision as soon as possible. In any case, we must have the applicant's decision by April 15. Applications can be found at **www.hopkinsmedicine.org/ graduateprograms/application.cfm**.

Financial Aid
Fellowships for tuition and support stipends (regardless of citizenship or national origin) are available from the general funds of the university. U.S. citizens and Permanent Residents are eligible for support from training grants from the National Institutes of Health (NIH). Students are encouraged to apply for individual fellowships from the National Science Foundation and for NRSA awards from the NIH. Only online applications

for admission are accepted and must be received by December 15.

Requirements for the Ph.D. Degree

The first two years are ordinarily devoted to advanced courses in engineering science and in biomedical science. Engineering, mathematics, and other physical science courses to be taken are arranged between students and their advisors. Each student is assigned a panel of three advisors during the first two years. Eighteen credit hours of course work in engineering, mathematics or physical sciences are required. In addition, students must complete eighteen credit hours of course work in the life sciences. Of these 36 credit hours, at least six must be at the graduate level. At least three credit hours in a course with strong engineering or mathematical theory content at the 600-level must be taken.

Summers are spent working in a biomedical laboratory to gain experience and to seek out a suitable thesis research area. By the beginning of the third year, students should start original research leading to the dissertation. Students must fulfill a modest teaching requirement during one year of their program. The remaining time is spent in thesis research. The program typically takes five to six years to complete.

The student must pass a preliminary oral examination which will be a Graduate Board examination. This is taken in the first half of the third year. The student must then conduct original research, describe it in a dissertation, and pass a final oral examination that is a defense of the dissertation. There is a minimum residency requirement of two consecutive academic years.

Integrated M.D./Ph.D. Program

Candidates for the Ph.D. in biomedical engineering who wish to apply jointly for the M.D. degree must apply directly through the School of Medicine. Although the combined programs would normally require at least seven years to execute sequentially, the combined program can ordinarily be completed in six years, with appropriate planning. Good preparation in biology and chemistry as well as mathematics, engineering, and the physical sciences is essential. Life science graduate requirements are met by the first-year program of the School of Medicine. This program is more arduous than the Ph.D. program alone, but it may have marked advantage for students interested in clinical research and applications in hospital systems and in the delivery of health care. The catalog for the School of Medicine should be consulted for admissions requirements and procedures.

Information about applying to the combined M.D.-Ph.D. program can be found at **www.hopkinsmedicine.org/mdphd/admissions/Howtoapply.html**. Applications submitted for consideration of the combined degree will be reviewed by the Medical School admissions committee. If the Medical School admissions committee accepts the application, it is then passed along to the Biomedical Engineering Ph.D. Program admissions committee for review. A student applying to the combined program who wishes to be considered for the straight Ph.D. program must submit a written request to have his/her application forwarded to the Biomedical Engineering Ph.D. Program office for admission consideration if his/her application is not accepted by the Medical School admissions committee.

Undergraduate Courses

580.111 (E,N) BME Modeling and Design
Working in teams with upperclassmen and faculty this course introduces biomedical engineering freshmen to an orderly method for analyzing and modeling biological systems. Students will use engineering principles to solve design problems that are biological, physiological, and/or medical. Freshmen are expected to use the informational content being taught in calculus, physics, and chemistry and apply this knowledge to the solution of practical problems encountered in biomedical engineering.
Haase   2 credits   fall

580.112 (E,N)
A spring semester course where freshmen work with a team of sophomores, juniors and seniors to solve open-ended biomedical engineering problems in the clinical setting for a physician or a product-developing company.

Freshman are expected to learn from the upperclassmen, learn about the project, and learn the skills (e.g. CAD, data acquisition, computer programming) necessary to make the project successful. At least one oral presentation is required. Permission of course directors required.

Allen, Acharya   3 credits   spring

580.202 Biomedical Engineering in the Real World
A series of weekly lectures to inform students about careers in biomedical engineering and to discuss technological, social, ethical, legal, and economic issues relevant to the profession. Topics include academic careers in biomedical engineering; biomedical engineering in industry (large corporations to sole entrepreneurship); health care delivery; ethical issues; legal issues (patenting, licensing, product liability); standards and government

regulations; and economic issues in biomedical engineering industry (start-up companies, global businesses).
Popel   1 credit   spring

580.211-212 (E,N) Design Team—Sophomore

Sophomore-level version of 580.311-312. Permission of course directors required.
Allen, Acharya   3 credits per semester   fall and spring

580.221 (N) Molecules and Cells

An introduction to modern molecular and cellular biology in the context of potential biomedical engineering applications. Topics covered: reactions between molecules, including receptor-ligand and antigen-antibody specificity, protein structure, enzyme catalysis, genetic information, protein processing and secretion, cell physiology and cell functions. Prerequisite: 030.101 Introductory Chemistry.
Haase   4 credits   fall

580.222 (E) Biomedical Systems and Controls

An introduction to linear systems and linear systems: analysis, stability and control. Topics include first and second order systems, linear time invariant discrete and continuous systems, convolution, Fourier series, Fourier transforms, Laplace transforms, stability of linear systems, input output and state space representation of linear systems, stability, observability, controllability, and PID controller design. Prerequisites: 171.102, 110.201, 110.302.
Miller, Vidal   4 credits   spring

580.223 (E) Biomedical Models and Simulations

This course introduces students to modeling and analysis of biological systems. The first portion of the course focuses on linear systems. Topics include harmonic oscillators, pharmacokinetics, reaction-diffusion equation, heat transfer, and fluid flow. The second half of the course focuses on nonlinear systems. Topics include iterated maps, bifurcations, chaos, stability of autonomous systems, the Hodgkin-Huxley model, bistability, limit cycles, and the Poincare-Bendixson theorem. The course also introduces students to the Matlab programming language, which allows them to implement the models discussed in class. Prerequisites: 110.201, 110.302.
Winslow, Popel   4 credits   spring

580.228 (N) Introduction to Human Physiology

This course will provide students with an understanding of the structure and function relationships of the human body. The associations that exist between cells, tissues, and organs will be presented and discussed from multiple perspectives: from the molecular level to studies of human pathology through the use of clinical correlations. The course structure will include lectures and seminar-style discussions of the primary literature. Freshmen and sophomores only.
Goldberg   3 credits   fall/even years

580.302 Careers in Biomedical Engineering

See description for 580.202. This course is designed for upperclassmen who wish to meet with weekly speakers to discuss career issues.
Popel   1 credit   spring

580.311-312 (E,N) Design Team—Junior

A two-semester course sequence where juniors and seniors work with, or act as, a team leader and a group of BME students including freshmen and sophomores, to solve open-ended biomedical engineering problems in the clinical setting for a physician or a biomedical company. Upperclassmen are expected to apply their general knowledge and experience, and their knowledge in their concentration area, to generate the solution that considers multiple realistic constraints to practical problems encountered in medicine and to teach lower classmen while doing it. Permission of course director required.
Allen, Acharya   3 credits per semester   fall and spring

580.321 (E,N) Statistical Mechanics and Thermodynamics

Basic principles of statistical physics and thermodynamics with application to biological systems. Topics include fundamental principles of thermodynamics, chemical equilibrium and thermodynamics of reactions in solutions, and elementary statistical mechanics. Prerequisites: 110.108-109, 030.101-102, 171.101-102.
Beer   4 credits   fall

580.411-412 (E) Design Team—Senior

Senior-level version of 580.311-312. Permission of course directors required.
Allen, Acharya   3 credits per semester   fall and spring

580.413-414 (E) Design Team—Leader

A two-semester sequence where leaders direct a team of undergraduate biomedical engineering students in a series of design problems. Prior design team experience and permission of course directors required.
Allen, Acharya   4 credits per semester   fall and spring

580.415 (S,W) Ethics of Biomedical Engineering Innovation

Engineers confront problems and make decisions that hold long term social consequences for individuals, organizations, communities, and the profession. For biomedical engineers, these decisions may relate to: inventions such as medical devices and pharmaceuticals; neural prosthetics and synthetic biological organisms; responsible and sustainable design; availability of biotechnology in the developing world. Using a combination of cases, fieldwork, and readings, we examine the ethical issues, standards, theory and consequences of recent and emerging engineering interventions as a way to understand the profession and to form a basis for future decisions. In addition students will learn and practice multiple forms of communication, including oral, visual, and written rhetoric. A particular focus will be communication targeted to different stakeholders including other professionals and the public. Students will apply good communication principle to the discussion of biomedical engineering ethics, develop their own ethical case studies, and participate in group projects to aid ethical decision-making, and to improve communication of complex biomedical ethical issues to others. (Co-listed as 661.315)
Rice, Logsdon, Mac Gabhann, Yazdi   3 credits   fall

580.420 (E,N) Build-a-Genome

In this combination lecture/laboratory "Synthetic Biology" course students will learn how to make DNA building blocks used in an international project to build the world's first synthetic eukaryotic genome, Saccharomyces cerevisiae v. 2.0. Following a biotechnology boot-camp, students will have 24/7 access to computational and wet-lab resources and will be expected to spend 15-20 hours per week on this course. Must understand fundamentals of DNA structure, DNA electrophoresis and analysis, Polymerase Chain Reaction (PCR) and must be either a) Experienced with molecular biology lab work or b) Adept at programming with a biological twist. Advanced students will be expected to contribute to the computational and biotech infrastructure. Co-listed with 020.420. Permission required.

Bader, Boeke, Ostermeier   4 credits   fall and spring

580.421 (E,N) Systems Bioengineering I

A quantitative, model-oriented investigation of the cardiovascular system. Topics are organized in three segments. (1) Molecular/cellular physiology, including electrical signaling and muscle contraction. (2) Systems cardiovascular physiology, emphasizing circuit-diagram analysis of hemodynamics. (3) Cardiovascular horizons and challenges for biomedical engineers, including heart failure and its investigation/treatment by computer simulation, by gene-array analysis, by stem-cell technology, and by mechanical devices (left-ventricular assist and total-heart replacement). Prerequisites: 580.221, 580.222, 110.302. Corequisite: 580.423.

Trayanova, Staff   4 credits   fall

580.422 (E,N) Systems Bioengineering II

A quantitative, model-oriented approach to the study of the nervous system. The course requires the use of simulations to explore dynamics of neural encoding of physiological signals. The first half of the course introduces functional anatomy of the central nervous system, models of neurons, neural networks, and learning and memory. The second half of the course introduces the structure and function of the auditory, visual and motor systems, with emphasis on the neural coding of sensory signals, adaptation of sensori-motor maps, and control of movements. Prerequisites: 580.221, 580.222, 110.302. Corequisite: 580.424.

Wang, Staff   4 credits   spring

580.423-424 Laboratory in Systems Bioengineering I, II

A two-semester laboratory course in which various physiological preparations are used as examples of problems of applying technology in biological systems. The emphasis in this course is on the design of experimental measurements and on physical models of biological systems. Corequisites: 580.421-422.

Haase, Staff   2 credits

580.425 (E,N) Ionic Channels in Excitable Membranes

Ionic channels are key signaling molecules that support electrical communication throughout the body. As such, these channels are a central focus of biomedical engineering as it relates to neuroscience, computational biology, biophysics, and drug discovery. This course introduces the engineering (stochastic and mathematical models) and molecular strategies (cloning and expression) used to understand the function of ionic channels. The course also surveys key papers that paint the current picture of how channels open (gating) and conduct ions (permeation). Biological implications of these properties are emphasized throughout. Finally, the course introduces how optical (fluorescence methods) and electrophysiological methods (patch clamp) now promise to revolutionize understanding of ionic channels. This course can be viewed as a valuable partner of Models of Physiological Processes in the Neuron (580.439). Prerequisites: 580.421-422, or equivalent introductory biology. Recommended: 110.201, 110.302, signals, and elementary probability.

Yue   3 credits   spring/odd years

580.429 (E,N) Systems Bioengineering III

Computational and theoretical systems biology at the cellular and molecular level. Topics include organizational patterns of biological networks; analysis of metabolic networks, gene regulatory networks, and signal transduction networks; inference of pathway structure; and behavior of cellular and molecular circuits. Prerequisites: 580.221, 580.222.

Bader   4 credits   fall

580.431 (E,N) Computational Motor Control

See description for 580.631.

Shadmehr   3 credits   fall

580.434 (E) Bioelectricity

Topics will include dielectric properties of biological tissues, electromanipulation of cells, electrical stimulation, defibrillation, impedance imaging, standards for electromagnetic field exposure, and electrical safety. Special emphasis will be placed on theoretical concepts and experimental approaches used to characterize the bioelectrical properties of cardiac muscle. Prerequisite: 580.421. Recommended 520.213.

Tung   3 credits   fall/even years

580.439 (E,N) Models of Physiological Processes in the Neuron

Single-neuron modeling, emphasizing the use of computational models as links between the properties of neurons at several levels of detail. Topics include thermodynamics of ion flow in aqueous environments, biology and biophysics of ion channels, gating, nonlinear dynamics as a way of studying the collective properties of channels in a membrane, synaptic transmission, integration of electrical activity in multi-compartment dendritic tree models, and properties of neural networks. Students will study the properties of computational models of neurons; graduate students will develop a neuron model using data from the literature. Prerequisites: 580.422 or equivalent, 110.302, 500.303 or equivalent. Recommended: 520.222.

Young   4 credits   fall

580.441 (E) Cellular Engineering

This course focuses on principles and applications in cell engineering. Class lectures include an overview of molecular biology fundamentals, experimental and mathematical techniques, binding equilibrium, cell-cell interactions, cell-matrix interactions, and cell dynamics at both theoretical and experimental levels. Lectures will cover the effects of physical (e.g. shear stress, strain), chemical (e.g. cytokines, growth factors), and electrical stimuli on cell function. Furthermore, topics in metabolic engineering, enzyme evolution, polymeric biomaterials, and drug and gene delivery will be discussed. This course is intended as part 1 of a two-semester sequence recommended for students in the Cell and Tissue Engineering focus area. Prerequisites: 580.221 or 020.305 and 020.306 (or equivalent) and 030.205 (co-listed as 580.641). Prior experience with Matlab is preferred, but not required.

Green, Yarema   3 credits   fall

580.442 (E) Tissue Engineering

This course focuses on the application of engineering fundamentals to designing biological tissue substitutes. Concepts of tissue development, structure, and function will be introduced. Students will learn to recognize the majority of histological tissue structures in the body and understand the basic building blocks of the tissue and clinical need for replacement. The engineering components required to develop tissue-engineered grafts will be explored including biomechanics and transport phenomena along with the use of biomaterials and bioreactors to regulate the cellular microenvironment. Emphasis will be placed on different sources of stem cells and their applications to tissue engineering. Clinical and regulatory perspectives will be discussed. This course is intended as part 2 of a two-semester sequence recommended for students in the Cell and Tissue Engineering focus area. Prerequisites: 580.221 or 020.305 and 020.306, 030.205. Recommended 580.441/580.641. (Co-listed as 580.642)

Elisseeff, Grayson   3 credits   spring

580.446 (E,N) Survey of Synthetic Biology

This course surveys basic fundamentals and current topics in synthetic biology including genome synthesis strategies, synthetic genetic systems, the engineering of proteins and genetic circuits, modeling of signaling and genetic circuits, and intellectual property issues. (Co-listed as 020.451 and 540.446)

Bader, Boeke, Levchenko, Mathews, Ostermeier, Scheifele   1 hour   spring

580.448 (E,N) Biomechanics of Cells and Organisms

The significance of the mechanical factors to cell biology under normal and pathological conditions is shown based on concepts of continuum and statistical mechanics. The main experimental techniques to probe the cellular mechanical properties are introduced and the connection between the models and experiments is demonstrated. We also discuss the role of proteins, membranes and cytoskeleton in cellular function and how to describe them using mathematical models. Prerequisites: 171.101-102, 110.108-109, 110.202. (Co-listed as 530.410)

Sun, Spector   3 credits   spring

580.451/452 (E,N) Cellular and Tissue Engineering Laboratory

Cell and tissue engineering is a field that relies heavily on experimental techniques. This laboratory course will consist of six experiments that will provide students with valuable hands-on experience in cell and tissue engineering. Students will learn basic cell culture procedures and specialized techniques related to faculty expertise in cell engineering, carbohydrate-based cell adhesion, microfluidics, gene delivery therapy, microfabrication and cell encapsulation.

Haase   2 credits   fall or spring

580.455 (E) Introduction to Orthopaedic Biomechanics

This course will cover static and dynamic forces in the musculoskeletal system, joint reactions, soft and hard tissue response to force loads, muscle mechanics, material properties, biomechanical lumped parameter systems, modeling and injury mechanisms. Prerequisites: 110.302.

Allen   3 credits   spring/odd years

580.466 (E,Q) Statistical Methods in Imaging

Denoising, segmentation, texture modeling, tracking, object recognition are challenging problems in imaging. We will present a collection of statistical models and methods in order to address these, including the E.M. algorithm, Maximum Entropy Modeling, Markov Random Fields, Markov Chain Monte Carlo, Boltzmann Machines, and Multilayer Perceptrons. Prerequisites: 110.202, 550.310 or equivalent.

Jedynak   3 credits   spring

580.469 (E) Design of Economic Health Care Technologies

This course is offered to juniors and seniors in engineering with an interest in developing economic health care technologies for global health care needs. Health care technologies for global use need to be cost effective and serve the needs of the disadvantaged population. In the US as well health care costs are spiraling and economic health care technologies and solu-tions will be necessary. This laboratory course will focus on identifying the health care needs, coming up with innovative technical solutions, designing and building such instrument prototypes, and exploring how such technologies can be disseminated globally. A new laboratory, EcoHealth, will be set up to do rapid prototyping and the students will do independent designs in this lab after doing proper needs identification and will be responsible for finding appropriate target needs. Students will be required to write the problem statement and the need analysis, submit a patent on the design, and a short proposal to seek funding from philanthropic or Government/non Government agencies. The course will focus on hands on design and projects, doing research and writing reports (or patents) pertaining to novel and useful technologies, and will receive 2 design credits and writing credits. This course, along with the 4 credit 580.471 (Principles of Design of Medical Instrumentation) offered in fall, and the 2 credit

580.571 (Honors Instrumentation) offered during the Intersession comprises an 8 credit design sequence that can serve the requirements for a full Capstone Design experience. The enrollment is restricted and subject to approval by the course instructor. Selection of the students will depend on commitment and experience with hands on design and instrumentation development and an interest in global health care needs. Permission of instructor.

Thakor   2 credits   spring

580.470 (E) Biomedical Instrumentation I: Molecular and Cellular

This core course will explore the fundamentals of molecular and cellular measurements, related technologies, and their applications in scientific research. Fundamentals of molecules and cells measurements and interfaces will be reviewed first. Physical principles and properties at molecular and cellular level will be reviewed next. This will be followed by basic principles of sensors, actuators, circuits, and electronics. Finally, design and development of established as well as emerging technologies used for molecular and cell biology will be presented (electrophoresis, micro and nanotechnologies for DNA separation, microarray, DNA sequencing/synthesis, lab on a chip, fluorescence, confocal and two photon microscopy, atomic force microscopy, and dip pen lithography, etc.). Extensive laboratory work includes microfabrication techniques, cell culturing and patterning, microscopy, sensing at cellular level and molecular patterning and cellular modification and transformation, followed by a group project. Prerequisite: 520.345, 580.421, 580.422 and 580.429. Optionally, 580.440 Cellular and Tissue Engineering or 580.495 Microfabrication Laboratory.

Thakor   3 credits   spring

580.471 (E) Principles of the Design of Biomedical Instrumentation II: Physiological and Clinical

This core design course will cover lectures and hands on labs. The material covered will include fundamentals of biomedical sensors and instrumentation, FDA regulations, designing with electronics, biopotentials and ECG amplifier design, recording from heart, muscle, brain, etc., diagnostic and therapeutic devices (including pacemakers and defibrillators), applications in prosthetics and rehabilitation, and safety. The course includes extensive laboratory work involving circuits, electronics, sensor design and interface, and building complete biomedical instrumentation. The students will also carry out design challenge projects, individually or in teams (examples include "smart cane for blind," "computer interface for quadriplegic"). Prerequisite: 520.345.

Thakor   4 credits   fall

580.472 (E) Medical Imaging Systems

An introduction to the physics, instrumentation, and signal processing methods used in general radiography, X-ray computed tomography, ultrasound imaging, magnetic resonance imaging, and nuclear medicine. The primary focus is on the methods required to reconstruct images within each modality, with emphasis on the resolution, contrast, and signal-to-noise ratio of the resulting images. Prerequisite: 520.214 or 580.222. (Co-listed as 520.432)

Prince   3 credits   fall

580.473 (E) Modern Biomedical Imaging, Instrumentation and Techniques

An intermediate biomedical imaging course covering modern biomedical imaging instrumentation and techniques as applied to diagnostic radiology and other biomedical applications. It includes recent advances in various biomedical imaging modalities, multi-modality imaging and molecular imaging. The course is team taught by experts in the respective fields and provides a broad based knowledge of modern biomedical imaging to prepare students for graduate studies and research in biomedical imaging. Also, the course will offer tours and practical experience with modern biomedical imaging equipment in clinical and research settings. Prerequisites 520.432 or 580.472

Tsui   3 credits   spring

580.474 (E) Molecular and Cellular Imaging

Introduction to non-invasive techniques as applied to an early diagnosis of disease, altered gene expression, cellular therapeutics, and fundamental molecular or metabolic changes. Includes magnetic resonance imaging, radionuclide imaging, and optical imaging techniques. Covered will be: principles of specific targeting and non-specific uptake of diagnostic contrast agents; NMR spectroscopy of metabolic changes in cancer; use of cell tracking using exogenous tags; imaging of stem cells, imaging using reporter genes, theranostics (combined therapeutics and diagnostics), imaging cancer, imaging of neurodegenerative disease, and imaging of cardiovascular disease. The emphasis of the overall course is to learn how molecular/cellular imaging will change the way future diagnostic radiology and drug development will be practiced. Prerequisites 580.221 or equivalent. Senior standing or approval of instructor.

Bulte, Gilad, Glunde, Pathak   3 credits   spring

580.475 (E) Quantummechanical Basics of Nuclear Magnetic Resonance

Basics of NMR spectroscopy theory, data acquisition and processing. Topics include phenomenological/semi-classical description of NMR, introduction to quantum mechanics, quantum mechanics of NMR, density matrix, Cartesian spin operator formalism, homonuclear and heteronuclear pulse sequences for coupled spins, polarization transfer and coherence transfer, coherence transfer formalism, phase cycling for coherence selection, pulse sequences for multidimensional NMR, phase-sensitive and magnitude detection, and coherence selection using pulsed magnetic field gradients. Prerequisites: basic physics and mathematics.

McMahon, Pekar   3 credits   fall/even years

580.476 Magnetic Resonance in Medicine

This course provides the student with a complete introduction to the physical principles, hardware design, and signal processing used in magnetic resonance imaging

and magnetic resonance spectroscopy. The course is designed for students who wish to pursue research in magnetic resonance. Prerequisite: 580.222 Systems and Controls or 520.214 Signals and Systems. (Co-listed as 520.673 and 520.673)
Bottomley, Edelstein   3 credits   fall

580.477 (E) Advanced Topics in Magnetic Resonance Imaging
An advanced imaging course with in-depth quantitative coverage of topics central to magnetic resonance imaging, ranging from techniques currently used in the radiology practice to new developments at the cutting edge of MRI research. Topics include: steady-state imaging and contrast mechanisms, MRI simulations, RF pulse and coil design, flow imaging and angiography, cardiac imaging, diffusion imaging, functional MRI, parallel imaging, and high-field imaging. As part of the course, students will be expected to read and understand classic and current literature. The course is taught by a team of experts in the respective fields and will provide an excellent foundation for students interested in deep understanding of magnetic resonance imaging. Prerequisites: Junior or senior standing, basic physics and mathematics, MATLAB, Magnetic Resonance in Medicine 580.476/676. (Co-listed as 580.677 and 520.677)
Herzka   3 credits   spring

580.481 (E,Q) Computer Vision
This course gives an overview of fundamental methods in computer vision from a computational perspective. Methods include computation of 3-D geometric constraints from binocular stereo, motion, texture, shape-from-shading, and photometric stereo. Edge detection and color perception are studied as well. Elements of machine vision and biological vision are also included. Prerequisites: 110.201 and 110.302. (Co-listed as 600.461)
Vidal   3 credits   spring

580.488 (E,N) Foundations of Computational Biology and Bioinformatics II
See description for 580.688.
Karchin   3 hours   spring

580.491 (E) Learning Theory
This course introduces the probabilistic foundations of learning theory. We will discuss topics in regression, estimation, optimal control, system identification, Bayesian learning, and classification. Our aim is to first derive some of the important mathematical results in learning theory, and then apply the framework to problems in biology, particularly animal learning and control of action. Prerequisites: 550.291 or equivalent linear algebra and probability theory.
Shadmehr   3 credits   spring

580.492 (E) Build-a-Genome Mentor
In addition to producing and sequencing DNA segments like regular B-a-G students, mentors will help prepare and distribute reagents, and maintain a Moddle site to track student reagent use and productivity. Mentors will also be expected to mentor specific students who are learn-

ing new techniques for the first time, contribute to the computational and biotech infrastructure associated with Build-a-Genome, and pursue at least one independent research project. Co-listed with 020.451. Permission required.
Bader, Boeke, Ostermeier   4 credits   fall and spring

580.495 Microfabrication Laboratory
This laboratory course is an introduction to the principles of microfabrication and microengineering of devices and structures for medicine, biology and the life sciences. Course comprises of laboratory work and accompanying lectures that cover photolithography, soft-lithography, silicon oxidation, physical deposition, electrochemical deposition, etching, packaging, design and analysis CAD tools, and foundry services. Permission of instructor is required. Due to the popularity of this course registration is first-come, first-served to undergraduates with senior standing only. (Co-listed as 520.495 and 530.495)
Andreou, Wang   4 credits   fall

580.496 (E) Micro/Nanoscience and Biotechnology
An introduction to the physical and chemical principles important to MEMS, BioMEMS, and bionanotechnology. Topics include scaling laws, colloids and surfaces, micro and nanofluidics, thermal forces and diffusion, chemical forces, electrokinetics, electric aspects of surface chemistry, capillary forces and surface tension, and top-down and bottom-up nanofabrication.
Wang   3 credits   fall

580.501-503 Freshman/Sophomore Research or Practicum in Biomedical Engineering
Research projects or engineering design projects under the supervision of any member of the BME faculty.
Staff   up to 3 credits per term

580.511-513 Freshman/Sophomore Independent Study in Biomedical Engineering
Directed readings or other literature research under the direction of any member of the BME faculty.
Staff   up to 3 credits per term

580.531-533 Junior/Senior Research or Practicum in Biomedical Engineering
Research projects or engineering design projects under the supervision of any member of the BME faculty. Prerequisite: junior or senior standing.
Staff   up to 3 credits per term

580.541-543 Junior/Senior Independent Study in Biomedical Engineering
Directed readings or other literature research under the direction of any BME faculty member. Prerequisite: junior or senior standing.
Staff   up to 3 credits per term

580.571 (E) Honors Instrumentation
Students enrolled jointly in 580.471 and 580.571 will not be required to take exams. Instead, students will develop a term paper and patent application and carry out a hands-on individual or team project throughout the

semester and the intersession. Previous projects include design of EEG amplifier, voltage clamp and patch clamp, vision aid of blind, pacemaker/defibrillator, sleep detection and alert device, glucose sensor and regulation, temperature controller, eye movement detection and device control, ultrasound ranging and tissue properties, impedance plethysmography, lie detector, blood alcohol detector, pulse oximeter, etc. Corequisite: must be enrolled in 580.471.
Thakor   2 credits

580.580-581 (E) Biomedical Engineering Design Project

Independent or team design project to design and evaluate a system. The design should demonstrate creative thinking, multiple realistic constraints, and experimental skills, and must draw upon advanced topics of biomedical and traditional engineering. Project proposal and permission of the undergraduate design director are required.
Allen   3 credits

Graduate Courses

580.601-602-603 Special Topics in Bioengineering Innovation and Design

This year long seminar series features experts from the medical device industry, venture capital firms, FDA, patent attorneys, entrepreneurs, and many more. They will share their real-world insights into the medical device innovation and commercialization process. Some of the topics covered will include bioethics, regulatory and reimbursement planning, medical device recalls, good design practices, and entrepreneurial success stories. The overarching philosophy of this seminar series is to complement the theoretical and practical aspects of the program curriculum, by learning from the experiences and insights of professionals in the field. Registration restricted to students enrolled in the CBID masters program.
Staff   summer, fall, spring

580.604/605/606 The Business of Bioengineering Innovation and Design

This course comprises two distinct, but related, components. The first is a broad introduction to the terms, concepts, and values of business and management. Particular emphasis will be placed on the economic, financial, and corporate contexts of our business culture, and how they impact the organization, strategy, and decision-making of business firms. The second component is an introduction to the sociological and economic forces that shape the development and diffusion of new technologies. This part is primarily designed to provide a framework for determining the commercial viability of new medical devices and the best path for realizing their value, including how to develop a compelling value proposition, analyze markets and competitors, and protect intellectual property. Throughout, the course utilizes individual exercises, case analyses, and team projects. Registration restricted to students enrolled in the CBID masters program.
Staff   summer, fall, spring

580.607 Regulation of Medical Devices

This course introduces graduate students in Bioengineering Innovation and Design to the medical device regulatory framework, as it pertains to bringing a medical device from concept to market. Topics covered include; FDA Design Controls; Regulatory Approval mechanisms, including the 510k and PMA process; Investigational Device exemption (IDE); planning clinical trials needed for bringing a medical device to market; and postmarket surveillance. Students learn from a series of invited lecturers from the FDA as well as professionals from the medical device industry. Registration restricted to students enrolled in the CBID masters program.
Staff   summer

580.608 Identification and Validation of Medical Device Needs

This course teaches the art and skill of identifying medical device opportunities by experiencing real world scenarios in an immersive clinical environment. Students rotate through multiple clinical disciplines and become part of the team of senior clinicians, surgeons, residents, fellows, nurses and medical technologists. They learn to identify unmet medical device needs through direct observations in a variety of clinical settings including the hospital ward and operating room, interviews (with patients, doctors, nurses, hospital administration), literature survey, and more. Concurrently, they learn the process of filtering all observations to a few valid medical device opportunities by assessing the market size, intellectual property landscape, regulatory framework, and competitor dynamics in addition to the clinical impact that such a device could have. The ability to identify a relevant medical device need is an important first step in the medical device innovation cycle; this course aims to provide students with practical hands-on training in that process. Registration restricted to students enrolled in the CBID masters program.
Staff   summer

580.610 Computational Functional Genomics

An introduction to mathematical and computational techniques for functional genomics, a growing area of research in cell biology and genetics whose objective is to understand the biological function of genes and their interactions. Computational functional genomics focuses on the problems of collecting, processing and analyzing data related to genome-wide patterns of gene expression with the objective to discover mechanisms by which a cell's gene expression is coordinated. This has become feasible with the development of DNA microarray technology, which allows the simultaneous measurement of gene expression levels of thousand of genes. Topics include an introduction to cell biology (cells, genome, DNA, transcription, translation, control of gene expression, DNA and RNA manipulation), DNA micro-array technology and experimental design, processing and analysis of micro array data (data reduction and filtering, clustering), and computational models for genetic regulatory networks (Boolean networks, Bayesian networks, ODE-based net-

works). Prerequisite: working knowledge of elementary probability and statistics. (Co-listed as 520.610)
Goutsias   2 hours   spring

580.611-612 Biomedical Device Innovation and Design (Design Team)
The two-semester design project provides teams of students with hands on design experience and takes them through a practical journey of the entire medical device innovation cycle—from idea to market. Student teams begin by selecting a project after scrutiny of various factors such as clinical impact, commercial viability and potential, and technical feasibility. Next, they define the needs and requirements of such a device, in close consultation with the target user (clinician and patient, typically). This is followed by development of an engineering solution: invention, design and prototyping of the device. Concurrently, teams develop a commercialization strategy that includes planning for regulatory and reimbursement approval, generating and protecting intellectual property, going from prototype to manufacturing, and taking the final product to market either through the startup or licensing route. Registration restricted to students enrolled in the CBID masters program.
Staff   fall, spring

580.613/614/615 Global Health Innovation and Design
This course trains our graduate students in the process of identification, invention, and implementation of healthcare technologies, specifically targeting large unmet clinical needs in resource restrained settings in developing countries. The course begins with an immersive two-week clinical rotation in our partnering hospitals and community health centers in Asia and Africa. Over the course of two semesters, students work in teams to develop and prototype multiple solutions, working closely with various stakeholders (physicians, patients, community health workers, and NGOs), to develop a clinical trial plan, identify manufacturing partners, and develop an appropriate business model that can make the technology accessible and sustainable. Registration restricted to students enrolled in the CBID masters program.
Staff   summer, fall, spring

580.616 Introduction to Linear Systems
This course examines linear, discrete- and continuous-time, and multi-input-output systems in control and related areas. Least squares and matrix perturbation problems are considered. Topics covered include state-space models, stability, controllability, observability, transfer function matrices, realization theory, feedback compensators, state feedback, optimal regulation, observers, observer-based compensators, measures of control performance, and robustness issues using singular values of transfer functions. BME EN.580.616 can be used to fulfill the requirement of ME EN.530.616 or ECE EN.520.601.
Sarma   3 hours   fall

580.617 Advanced Topics in Biomaterials
This course reviews recent advances in biomaterials focusing on the design principles in polymeric materials and scaffolds. It will cover topics from molecular designs of polymeric biomaterials, materials surface engineering, processing of polymeric scaffolds, to manipulation of cellular behaviors through materials engineering. Specific examples in cell and tissue engineering, and drug and gene delivery will be discussed. (Co-listed as 510.617)
Mao   3 hours   fall

580.625-626 Structure and Function of the Auditory and Vestibular Systems
Physiological mechanisms of hearing and balance. Topics include transmission of sound in the ear, transduction of sound and head orientation by hair cells, biophysics and biochemistry of hair cells, representation of sound and balance in eighth-nerve discharge patterns, anatomy of the central auditory and vestibular systems, and synaptic transmission and signal processing in central neurons. Aspects of hearing and balance such as speech perception, sound localization, vestibular reflexes and vestibular compensation are discussed with an integrated perspective covering perceptual, physiological, and mechanistic data. Prerequisites: 580.422 or equivalent. Recommended: 580.222.
Hearing Science Center Staff   3 hours
580.625 offered fall odd-numbered years/
580.626 offered fall even-number years

580.628 Topics in Systems Neuroscience
This course consists of weekly discussions of current literature in systems neuroscience. The selected readings will focus on neural mechanisms for perception, attention, motor behavior, learning, and memory, as studied using physiological, psychophysical, computational, and imaging techniques. Students are expected to give presentations and participate in discussions. Prerequisite: 580.421-422 Physiological Foundations or equivalent.
X. Wang, Zhang   1 hour   fall

580.629 Topics in Systems Neuroscience
This course consists of weekly discussions of current literature in systems neuroscience. The selected readings will focus on neural mechanisms for perception, attention, motor behavior, learning, and memory, as studied using physiological, psychophysical, computational, and imaging techniques. Students are expected to give presentations and participate in discussions. Prerequisite: 580.421-422 or equivalent.
X. Wang, Shadmehr   1 hour   spring

580.630 Theoretical Neuroscience
Theoretical methods for analyzing information encoding and functional representations in neural systems. Models of single and multiple neural spike trains based on stochastic processes and information theory; detection and estimation of behaviorally relevant parameters from spike trains; system theoretic methods for analyzing sensory receptive fields; network models of neural systems. Both theoretical methods and the properties of specific well-studied neural systems will be discussed. Prerequisites: Introduction to Neuroscience (580.422 or equivalent), Probability (550.420 or equivalent), and Systems and Controls (580.222).
X. Wang, Young, Zhang   2 hours   spring/even year

580.631 Computational Motor Control
 This course introduces tools from robotics, control theory, and computational neuroscience to understand in some depth the primate motor system. Our approach is to use mathematics to explore functions of muscles, spinal reflex systems, integration of vision and proprioception in the posterior parietal cortex, formation of motor plans, and online control. Our focus is on how various parts of the cortical and sub-cortical motor system contribute to the control and learning of movements, and how motor disorders arise from damage to these neural structures. Prerequisites: 110.302 Differential Equations, 110.201 Linear Algebra.
Shadmehr   3 hours   fall

580.632 Ionic Channels in Excitable Membranes
See 580.425 for description. Advanced homework problems, paper presentations, and exam questions are added to the core curriculum.
Yue   3 hours   spring/odd years

580.635 Topics in Bioelectromagnetic Phenomena
This course reviews theoretical concepts and experimental approaches used to characterize electric, magnetic, and electromagnetic phenomena that arise in biological tissues. Topics include volume conductor models of cells and tissues, complex conductive properties of tissue and cell suspensions, bioelectric and biomagnetic measurements, electric and magnetic stimulation, and impedance plethysmography. Selected topics will be chosen for oral presentations by class participants.
Tung   3 hours   fall/odd years

580.636 Feedback Control in Biological Signaling Pathways
Signal transduction pathways in biological systems need to be precisely regulated. This control is done through feedback regulatory loops. Students in this course will formulate mathematical models of signaling pathways and analyze their behavior using engineering control theory. Prerequisites: 110.302 Differential Equations, 520.353 Control Theory.
Iglesias   3 hours   spring

580.637 Contemporary Topics in the Engineering of Cardiac Tissue
Cardiac ionic currents, molecular correlates and blockers, calcium clock repolarization reserve, alternans, electrical remodeling, cardiac memory, defective calcium cycling, ion channel mutations, human embryonic stem cells, paracrine signaling, extracellar matrix and cytoskeleton, synthetic tissue scaffolds, in vitro experimental models.
Tung   2 hours   fall/odd years

580.639 Models of Physiological Processes in the Neuron
Graduate version of 580.439. Differs in that an advanced modeling project using data from the literature is required. Same prerequisites.
Young   4 hours   fall

580.641 Cellular Engineering
Graduate version of 580.441.
Green, Yarema   3 hours   fall

580.642 Tissue Engineering
Graduate version of 580.442.
Elisseeff, Grayson   3 hours   spring

580.651 Introduction to Nonlinear Dynamics in Physiology
This course is designed for students who may be interested in applying the techniques of nonlinear dynamics and chaos to the analysis of physiological data. Topics covered will include fractals, strange attractors, bifurcations, state-space attractor reconstruction, Poincaré sections, dimension calculations, Lyapunov exponents, entropy, tests for determinism, nonlinear forecasting. Examples will be drawn from studies in cardiology, brain function, and the oculomotor system. Prerequisite: basic knowledge of signals and systems or permission of instructor.
Shelhamer   3 hours   fall/even years

580.655 Orthopaedic Biomechanics
Graduate version of 580.455. Same prerequisites. Graduate students only.
Allen   3 hours   spring/odd years

580.670 Biomedical Instrumentation II: Molecules and Cells
Graduate version of 580.470. Same prerequisites.
Thakor   3 hours   spring

580.671 Statistical Mechanics in Biological Systems
Principles of statistical physics are discussed in the context of biological problems. After an introduction, topics covered will include equilibrium theory of liquids and polymers, theory of chemical reactions in complex environments, stochastic models, dynamics of membrane and channels, theory of biological motors, computer simulation of liquids and proteins. (Co-listed as 530.671)
Sun   3 hours   fall

580.672 Biosensing and BioMEMS
The course discusses the principles of biosensing and introduces micro- and nano-scale devices for fluidic control and molecular/cellular manipulation, measurements of biological phenomena, and clinical applications. (Co-listed as 530.672)
J. Wang   3 hours   spring

580.673 Magnetic Resonance in Medicine
Graduate version of 580.476. Same prerequisites. (Co-listed as 520.673)
Bottomley, Edelstein   3 hours   fall

580.677 Advanced Topics in Magnetic Resonance Imaging
Graduate version of 580.477. Same prerequisites. (Co-listed as 520.677)
Herzka   3 hours   spring

580.681 Advanced Topics in Computer Vision
State-of-the-art methods in dynamic vision, with an emphasis on segmentation, reconstruction, and recognition of static and dynamic scenes. Topics include reconstruction of static scenes (tracking and correspondence,

multiple view geometry, self-calibration), reconstruction of dynamic scenes (2-D and 3-D motion sementation, nonrigid motion analysis), recognition of visual dynamics (dynamic textures, face and hand gestures, human gaits, crowd motion analysis), as well as geometric and statistical methods for clustering and unsupervised learning, such as K-means, Expectation Maximization, and Generalized Principal Component Analysis. Applications in robotics and biomedical imaging are also included. Prerequisite: 110.202 and 600.461 or instructor's permission. (Co-listed as 600.681)

Vidal   3 hours   spring

580.682 Computational Models of the Cardiac Myocyte
The cardiac myocyte is one of the most extensively studied cells in biology. As such, it serves as an important example of how to develop quantitative, dynamic, computational models of cell function. "Computational Models of the Cardiac Myocyte" will present a comprehensive review of all aspects of modeling of the cardiac myocyte as an introduction to the discipline of computational cell biology. The course will be presented in an innovative way. Students will be expected to review web-based course material prior to weekly lab meetings. Weekly 3 hour lab session will be used to interact with the instructors, and to implement and study computational models. Recommended prerequisites: 580.421-422 or equivalent, 110.201 and 110.302 or 550.291, knowledge of C/C++ OR Matlab. Graduate level course open to qualified undergraduate seniors with permission of the instructors.

Winslow, Greenstein   3 hours   fall

580.687 Foundations of Computational Biology I
This course presents the fundamental concepts in equilibrium and non-equilibrium statistical mechanics and apply them to topics in modern molecular computational biology. Monte Carlo and statistical ensembles are presented. Field theories are introduced to describe the mechanics of membranes, cytoskeleton and biofluids. Kinetic theory, master equations and Fokker-Planck equations are discussed in the context of ion channels and molecular motors. (Co-listed with 530.687)

Sun   3 hours   fall

580.688 Foundations of Computational Biology and Bioinformatics II
This course will introduce probabilistic modeling and information theory applied to biological sequence analysis, focusing on statistical models of protein families, alignment algorithms, and models of evolution. Topics will include probability theory, score matrices, hidden Markov models, maximum likelihood, expectation maximization and dynamic programming algorithms. Prerequisites: Mathematics through Linear Algebra and differential equations; Molecular Biology and genetics at the level of 580.221 or equivalent; 600.226 or equivalent. Homework assignments will require programming in Python. Foundations of Computational Biology and Bioinformatics I is not a prerequisite for this course. (Co-listed with 600.488 and 600.688)

Karchin   3 hours   spring

580.690 Systems Biology of Cell Regulation
This course will explore the recent advances in systems biology analysis of intracellular processes. Examples of the modeling and experimental studies of metabolic, genetic, signal transduction and cell cycle regulation networks will be studied in detail. The classes will alternate between consideration of network-driven and network element- (gene, metabolite or protein) driven approaches. Prerequisites: 110.201, 110.302 or equivalent. Recommended prerequisite: advanced biology.

Levchenko   3 hours   spring

580.691 Learning Theory
This course introduces the probabilistic foundations of learning theory. We will discuss topics in regression, estimation, optimal control, system identification, Bayesian learning, and classification. Our aim is to first derive some of the important mathematical results in learning theory, and then apply the framework to problems in biology, particularly animal learning and control of action. Prerequisites: 550.291 or equivalent linear algebra, probability theory.

Shadmehr   3 hours   spring

580.692 Advanced Topics in Machine Learning: Modeling and Segmentation of Multivariate Mixed Data
The aim of this two-semester course is to describe the foundations of computational methods for the statistical and dynamical modeling of multivariate data. The emphasis of the second semester is to use methods from algebraic geometry, probability theory and dynamical systems theory to build models of data. Topics include nonlinear dimensionality reduction (PCA, LLE), unsupervised learning (central clustering, subspace clustering, GPCA), and estimation and identification of dynamical systems (Kalman filtering, subspace identification, hybrid system identification). We will apply these tools to model data from computer vision, biomedical imaging, neuroscience, and computational biology.

Vidal   3 hours   spring

580.701 Sensorimotor Systems
A weekly seminar course that covers recent research papers in the field of sensorimotor neuroscience. The papers address questions of interest in both basic neuroscience and clinical neuroscience. The papers are presented by students, and the audience typically includes a number of clinical and basic science faculty, as well as graduate students and postdocs. The course web page is at **jhu.motor.lab.googlepages.com**.

Shadmehr   3 hours   fall

580.702-703 Neuroengineering Seminar
Neuroengineering represents the application of engineering principles to develop systems for neurological research and clinical applications. Examples of research in this area include design of instrumentation for brain monitoring, development of signal processing methods to analyze brain rhythms, contemporary imaging methods ranging from optical/CT/MRI, use of micro- and nanotechnologies to probe from neurons and brain, and development and application of neural stimulators, prosthesis, and deep

brain stimulations and robotic/image-guided therapeutic devices. This two-semester course will have one-hour-long weekly lectures and seminars by training program faculty (from BME, EE, Radiology, Neurology, and Neurosurgery). During the second semester, the students will then engage in a short project of clinical (or scientific) significance to increase awareness of the literature, work with the faculty members and their lab and gain hands-on experience. Ph D students only.

Thakor   3 hours   fall and spring

580.744 Pattern Theory: From Representation to Inference
This course examines the metric pattern theory of Ulf Grenander in which shapes and patterns are studied as random processes on graphs. The course begins with the study of Markov processes on directed acyclic graphs, including Markov chains and branching processes, and on random fields on regular lattices. Moving to the continuum, the course examines Gaussian random fields, second order representation theory and random processes of geometric shape through Gaussian fields on manifolds. Numerous examples are examined in image understanding and image analysis.

Miller   3 hours   spring

580.771 Principles of Biomedical Instrumentation
This course is designed for graduate students interested in learning basic biomedical instrumentation design concepts and translating these into advanced projects based on their research on current state-of-the-art. They will first gain the basic knowledge of instrumentation design, explore various applications, and critically gain hands-on experience through laboratory and projects. At the end of the course, students would get an excellent awareness of biological or clinical measurement techniques, design of sensors and electronics (or electro-mechanical/chemical, microprocessor system and their use). They will systematically learn to design instrumentation with a focus on the use of sensors, electronics to design a core instrumentation system such as an ECG amplifier. Armed with

that knowledge and lab skills, students will be encouraged to discuss various advanced instrumentation applications, such as brain monitor, pacemaker/defibrillator, or prosthetics. Further, they will be "challenged" to come up with some novel design ideas and implement them in a semester-long design project. Students will take part in reading the literature, learning about the state-of-the-art through journal papers and patents, and discussing, critiquing, and improving on these ideas. Finally, they will be implementing a selected idea into a semester-long advanced group project.

Thakor   4 hours   fall

580.774 Molecular and Cellular Imaging
Graduate version of 580.474. Same prerequisites.
Bulte, Gilad, Glunde, Pathak   3 hours   spring

580.801-802 Research in Biomedical Engineering
Staff   credit varies

Cross-Listed Courses

520.315 Introduction to Information Processing of Sensory Signals
Hermansky   3 credits

520.445 Introduction to Speech and Audio Processing
Elhilali   3 credits

520.622 Principles of Network Systems
Goutsias   3 hours

530.426 Biofluid Mechanics
Mittal   3 credits   fall

530.448 Biosolid Mechanics
Nguyen   3 credits

520.622 Principles of Network System
Goutsias   3 hours

550.635: Topics in Bioinformatics
Geman   3 hours

Chemical and Biomolecular Engineering

The Department of Chemical and Biomolecular Engineering offers courses and training culminating in the bachelor of science degree in chemical and biomolecular engineering. This discipline is dedicated to solving problems and generating valuable products involving chemical and biological transformations at the molecular scale. The undergraduate program emphasizes the molecular science aspects of biology and chemistry along with the engineering concepts essential to developing commercial products and processes. By selecting an appropriate concentration or by choice of free electives, students can prepare for a professional career path or for further study in chemical, biomolecular, or a related engineering field as well as medical, law, or business school. In the tradition of the Johns Hopkins University, many undergraduates are also involved in research, working closely with faculty and graduate students in research groups.

Students pursuing a B.S. degree in chemical and biomolecular engineering have the opportunity, if they choose, to take some of their courses in a particular area in order to obtain a concentration. The two concentrations that students may choose to complete, Interfaces and Nanotechnology (IN) and Molecular and Cellular Bioengineering (MCB), are described below.

Interfaces and Nanotechnology (IN) Concentration

Material properties of nanostructures depend upon their dimensions; by synthesizing structures in the nanometer size range, materials with new optical, electrical, and magnetic properties can be created. The ability to fabricate these structures and assemble them into ordered aggregates is central to exploiting these new materials. As such, engineering at the nanoscale will be dominated by surface science, as surface to volume ratios become large. Furthermore, self-assembly techniques, in which molecules or synthetic units can spontaneously assemble in ordered structures with nanometer length scales, are ripe for exploitation to create new materials and devices for a wide range of electronic, optical, fluidic and biomedical applications. In this concentration, students take a chemistry course on Materials and Surface Characterization and electives on interfaces and nanotechnology such as Interfacial Science, Colloids and Nanoparticles, and Micro- and Nanotechnology.

Molecular and Cellular Bioengineering (MCB) Concentration

Many biological transformations of interest in biotechnology and biomedicine involve transformations at molecular and cellular levels. These molecular transformations include the genetic manipulation of cells in order to produce valuable designer protein and vaccines for the biopharmaceutical industry. Alternatively, cellular transformation events can be critical to the onset of diseases such as arteriosclerosis and cancer. Cellular transformations can be critical to the treatment of diseases such as inducing the death of cancer cells or the manipulation of stem cells along desirable pathways. Students wishing to study molecular and cellular events in biological systems and their applications in more detail can pursue an optional concentration in Molecular and Cellular Bioengineering. Students in this concentration will take electives in bioengineering subjects such as Cell Engineering, Tissue Engineering, Drug Delivery, Biological Macromolecules, or Molecular Evolution. In addition, students will take Biomolecular Engineering Laboratory in order to equip students with the hands-on skills needed for future careers involving the application of biological systems at the molecular and cellular level.

The mission is to define and educate a new archetype of innovative and fundamentally-grounded engineer at the undergraduate and graduate levels through the fusion of fundamental chemical engineering principles and emerging disciplines. We will nurture our passion for technological innovation, scientific discovery, and leadership in existing and newly created fields that transcend traditional boundaries. We will be known for developing leaders in our increasingly technological society who are unafraid to explore uncharted engineering, scientific, and medical frontiers that will benefit humanity. Recent graduates of the Chemical and Biomolecular Engineering program will:

- Pursue careers in industrial, academic, or government organizations related to chemical, physical, and life sciences and engineering, and/or pursue graduate or professional education.
- solve diverse traditional and emerging problems in the workplace, using their mastery of chemical and biomolecular engineering skills.

The department also offers graduate programs leading to the master of science and Ph.D. degrees. These programs emphasize research leading to a written thesis.

Undergraduate students strongly involved in research may be interested in our B.S./M.S.E. program in Chemical and Biomolecular Engineering that allows students to obtain a masters of science in engineering immediately after the bachelors of science by adding an additional year of study.

The Faculty

Gregory Aranovich, Research Professor: molecular thermodynamics, phase equilibria, adsorption phenomena, and separation processes.

Dilip Asthagiri, Assistant Professor: hydration phenomena and statistical mechanics of aqueous systems; *ab initio* molecular dynamics approaches to chemistry in liquids; metal-protein and protein-protein interactions.

Michael J. Betenbaugh, Professor: genomics, recombinant DNA biotechnology, biopharmaceuticals, metabolic engineering, insect and mammalian cell culture, glycosylation engineering, and cell death processes.

Michael A. Bevan, Associate Professor: measuring and manipulating nanoparticle and biomolecular interactions, dynamics, and structures in interfacial and confined systems.

Honggang Cui, Assistant Professor: nanoscience and nanotechnology, biomolecular engineering, peptide synthesis and assembly, drug delivery, supramolecular polymers, nanoparticle imaging and diagnosis.

Lise Dahuron, Lecturer (Director of Undergraduate Studies): separations, distillation, membrane technology, new product development, process design.

Marc D. Donohue, Professor: phase equilibria, statistical thermodynamics, kinetics of diffusion and phase transitions, adsorption.

German Drazer, Assistant Professor: transport phenomena in micro/nanofluidic systems, mixing, separation and detection in microdevices, multiscale modeling of molecular systems, interfacial phenomena at molecular scales, structure and transport in suspensions of nanoparticles, transport in porous media.

Joelle Frechette, Assistant Professor: properties of surfaces and thin films; properties of interfaces and confined fluids; surface separation; Microelectromechanical systems (MEMS) in liquids and at the nanoscale.

Zachary Gagnon, Assistant Professor: electrokinetic phenomena in micro/nanofluidic environments, cell signaling, cell migration, micro/nano fabrication, dielectrophoresis, biological separation, manipulation and characterization in microdevices.

Sharon Gerecht, Assistant Professor: embryonic and adult stem cells, vascular regeneration, micro/nano fabrication, biomaterials, tissue engineering

An Goffin, Lecturer: fluid and bioactive interfaces, kinetic processes, principles in chemical engineering, product design.

David Gracias, Associate Professor: micro and nanotechnology, surface science, metamaterials, complex systems, nanoelectronics, nanomedicine, regenerative medicine, drug delivery and microfluidics.

Jeffrey Gray, Associate Professor: biomolecular modeling, protein-protein docking, therapeutic antibodies, allostery, protein-surface interactions and design.

Michael J. Karweit, Research Professor: numerical analysis, statistics, fluid mechanics, acoustics.

Joseph L. Katz, Professor Emeritus: nucleation processes (e.g., condensation of supersaturated vapors, boiling of superheated liquids and its applications, e.g., the Ouzo effect, parts per quadrillion detection) formation of nanosized ceramic oxide powders in flames, new proteomics tools.

Konstantinos Konstantopoulos, Professor (Department Chair): cell and molecular engineering; functional genomics; fluid mechanics in medical applications: cancer metastasis, thrombosis, inflammation/bacterial infection.

Marc A. Ostermeier, Associate Professor: biomolecular engineering, molecular evolution, protein engineering, combinatorial methods, biosensors, protein therapeutics.

Sai Prakash, Lecturer: microstructure evolution in polymeric membranes, cryogenic scanning electron microscopy, membrane technology, fluid mechanics of particle filtration, sol-gels, ellipsometry, numerical analysis.

Denis Wirtz, Professor: cell adhesion and migration, cell mechanics, cytoskeleton, receptor-ligand interactions, cancer, particle tracking, new proteomics tools.

Joint, Part-Time, and Visiting Appointments

Shyam Biswal, Associate Professor (Environmental Health Sciences, Toxicological Sciences)

Jeff Bulte, Professor (JHMI, Dept of Radiology and Radiological Sciences and Institute for Cell Engineering)

Sam Denmeade, Associate Professor (JHMI, Oncology)

Jennifer Elisseeff, Assistant Professor (BME)

Jonah Erlebacher, Associate Professor (Material Science)

Justin Hanes, Professor (INBT, Oncology)

Jan Hoh, Associate Professor (JHMI, Physiology)

John Isaacs, Professor (JHMI, Oncology, Urology)

Jerry S.H. Lee, Adjunct Assistant Professor (Program Director, NCI)

Ben Park, Assistant Professor (JHMI, Oncology)

Aleksander Popel, Professor (JHMI, Cardiovascular Systems)

Peter Searson, Professor (Material Science)

Sean X. Sun, Associate Professor (Mechanical Engineering)

Michael Yu, Associate Professor (Material Science)

Facilities

The offices and state-of-the-art laboratories of Chemical and Biomolecular Engineering are located in the New Engineering Building and Maryland Hall on the Homewood campus. The research laboratories are well-equipped for studies in the areas of biochemical engineering, cell and tissue engineering, phase equilibria, membrane science, polymer science, interfacial phenomena, separation processes, fluid mechanics, and nucleation phenomena. The Milton S. Eisenhower Library on the Homewood campus contains over two million volumes and access to more than 325 electronic journals. The university's other libraries located at the School of Medicine and at the Applied Physics Laboratory are also available to students. Through close collaborations with scientists at the National Institutes of Health, and the National Institute of Standards and Technology, The Institute for Genomic Research, Human Genome Sciences, Inc., and the Food and Drug Administration, students and faculty also have access to a variety of world-class facilities and other resources for research.

Financial Aid

Undergraduate scholarships and financial assistance are described in the catalog (see page 23). Part-time work is available in the Chemical and Biomolecular Engineering research laboratories on research projects supported by grants and contracts. There also is a federally sponsored work-study program for qualified students. A program has been established in the School of Engineering to coordinate work projects with local industries.

Financial assistance to graduate students is available in the forms of research assistantships, teaching assistantships, fellowships, and partial or full tuition remission. The financial aid package is specified following acceptance into the graduate program.

Undergraduate Program

The undergraduate program in chemical engineering is accredited by ABET. As permitted under the ABET guidelines, we are continually upgrading our undergraduate programs to include the latest advances in chemical and biomolecular engineering. Such modifications will enable us to offer the best possible education experience to our undergraduates. For the latest chemical engineering educational programs, potential applicants are referred to our website at **www.jhu.edu/chembe.**

Requirements for the B.S. Degree

(See also General Requirements for Departmental Majors, page 48.)

The bachelor of science degree requires a minimum of 128 credits. Additional details are given in the *Chemical and Biomolecular Engineering Undergraduate Advising Manual* available from the department or online at **www.jhu.edu/chembe/undergraduate programs/**. The 128 credits must include:

- *Chemical and Biomolecular Engineering Core Courses.* The following ChemBE courses are required 540.101, 540.202, 540.203, 540.204, 540.301, 540.303, 540.304, 540.305, 540.306, 540.311 (or 540.313), 540.314, 540.409, and 540.490. Students also must have a grade point average of at least 2.00 in the chemical and biomolecular engineering core courses to graduate. The core courses for GPA calculation comprise all of the above courses except for 540.101 and 540.490.

- *Other Engineering Courses.* A minimum of 48 engineering credits are required for the degree; therefore, in addition to the 42 credits of chemical and biomolecular engineering core courses, students are required to take at least six engineering elective credits.

- *Physics Courses and Laboratories.* The following physics courses are required: 171.101, 173.111 and 171.102.

- *Basic Chemistry Courses and Laboratories.* The following chemistry courses are required: 030.101, 030.105, 030.102, and 030.106.

- *Advanced Chemistry and Biology Courses.* The following three advanced chemistry/biology courses are required 020.305, 030.205, and 020.306. Students must choose one of the following laboratory courses, 030.307 or 020.315. Students are required to take one additional course beyond these required courses. Students who are concentrating in Molecular and Cellular Bioengineering or Interfaces and Nanotechnology have additional and/or alternate requirements (see next page).

- *Mathematics Requirement.* The following mathematics courses are required: Calculus I, II and III (110.108, 110.109 and 110.202) and Differential Equations with Applications (110.302). Calculus is so essential to Chemical Engineering that a grade of C- or better in both Calculus I and Calculus II is required.

- *Humanities and Social Sciences Courses.* Eighteen credits designated as humanities (H) or social science (S) are required. Students are required to take these courses in at least two subject areas other than writing. At least one of these courses must be an advanced course at the 300 level or higher. See the Chemical and Biomolecular Engineering Undergraduate Advising Manual for more details.

- *Writing Courses.* Two writing intensive or 'W' courses are required. One of the courses must be 661.315. The courses that are taken to satisfy the university writing requirement must be passed with a grade of C- or better.

- *Undesignated Electives.* A minimum of 128 credits is required for the degree. Therefore, in addition to all the credits taken to fulfill the requirements mentioned in the various sections above (e.g., chemical engineering core courses, engineering electives, basic science, advanced chemistry electives, mathematics requirement, and H & S courses) additional credits (called undesignated credits) are required.

Sample Program for Chemical and Biomolecular Engineering Degree

Freshman Year/Fall

030.101	Intro to Chemistry I	3
030.105	Intro to Chemistry I Lab	1
110.108	Calculus I	4
171.101	General Physics I	4
173.111	General Physics Lab I	1
540.101	Chemical and Biomolecular Engineering in Workplace	1
H/S Elective		3
Total		17

Freshman Year/Spring

030.102	Intro to Chemistry II	3
030.106	Intro to Chemistry II Laboratory	1
110.109	Calculus II	4
171.102	General Physics II	4
H/S Elective		3
Total		15

Sophomore Year/Fall

540.202	Intro to Chemical and Biological Process Analysis	4
540.490	Chemical and Biomolecular Lab Safety and Ethics	1
110.202	Calculus III	4
020.305	Biochemistry	4
030.205	Organic Chemistry I	4
Total		17

Sophomore Year/Spring

540.203	Engineering Thermo	3
540.303	Transport I	3
110.302	Differential Equations with Applications	4
020.306	Cell Biology	4
Undesignated Elective		3
Total		17

Junior Year/Fall

540.204	Applied Physical Chem.	3
540.304	Transport II	4
030.307	Physical Chemistry or 020.315 Biochemistry Lab	3 or 2
540.305	Modeling and Statistic Analysis for Chemical and Biomolecular Engineering	3
H/S Elective		3
Total		15-16

Junior Year/Spring

540.301	Kinetic Processes	3
540.306	Chemical and Biological Separations	3
661.315	Culture of the Engineering Profession	3
Undesignated Elective		3
Advanced Chemistry Elective		3
Total		15

Senior Year/Fall

540.311	Chemical Engineering Lab	6
540.409	Modeling Dynamics and Control for Chemical and Biological Systems	4
H/S Elective		3
Engineering Elective		3
Total		16

Senior Year/Spring

540.314	Chemical and Biomolecular Product Design	4
Engineering Elective		3
H/S Elective		3
Undesignated Electives		6
Total		16

Concentrations

Students pursing a degree in Chemical and Biomolecular Engineering have the option of concentrating in specific fields including Interfaces and Nanotechnology and Molecular and Cellular Bioengineering. Students completing a concentration will have this fact designated on their official university checklist. These concentrations have additional and/or alternate requirements, as described.

Molecular and Cellular Bioengineering (MCB) Concentration

Students must fulfill the following requirements:

- The Advanced Chemistry and Biology laboratory requirement is fulfilled with a 020.315 Biochemistry Lab.
- Six credits of bioengineering electives are required. See department for a list of approved electives.
- Students take 540.313 Chemical and Biomolecular Engineering Lab instead of 540.311 Chemical Engineering Lab.

Interfaces and Nanotechnology (IN) Concentration

Students must fulfill the following requirements

- Materials and Surface Characterization (030.452) is required and satisfies three credits of the advanced chemistry electives.
- Six credits of interfaces and nanotechnology electives are required. See department for a list of approved electives.

Sample Program: Molecular and Cellular Bioengineering Concentration

Freshman Year/Fall

030.101 Intro to Chemistry I	3
030.105 Intro to Chemistry I Lab	1
110.108 Calculus I	4
171.101 General Physics I	4
173.111 General Physics Lab I	1
540.101 Chemical and Biomolecular Engineering in Workplace	1
H/S Elective	3
Total	17

Freshman Year/Spring

030.102 Intro to Chemistry II	3
030.106 Intro to Chemistry II Laboratory	1
110.109 Calculus II	4
171.102 General Physics II	4
H/S Elective	3
Total	15

Sophomore Year/Fall

540.202 Intro to Chemical and Biological Process Analysis	4
540.490 Chemical and Biomolecular Lab Safety and Ethics	1
110.202 Calculus III	4
020.305 Biochemistry	4
030.205 Organic Chemistry I	4
Total	17

Sophomore Year/Spring

540.203 Engineering Thermo	3
540.303 Transport I	3
110.302 Differential Equations with Applications	4
020.306 Cell Biology	4
Undesignated Elective	3
Total	17

Junior Year/Fall

540.204 Applied Physical Chemistry	3
540.304 Transport II	4
020.315 Biochemistry Lab	2
540.305 Modeling and Statistic Analysis for Chemical and Biomolecular Eng.	3
H/S Elective	3
Total	15

Junior Year/Spring

540.301 Kinetic Processes	3
540.306 Chemical and Biological Separations	3
Undesignated Elective	3
661.315 Culture of the Engineering Profession	3
Advanced Chemistry Elective	3
Total	15

Senior Year/Fall

540.313 Biomolecular Engineering Lab	6
540.409 Modeling Dynamics and Control for Chemical and Biological Systems	4
H/S Elective	3
Bioengineering Elective	3
Total	16

Senior Year/Spring

540.314 Chemical and Biomolecular Product Design	4
Bioengineering Elective	3
H/S Elective	3
Undesignated Electives	6
Total	16

Sample Program: Interfaces and Nanotechnology Concentration

Freshman Year/Fall

030.101 Intro to Chemistry I	3
030.105 Intro to Chemistry I Lab	1
110.108 Calculus I	4
171.101 General Physics I	4
173.111 General Physics Lab I	1
540.101 Chemical and Biomolecular Engineering in Workplace	1
H/S Elective	3
Total	17

Freshman Year/Spring

030.102 Intro to Chemistry II	3
030.106 Intro to Chemistry II Lab	1
110.109 Calculus II	4
171.102 General Physics II	4
H/S Elective	3
Total	15

Sophomore Year/Fall

540.202 Intro to Chemical and Biological Process Analysis	4
540.490 Chemical and Biomolecular Lab Safety and Ethics	1
110.202 Calculus III	4
020.305 Biochemistry	4
030.205 Organic Chemistry I	4
Total	17

Sophomore Year/Spring

540.203 Engineering Thermo	3
540.303 Transport I	3
110.302 Differential Equations with Applications	4
020.306 Cell Biology	4
Undesignated Elective	3
Total	17

Junior Year/Fall

540.204 Applied Physical Chemistry	3
540.304 Transport II	4
030.307 Physical Chemistry Instrumentation Lab III	3
540.305 Modeling and Statistic Analysis for Chemical and Biomolecular Eng.	3
H/S Elective	3
Total	16

Junior Year/Spring

540.301 Kinetic Processes	3
540.306 Chemical and Biological Separations	3
661.315 Culture of the Engineering Profession	3

Undesignated Elective	3
H/S Elective	3
Total	15

Senior Year/Fall

540.311 Chemical Engineering Lab	6
540.409 Modeling Dynamics & Control for Chemical and Biological Systems	4
030.452 Materials and Surface Characterization	3
I/N Engineering Elective	3
Total	16

Senior Year/Spring

540.314 Chemical and Biomolecular Product Design	4
I/N Engineering Elective	3
H/S Elective	3
Undesignated Electives	6
Total	16

B.S./M.S.E. Program in Chemical and Biomolecular Engineering

The B.S./M.S.E. program in Chemical and Biomolecular Engineering allows students to obtain a master of science in engineering immediately after the bachelor of science degree by adding up to an additional year of study. For students who qualify academically, the Whiting School of Engineering allows a 50 percent waiver after the completion of eight semesters or having received the bachelor of science degree.

Graduate Program

Graduate Degree Requirements

Master of Science in Engineering

Students have two options in pursuing an M.S.E. in Chemical and Biomolecular Engineering.

1. Master's of Science in Engineering (requiring an essay)

• The student must complete six graduate (600-799) level courses approved by the student's research advisor. The student and advisor select these courses to design a curriculum appropriate for the student's research interest and educational goals.

• These six courses cannot include seminars, independent study, graduate research or special studies.

• At least four of the six courses must be in the Chemical and Biomolecular Engineering Department.

- Students are allowed to count 400-level courses toward their MSE degree if (1) the course is not offered at the 600-level, and (2) if the department offering the course considers it to be a graduate-level course in their program. Courses offered at both the 400- and 600-level must be taken at the 600-level to fulfill MSE course requirements.
- The student must also enroll in at least two semesters of graduate seminars (540.600/601) throughout his or her tenure in the Department of Chemical and Biomolecular Engineering at Johns Hopkins University.
- The student must write an essay based on original research and literature review and present his or her results at an open seminar attended by the faculty and students. The essay must be approved by the departmental graduate committee which consists of the graduate research advisor and at least one more faculty member from the Department of Chemical and Biomolecular Engineering.

2. Master's of Science in Engineering (course work only)

- The student must complete ten graduate (600-799) level courses approved by Director of Graduate Studies. The student and Director of Graduate Studies select these courses to design a curriculum appropriate for the student's interest and educational goals
- These ten courses cannot include seminars, independent study, graduate research or special studies.
- At least six of the ten courses must be in the Chemical and Biomolecular Engineering Department.
- Students are allowed to count 400-level courses toward their MSE degree if (1) the course is not offered at the 600-level, and (2) if the department offering the course considers it to be a graduate-level course in their program. Courses offered at both the 400- and 600-level must be taken at the 600-level to fulfill MSE course requirements.
- The student must also enroll in at least two semesters of graduate seminars (540.600/601) throughout his or her tenure in the Department of Chemical and Biomolecular Engineering at Johns Hopkins University.

Recommended courses for all MSE students
Completion of two of the four core courses of the Ph.D. program is recommended (but not required) for MSE students. The four core Ph.D. courses are:

540.630 Thermodynamics & Statistical Mechanics

540.652 Fundamentals of Biotransport Phenomena

540.602 Cellular and Molecular Biotechnology

540.615 Interfacial Science with Applications to Nanoscale Systems.

Additional information and requirements can be found in the department Graduate Handbook.

Doctor of Philosophy
The Ph.D. degree is awarded for original research performed under the guidance of a thesis advisor. The formal requirements for this degree are:

1. Successful completion of six graduate-level courses including the four required core courses.
2. Successful completion of the Preliminary Research Exam during the student's first year.
3. Successfully serve as a teaching assistant for at least two required undergraduate courses.
4. Completion of an original research project, documented in a dissertation that is defended by the candidate in a public presentation.
5. Successful completion of the Graduate Board Oral Exam.

Course Work
Student must successfully complete six graduate-level courses including the four required core courses listed below:

540.630 Thermodynamics & Statistical Mechanics

540.652 Fundamentals of Biotransport Phenomena

540.602 Cellular and Molecular Biotechnology

540.615 Interfacial Science with Applications to Nanoscale Systems.

Students are strongly encouraged to take the four required courses in the first fall semester. However, students who do not have an undergraduate degree in Chemical Engineering or a closely related field may need additional course and should discuss an appropriate course plan with the Director of the Graduate Program.

The remaining two engineering or science courses are chosen with the help of the student's advisor to design a curriculum appropriate for the student's research interest. These two courses cannot include seminars, independent study, graduate research or special studies.

Each of the six courses must be passed with a letter grade of B- or higher. In addition, the student must maintain an overall grade point average (GPA) of 3.0 or better. If the student's GPA falls below 3.0, the student must re-take one or more of the courses and earn a higher grade, upon which

the prior grade in those courses are not counted toward the GPA. If a student receives a grade of C+ or lower in a required core course, the student will be allowed to re-take the course once to achieve a grade of B- or higher. Failure to receive a B- or better the second time will be cause for dismissal from the program. Receipt of grades of C+ or lower in two or more required courses will ordinarily be cause for dismissal from the program without the opportunity to re-take those courses.

In addition

- all first year students must enroll in 540.490 Chemical and Biomolecular Engineering Safety during their first semester
- students must enroll in graduate seminars (540.600/601) every semester. Students are expected to attend department seminars throughout their tenure in the department.

Preliminary Research Exam (1st year Ph.D. students)

The departmental Preliminary Research Exam is an oral exam for first year students consisting of a presentation by the student on a seminal paper in the student's research field and questions by a faculty committee. The exam aims to probe the student's critical thinking, dedication and approach toward research and learning. The exam is offered in January each year. More details on the exam can be found in the ChemBE Graduate Handbook.

Ph.D. Thesis Criteria and Graduate Board Oral Exam

Candidates must write a dissertation conforming to university requirements that describes the students work and results in detail. A public defense of the dissertation is required, and will be followed by a closed examination session. Because the closed examination session fulfills the university Graduate Board Oral (GBO) examination requirement, all procedures pertaining to GBOs as established by the University Graduate Board must be followed.

The committee for the closed examination shall consist of five faculty members, chosen by the Graduate Program Committee, with at least two members being from outside the department. The committee consists of the three members of the student's thesis committee (the advisor and two readers—one reader from inside the department and reader from outside the department) and two additional members, one from outside the department and one from inside the department. The outcome of the closed examination will be decided by majority vote of the committee.

There is no foreign language requirement for the Ph.D. degree. A student with a strong undergraduate background usually earns the Ph.D. degree in four to five years.

Additional information can be found in the department Graduate Handbook.

Undergraduate Courses

540.101 (E) Chemical and Biomolecular Engineering in the Workplace: Biotechnology, Nanotechnology, and Beyond

A series of lectures will introduce the student to the myriad of different career opportunities available to chemical and biomolecular engineers. Weekly seminars by invited guests in combination with department faculty will introduce students to important real world problems in molecular biotechnology, electronics, law, medicine, biopharmaceuticals, energy, and the environment. Students will learn how chemical and biomolecular engineering concepts can impact these areas and the role of engineers in industry, academics, medicine and the non-profit sector. A variety of different companies and institutions will be profiled on a weekly basis. Prerequisites: none.

Dahuron   1 credit   fall

540.202 (E) Introduction to Chemical and Biological Process Analysis

Introduction to chemical and biomolecular engineering and the fundamental principles of chemical process analysis. Formulation and solution of material and energy balances on chemical processes. Reductionist approaches to the solution of complex, multi-unit processes will be emphasized. Introduction to the basic concepts of thermodynamics as well as chemical and biochemical reactions and computer programming. Prerequisites: 030.101, 171.101.

Dahuron, Gray   4 credits   fall, spring

540.203 (E) Engineering Thermodynamics

Development of classical thermodynamic relationships and constitutive equations for one and two component systems. The objectives of this course are two-fold: (a) to obtain a firm grasp of the basic concepts of thermodynamics; (b) to develop skills in applying thermodynamics to engineering problems. Topics covered include: fundamentals of thermodynamics, PVT properties of pure substances, power cycle and refrigeration, introduction to phase equilibria, and chemical reaction equilibria. Applications include the analysis and design of engines, refrigerators, heat pumps, compressors, and turbines. Prerequisites: 540.202. Corequisite: 110.202.

Frechette, Bevan   3 credits   fall, spring

540.204 (E) Applied Physical Chemistry
Introduction of the methods used to solve thermodynamic problems faced by chemical and biomolecular engineers, including phase and chemical equilibria problems, the thermodynamic properties of interfaces, and the thermodynamics of macromolecules. The basic thermodynamic relationships to describe phase equilibrium of single-component and multicomponent systems are developed. Thermodynamic models for calculating fugacity are presented. Multicomponent phase equilibrium problems addressed include liquid-vapor, liquid-liquid, and liquid-liquid-vapor equilibrium. Basic thermodynamic relationships to describe chemical equilibria, the physical chemistry of liquid-liquid and liquid-solid interfaces, and the conformation of biological macromolecules are also presented. Prerequisite: 540.203.
Gracias   3 credits   fall

540.301 (E) Kinetic Processes
Review of numerical methods applied to kinetic phenomena and reactor design in chemical and biological processes. Homogeneous kinetics and interpretation of reaction rate data. Batch, plug flow, and stirred tank reactor analyses, including reactors in parallel and in series. Selectivity and optimization considerations in multiple reaction systems. Nonisothermal reactors. Elements of heterogeneous kinetics, including adsorption isotherms and heterogeneous catalysis. Coupled transport and chemical/biological reaction rates. Prerequisites: 540.203, 540.303 or permission of instructor.
Cui/Goffin   3 credits   spring

540.303 (E,N) Transport Phenomena I
Introduction to the field of transport phenomena. Molecular mechanisms of momentum transport (viscous flow), energy transport (heat conduction), and mass transport (diffusion). Isothermal equations of change (continuity, motion, and energy). The development of the Navier Stokes equation. The development of nonisothermal and multicomponent equations of change for heat and mass transfer. Exact solutions to steady state, isothermal unidirectional flow problems, to steady state heat and mass transfer problems. The analogies between heat, mass, and momentum transfer are emphasized throughout the course. Corequisite: 110.302 or equivalent.
Konstantopoulos, Prakash   3 credits   spring

540.304 (E,N) Transport Phenomena II
Dimensional analysis and dimensionless groups. Laminar boundary layers, introduction to turbulent flow. Definition of the friction factor. Macroscopic mass, momentum and mechanical energy balances (Bernouilli's equation). Metering of fluids. Convective heat and mass transfer. Heat and mass transfer in boundary layers. Correlations for convective heat and mass transfer. Boiling and condensation. Interphase mass transfer. Prerequisite: 540.303.
Gagnon   4 credits   fall

540.305 Modeling and Statistical Analysis of Data for Chemical and Biomolecular Engineers
Collecting and analyzing data is an indispensable component of any scientific enterprise. The sequence of operations that is typical in science is: hypothesis to data to inference. Since data is almost always imperfect (or incomplete), we have to rely on probability theory to infer the validity of the hypothesis. In this course, we adopt the Laplace-Bayes approach to probability theory and suggest how we can use this approach to reason in situations of imperfect data. Concepts such as determining the odds ratio, the role of Occam's factor, etc. will be discussed. We will motivate commonly encountered probability distributions using examples in Chemical Engineering. Modeling is an indispensable component of data analysis, and we will rely on MATLAB and Python programming environments to become familiar with computational aspects of data analysis. Prerequisite: 540.202. Recommended corequisites: 540.203, 540.303, 540.304.
Asthagiri   3 credits   fall

540.306 (E) Chemical and Biological Separations
This course covers staged and continuous-contacting separations processes critical to the chemical and biochemical industries. Separations technologies studied include distillation, liquid-liquid extraction, gas absorption, membrane ultrafiltration, reverse osmosis, dialysis, adsorption, and chromatography. Particular emphasis is placed on the biochemical uses of these processes and consequently on how the treatment of these processes differs from the more traditional approach. Prerequisites: 540.202, 540.303 or permission of instructor.
Betenbaugh   3 credits   spring

540.311 (E,W) Chemical Engineering Laboratory
Students are challenged with laboratory projects that are not well-defined and learn to develop an effective framework for approaching experimental work by identifying the important operating variables, deciding how best to obtain them, and using measured or calculated values of these operating variables to predict, carry out, analyze, and improve upon experiments. Each student analyzes three projects: distillation, gas absorption, and one of the projects in 540.313. In addition to technical objectives, this course stresses oral and written communication skills and the ability to work effectively in groups. Prerequisites: 540.301, 540.304, 540.306.
Dahuron, Prakash   6 credits   fall

540.312 (E,W) Chemical and Biomolecular Engineering Lab
Prakash   3 credits   fall

540.313 (E,W) Chemical and Biomolecular Engineering Lab
Students are challenged with laboratory projects that are not well-defined and learn to develop an effective framework for approaching experimental work by identifying the important operating variables, deciding how best to obtain them, and using measured or calculated values of these operating variables to predict, carry out, analyze, and improve upon experiments. Each student analyzes two of the following projects: membrane separation, biocatalysis and bioreactor, and one of the projects in 540.311. In addition to technical objectives, this course stresses oral and written communication skills and the ability to work effec-

tively in groups. Prerequisites; 540.301, 540.304, 540.306, 540.490.
Dahuron, Gerecht, Ostermeier, Prakash   6 credits
fall, summer

540.314 (E) Chemical and Biomolecular Product and Process Design
This course guides the student through the contrasting aspects of product design and of process design. Product design concerns the recognition of customer needs, the creation of suitable specifications, and the selection of best products to fulfill the needs. Process design concerns the quantitative description of processes which serve to produce many commodity or specialty chemicals, the estimation of process profitability, and the potential for profitability improvement through incremental changes in the process. Students work in small teams to complete a major project demonstrating their understanding of and proficiency in the primary objectives of the course. Students report several times both orally and in writing on their accomplishments. Prerequisites: 540.301, 540.304, 540.306, 540.311 or 540.313 or permission of instructor.
Dahuron, Prakash, Goffin   4 credits   spring

540.402 (E) Cellular and Molecular Biotechnology
This course provides details of the latest advances in cellular and molecular biology for mammalian systems, with special implications for biotechnology. Topics covered include tissue organization, gene expression, signal transduction, immunology, proteomics, genomics, and post-transnational processing. Special emerging areas in biotechnology involving mammalian cells will be described including nanobiotechnology for mammalian cells, metabolic and cellular engineering, stem cell therapies, and tissue engineering.
Betenbaugh   3 credits   fall

540.403 (E) Colloids and Interfaces
This course covers fundamental principles related to interactions, dynamics, and structure in colloidal, nanoparticle, and interfacial systems. Concepts covered include hydrodynamics, Brownian motion, diffusion, sedimentation, electrophoresis, colloidal and surface forces, polymeric forces, aggregation, deposition, and experimental methods. Modern topics related to colloids in nano-science and technology will be discussed throughout the course with frequent references to recent literature. Prerequisite: 540.203.
Bevan   3 credits   fall

540.409 (E,Q) Modeling, Dynamics, and Control for Chemical and Biological Systems
In this class you will learn to model and control chemical and biological processes. Previous ChemBE courses have usually focused on mathematical models of steady-state behavior; here, you will learn to model dynamics, that is, responses over time. In particular, you will model the transient response around a steady-state solution, and you will design appropriate control systems to maintain desired process behavior. In the chemical process industries, correct process control is essential for safety, environmental security, and economic optimality. In biological systems,

complex control loops already exist to maintain homeostasis and enable interesting function. It is necessary to create models for these existing biological systems and then to identify appropriate means to judiciously interrupt the circuits to change the system's behavior, for example by using a drug to combat a disease.
Gray, Goffin   4 credits   fall

540.414 (E) Computational Protein Structure Prediction and Design
The prediction of protein structure from the amino acid sequence has been a grand challenge problem for over fifty years. With recent progress in research, it is now possible to blindly predict many protein structures and even to design new structures from scratch. This class will introduce the fundamental concepts in protein structure, biophysics, optimization and informatics that have enabled the breakthroughs in computational structure prediction and design. Problems covered will include protein folding and docking, design of ligand-binding sites, design of turns and folds, design of protein interfaces. Students will learn to use molecular visualization tools and write programs with the PyRosetta protein structure software suite, including a computational project. Some programming experience is helpful. Prerequisites: 020.305, 540.230.
Gray   3 credits   spring

540.415 (E) Interfacial science with Applications to Nanoscale Systems
Nanostructured materials intrinsically possess large surface area (interface area) to volume ratios. It is this large interfacial area that gives rise to many of the amazing properties and technologies associated with nanotechnology. In this class we will examine how the properties of surfaces, interfaces, and nanoscale features differ from their macroscopic behavior. We will compare and contrast fluid-fluid interfaces with solid-fluid and solid-solid interfaces, discussing fundamental interfacial physics and chemistry, as well as touching on state-of-the-art technologies.
Frechette   3 credits   fall

540.426 (E) Biomacromolecules at the Nanoscale
Wirtz   3 credits   fall

540.437 (E) Application of Molecular Evolution to Biotechnology
One of the most promising strategies for successfully designing complex biomolecular fuinctions is to exploit nature's principles of evolution. This course provides an overview of the basics of molecular evolution as well as its experimental implementation. Current research problems in evolution-based biomolecular engineering will be used to illustrate principles in the design of biomolecules (i.e. protein engineering, RNA/DNA engineering), genetic circuits and complex biological systems including cells. Prerequisite: 020.305.
Ostermeier   3 credits   spring

540.440 (E) Micro and Nanotechnology
Micro/Nanotechnology is the field of fabrication, characterization, and manipulation of extremely small objects (dimensions on the micron to nanometer length scale).

These objects, because of their small size are expected to be at the frontier of technological innovation for the next decade. This lecture plus laboratory course will include a description of the materials used in microtechnology, methods employed to fabricate nanoscale objects, techniques involved in characterizing and exploiting the properties of small structures, and examples of how this technology is revolutionizing the areas of electronics, optics, bioengineering and medicine.

Gracias   3 credits   spring

540.447 (E) Topics in Fluid Mechanics
This course focuses on a selection of problems in fluid mechanics at low and moderate Reynolds numbers. This is a highly interactive class in which students are expected to choose topics and prepare a presentation at least twice a semester. Therefore, the list of problems will vary depending on student selection. Typically, one meeting per week will be an introductory class and the following meeting will be a seminar on a specific topic or paper.

Drazer   3 credits   fall

540.459 (E) Bioengineering in Regenerative Medicine
The course will focus on principles in tissue engineering, mechanisms of regeneration, and stem cell therapies. Topics will include introduction to regenerative medicine, bioreactors and scaffolds in tissue engineering, adult and pluripotent stem cells, engineering the niche, and four sessions will focus on legal and ethical issues. Selected approaches to analyze tissues and stem cell cultures will also be discussed. In addition, the course will be integrated with students' presentations on selected topics in stem cell engineering.

Gerecht   3 credits   fall

540.490 Chemical and Laboratory Safety
This course is meant to provide the student with a basic knowledge of laboratory safety; hazards, regulations, personal protective equipment, good laboratory practice, elementary toxicology, and engineering controls. It has been developed by the Department of Chemical and Biomolecular Engineering to assist with regulatory compliance, minimize hazards, and reduce the severity of any incidents that may occur in the department's laboratories. The course is a prerequisite of 540.311/313. It is required of all Chemical and Biomolecular Engineering undergraduates.

Staff   1 credit   fall

540.501-506 Undergraduate Independent Study
Students do a reading course in specialized areas not directly available by lecture courses. Assignments and problems are prescribed by a faculty member.

1-3 credits

540.521-528 Undergraduate Research
Students do individual projects (or in collaboration with faculty and/or graduate students) in areas basic to chemical engineering.

1-3 credits

Cross-Listed

500.101 (E) What is Engineering?
This is a course of lectures, laboratories, and special projects. Its objective is to introduce students not only to different fields of engineering but also to the analytic tools and techniques that the profession uses. Assignments include hands-on and virtual experiments, oral presentations of product design, and design/construction/testing of structures. Open to freshmen only.

Karweit   3 credits

500.200 (E,Q) Computing for Engineers and Scientists
This course introduces a variety of techniques for solving problems in engineering and science on a computer using MATLAB. Topics include structure and operation of a computer, the programming language MATLAB, computational mathematics, and elementary numerical analysis. Prerequisite: 110.109

Karweit   3 credits

540.659 (E) Bioengineering in Regenerative Medicine
The course will focus on principles in tissue engineering, mechanisms of regeneration, and stem cell therapies. Topics will include introduction to regenerative medicine, bioreactors and scaffolds in tissue engineering, adult and pluripotent stem cells, engineering the niche, and four sessions will focus on legal and ethical issues. Selected approaches to analyze tissues and stem cell cultures will also be discussed. In addition, the course will be integrated with students' presentations on selected topics in stem cell engineering.

540.640 (E) Micro and Nanotechnology
Micro/Nanotechnology is the field of fabrication, characterization and manipulation of extremely small objects (dimensions on the micron to nanometer length scale). Microscale objects, because of their small size are expected to be at the frontier of technological innovation for the next decade. This course will include a description of the materials used in microtechnology, methods employed to fabricate nanoscale objects, techniques involved in characterizing and exploiting the properties of small structures, and examples of how this technology is revolutionizing the areas of electronics and medicine.

Gracias   3 credits   spring

Graduate Courses

540.602 Cellular and Molecular Biotechnology
Molecular biology techniques, DNA, RNA, and proteins; control of gene expression; microarray technology and proteomics; cell-cell signaling and communication; cell adhesion; extracellular matrix; introductory glycobiology. Cell structure: membrane, cytoskeleton, organelles, proteins secretion and degradation. Cell Replication and Death: cell cycle, cell division, senescence, and apoptosis Multicellular Systems: fertilization. Tissue Development: nervous system, ectoderm (neuronal crest), mesoderm, endoderm metamorphosis, regeneration, aging. Stem Cell

Biology: Adult and fetal stem cells, germ and embryonic stem cells, cell expansion of undifferentiated and progenitor cells, differentiation regulation, and control/engineering of stem cell renewal and differentiation in vitro.
Betenbaugh   fall

540.603 (E) Colloids and Interfaces
(For description, see 540.403)
Bevan

Add 540.614 (E) Computational Protein Structure Prediction and Design
(For description see 540.414)
Gray   3 credits   spring semester

540.615 (E) Interfacial Science with Applications to Nanoscale Systems
Nanostructured materials intrinsically possess large surface area (interface area) to volume ratios. It is this large interfacial area that gives rise to many of the amazing properties and technologies associated with nanotechnology. In this class we will examine how the properties of surfaces, interfaces, and nanoscale features differ from their macroscopic behavior. We will compare and contrast fluid-fluid interfaces with solid-fluid and solid-solid interfaces, discussing fundamental interfacial physics and chemistry, as well as touching on state-of-the-art technologies.
Frechette   3 credits   fall

540.626 (E) Introduction to Biomacromolecules
(For description, see 540.426)
Wirtz

540.630 Thermodynamics and Statistical Mechanics for Chemical and Biomolecular Systems
We will develop equilibrium thermodynamics and statistical mechanics from the unified perspective of entropy maximization subject to constraints. After a brief review of classical thermodynamics, we will undertake the study of statistical mechanics leading up to the study of liquids, especially liquid water, and of the hydration of (bio)molecules. We will show how hydration of solutes is conceptually simple when viewed on the basis of quasi-chemical generalizations of the potential distribution theorem.

We will highlight how the quasi-chemical generalizations readily allow one to include quantum chemical-level of description in the statistical mechanics of biologically interesting processes. Time permitting, toward the end we will devote couple of lectures to modern developments in statistical mechanics that connect non-equilibrium work to equilibrium free energies.
Asthagiri   fall

540.637 (E) Application of Molecular Evolution to Biotechnology
(For description see 540.437)
Ostermeier   3 credits   semester/spring

540.640 Micro to Nanotechnology
(For description see 540.440)
Gracias

540.647 (E) Topics in Fluid Mechanics
(For a description see 540.447)
Drazer   3 credits   fall

540.652 Fundamentals of Biotransport Phenomena
This lecture course introduces students to the application of engineering fundamentals from transport and kinetic processes to vascular biology and medicine. The first half of the course addresses the derivation of the governing equations for Newtonian fluids, their solution in the creeping flow limit. The second half of the course considers how these concepts can be used to understand the behavior of a deformable cell near planar surfaces.
Drazer   fall

540.659 (E) Macromolecules at the Nanoscale
Wirtz

540.600-601 Chemical and Biomolecular Engineering Seminar
Lectures are presented on current subjects relevant to chemical engineering.
1 credit

540.801 Graduate Research
1–12 hours

Civil Engineering

Civil engineers apply sophisticated analysis and design techniques to advance the needs of society for shelter, infrastructure, and a safe environment. Graduates are employed in the fields of structural analysis and design, soil mechanics and foundation design, environmental engineering and policy, and coastal and ocean engineering, and increasingly are taking on far-reaching management roles in infrastructure, hazard mitigation, sustainability, and technical roles in the planning, design, and construction of large-scale engineered systems. In addition, a civil engineering degree provides exposure to broad societal challenges and the logical thinking necessary for pursuing careers in other professional fields, such as law, business, and medicine.

The Department of Civil Engineering offers programs at the undergraduate, graduate, and postdoctoral levels. Civil Engineering at Hopkins offers a unique balance centered in mechanics fundamentals, and enriched by state-of-the-art tools in modeling, simulation, and physical experimentation. The small size of the CE Department fosters a collegial, close-knit relationship between the students, staff, and faculty, while our partnerships with other Johns Hopkins Departments provide a wide range of collaborative opportunities that span the larger disciplines of fluids, systems, structures, and materials. A wide range of research opportunities distinguishes the program. Students have participated in projects on structural reliability, earthquake resistance of structures, testing and analysis of historic bridges, failure of brittle materials, cold-formed steel members and their connections, and coastal and ocean engineering to name a few. A five-year bachelor's/master's degree program is also offered. Graduates of Johns Hopkins University have traditionally risen to leadership roles in education, research, industry, and government.

The Faculty

Annalingam Anandarajah, Professor: geomechanics, constitutive modeling, finite element modeling, geotechnical engineering.

Robert A. Dalrymple, Professor and Willard and Lillian Hackerman Chair in Civil Engineering: coastal engineering, water wave mechanics, fluid mechanics.

Somnath Ghosh, Professor and Michael G. Callas Chair in Civil Engineering: multiscale mechanics, finite elements, material fatigue modeling.

Lori Graham-Brady, Professor: probabilistic mechanics, finite elements, stochastic modeling of materials.

James K. Guest, Assistant Professor: structural analysis and optimal design, material design, computational mechanics.

Takeru Igusa, Professor: structural dynamics, earthquake engineering, analysis of uncertainties.

Nicholas P. Jones, Professor in Civil Engineering and Dean of the Whiting School of Engineering: structural dynamics, flow-induced vibration, wind engineering.

Judith Mitrani-Reiser, Assistant Professor: performance-based engineering, structural dynamics, earthquake engineering, multi-hazard loss estimation.

Narutoshi Nakata, Assistant Professor: structural dynamics, experimental method, smart structures technology, earthquake engineering.

Benjamin Schafer, Professor, Swirnow Family Faculty Scholar and Department Chair: structural stability, computational mechanics, experimental methods, thin-walled structures.

Lian Shen, Assistant Research Professor: computational fluid dynamics, environmental fluid mechanics, water wave, turbulence, ocean and coastal engineering.

Joint Appointments

William P. Ball, Professor (DOGEE): environmental engineering.

Edward J. Bouwer, Professor (DOGEE): environmental microbiology, waste treatment.

J. Hugh Ellis, Professor (DOGEE): structural health engineering, environmental systems.

Seth Guikema, Assistant Professor (DOGEE): probabilistic risk analysis, environmental life-cycle assessment.

Alan T. Stone, Professor (DOGEE): environmental and aquatic chemistry.

Peter R. Wilcock, Professor (DOGEE): sediment transport, slope stability.

DOGEE is the Department of Geography and Environmental Engineering.

Visiting Appointments and Lecturers

John A. Matteo, Lecturer: structural engineering and architecture.

Kirk Mettam, Lecturer: structural engineering and architecture.

Charles J. Russo, Lecturer: structural design.

Rachel Sangree, Lecturer: structural engineering and historic structures.

Niklas W. Vigener, Lecturer: investigation and evaluation of structures.

Facilities

The Department's teaching and research labs are located in Latrobe Hall and the Stieff Building. Teaching laboratories, all located in Latrobe Hall, include a modern multi-use facility for exploring experiments in statics, mechanics of materials, dynamics and other courses, a dedicated soil mechanics laboratory, and a dedicated computing facility. Research laboratories include the Smart Structures and Hybrid Testing Laboratory, the Thin-walled Structures Laboratory, and the Sensor Technology and Infrastructure Risk Mitigation (STIRM) Laboratory in Latrobe Hall, and the Coastal Engineering Laboratory in the Stieff Building. The department also provides space for undergraduate research, the student chapter of the American Society of Civil Engineers, a graduate student lounge, and office space for each graduate student.

The department sponsors an undergraduate and graduate seminar series, as well as the Richard J. Carroll endowed lectureship; all of which are designed to bring prominent civil engineers to campus to speak with students and faculty.

Financial Aid

Scholarships and other forms of financial assistance for undergraduates are described under Admissions and Finances (see page 23). In addition, some undergraduate students are employed by Departmental faculty to provide assistance on research projects.

Financial assistance to graduate students is available on a competitive basis in the form of partial or complete tuition fellowships, fellowships with stipends, teaching assistantships, and research assistantships. In addition to university-wide fellowships, graduate students in civil engineering are also eligible for fellowships from the Joseph Meyerhoff Scholarship Fund, the Richard D. Hickman Endowment, and the Hoomes Rich Graduate Fellowship.

Undergraduate Program

The mission of the undergraduate program is to educate intellectual leaders of the profession by instilling in them a fundamental understanding of the mathematical principles of physics and nature that underlie engineering science, a practical appreciation of the challenges of creative engineering design, and a sense of responsibility for professional service. The undergraduate program has been designed to provide a firm foundation in a wide breadth of modern civil engineering so that the following broad program educational objectives are fulfilled:

- Graduates are prepared for advanced study in engineering or other fields.
- Graduates are prepared for successful engineering practice.

Some flexibility is built into the curriculum so that students may pursue particular interests such as structural engineering, geotechnical engineering, coastal and ocean engineering, or environmental engineering. Upon completion of the B.S. in civil engineering, students will demonstrate the ability to:

- Understand the principles of physical science, mathematics and engineering science on which engineering research and practice are based;
- Have knowledge and skills to design, conduct, and evaluate experiments;
- Demonstrate critical thinking skills and an ability for independent study needed to engage in lifelong learning;
- Are prepared for career advancement through graduate study and/or professional practice;
- Possess knowledge and skills to identify, formulate, and execute solutions to engineering problems using modern engineering tools and synthesizing different fields of knowledge;
- Communicate effectively to function in multidisciplinary teams and to deal with other professions in public and private sectors;
- Are broadly educated to understand contemporary issues and the context in which civil engineering is practiced in modern society;
- Understand professional ethics and the value of service through participation in technical activities, and in community, state, and national organizations.

The program has been accredited by ABET, the Accreditation Board for Engineering and Technology, since 1936.

Requirements for the B.S. Degree

The B.S. degree in civil engineering requires 128 credits. A brief summary of the requirements, which is given below, is intended only as a guide, and were in effect for students matriculating during the 2010–2011 Academic Year. Students matriculating afterwards or looking for more detailed information should look at the department website at www.ce.jhu.edu/current-undergraduate-curriculum/. Each student is assigned an advisor who will provide guidance to ensure all requirements are met.

No course listed as a requirement may be taken satisfactory/unsatisfactory (S/U). Any other course used to fulfill a requirement under humanities and social sciences or under unspecified electives can

be taken satisfactory/unsatisfactory. Technical electives may be taken satisfactory/unsatisfactory only with the approval of the advisor. No more than two grades of D in the required engineering and technical electives may be counted.

Basic Sciences (17 credits):
171.101 General Physics for Physical Science Majors I
171.102 General Physics for Physical Science Majors II
173.111 General Physics Laboratory I
173.112 General Physics Laboratory II
030.101 Introductory Chemistry I
030.105 Introductory Chemistry Laboratory
270.220 The Dynamic Earth: An Introduction to Geology or 030.102 Introductory Chemistry II or another natural science course

Mathematics (16 credits):
110.108 Calculus I
110.109 Calculus II
110.201 Linear Algebra
110.302 Differential Equations with Applications or 110.202 Calculus III

Humanities and Social Sciences (24 credits):
Students are encouraged to explore their non-engineering interests, which the faculty views as an integral part of a sound education. Furthermore, since civil engineers provide professional services to the public and have significant influence on society, it is important that they have an appreciation of societal concerns and humanistic issues. Requirements are as follows:

- Courses used for the Humanities (H) and Social Sciences (S) elective requirements must total at least 24 credits and may include any course labeled as H and/or S. At least two courses (6 credits) must be 300 level or above.

- Courses used for the H elective requirements must total at least 9 credits.

- Two writing-intensive courses (at least 6 credits) are required, one of which must be 060.113/114 (Expository Writing) or 220.105 (Introduction to Fiction and Poetry: Telling It Straight). The second writing course of at least 3 credits must be taken from the Krieger School of Arts and Sciences. These writing-intensive courses must be taken for a letter grade and passed with a grade of C or better.

- Courses used for the S elective requirements must total at least 9 credits. These must include one course from the Economics Department (180. xxx).

Unspecified Electives (7 credits):

Common Engineering (55 credits):
560.141 Perspectives on the Evolution of Structures
560.201 Statics & Mechanics of Materials
560.202 Dynamics
560.206 Solid Mechanics & Theory of Structures
560.220 Civil Engineering Analysis
560.305 Soil Mechanics
560.320 Steel Structures
560.325 Concrete Structures *or* 570.305 Environmental Engineering Systems
560.330 Foundation Design
560.349 Civil Engineering Design I
560.350 Civil Engineering Design II
560.351 Introduction to Fluid Mechanics
560.380 Introduction to Ocean & Wind Engineering
560.435 Probability & Statistics in Civil Engineering
560.491 Civil Engineering Seminar I
560.492 Civil Engineering Seminar II
510.201 Introduction to Engineering Materials
570.301 Environmental Engineering I: Fundamentals
570.302 Environmental Engineering II: Water & Wastewater Treatment

Technical Electives (9 credits):
Technical electives are higher-level courses in civil engineering (560.XXX) or mathematics (Q), basic sciences (N) or engineering (E) and are to be selected by students in consultation with their advisor. Other than courses specifically listed on the Technical Courses listing on the department website, courses below the 200-level cannot be counted as technical electives except with the approval of the advisor. Additional semesters of Civil Engineering Seminar (560.493-494) can be counted as technical electives.

Sample B.S. Program
The Civil Engineering undergraduate advising manual available at **www.ce.jhu.edu/current-undergraduate-curriculum**/ contains a sample civil engineering program. This sample illustrates the general sequence of courses. Electives may be substituted to coincide with a specific interest. The manual also contains information and advice on technical and nontechnical electives and design credits.

Minor in Principles of Civil Engineering
This program is available to nondepartmental majors only who would like an overview of the principles of civil engineering. The following courses are required:

171.101 General Physics for Physical Science Majors 110.108-109 Calculus I, II

560.141 Perspectives on the Evolution of Structures

560.201 Statics and Mechanics

560.206 Solid Mechanics and Theory of Structures

560.491 or 492 Civil Engineering Seminar

- A two-course sequence in civil engineering selected in consultation with a civil engineering faculty member (see http://www.ce.jhu.edu/current-undergraduate-minor/ for more specifics on these courses).

Bachelor's/Master's Honors Programs

The Department of Civil Engineering offers combined bachelor's/master's degrees. One program combines a B.S. in civil engineering with a Master of Science in Engineering (M.S.E.) in Civil Engineering. The other option combines a B.S. in Civil Engineering with a Master of Science in Engineering Management (M.S.E.M.). Formal application through the Department is required. Students may be admitted as early as the junior year. For students who are admitted to this program, the two degrees typically require five years total to complete. For these students, there is an automatic tuition waiver of 50 percent after the first eight semesters of undergraduate work. More information about these programs can be found at www.ce.jhu.edu/current-undergraduate-concurrent/.

Graduate Programs

The Department of Civil Engineering offers a graduate program that is based primarily in structural, geotechnical, and coastal engineering, mechanics of materials, and hazards management. Fundamental to these areas is research in solid, structural, fluid, and stochastic mechanics. To be admitted to the program, students are expected to have graduated with an outstanding record in an appropriate undergraduate program.

Today structural, geotechnical, and coastal and ocean engineering are dynamic, complex, and technologically sophisticated fields. Powerful computational methods and high-strength materials have offered new opportunities and new challenges in these fields. The graduate program is designed to instill in the student the fundamental theoretical concepts of mechanics as well as practical knowledge of modern structural, geotechnical, and coastal and ocean engineering.

Requirements for the M.S.E. Degree

After admission to the M.S.E. program, students must satisfactorily complete one of two requirements: 10 Courses (course-only option), or 8 Courses and a final M.S.E. Essay and Defense to obtain the M.S.E. degree. All courses must be 300-level or above, with a maximum of two (2) courses below the 400-level. Research advisors, in consultation with the faculty in the Civil Engineering Department, will determine whether the 8 or 10 courses leading to this degree are appropriate and if they have been completed satisfactorily. No more than one course with a grade lower than a B- may be counted toward the course requirement. Typically the M.S.E. degree requires one to two years to complete, if the student is making steady progress. In some cases, the degree may take longer.

The M.S.E. Essay must be approved by the student's faculty advisor and one reader, who will typically be a full-time Johns Hopkins Civil Engineering faculty member. Any external reader must be approved by the Chair of the Civil Engineering Department.

Requirements for the Ph.D. Degree

The Ph.D. in civil engineering degree requires a minimum approved program of 10 technical courses beyond the bachelor's degree, eight of which must be at the 600- or 700-level. All doctoral candidates are expected to demonstrate a high level of oral and written proficiency in English. International students are encouraged to participate in ESL testing recommended courses through the Language Teaching Center. Candidates must pass a department qualifying examination of their general scientific preparation, submit for approval a detailed preliminary proposal for the dissertation, and pass a Graduate Board oral examination. The Ph.D. degree is awarded following a successful defense of the doctoral dissertation. Appropriate graduate courses taken at another institution may be used toward the Ph.D. degree; exact credits are worked out on a case-by-case basis. A master's degree in civil engineering is generally considered sufficient evidence for a maximum of four courses. Students transferring courses from a prior master's degree are required to fulfill the remainder of the course requirement (typically six courses) with only courses at the 600- or 700-level.

Undergraduate Courses

500/560.141 (E,N,W) Perspectives on the Evolution of Structures
Why do buildings and bridges look the way they do today? Students will be provided the tools to answer this question for themselves through a study of the history of the design of buildings and bridges throughout the world from both the engineering and architectural/aesthetic perspectives. Only simple mathematics is required (no calculus). Students will participate in individual and group critique of structures from engineering, architectural, and social points of view.
Schafer   3 credits

560.201 (E,N) Statics and Mechanics of Materials
Basic principles of classical mechanics applied to the equilibrium of particles and rigid bodies at rest, under the influence of various force systems. In addition, the following topics are studied: free body concept, analysis of simple structures, centroids and centers of gravity, and moments of inertia. Includes laboratory experience. No freshmen without permission of instructor. Prerequisite: General Physics I.
Brady   4 credits

560.202 (E,N) Dynamics
This course will introduce the principles and theories of dynamics to solve problems of the accelerated motion of a body. Topics in this course include: kinematics and kinetics of particles and rigid bodies; principles of force-acceleration, work-energy, and impulse-momentum; vibration and introduction of structural dynamics. Prerequisites: (530.201 or 560.201) and {171.101 or (530.103 and 530.104)} and 110.109.
Nakata   4 credits

560.206 (E) Solid Mechanics and Theory of Structures
Application of the principles of structural analysis for statically determinate and indeterminate structures (including trusses, beams, and frames). Calculation of internal forces and stresses in members and structures. Determination of deflections by equilibrium and energy methods. Analysis of indeterminate structures by flexibility and stiffness methods. Prerequisite: 560.201 or 530.201, 560.220 or permission of instructor.
Guest   4 credits

560.220 (E) Civil Engineering Analysis
Civil engineering problems are formulated and then solved by numerical methods. Matrix inversion, data fitting and interpolation, root-finding, and solutions of ordinary and partial differential equations are presented. Matlab programming will be introduced to facilitate the solutions. Prerequisite: 110.108, 110.109 Calculus I, II.
Mitrani-Reiser   3 credits

560.305 (E) Soil Mechanics
Basic principles of soil mechanics. Classification of soils. Compaction theory. Consolidation, seepage and settlement analysis. Stress-strain and shear strength of soils. Introduction to earth pressure theories and slope stability analyses. Laboratory is included. Prerequisite: 560.206. Corequisite: 560.351 Fluid Mechanics.
Anandarajah   4 credits

560.320 (E) Steel Structures
Principles, analysis, and methodologies for conceptual and detailed design of steel buildings using the load and resistance factor design approach. Topics include analysis and design of tension members, beams, columns, beam-columns, and simple connections. Prerequisite: 560.206.
Sangree, Schafer   3 credits

560.325 (E) Concrete Structures
Principles of behavior of reinforced concrete beams, columns and slabs, with application to the design of elementary structures are introduced. The ultimate strength and elastic methods of analysis are used. Prerequisite: 560.206.
Sangree   3 credits

560.330 (E) Foundation Design
Application of soil mechanics theory and soil test results to the analysis and design of foundations for structures; retaining walls; embankments; design of pile, and shallow footing foundations; slope stability. Prerequisite: 560.305.
Anandarajah   3 credits

560.349 (E) Civil Engineering Design I
A study of the engineering design process from problem definition to the final design. There are team projects which include written and oral presentations. Prerequisite: senior in Civil Engineering.
Russo, Vigener   2 credits

560.350 (E) Civil Engineering Design II
Capstone design course focused on semester long civil engineering project undertaken from initial conception to final design. Project is completed in teams and requires written and oral presentations. Prerequisite: 560.349.
Matteo   3 credits

560.351 (E) Introduction to Fluid Mechanics
Introduction to the use of the principles of continuity, momentum, and energy to fluid motion. Topics include hydrostatics, ideal-fluid flow, laminar flow, turbulent flow, form and surface resistance with applications to fluid measurement, flow in conduits and channels, pumps and turbines. Selected laboratory exercises are included. Prerequisites: statics, dynamics, differential equations.
Dalrymple, Shen, Wilcock   3 credits

560.380 (E) Introduction to Ocean and Wind Engineering
Fundamentals of hydrodynamics, aerodynamics and flow-structure interactions with applications in coastal/ocean engineering and wind engineering. Topics include wind and current past blunt bodies, flow-induced structure vibrations, ocean waves and wave loads, wind field

and wind loads, sustainable energy from wind and wave, and model testing. Prerequisite: Introduction to Fluid Mechanics.
Shen   3 credits

560.435 (E,Q) Probability and Statistics in Civil Engineering
Development and applications of the analysis of uncertainty, including basic probability, statistics and decision theory, in civil engineering areas of soil mechanics, structures, transportation and water resources. Students from other disciplines will have opportunities to apply these concepts to applications in their own majors. Corequisite: 110.109 Calculus II or permission of instructor.
Igusa   3 credits

560.440 (E) Applied Finite Elements
Finite Element Methods (FEM) are one of the most powerful engineering tools that are widely used in various disciplines. This course introduces concepts, capabilities, and limitations of FEM and is intended to facilitate applications of FEM in student's research. The course covers fundamental theories with a focus on stiffness formulation techniques, element types, and computational procedures. The course also offers finite element programming with MATLAB. Prerequisite: 560.206 or equivalent.
Nakata   3 credits

560.445 (E) Advanced Structural Analysis
Matrix methods for the analysis of statically indeterminate structures such as beams, plane and space trusses, and plane and space frames. Stiffness and flexibility methods. Linear elastic analysis and introduction to nonlinear analysis. Prerequisite: 560.206.
Guest   3 credits

560.460 (E) Applied Structural Optimization
Basic principles of optimization applied to the design of structures. Algorithms and tools for structural component design, member selection, and structural layout (topology) optimization. Course will entail MATLAB programming and use of commercial structural engineering software. Prerequisite: 560.445 or 560.730 or permission of instructor.
Guest   3 credits

560.475 (E) Advanced Soil Mechanics
Difference between soils and other materials, stresses in soils due to structural foundations, elastic, consolidation and secondary consolidation settlements of footings, shear strength and stress-strain behavior of clays and sands, approximate nonlinear elastic, Mohr-Coulomb, Ramberg-Osgood, and Hyperbolic stress-strain models for soils, nonlinear Winkler foundation analysis of piles, pile groups, and drilled shafts due to vertical and horizontal loads, foundation spring constants for superstructure analysis. Prerequisite: 560.305.
Anandarajah   3 credits

560.491-494 (E) Civil Engineering Seminar
Seminar series of speakers on various aspects of civil engineering. Juniors and seniors in Civil Engineering are expected to enroll in this sequence; juniors and seniors receive one-half credit. Different speakers are invited each semester.
Staff   0.5 credit

560.525-526 Independent Study in Civil Engineering
Prerequisite: permission of instructor.
Staff   1-3 credits

Graduate Courses

560.620 Advanced Steel Design
This course examines advanced designs of structural steel building, including consideration of hot-rolled and cold-formed steel shapes and overall concepts of the structural system.
Staff   3 hours

560.691-692 Graduate Seminar
Graduate students are expected to register for this course each semester. Both internal and outside speakers are included.
Staff

560.700: Applications of Science-Based Coupling of Models
Team-taught course will build on fundamentals to address applications of science-based parameterization in geophysics, solid mechanics, turbulence, combustion and multi-phase flow.
Brady   3 hours

560.701 Uncertainty Analysis and Downscaling
This course will describe several approaches used to infer small-scale information from large-scale observations (downscaling). Downscaling is especially useful for multi-scale phenomena characterized with power-law spectra or fractal geometry. The second part of this course will explore uncertainty models in the analytical context of downscaling. Assimilation of data and models, statistical analysis of spatial-temporal data. Applications to downscaling in atmospheric data.
Igusa, Meneveau   3 hours

560.702 Modeling Complex Systems Colloquium
Course will address various themes related to modeling complex systems through critical evaluation of technical articles, open discussion, faculty presentations, and computational workshops. Teams of 3 to 5 faculty will develop monthly units based on different themes, examples of which may include: optimization and uncertainty modeling in science and engineering, particle-based modeling, experimental and field measurements in multi-scale models, linking atomistic- to continuum-scale models, challenges in climate and ocean modeling, homogenization and upscaling of small-scale data. This course is a requirement for MCS IGERT trainees, but it is open to all graduate students.
Brady   3 hours

560.728 Stochastic Micromechanics
The course builds on the knowledge gained in classes on structural mechanics and solid mechanics, extending the concepts of those classes in two directions, (1) the inclusion of uncertainty in problems in mechanics and (2) consideration of mechanics phenomena which occur at small scales.
Brady   3 hours

560.729 Structural Mechanics
Basics of the theory of elasticity for engineers. Stress, strain and constitutive laws. Stress function solutions. Plane stress, plane strain, and axisymmetric problems. Work and energy methods. Beams on elastic foundations.
Brady   3 hours

560.730 Finite Element Methods
Introduction to the finite element methods for approximate numerical solutions to engineering problems. The basic theories are presented. Topics will include the principle of virtual work, variational method, and weighted residual method to obtain finite element formulations.
Ghosh   3 hours

560.733 Computational Plasticity
Material plasticity analyzed through computational techniques are discussed in this course. Topics include plasticity, viscoplasticity, integration algorithms, variational formulation and finite element methods, nonlinear continuum mechanics.
Brady   3 hours

560.734 Advanced Probability and Statistics
Introduction to tools for analyzing uncertainties in analytical models and experimental or observational data. Possible topics, chosen according to student interests: spatial statistics, basis function and kernel methods, principal components analysis, maximum likelihood estimators, statistical classifiers, frequency domain methods. Prerequisite: 560.435 or other introductory course in probability and statistics.
Igusa   3 hours

560.736 Experimental Methods in Structural Engineering
This course will introduce experimental methods in Structural Engineering, providing capabilities and limitations of conventional and advanced techniques. Topics in this course include: similitude law, material testing, sensors, actuators, data acquisition, signal processing, system identification, and structural modeling. Advanced experimental methods include shake table test and hybrid simulation. The course consists of lecture and laboratory sessions.
Nakata   3 hours

560.738 Introduction to Systems Modeling and Analysis
Students will learn to develop agent-based and systems dynamics models to simulate complex systems. Models with hierarchical and other structures will be examined, and applications will be chosen based on student interest. Students will also learn to link their models with GIS data.
Igusa   3 hours

560.741 Theoretical and Computational Plasticity
Course discusses the principles behind elastoplastic and viscoplastic constitutive laws for engineering materials, sample constitutive models, explicit and implicit integration algorithms, and finite element implementation of plasticity models. Prerequisite: Knowledge in continuum mechanics or instructors permission.
Anandarajah   3 hours

560.752 Structural Dynamics
Functional and computational examination of elastic and inelastic single degree of freedom systems with classical and non-classical damping subject to various input excitations including earthquakes with emphasis on the study of system response. Extension to multi-degree of freedom systems with emphasis on modal analysis and numerical methods. Use of the principles of structural dynamics in earthquake response.
Mitrani-Reiser, Schafer   3 hours

560.757 Random Fields
Stochastic field theory, as applied to 1-, 2-, and n-dimensional random processes. Descriptors of homogeneous and non-homogeneous random fields. Study of load average processes. Review of various other topics in random field theory and application.
Brady   3 hours

560.758 Random Vibrations
Random process theory. Modeling of stationary and nonstationary excitations, and prediction of response of single- and multiple-degree-of-freedom systems and continuous systems. Prerequisite: 560.752 or equivalent.
Igusa   3 hours

560.760 Structural Stability
Concepts of stability of equilibrium; stability criteria. Work, energy and variational methods. Elastic buckling of columns, beams, frames, and plates. Introduction to inelastic and dynamic buckling. Prerequisite: 560.445 or equivalent.
Schafer   3 hours

560.761 Cold-Formed Steel Structures
Practical introduction to the analysis, design, and experimentation of cold-formed steel members and structures. Followed by an in-depth treatment of the theories which underpin modern analytical and computational tools used in exploring cold-formed steel behavior, and an introduction to topics under current research.
Schafer   3 hours

560.777 CFD for Free-Surface Problems
Introduction to contemporary numerical methods for free-surface flows. Select topics from boundary-fitted grids, ALE/mesh-adaptation, immersed boundary, level set, VOF, front tracking, meshless approaches, boundary integral equation, high-order spectral and spectral element approaches, and mixed Euler-Langrangian method will be discussed.
Shen   3 hours

560.780 Coastal Engineering
Coastal processes and their influence on engineering at the shoreline. Waves and currents, equilibrium beach profiles, littoral transport, shoreline modeling and the behavior of tidal inlets. The impact of structures on the shoreline.
Dalrymple   3 hours

560.781 Introduction to Water Wave Mechanics
The theories governing water wave motion, from linear to nonlinear waves, is presented. Wave propagation and transformation, including shoaling, refraction, and diffraction, is shown. Wave breaking and the basic interaction of waves with structures and the ocean bottom are covered.
Dalrymple   3 hours

560.782 Hydrodynamics
Fundamentals of fluid mechanics in the context of ocean science and engineering, naval architecture, and coastal processes, at engineering scales.
Shen   3 hours

560.783 Hydrodynamic Loads on Structures and Ships
Hydrodynamics with applications in surface ships, coastal and offshore structures, and aquatic animal propulsion. Waves, winds and currents in sea environment. Interactions between surface waves and floating bodies. Sea loads on offshore structures. Ship hydrodynamics and seakeeping. Fish swimming mechanism and biomimetics.
Shen   3 hours

560.784 Bridge Design
History, aesthetics, and classification of bridges. Design and engineering of modern steel and concrete highway bridges.
Staff   3 hours

560.785 Coastal and Ocean Modeling
Course discusses the numerical and physical modeling techniques used in coastal and ocean engineering, including finite difference, finite and boundary element methods, and particle methods. Some aspects of parallel computing will be included.
Dalrymple   3 hours

560.786 Structural Reliability
Reliability theory and its application to problems in civil engineering (primarily structural) design and analysis. The course will include some review of probability theory, statistics and the theory of stochastic processes/fields, second moment methods along with first and second order reliability approaches. Probabilistic modeling of loads is considered. Component-wise measures of reliability are investigated as a gateway to the theory, but estimation of structural system reliability is the overall objective of the class. The relationship of the theory of reliability to structural design codes is discussed.
Schafer   3 hours

560.787 Structural Optimization
Introduction to optimization theory and algorithms and their application to the design of structures, including structural systems, mechanisms, devices, and materials. Strong emphasis on topology optimization using finite element methods and design problems governed by solid and structural mechanics. Extensions to other physics and multiple physics are also introduced (e.g., fluids, heat transfer, optics, etc.). Course assumes familiarity with finite element methods and assumes no prior coursework in optimization.
Guest   3 hours

560.788 Advanced Ocean Science and Engineering
Course introduces contemporary ocean science and engineering research, and discusses select topics in the areas of air-sea exchange, nonlinear waves, hydrodynamics, wave-turbulence interaction, and flow-structure interaction. Prerequisite: EN.560.782 and EN.560.783, or instructor's permission.
Shen   3 hours

560.835-836 Graduate Research in Civil Engineering
Prerequisite: permission of instructor.
Staff

Computer Science

The field of computer science is exceedingly exciting, challenging, and pervasive. The availability of relatively inexpensive high performance computing capabilities, ubiquitous high speed and wireless networking, and mobile computing have together created a technology-driven restructuring of the way society and most professions now operate. Information, and its associated processing and transport, is the commodity upon which corporations are built and lives are improved. At the center of this revolution, making it happen, are those who study computer science.

There are two dimensions to the field of computer science that establish it as a unique area. CS can be viewed as a stand-alone discipline worth of study unto itself, and/or as an empowering discipline to be studied in conjunction with other areas. Core CS careers include (but are not limited to) software design and development, computer systems engineering or administration, and information security. Application areas span a wide range of fields and disciplines such as robotics, medical or health informatics, gaming/entertainment, and business computing, to name a few.

Because computer science is a highly diverse and broadly applied field, studies can proceed in many different directions. Accordingly, the undergraduate and graduate programs in the Department of Computer Science at Johns Hopkins are flexible curricula designed to accommodate a wide range of goals. Whether the ultimate goal is a mainstream career in computer science or a desire to combine expertise in computer science with another area, a student at Johns Hopkins can pursue appropriately customized versions of the following computer science programs: minor, bachelor of science, bachelor of arts, masters of science in engineering, and doctor of philosophy. Most of this catalog section is devoted to details regarding these programs.

Computer science research laboratories are currently active in the following areas at Hopkins: algorithm design and analysis, human-computer interaction, machine learning, computer vision and image processing, computer graphics, geometric modeling, programming languages, natural language and speech processing, information retrieval, cryptography and information security, secure and robust systems, storage systems, high-performance and scientific computing, networks and distributed systems, stream processing, parallel and distributed databases, robotics, computer-integrated surgical systems, and wireless and sensor systems.

Additionally, interdisciplinary research centers in the university have heavy involvement by Computer Science faculty: the Information Security Institute (ISI), the Center for Computer-Integrated Surgical Systems and Technology (CISST), the Laboratory for Computational Sensing and Robotics (LCSR), the Center for Language and Speech Processing (CLSP), and the Institute for Data Intensive Engineering and Science (IDIES). An important component of the educational process in the department is the opportunity for student participation in the research programs of the faculty, and all faculty members have research laboratories in which individual projects are available for undergraduate and graduate students. Original research in close association with individual faculty members is emphasized at the graduate level.

There are several closely related programs which involve significant coursework and faculty involvement from the Department of Computer Science. A minor in Computer Integrated Surgery is administered by the Engineering Research Center for Computer Integrated Surgical Systems and Technology in the Laboratory for Computational Sensing and Robotics (LCSR). The LCSR also offers a minor in robotics. Details of these programs may be found in this catalog section following the minor in computer science. Undergraduates with a strong interest in system design and performance may elect to pursue a bachelor degree in computer engineering. This field of study includes course work in computer science, as well as electrical and computer engineering. Although jointly administered by both departments, specific goals and requirements of the computer engineering degrees may be found in the catalog section pertaining to the Department of Electrical and Computer Engineering only. Lastly, the Master of Science in Security Informatics (MSSI) is a specialized graduate program offered through the Information Security Institute (ISI) in the WSE. The field of security informatics is fundamentally based on information security and assurance technologies (hardware, software, and networks) as related to issues such as policy, management, privacy/trust, health care, and law, from both national and international perspectives. Interested students can obtain detailed information regarding the MSSI online at www.jhuisi.jhu.edu or in the ISI section of this catalog.

For additional information regarding the academic programs available, and the facilities provided, please consult the sections which follow, or the departmental website www.cs.jhu.edu or the

department office, 224 New Engineering Bldg, Baltimore, MD 21218-2694.

The Faculty

Yanif Ahmad, Assistant Professor: data management, stream processing, declarative languages, parallel and distributed databases.

Yair Amir, Professor: systems, distributed algorithms, secure distributed systems, overlay networks, wireless backbones, replication, survivability.

Giuseppe Ateniese, Associate Professor: applied cryptography, network security, and secure e-commerce.

Baruch Awerbuch, Professor: wireless networks, algorithmic theory of communication networks, online and distributed computing.

Vladimir Braverman, Assistant Professor: algorithms, massive data sets, data streams, and database systems.

Randal Burns, Associate Professor: storage systems, high performance and scientific computing, and database federations.

Jason M. Eisner, Associate Professor: computational linguistics (syntax and phonology), natural language processing, statistical machine learning, programming language design.

Peter Fröhlich, Senior Lecturer: programming languages, software engineering, systems software.

Gregory D. Hager, Professor (Chair): vision, robotics, human-machine systems, computer-assisted surgery.

Susan Hohenberger, Assistant Professor: cryptography, computer security, algorithms, and complexity theory.

Michael Kazhdan, Assistant Professor: computer graphics, 3D shape analysis, 3D shape matching.

S. Rao Kosaraju, Edward J. Schaefer Professor in Engineering: design of algorithms, parallel computation, pattern matching, computational geometry.

Gerald M. Masson, Professor (Director, Information Security Institute): computer engineering, fault-tolerant computing, computer communications and networking.

Aviel Rubin, Professor (Technical Director, Information Security Institute): system and networking security, computer privacy, applied cryptography.

Joanne Selinski, Senior Lecturer and Director of Undergraduate Studies: CS education, graph theory.

Scott F. Smith, Professor: programming languages, type systems, security in language design, component programming languages.

Russell H. Taylor, Professor (Director, CISST ERC): medical robotics, computer-integrated interventional medicine, medical image analysis, human-machine systems.

Andreas Terzis, Associate Professor: P2P, overlay and sensor networks, resilient internet infrastructure, NP-based architectures.

David Yarowsky, Professor: natural language and speech processing, information retrieval, machine translation, and machine learning.

Joint Appointments

Joel Bader, Associate Professor (Biomedical Engineering): bioinformatics and computational biology.

Emad Boctor, Assistant Professor (Radiology-Medical Imaging Physics): image-guided intervention, ultrasound imaging, elasticity, and thermal imaging.

Gregory Chirikjian, Professor (Mechanical Engineering): robotics, kinematics, dynamics, control, motion planning.

Noah Cowan, Assistant Professor (Mechanical Engineering): sensor-based control of locomotion and manipulation, and biologically inspired robotics.

Ralph Etienne-Cummings, Professor (Electrical and Computer Engineering): mixed-signal VLSI, computational sensors, robotics, neuromorphic engineering.

James Fill, Professor (Applied Mathematics and Statistics): probability, stochastic processes, random structures, and algorithms.

Rachel Karchin, Assistant Professor (Biomedical Engineering): computational molecular biology, bioinformatics, genetic variation.

Sanjeev Khudanpur, Associate Professor (Electrical and Computer Engineering): information theory, statistical language modeling for speech recognition and machine translation.

Han Liu, Assistant Professor (Biostatistics): statistical machine learning, high dimensional nonparametric learning and massive-data analysis, multiple hypothesis testing, time series analysis, genomics, proteomics, cognitive neuroscience.

Michael I. Miller, Professor (Biomedical Engineering): image understanding, computer vision, medical imaging, computational anatomy.

Carey Priebe, Professor (Applied Mathematics and Statistics): computational statistics, kernel and mixture estimates, statistical pattern recognition, and statistical image analysis.

Jerry L. Prince, William B. Kouwenhoven Professor (Electrical and Computer Engineering) (Associate Director for Research, CISST ERC): image processing, computer vision, medical imaging.

Jeff Siewerdsen, Associate Professor (Biomedical Engineering): imaging physics, diagnostic radiology, image-guided interventions.

Alexander Szalay, Professor (Physics and Astronomy): theoretical astrophysics, galaxy formation.

Rene Vidal, Associate Professor (Biomedical Engineering): computer vision, machine learning, robotics, and control.

Louis Whitcomb, Professor (Mechanical Engineering): dynamics and control of mechanical systems.

Raimond L. Winslow, Professor (Biomedical Engineering): modeling of biological systems, nonlinear systems theory, grid computing and data management, biomedical ontologies.

Adjunct, Research, and Visiting Faculty

Amihood Amir, Research Professor: algorithms design and analysis, multidimensional pattern matching, knowledge discovery algorithms, real time systems algorithms, computational molecular biology.

Mitra Basu, Visiting Professor: computational biology, pattern recognition, neural networks, artificial intelligence.

Philippe Burlina, Assistant Research Professor: computer vision, visual analysis and communications, multi-modality image exploitation, enterprise software systems for content and e-process management.

Chris Callison-Burch, Assistant Research Professor: statistical natural language processing, machine translation, paraphrasing, evaluation of human language technologies.

Kenneth Church, Research Professor: natural language processing, speech, data mining.

Robert Cole, Assistant Research Professor: data networking, performance modeling, internet protocol design and mobile ad-hoc networks (MANETS).

Bharat Doshi, Research Professor: optical and wireless networking technologies, internet protocols and architectures, speech technologies and signal processing, and network design and analysis algorithms and tools.

Mark Dredze, Assistant Research Professor: machine learning, natural language processing, intelligent user interfaces, intelligent email.

Gabor Fichtinger, Associate Research Professor: applied surgical robotics, surgical CAD/CAM systems, percutaneous therapies, stereotactic radiosurgery.

Matthew Green, Assistant Research Professor: applied cryptography, cryptographic protocol design, analysis of practical security systems, privacy-preserving storage and identification technologies.

John Linwood Griffin, Assistant Research Professor: data protection in information storage systems and networks, computer virtualization and performance.

Ragib Hasan, Assistant Research Scientist: computer security, secure provenance, trust management, storage systems.

Peter Kazanzides, Associate Research Professor: medical robotics, computer-assisted surgery, real-time systems.

Rajesh Kumar, Associate Research Professor: applications of robotics and vision in medicine and surgery.

Michael Lavine, Assistant Research Professor: computer forensics, information assurance and security, critical infrastructure protection.

Adam Lopez, Assistant Research Scientist: natural language processing, machine learning, language and automata theory, algorithms.

James Mayfield, Associate Research Professor: information retrieval, cross-language retrieval, information extraction, natural language processing.

Amitabh Mishra, Assistant Research Professor: wireless cellular, ad hoc and sensor networks, dynamic spectrum access networks, telecommunications.

Fabian Monrose, Associate Research Professor: computer and network security, biometrics and user authentication.

Christine Piatko, Assistant Research Professor: computational geometry, information visualization, information retrieval.

John W. Sheppard, Associate Research Professor: artificial intelligence, machine learning, data mining.

Sam Small, Assistant Research Scientist: systems and network security.

Veselin Stoyanov, Assistant Research Scientist: sentiment analysis, corefrence resolution, information extraction, natural language processing, machine learning, artificial intelligence, cognitive science, linguistics.

Jonathan Trostle, Assistant Research Professor: network and operating system security, cryptography, network security management.

Ben Van Durme, Assistant Research Professor: artificial intelligence, natural language processing (computational semantics), and streaming algorithms.

I-Jeng Wang, Assistant Research Professor: wireless networking, Bayesian networks, probabilistic models.

Theresa Wilson, Assistant Research Scientist: artificial intelligence, computational linguistics, natural language processing, subjectivity and sentiment analysis in text and speech.

Lawrence B. Wolff, Research Professor: computer vision, multi-sensor image fusion, augmented reality, biometrics.

Qinqing Zhang, Assistant Research Professor: wireless communications and networking, Mobile Ad-hoc networks, cellular system and network technologies, multimedia applications and QoS, Internet protocol and algorithm design, performance analysis.

Part-Time Lecturers

Sheela Kosaraju: computer ethics.

Harold Lehmann: medical informatics.

Facilities

The general department computing facilities include over 70 workstations and servers; a large undergraduate laboratory comprised of 24 Linux workstations, 12 Windows stations, and a separate collaboration room allowing students to work in a team-based environment; a Masters' Students Office consisting of 16 Linux workstations and a collaboration area; assigned locations and computers for Ph.D. students; multiple high-speed networked laser printers, as well as a networked color copier; remotely accessible Linux and Unix computer servers available to both graduate and undergraduate students.

Focused research laboratories have significant resources that provide greater specialization, including isolated networks of PCs for security studies, sensor and wireless computing testbeds, robots and computer vision systems, a mock operating room equipped with medical robots and imaging equipment, and more.

The general department computing facilities are tied together by our own LAN, and access to specialized hardware in other departments, labs, and institutions is available via the university intranet and the Internet. In addition, the university provides wireless access to the JHU intranet and the Internet, as well as server systems that provide email accounts for all students.

Undergraduate Programs

(See also General Requirements for Departmental Majors)

The objectives of our bachelor degree programs are to train computer scientists who will be able to:

- Successfully engage in professional practice in the computing sciences or apply computer science tools and techniques to another field of interest.
- Pursue advanced study in the computing sciences.
- Behave in a professional and ethical manner.
- Work successfully in both independent and team environments.

A successful major program of study leads to either the bachelor of science in computer science (B.S.) or the bachelor of arts in computer science (B.A.). Students should decide which degree program to complete by about their junior year. Both degree programs require specific courses and/or credits in several key areas: computer science, math, basic science, humanities and social sciences. However, there is much flexibility in how these requirements are fulfilled. Undergraduate majors may choose to pursue a broad selection of computer science and distributional courses, or to pursue a specific concentration within the field. Current concentrations reflect departmental and school strengths: information security, natural language processing, robotics, software engineering, and video game design. Further information on these concentrations may be found in the computer science undergraduate advising manual.

All undergraduate students majoring or minoring in computer science must have a faculty advisor in the department. They will be assigned an advisor as entering freshmen or upon deciding on the major/minor. Every major must follow a program approved by his/her faculty advisor.

The department also offers a minor in computer science, and tangentially, a minor in computer integrated surgery and a minor in robotics. Some students majoring in computer science may be eligible for a concurrent bachelor's/master's degree program. Requirements for these programs are included here as well. Additional details regarding undergraduate programs can be found in the department's undergraduate advising manual or on the website at www.cs.jhu.edu.

Requirements for the B.S. Degree

The bachelor of science degree in computer science degree program is accredited by the Computing Accreditation Commission of ABET,

www.abet.org. It provides for the acquisition of the following knowledge base and skill set:

- An ability to apply knowledge of computing and mathematics appropriate to the discipline.
- An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.
- An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.
- An ability to function effectively on teams to accomplish a common goal.
- An understanding of professional, ethical, legal, security, and social issues and responsibilities.
- An ability to communicate effectively with a range of audiences.
- An ability to analyze the local and global impact of computing on individuals, organizations, and society.
- Recognition of the need for and an ability to engage in continuing professional development.
- An ability to use current techniques, skills, and tools necessary for computing practice.
- An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
- An ability to apply design and development principles in the construction of software systems of varying complexity.

To meet the course credit requirements for the B.S. in computer science, the student must complete a minimum of 126 credits. The basic requirements for the B.S. degree are as follows: 42 credits in computer science, 22 credits in mathematics, 16 credits in basic sciences, 18 credits in humanities/social sciences, and 2 writing intensive courses. Details and course recommendations of these distributional requirements are below. These requirements add up to 98 credits and fulfill general university distribution requirements. Of the remaining 28 elective credits that students choose freely, at least 12 of them must be in the humanities, social science, arts, or other disciplines that serve to broaden the student's background. These 12 credits may not be CS, ECE or math courses. Freshman majors are also expected to take 600.105 M&Ms (optional for transfers into the major). This is a one credit S/U course that may only be counted as an elective.

Except for electives, courses should not be taken on a satisfactory/unsatisfactory basis. By university policy, no more than 18 D or D+ credits can be counted toward the total credit requirements for a degree.

Computer Science (42 credits):

- The following foundational courses in computer science must be included in a student's program:
  600.104 Computer Ethics
  600.107 Intro to Programming in Java
      (or AP credit)
  600.120 Intermediate Programming
  600.226 Data Structures
  600.271 Automata and Computation Theory
  600.333 Computer System Fundamentals

- At least 16 credit hours, not including 600.333/433, must be at the 300-level or above. At least one course in each classification area of Analysis, Applications, and Systems must be chosen. An exhaustive list of the area classifications for each of our courses may be found on the department's website.

- Students must take at least one of the following courses which contain oral communication components: 600.255, 600.321/421, 600.355, 600.392, 600.446, 600.520.

- With the advisor's explicit permission regarding course selections, up to 6 of the 42 required credits may be taken in the Department of Electrical and Computer Engineering or the Information Security Institute.

- No more than 6 credits of independent study (including 600.491-492 Computer Science Workshop I, II) and no more than 3 credits of short courses can be counted toward this requirement. However, B.S. students doing the Senior Honors Thesis (600.519-520) may use an additional three credits of independent work toward their CS requirements, for a total of nine credits.

- No courses with grades below C- or with satisfactory/unsatisfactory grades can be used to fulfill this requirement unless they are not offered for a grade.

Mathematics (22 credits):

- The following courses must be included:
  110.108 Calculus I
  110.109 Calculus II
  550.171 Discrete Mathematics

- The remaining courses must be 200-level or above, chosen from Mathematics (110.xxx) or Applied Math and Statistics (550.xxx), and must include coverage of both probability and statistics. Some highly recommended math electives are Probability & Statistics, Calculus III, Linear

Algebra, and Differential Equations. Note that students will need at least six courses to fulfill the credit requirement.

Basic Sciences (16 credits):

At least two semesters of physics or two semesters of chemistry, with the associated laboratories, must be included. The remaining courses must be chosen in accordance with the list posted on the department's website, which includes most courses in Physics, Chemistry, Biology, Biophysics, Earth & Planetary Sciences, and some 'N' designated courses in Neuroscience & Cognitive Science, but not all.

Humanities/Social Sciences (18 credits):

Six courses in the humanities and social sciences must be taken, with each course at least 3 credits. These courses must have either an 'H' or 'S' area designator on them; however, foreign language courses may also be used to satisfy this requirement.

Writing Requirement:

Students are required to fulfill the university's requirement of two writing intensive (W) courses, each at least 3 credits. Students must receive at least a C- grade or better in these writing courses. These courses may overlap other requirements. At least one of the following options must be chosen:

    060.113 Expository Writing
    220.105/106 Intro to Fiction and Poetry
        Writing
    661.110 Technical Communication

Requirements for the B.A. Degree

To meet the course credit requirements for the B.A. in computer science, the student must complete a minimum of 120 credits. The basic requirements for the B.A. degree are: 30 credits in computer science, 18 credits in mathematics, 12 credits in basic sciences, 18 credits in humanities/social sciences, 6 credits in foreign languages, and 4 writing intensive courses. Details and course recommendations of these distributional requirements are below. These requirements add up to 84 credits and fulfill general university distribution requirements. The remaining 36 credits are electives, to be chosen by the student with the guidance and approval of his/her advisor. Freshman majors are also expected to take 600.105 M&Ms (optional for transfers into the major). This is a one credit S/U course that may only be counted as an elective.

Except for electives, courses should not be taken on a satisfactory/unsatisfactory basis. By university policy, no more than 18 D or D+ credits can be counted toward the total credit requirements for a degree.

Computer Science (30 credits):

- The following foundational courses in computer science must be included in a student's program:
    600.107 Intro to Programming in Java (or AP credit)
    600.120 Intermediate Programming
    600.226 Data Structures
    600.271 Automata and Computation Theory
    600.333 Computer System Fundamentals
- At least 15 credit hours must be at the 300-level or above. With the advisor's permission, up to 6 of the 30 required credits may be taken in the Department of Electrical and Computer Engineering.
- No more than 3 credits of short courses or 3 credits of independent study (including 600.491-492) may be applied toward this requirement. However, B.A. students doing the Senior Honors Thesis (600.519-520) may use an additional 3 credits of independent work toward their CS requirements, for a total of 6 credits.
- No courses with grades below C- or with satisfactory/unsatisfactory grades may be used to fulfill this requirement unless they are not offered for a grade.

Mathematics (18 credits):

- The following courses must be included:
    110.108 Calculus I
    110.109 Calculus II
    550.171 Discrete Mathematics
- The remaining courses may be chosen from Mathematics (110.xxx) or Applied Math and Statistics (550.xxx). At least one course must be 200-level or above. Highly recommended: Calculus III, Linear Algebra, Differential Equations, Probability/Statistics. Note that students will need at least five courses to fulfill the credit requirement.

Basic Sciences (12 credits):

At least two semesters of physics or chemistry or a combination of both, with the associated laboratories, must be included. The remaining courses must be chosen in accordance with the list posted on the department website, which includes most courses in Physics, Chemistry, Biology, Biophysics, Earth & Planetary Sciences, and some 'N' designated courses in Neuroscience & Cognitive Science, but not all.

Humanities/Social Sciences (18 credits):

Six courses in the Humanities/Social Sciences must be taken, with each course at least 3 credits. At least two 3-credit courses at the 300-level or above are required. As befits a B.A. degree, students have ample flexibility to choose courses that broaden the

scope of their study, in consultation with their advisors. A subset of the courses selected to satisfy this requirement should demonstrate coherence within an area. Any course with (H) or (S) area designators may fulfill these distributional requirements.

Foreign Languages (6 credits):
Two courses in a foreign language, with a total of at least 6 credits are required. These foreign language credits are in addition to the 18 required humanities/social sciences credits.

Writing Requirement:
All B.A. candidates in computer science are required to fulfill the university's requirement of four writing intensive (W) courses, each at least 3 credits. Students must receive at least a C- grade in these courses. Highly recommended, at least one of:

  060.113 Expository Writing
  220.105/106 Intro to Fiction and Poetry
      Writing
  661.110 Technical Communication

Minor in Computer Science
To satisfy the course credit requirements for a minor in computer science, a student must take a minimum of seven courses, with a total of at least 22 credits, earning at least a C- in each course. These must include four core courses, to provide the student with a foundation, and three upper-level courses (300-level and above), to allow the student to pursue an advanced topic in depth.

Core Courses (4):
- 600.107 Intro to Programming in Java
  (or AP credit)
- 600.120 Intermediate Programming
- 600.226 Data Structures
- 600.271 Automata and Computation Theory

With the approval of a faculty member in the Department of Computer Science, serving as a computer science minor advisor, substitutions for these core courses are possible.

Upper-Level Courses (3):
These courses should be chosen to form a cohesive minor and must be accepted by the computer science minor advisor. It is strongly recommended that students choose all three courses from within one of the three research areas of analysis, applications, and systems. Each upper-level course description in this catalog includes its area for reference. In addition, a current listing of courses grouped by area is provided on the departmental website.

Short courses cannot be used toward the minor requirements. All courses must be taken for a grade, not S/U.

Students whose primary major is in the Whiting School may use the same courses to satisfy the requirements of the primary major and also those of a computer science minor. Students who plan to fulfill requirements for a minor must go to the Department of Computer Science director of undergraduate studies to declare the minor and be advised on course selections, and inform the Office of Academic Advising by the end of their junior year.

Minor in Computer Integrated Surgery
The Department of Computer Science offers a minor in Computer Integrated Surgery (CIS) for full-time, undergraduate students at Johns Hopkins. The minor is particularly well suited for students interested in computer integrated surgery issues who are majoring in a variety of disciplines including biomedical engineering, computer science, computer engineering, electrical engineering, and mechanical engineering. The minor provides formal recognition of the depth and strength of a student's knowledge of the concepts fundamental to CIS beyond the minimal requirements of his/her major.

The Computer Science Department of the Whiting School of Engineering is responsible for the minor in computer integrated surgery. In order to minor in CIS, a student will require a minor advisor from the Engineering Research Center in Computer Integrated Surgical Systems and Technology (CISST ERC) in the Laboratory for Computational Sensing and Robotics. Current faculty members available as advisors include Professors Russell Taylor (CS), Greg Hager (CS), Jerry Prince (ECE), Ralph Etienne-Cummings (ECE), Louis Whitcomb (ME), Noah Cowan (ME), Peter Kazanzides (CS), Rajesh Kumar (CS), Iulian Iordachita (ME), and Emad Boctor (Radiology).

To satisfy the requirements for the minor in CIS, a student must have a fundamental background in computer programming and computer science, sufficient mathematical background, and also take a minimum of six courses (with a total of at least 18 credits, earning at least a C- in each course) directly related to concepts relevant to CIS. These six CIS courses must include three core courses, which provide the student with the fundamental basis for CIS, and three upper-level courses (300 level or above) to allow the student to pursue an advanced CIS topic in depth.

Required Fundamental Computer Science Courses

  600.120 Intermediate Programming
  600.226 Data Structures
  or
  Equivalent experience determined by your
    advisor

Required Fundamental Mathematics Courses

  110.106 or 110.108 Calculus I
  110.107 or 110.109 Calculus II
  110.202 or 110.211-212 Calculus III
  550.291, 110.201, or 110.211-12 Linear Algebra

Required Fundamental Computer Integrated Surgery Courses

- 600.445 Computer Integrated Surgery I

- A design course in CIS. Either Computer Integrated Surgery II (600.446) or a design course in biomedical engineering, electrical and computer engineering, or mechanical engineering with substantial CIS content approved by the student's faculty advisor in the CIS minor.

- One course in imaging, chosen from the following:

  600.361 Computer Vision (undergraduate version)

  600.461 Computer Vision (graduate version)

  520.414 Image Processing and Analysis I

  520.432/580.472 Medical Imaging Systems

  or

- One course in robotics, chosen from the following:

  530.420 Robotic Sensors and Actuators
  530.421 Mechatronics
  530.646 Introduction to Robotics

- Three advanced specialty courses chosen in consultation with the student's faculty advisor in the CIS minor which define a topic relevant to CIS (such as CIS instrumentation, CIS imaging, or the mechanics of CIS). Note that these courses must be chosen together with the other three required CIS courses (600.445, the CIS design course and the CIS imaging course) to include at least one biomedical course and must be selected from the following courses or equivalent courses with significant CIS content, as determined by the CIS advisor:

  580.470 Biomedical Sensors
  600.461 Computer Vision
  530.651 Haptic Systems for Teleoperation
    and Virtual Reality
  520.414 Image Processing and Analysis I
  530.646 Introduction to Robotics

  580.450 Mechanics of Living Tissues
  530.421 Mechatronics
  580.472 Medical Imaging Systems
  580.471 Principles of the Design of
    Biomedical Instrumentation
  530.420 Robot Sensors and Actuator

Please visit **www.lcsr.jhu.edu/Education/Under graduate/CISminor** for current course listing.

Minor in Robotics

The field of robotics integrates sensing, information processing, and movement to accomplish specific tasks in the physical world. As such, it encompasses several topics, including mechanics and dynamics, kinematics, sensing, signal processing, control systems, planning, and artificial intelligence. Applications of these concepts appear in many areas including medicine, manufacturing, space exploration, disaster recovery, ordinance disposal, deep-sea navigation, home care, and home automation.

The faculty of the Laboratory for Computational Sensing and Robotics (LCSR), in collaboration with the academic departments and centers of the Whiting School of Engineering, offers a robotics minor in order to provide a structure in which undergraduate students at Johns Hopkins University can advance their knowledge in robotics while receiving recognition on their transcript for this pursuit. The minor is not "owned" by any one department, but rather it is managed by the LCSR itself. Any student from any department within the university can work toward the minor.

Robotics is fundamentally integrative and multidisciplinary. Therefore, any candidate for the robotics minor must cover a set of core skills that cut across these disciplines, as well as obtain advanced supplementary skills.

Core skills include the following:

- Robot kinematics and dynamics (R)
- Systems theory, signal processing, control (S)
- Computation and sensing (C)

Supplementary advanced skills may be obtained in the following areas:

- Specialized applications, such as space, medicine, underwater, or haptics

- Advanced kinematics and dynamics

- Advanced systems theory

- Advanced computation, such as AI, machine learning, motion planning

- Advanced sensing such as computer vision

The full minor course listing (provided on the robotics minor website) specifies which courses fill these requirements. Note that ALL core areas must be filled, but that ANY advanced/supplementary courses can be chosen from the list. This allows students to strike a balance between breadth and depth.

Requirements

An undergraduate qualifies for the minor provided he or she has taken at least 18 credits (at the 300 level or above, with a C- or above) from an approved list of courses (provided on the robotics minor website), with the following requirements and restrictions:

- Between 2 and 4 courses chosen to cover the three core skills (see table below).
- At least 2 courses chosen from advanced supplementary skills (see table).
- At least 3 credits of the 18 must be a laboratory course (at least 15 hours of laboratory time that includes working with physical hardware and/or real data);
- At most 3 credits of the 18 can be an independent research or individual study with a faculty member on the list of approved faculty advisors;
- At least 2 courses must be primarily listed in a department other than the student's home department (it is acceptable if such a course is cross-listed in the student's home department).

Please visit the robotics minor website at **https://lcsr.jhu.edu/Robotics_Minor** for more details including a check-out sheet, a list of available advisors, sample curricula and the full minor course listing.

Short Courses

The Department of Computer Science offers 1-credit short courses covering a variety of topics in computer science and engineering. The purpose of the short courses is to expose students to topics of current interest in the field of computer science and engineering. Short courses are taught not only by faculty and graduate students in the Department of Computer Science and visiting faculty from other universities, but by individuals from local government or industry who have demonstrable expertise in a given area and are practicing the application of computer science theory and concepts.

Students should be aware that short course offerings are likely to change from year to year, depending on instructor commitments: there is no guarantee that the same course will be available at a later time. Students interested in getting details about a particular short course can contact the instructor through the departmental office. No more than 3 credits of short courses may be applied toward the computer science course credit requirement for the B.S. or the B.A. degrees.

Double Majors with Computer Science

It is possible for students to pursue a double major program in which one of the majors is computer science. The computer science requirements are flexible enough to allow for combination with most majors in the Whiting School of Engineering and the Krieger School of Arts and Sciences. Whether computer science is your primary or secondary major, you will be assigned a faculty advisor in the department. In order to declare a first or second major in computer science, students should see the Director of Undergraduate Studies before the start of senior year. Those students must also inform the Office of Academic Affairs of the Whiting School of Engineering and the Registrar of their double major status. Subject to restrictions set by the department offering a second major, students whose primary major is in the Whiting School may use courses to satisfy both the requirements of the student's primary major and those of a double major.

Concurrent Bachelor's/Master's Program

As early as the end of their sophomore year, qualified students may apply for admission to a concurrent bachelor's/master's program which combines a B.S. or B.A. degree (in any department) with a master of science in engineering degree in Computer Science. This program allows students to simultaneously pursue both an undergraduate and a graduate degree program of study. Generally, the concurrent B.S./M.S.E. or B.A./M.S.E. program is accomplished in five years, although some students take more or less time. Applicants are judged on the basis of their performance in courses and their letters of recommendation. Double counting of at most two courses is subject to current WSE and departmental policies. Students may not take a 600.3xx course as an undergraduate and the corresponding 600.4xx course for the MSE. Upon admission to the program students will be assigned a graduate faculty advisor in the Computer Science Department who must approve the courses to be applied toward the master's degree. For information on the requirements of the M.S.E. degree, see below, or ask in the departmental office for the document that lists those requirements.

Graduate Programs

Every graduate student in the Department of Computer Science must follow a program approved by a faculty advisor in the department. The advisor assigned to a student may change, subject to the acceptance of the new advisor.

Requirements for the M.S.E. Degree

The master of science in engineering (M.S.E.) is a full- or part-time day program offered by the Department of Computer Science. Most students complete the program in three full-time semesters. Two consecutive semesters of residence as a full-time graduate student are required. Those interested in part-time evening study should refer to the Engineering Programs for Professionals at **www.epp.jhu.edu**.

Entering students are expected to have completed a program of study equivalent to that required by the B.S. in computer science. Applicants from other disciplines are required to have course work (or equivalent experience) in intermediate programming (C++ and Java), data structures, and automata theory. Upon admission to the master of science in engineering program, a student is assigned a graduate advisor from the Department of Computer Science who must approve the courses to be applied to the M.S.E. degree.

The Department of Computer Science classifies its courses into three sub-areas: Analysis, Applications, and Systems. All M.S.E. candidates must complete at least two graduate courses (6 credit hours, 400-level and above) from each of these three areas. Each upper-level course description in this catalog includes its area for reference. A course in multiple areas may only be counted toward one requirement. A current listing of courses grouped by area is provided on the departmental website. While this listing includes a few highly relevant courses outside the Department of Computer Science, only one such course may be applied toward the area requirements. M.S.E. students must also complete an additional two elective graduate courses (chosen from any CS area or from closely related departments such as Electrical and Computer Engineering, Cognitive Science, Mathematics, or Applied Mathematics and Statistics) for a total of eight graduate courses. *The course work program must be approved by the student's faculty advisor and the department.*

In addition to the eight courses, a student must elect one of the following options in order to fulfill the degree requirements:

- Two additional graduate courses in Computer Science, approved as above.

- A supervised research project including an approved project report that will be made publicly available.

- An original, faculty-approved master's essay, submitted for binding to the Milton S. Eisenhower Library.

By satisfying the Ph.D. qualifying course requirements and the first qualifying project, a student will also satisfy the M.S.E. degree requirements (unless more than two course requirements have been satisfied using courses transferred from other institutions). Please refer to the Ph.D. program information for details.

All M.S.E. degree candidates are encouraged to regularly attend the department seminars. You may enroll in Computer Science Seminar 600.601-602; however, these courses may not be counted toward the degree course requirements.

Course Requirement Details

- All courses counted toward the M.S.E. degree requirement must be 400-level or above. At most, two courses with grades less than B- may be counted toward the course work requirements. No courses with grades less than C- may be counted.

- The overall grade point average of the courses counted toward the course work requirements must be a 3.0 or higher (B average).

- At most, two independent study courses (including 600.491-492 Computer Science Workshop I and II) can be counted toward the course requirements.

- Other than independent study courses and 600.464/664, no courses with grades of S can be counted toward the course work requirement. Courses with grades of S will not be included in the grade point average calculation.

- One of the courses required for the M.S.E. degree, but only one, can be replaced by 3 credits from comparable short courses.

- A majority of the courses counted toward the degree must be taught in the Department of Computer Science.

- At most, two courses can be transferred from graduate programs of other institutions to be counted toward the degree requirements. Such transfer courses must be approved by the student's faculty advisor and the department. It is the obligation of the student to provide all necessary data to the Department of Computer Science regarding the course(s) for which transfer credit is being requested.

• A grade of D or F results in probation; a second D or F is cause for being dropped from the program.

Tuition Support

Students studying for an M.S.E. degree may be eligible for partial tuition support after their first two semesters in the Department of Computer Science. There are also course assistant positions (paid by the hour) available for qualified students who are seeking financial support. Those interested must apply at the start of each semester for specific courses in need.

Requirements for the Ph.D. Degree

The goal of the Doctor of Philosophy (Ph.D.) program in the Department of Computer Science is to prepare first-rate scholars in the analysis, systems, and applications areas of computer science. Successful graduates may assume significant positions in academia, research institutes, industry, or government laboratories.

Applications for admission to the Ph.D. program in Computer Science are reviewed by a faculty committee. Although the specific criteria are not rigid, all students admitted will exhibit exceptional intellectual achievements and promise. Applicants must submit letters of recommendation, GRE scores, and (for foreign applicants) TOEFL scores.

In keeping with Hopkins' traditions, program requirements are flexible, as described below.

University Residency

Two consecutive semesters of residence as a full-time graduate student are required.

Seminar Attendance

All Ph.D. degree candidates are required to enroll and maintain satisfactory attendance in Computer Science Seminar 600.601-602 each semester for the duration of their enrollment in the program. Although seminar attendance is required, the seminar may not be counted toward the qualifying course requirement

Qualifying Course Requirements

The Department of Computer Science classifies its courses into three research areas: analysis, applications, and systems. All Ph.D. candidates must complete at least two graduate courses (400-level and above) from each of these three areas. Each upper-level course description in this catalog includes its area for reference. A courses in multiple areas may only be counted toward one requirement. A current listing of courses grouped by area is provided on the departmental website. While this listing includes a few highly relevant courses outside the Department of Computer Science, only one such course may be applied toward the area requirements. Ph.D. students must also complete an additional two elective graduate courses (chosen from any CS area or from closely related departments such as Electrical and Computer Engineering, Cognitive Science, Mathematics, or Applied Mathematics and Statistics) for a total of eight graduate courses. *The course work program must be approved by the student's faculty advisor and the department.* The overall grade point average for these eight courses must be at least equivalent to a B+. No course with a grade of less than C- may be counted toward this Ph.D. qualifying course requirement. Other than independent study courses and 600.464/664, no courses with grades of P can be counted toward the course work requirement. Courses with grades of P will not be included in the grade point average calculation. One of the courses required for the degree, but only one, may be replaced by 3 credits from comparable short courses. With approval of the student's faculty advisor, up to two courses can be transferred from graduate programs of other institutions; more than two such courses can be transferred with approval of the department. It is the obligation of the student to provide all necessary data to the Department of Computer Science regarding the course(s) for which transfer credit is being requested. Students are expected to complete the course requirements by the end of their second year as a Ph.D. candidate.

Qualifying Project Requirements

A Ph.D. student must complete two projects, each under the supervision and with the written agreement of a different faculty member in the Department of Computer Science. Upon conclusion of each project, the student must write a "Project Report" describing the project in detail. This report will be a public document and will be kept on file in the department office. The supervising faculty member must approve the project report. Departmental approval of a given project will be determined collectively by the faculty of the Department of Computer Science following the spring semester of each academic year. A factor taken into account in the departmental review of a project is the stated willingness of each supervising faculty member to enter the initial stages of a Ph.D. research advisor/advisee relationship with the student. Students are expected to complete the qualifying projects by the end of their second year as a Ph.D. candidate.

Upon completion of the Ph.D. qualifying course requirements and the first qualifying project, students are ordinarily eligible to receive a master of

science in engineering degree. The degree will be awarded upon student request.

Graduate Board Oral Examination (GBO)

This examination is a university requirement, to be taken within one year of passing the Ph.D. qualifying requirements. The oral exam is administered by a panel consisting of the research sponsor, two faculty members from the Department of Computer Science, and two from outside the department. The exam seeks to establish the student's readiness to conduct original research in the area of his or her "Preliminary Research Proposal," which should be distributed to the examiners in advance and presented by the student at the start of the exam.

Part-Time Ph.D.

Two consecutive semesters of residence as a full-time graduate student are required by the university. Part-time students must pass both the Ph.D. qualifying requirements and the Graduate Board oral exam within four years of being admitted to the program. Attempting to obtain a Ph.D. is a major commitment and involves close coordination with a faculty advisor in the department. Part-time students must be able to establish and maintain these close links.

Departmental Seminar

Ph.D. students must give an official departmental seminar on their research area. This is to be done after the GBO and prior to the dissertation defense, or as part of the dissertation defense.

Dissertation and Defense

Ph.D. students must write a dissertation consisting of original research in their chosen area. They must deliver a public presentation of the dissertation before a dissertation committee consisting of the faculty advisor, a second faculty member in the Department of Computer Science (who must have a primary tenure-track appointment in the Department if the advisor does not), and one or more other members with Ph.D. degrees. In conformity with University requirements, the members of the dissertation committee must submit a referee's letter to the Graduate Board recommending that the dissertation be accepted. Completed dissertations will be bound and submitted to the Milton S. Eisenhower Library.

Student Progress Review

Ph.D. students will be reviewed annually by the department faculty and notified by their advisors as to their standing in the program. Beginning in the third year of graduate study, this annual review is conducted primarily by the dissertation committee. The committee may establish milestones such as a written thesis proposal. While the membership of the committee may change, in general it should be chosen by the student, in consultation with the advisor and subject to the consent of the committee members.

Financial Aid

Financial aid is available for candidates of high promise. Fellowships provide a student with a stipend plus tuition. Teaching assistantships normally consist of tuition plus a stipend commensurate with the teaching or grading duties assigned. Research assistantships are available on sponsored research projects directed by members of the faculty. Students determined to have significant deficiency in spoken English may be required to take one or more semesters of English as a Second Language in order to qualify for employment as a teaching or research assistant.

Undergraduate Courses

600.102 (E) CS Foundations

This course is an introduction to computer science for majors and non-majors. Students are exposed to the discipline through vignettes of logic and algebra, computer systems and networks, algorithms, programming languages, computation theory, and selected applications. CS majors can only take this course in their first year of CS coursework. Prerequisite: 600.101 or equivalent knowledge. [General] (last offered Spring 2008)
Fröhlich   4 credits

600.103 (E) Fundamentals of Practical Computing

Intended audience: students majoring in science, engineering or medicine. This course will provide a sampling of the theory behind and practical use of a broad spectrum of computational tools and technologies. We will start with Scratch (a programming language for kids) and show how many of the same concepts show up in Web Programming (HTML & Javascript). There will be a taste of algorithms, databases (SQL), Unix, statistics packages (R), data mining and visualization tools (graphviz), natural language processing, web search, interpreted languages (Python & LISP), compiled languages (C), and more. Students should come away with a few tools and concepts that will prove useful in their major, as well as the confidence that they can search the web to find what they need, when they need it, just-in-time.
Church   3 credits

600.104 (HE) Computer Ethics—Theory and Practice

Students will examine a variety of issues regarding various policy, legal, and moral issues related to the computer science profession itself and to the proliferation of computers in all aspects of society, especially in the era of the Internet. The course will cover general issues related to various ethical frameworks and move to topics specifically related to computers. The topics will include privacy issues, computer crime, intellectual property law—specifically copyright and patent issues, globalization, and ethical responsibilities for computer science professionals. Short course.

Kosaraju   1 credit

600.105 M&Ms: Freshman Experience

This course is required for all freshman computer science majors. Transfers into the major and minors may enroll by permission only. Students will attend four 3-week blocks of meetings with different computer science professors, focused on a central theme. Active participation is required. Satisfactory/Unsatisfactory only. [General]

Selinski   1 credit   fall

600.106 Pre-Programming: Algorithmic Thinking

This course is intended for novice programmers, to be taken before or in conjunction with 600.107 or 600.109. The purpose is to provide students with the abstraction and logical thinking tools necessary for writing computer programs. It will introduce students to fundamental concepts and algorithms common to many programming languages. Students will primarily do paper solutions. Short course. Satisfactory/Unsatisfactory only. [General]

Staff   1 credit

600.107 (E) Introduction to Programming in Java

This course introduces fundamental structured and object-oriented programming concepts and techniques, using Java, and is intended for all who plan to use computer programming in their studies and careers. Topics covered include variables, arithmetic operators, control structures, arrays, functions, recursion, dynamic memory allocation, files, class usage and class writing. Program design and testing are also covered, in addition to more advanced object-oriented concepts including inheritance and exceptions as time permits. First-time programmers are strongly advised to take 600.108 concurrently. Prerequisite: familiarity with computers. [General]

Selinski   3 credits   fall, spring, summer

600.108 (E) Introduction to Programming Lab

This course is intended for novice programmers, and must be taken in conjunction with 600.107. The purpose of this course is to give first-time programmers extra hands-on practice with guided supervision. Students will work in pairs each week to develop working programs, with checkpoints for each development phase. Prerequisite: familiarity with computers. Corequisite: 600.107. Satisfactory/ Unsatisfactory only. [General]

Selinski   1 credit   fall, spring

600.111 (E) Python Scripting

For non-majors, this is an introductory "learning by doing" course focused on the quick prototyping of computational solutions to problems from a variety of disciplines. After an introduction to the UNIX and IDLE environments we briefly cover the basics of programming in Python. We then spend the rest of the semester surveying a variety of powerful Python libraries, frameworks, and tools. We use these building blocks to create, for example, systems for image and sound processing, data analysis and visualization, event-based simulation, or database-driven web applications. There will be several sizeable team-based programming projects. [Note: This course may not be used for the CS major or minor requirements, except perhaps as a substitute for 600.107.] Prerequisite: none.

Froehlich   3 credits

600.120 (E) Intermediate Programming

This course teaches intermediate to advanced programming, using C and C++. (Prior knowledge of these languages is not expected.) We will cover low-level programming techniques, as well as object-oriented class design, and the use of class libraries. Specific topics include pointers, dynamic memory allocation, polymorphism, overloading, inheritance, templates, collections, exceptions, and others as time permits. Students are expected to learn syntax and some language specific features independently. Course work involves significant programming projects in both languages. Prerequisite: 600.107 or AP CS or equivalent. [General]

Staff   4 credits   fall, spring

600.133 (E) Embedded Systems Fundamentals: Programming the Hardware-Software Interface

This hands-on course will be a gentle introduction to the field of embedded computing; computer systems that interact with the real world, making possible cell phones, MP3 players, flash drives, Wii games, and many more. Students will be programming different projects in modern microcontrollers, witnessing the effects immediately. The course will address the hardware-software interface of computer systems, setting a good foundation to understand the physical layer of computer applications and networking. The main topics are computer architecture fundamentals, assembly language, interfacing peripherals, programming device drivers, working with sensors, and data acquisition. Each student will be provided with the material to perform experiments individually, as well as with learning handouts. The course will be intensive but fun.

Staff   2 credits   intersession

600.145 (E) Introduction to Computer-Integrated Surgery

This course will give an introduction to the concepts and major elements of computer-integrated surgery (CIS) through clinical applications. Students will learn to ask questions and look for answers the way clinical engineers build and analyze CIS systems. Major topics will include medical imaging, image processing, surgical planning, surgical robotics, robot navigation, systems integration, and clinical validation. Optional visits to CIS laboratories

and clinical experiments will also be offered. No computer programming will be necessary to complete the assignments. Prerequisites: pre-calc required; knowledge of linear algebra helpful. Short course. [General]
Taylor   1 credit   intersession

600.146 (E) Introduction to Medical Imaging
This intersession class will provide an introduction to the principles of medical imaging. X-ray, CT and ultrasound imaging will be covered. The course will offer an introduction to the principles, instrumentation and applications of each modality. The class will be a mixture of lectures, class discussions and imaging demos using medical imaging resources at the Computational Sciences and Engineering Building. Assignments will test theoretical knowledge and also practical applications. Basic Matlab knowledge and pre-calculus math are recommended. Note: Students should not expect an in depth analysis of medical imaging systems. This class is not intended as a substitute for Medical Imaging courses offered during fall and spring terms.
Staff   1 credit   intersession

600.147 (E) Computer Applications in Radiation Therapy
The course consists of three parts: the physics of radiation therapy (one week), the computer in delivery systems—hardware (one week) and the computer in treatment planning systems—software (one week). The materials are generally high level topics in this area and they are not detailed mathematics or physics. It is for students to understand how important the role of software and hardware is in this particular field of medicine.
Staff   1 credit   intersession

600.161 (E) Exploring Vision in the Real World
The course will focus on real world applications of computer vision and image processing, primarily in the areas of medicine and sports. The goal is to introduce students to computer vision concepts and explain how they are the building blocks for interesting and practical applications. One such example is the use of stereo vision to enhance micro surgery. Another example is the use of computer vision to create realistic 3D real-time video fly-through in sporting events, such as the NFL Super Bowl. The class will consist of lectures and class discussions. Students will be evaluated on weekly assignments and participation in discussions. This course is designed to introduce computer vision to interested students with or without a computer science background. An engineering background is recommended but not required. Matlab programming will be part of homeworks. Pre-calculus level math and some linear algebra is required.
Staff   1 credit   intersession

600.202 (E) Introduction to Public Health and Biomedical Informatics
Information technology should radically change the practice of medicine, the research of health science, and the assurance of public health. In this course, we review the core technologies of informatics and how those technologies ought to be considered, used, and evaluated, using examples from Johns Hopkins, from developing countries, and from around the world. Topics covered include basic technology, data, information, knowledge, standards and interoperability, software engineering frameworks, electronic patient records, biosurveillance, and clinical research systems. This course should be of interest to those aiming toward the biosciences, computers, the information sciences, and cognate social sciences.
Lehmann   3 credits   summer

600.211 (E) UNIX Systems Programming
This course covers a variety of topics in UNIX programming, including process control, signal handling, daemon processes, and interprocess communication. Participants must be familiar with using the UNIX environment and be fluent in the C programming language. Prerequisite: 600.120. [General]
Fröhlich   3 credits

600.226 (E,Q) Data Structures
This course covers the design and implementation of data structures including collections, sequences, trees, and graphs. Other topics include sorting, searching, and hashing. Course work involves both written homework and Java programming assignments. An overview of Java will be provided. Prerequisite: AP CS, 600.107 or equivalent. [General]
Staff   3 credits   fall, spring

600.245 (E) Foundations of Computer Integrated Surgery
This course will give an introduction to the concepts and major elements of computer-integrated surgery (CIS) through clinical applications. Major topics will include medical imaging, image processing, surgical planning, surgical robotics, robot navigation, systems integration, and clinical validation. The class includes a human cadaver lab module to perform minimally invasive spine surgery with the use of novel technologies discussed in class. Grades will be calculated based on participation in class and three homework assignments. No computer programming will be necessary or required to complete the assignments, but bonus offered for demonstrating programming skills. Prerequsite: pre-calculus; recommended: linear algebra and vector calculus.
Kumar   3 credits   summer

600.250 (E) User Interfaces and Mobile Applications
This course will provide students with a rich development experience, focused on the design and implementation of user interfaces and mobile applications. A brief overview of human computer interaction will provide context for designing, prototyping and evaluating user interfaces. Students will invent their own mobile applications and implement them using the Android SDK, which is JAVA based. An overview of the Android platform and available technologies will be provided, as well as XML for layouts, and general concepts for effective mobile development. Students will be expected to explore and experiment with outside resources in order to learn technical details independently. There will also be an emphasis on building teamwork skills, and on using modern development tech-

niques and tools. Prerequisite: 600.120 and 600.226. [General]

Selinski   3 credits

600.255 (E) Introduction to Video Game Design

A broad survey course in video game design (as opposed to mathematical game theory), covering artistic, technical, as well as sociological aspects of video games. Students will learn about the history of video games, archetypal game styles, computer graphics and programming, user interface and interaction design, graphical design, spatial and object design, character animation, basic game physics, plot and character development, as well as psychological and sociological impact of games. Students will design and implement an experimental video game in interdisciplinary teams of 3-4 students as part of a semester-long project. Prerequisite: sophomores and above, permission of instructor, technical students should have taken at least one (preferably two or more) programming-related courses; artistic students should have taken at least one (preferably two or more) multimedia-related courses; corequisite: 600.256.

Froehlich   3 credits

600.256 Introduction to Video Game Design Lab

A lab course in support of 600.255: Introduction to Video Game Design covering a variety of multi-media techniques and applications from image processing, through sound design, to 3D modeling and animation. See 600.255: Introduction to Video Game Design for details about enrolling. Corequisite: 600.255.

Froehlich   1 credit

600.271 (E,Q) Automata and Computation Theory

This course is an introduction to the theory of computing. Topics include design of finite state automata, pushdown automata, linear bounded automata, Turing machines and phrase structure grammars; correspondence between automata and grammars; computable functions, decidable and undecidable problems, P and NP problems, NP-completeness, and randomization. Students may not take both 600.271 and 600.471, unless one is for an undergrad degree and the other for grad. Prerequisite: none. [General]

Kosaraju   3 credits   spring, summer

600.306 (E) Introduction to Speech

This course will introduce students to speech from an interdisciplinary perspective including computer science, electrical engineering, linguistics, and psychology. Topics such as pitch will be discussed from a variety of perspectives including signal processing (estimating fundamental frequency), perception, linguistics, and computational linguistics. Vowels will be described from multiple perspectives ranging from distinctive features in linguistics to formants in signal processing. Students will become familiar with a variety of topics ranging from spectrogram reading to using XML to program phones and Python (NLTK) to find interesting patterns in text corpora. To reach a diverse interdisciplinary audience, no background experience is required. Short course.

Church   1 credit

600.315 (E) Databases

Introduction to database management systems and database design, focusing on the relational and object-oriented data models, query languages and query optimization, transaction processing, parallel and distributed databases, recovery and security issues, commercial systems and case studies, heterogeneous and multimedia databases, and data mining. Course work includes significant practical implementation experience. Prerequisite: 600.226. [Systems]

Yarowsky   3 credits   fall

600.316 (E) Transaction Processing Systems

This course covers the design and implementation of transaction processing and database systems. Topics include transaction semantics, write-ahead logging, memory management, checkpoints, concurrency control, replication, restart recovery, and distributed commit protocols. The course employs examples of advanced database applications to develop this material. Examples include Internet databases, TP monitors, multidatabases, and federated databases. Course work includes a project. Prerequisites: 600.315/415 or equivalent, 600.120. [Systems] [Last offered 2009.]

Burns   3 credits

600.318 (E) Operating Systems

This course covers the fundamental topics related to operating systems theory and practice. Topics include processor management, storage management, concurrency control, multi-programming and processing, device drivers, operating system components (e.g., file system, kernel), modeling and performance measurement, protection and security, and recent innovations in operating system structure. Course work includes the implementation of operating systems techniques and routines, and critical parts of a small but functional operating system. Prerequisites: 600.120, 600.226, and 600.333; 600.211 recommended. [Systems]

Staff   4 credits   spring

600.319 (E) Storage Systems

Storage systems is one of the fastest growing and most interesting research areas in computer science. Storage systems often dominate the performance of computer systems as a whole. Also, they are responsible for the safe-keeping of an organization's most valuable assets—information! The course will cover the design and implementation of storage systems and the architecture and characteristics of the components on which storage systems are built. Topics will range from the device level up to distributed systems concepts. This will include disk drive hardware and firmware, file system and database structures, mirroring and RAID, disk array controllers, local storage interconnects, storage area networks, capacity planning and configuration, distributed file systems and network-attached storage, backup/restore and disaster recovery, and security for storage. Prerequisites: 600.226 and 600.333/433. [Systems] [Last offered 2008.]

Burns   3 credits

600.320 (E) Parallel Programming

This course prepares the programmer to tackle the massive data sets and huge problem size of modern scientific and enterprise computing. Google and IBM have commented that undergraduate CS majors are unable to "break the single server mindset" (www.google.com/intl/en/press/pressrel/20071008_ibm_univ.html). Students taking this course will abandon the comfort of serial algorithmic thinking and learn to harness the power of cutting-edge software and hardware technologies.

The issue of parallelism spans many architectural levels. Even ``single server'' systems must parallelize computation in order to exploit the inherent parallelism of recent multi-core processors. The course will examine different forms of parallelism in four sections. These are: (1) massive data-parallel computations with Hadoop!; (2) programming compute clusters with MPI; (3) thread-level parallelism in Java; and, (4) GPGPU parallel programming with NVIDIA's Cuda. Each section will be approximately three weeks and each section will involve a programming project. The course is also suitable for second-year undergraduate CS majors and undergraduate and graduate students from other science and engineering disciplines that have prior programming experience. Prerequisites: 600.120 or equiv. [Systems]
Burns   3 credits

600.321 (E) Object-Oriented Software Engineering

This course covers object-oriented software construction methodologies and their application. The main component of the course is a large team project on a topic of your choosing. Course topics covered include object-oriented analysis and design, UML, design patterns, refactoring, program testing, code repositories, team programming, and code reviews. Prerequisites: 600.226 and 600.120. [Systems or Applications]
Smith   3 credits   fall

600.324 (E) Network Security

This course focuses on communication security in computer systems and networks. The course is intended to provide students with an introduction to the field of network security. The course covers network security services such as authentication and access control, integrity and confidentiality of data, firewalls and related technologies, Web security and privacy. Course work involves implementing various security techniques. A course project is required. Prerequisites: 600.226, 600.344/444 or permission; 600.120 (or equivalent) recommended. [Systems]
Staff   3 credits

600.325 (E) Declarative Methods

Suppose you could simply write down a description of your problem, and let the computer figure out how to solve it. What notation could you use? What strategy should the computer then use? In this survey class, you'll learn to recognize when your problem is an instance of satisfiability, constraint programming, logic programming, dynamic programming, or mathematical programming (e.g., integer linear programming). For each of these related paradigms, you'll learn to reformulate hard problems in the required notation and apply off-the-shelf software that can solve any problem in that notation—including NP-complete problems and many of the problems you'll see in other courses and in the real world. You'll also gain some understanding of the general-purpose algorithms that power the software. Prerequisites: 600.226, Calc II. [Analysis]
Eisner   3 credits   spring

600.328 (E) Compilers and Interpreters

Introduction to compiler design, including lexical analysis, parsing, syntax-directed translation, symbol tables, run-time environments, and code generation and optimization. Students are required to write a compiler as a course project. Prerequisite: 600.120 and 600.226. [Systems]
Fröhlich   3 credits

600.333 (E) Computer System Fundamentals

CSF addresses the design and performance of the principal operational components of a reduced-instruction-set computing system (RISC) which supports the efficient execution of widely used instruction sets. Arithmetic and logic units, memory hierarchy designs, state-machine controllers, and other related hardware and firmware components are studied, and the qualities of their combined processing capabilities are assessed by means of execution times associated with a range of benchmark programs. Assembly language programming projects, homework problems, and exams are employed to assess a student's fundamental understanding of the tradeoffs resulting from an assortment of variations in digital system design decisions that ultimately characterize the performance of the computing system architecture that is developed. Prerequisite: 600.107 or equiv. [Systems]
Masson   3 credits   fall, summer

600.334 (E) Laboratory for Computer System Fundamentals

This course is a hands-on laboratory supplement to computer system fundamentals (600.333). Corequisite: 600.333.
Masson   1 credit   fall

600.335 (E) Artificial Intelligence

Artificial Intelligence (AI) is introduced by studying automated reasoning, automatic problem solvers and planners, knowledge representation mechanisms, game playing, machine learning, and statistical pattern recognition. The class is recommended for all scientists and engineers with a genuine curiosity about the fundamental obstacles to getting machines to perform tasks such as deduction, learning, planning, and navigation. Strong programming skills and a good grasp of the English language are expected; students will be asked to complete both programming assignments and writing assignments. The course will include a brief introduction to scientific writing and experimental design, including assignments to apply these concepts. Prerequisite: 600.226, 550.171; linear algebra, prob/stat recommended. [Applications]
Staff   3 credits   spring

600.336 (E) Algorithms for Sensor-Based Robotics
This is an introductory course presenting a series of algorithms related to the representation and use of geometric models acquired from sensor data. Course topics include: basic sensing and estimation techniques, geometric model representations, and motion planning algorithms. The course will also discuss applications in diverse areas such as mobile systems, robot manipulation, and medicine. Prerequisite: 600.226, calculus, prob/stat. [Analysis]
Hager   3 credits

600.337 (E) Distributed Systems
This course teaches how to design and implement protocols that enable processes to exchange information, cooperate, and coordinate efficiently in a consistent manner over a computer network. Topics include communication protocols, group communication, distributed databases, distributed operating systems, and security. The course gives hands-on experience as well as some theoretical background. Prerequisites: 600.120 and 600.226. [Systems]
Amir   3 credits

600.341 (E, Q) Basics of Applied Cryptography
This course is an introduction to algorithms, cryptography and network security, meant to give students a good foundation for upper-level courses in the area. Students will learn how to implement a simple cryptographic library in C. Prerequisites: 600.120 and 600.226. [Analysis]
Ateniese   3 credits

600.344 (E) Computer Network Fundamentals
This course considers intersystem communication issues. Topics include layered network architectures; the OSI model; bandwidth, data rates, modems, multiplexing, error detection/correction; switching; queuing models, circuit switching, packet switching; performance analysis of protocols, local area networks; and congestion control. Prerequisite: 600.333 or general knowledge of computer architecture. [Systems]
Terzis   3 credits   spring

600.355 (E) Video Game Design Project
An intensive capstone design project experience in video game development. Students will work in groups of 4-8 on developing a complete video game of publishable quality. Teams will (hopefully) include programmers, visual artists, composers, and writers. Students will be mentored by experts from industry and academia. Aside from the project itself, project management and communication skills will be emphasized. Enrollment is limited to ensure parity between the various disciplines. Prerequisite: 600.255/256 or permission; junior or senior standing recommended. [General]
Fröhlich   3 credits

600.357 (E,Q) Computer Graphics
This course introduces computer graphics techniques and applications, including image processing, rendering, modeling and animation. Prerequisites: 600.120, 600.226, and linear algebra; or permission of instructor. [Applications]
Kazhdan   3 credits   spring

600.361 (E,Q) Computer Vision
This course gives an overview of fundamental methods in computer vision from a computational perspective. Methods include computation of 3-D geometric constraints from binocular stereo, motion, texture, shape-from-shading, and photometric stereo. Edge detection and color perception are studied as well. Elements of machine vision and biological vision are also included. Prerequisites: 600.226. [Applications]
Hager   3 credits   fall

600.363 (E,Q) Introduction to Algorithms
This course concentrates on the design of algorithms and the rigorous analysis of their efficiency. Topics include the basic definitions of algorithmic complexity (worst case, average case); basic tools such as dynamic programming, sorting, searching, and selection; advanced data structures and their applications (such as union-find); graph algorithms and searching techniques such as minimum spanning trees, depth-first search, shortest paths, design of online algorithms and competitive analysis. Prerequisite: 600.226. [Analysis]
Braverman   3 credits   spring

600.392 (E) Senior Design Project
This course will give senior CS majors an intensive capstone design project experience. Students will work in groups with real world customers to develop a working system. Project design, management and communication skills will be emphasized. Software development methodologies may also be presented. Prerequisites: 600.120, 600.226; 600.321 recommended. [General]
Fröhlich   3 credits

Advanced Undergraduate/ Graduate Courses

600.402 (E) Medical Informatics
Key decision makers in government and industry and across the world believe that health information technology is crucial to improving health and safety and cutting costs, and are investing billions of dollars over the next few years to test that belief. In this course, you will learn to understand this new context and to figure out what role you might play in it. Prerequisite: none. Short course.
Lehmann   1 credit

600.405 (E, Q) Applications of Probabilistic Graphical Models in Language and Speech Processing
Probabilistic graphical models (PGMs) combine ideas from statistics and computer science into a unifying framework for modeling complex real-world phenomena. PGMs are now widespread in language and speech processing. PGMs are well suited to handle the inherent challenges of linguistic problems: complex and structured relationships, a large number of relevant attributes, and large volumes of data. This short course will provide students with advanced training in several specific applications of graphical models that are important in natural language processing. After reviewing the essentials of directed and undirected graphical models, we will discuss complex CRFs, approximate inference including variational and MCMC methods, Bayesian models and non-

parametric Bayesian models including Chinese Restaurant Processes. Students will also gain practical experience by solving problems using existing PGM software. Prerequisite: 600.465. Short course.

Staff   1 credit

600.406 (E) Developing Photo and Video Applications for Online Social Networks

How many hours do you spend on facebook a day? This experimental course will teach you how to create and launch web 2.0 applications. The class provides an introduction to the field of computer vision, giving you the tools to detect and track objects in the environment. Class topics include social network interfaces—primarily facebook application interface (API), image processing, face detection, virtual environment and rendering methods. Students will work in small teams to conceptualize, develop, distribute, and market new applications to facebook users. Course is appropriate for students interested in computer vision, entrepreneurship, or human-computer interaction. Prerequisite: 600.107 and 600.120. Short course.

Staff   2 credits

600.407 (E) General Purpose Computation on the GPU

Programmable graphics hardware not only provides a way to perform advanced real-time 3D rendering, but also a platform for highly parallel numerical computing. Over the past 5 years, the General Purpose Graphics Processor Unit (GPGPU) community has grown around performing non-graphics computations using the limited instruction set and framework of the graphics pipeline. This short course, which meets one hour per week from the Spring semester, will introduce students to GPGPU computing using NVIDIA's CUDA platform. Prerequisites: 600.120 and 600.333/433; computer graphics and linear algebra recommended. Short course.

Staff   1 credit

600.409 (E) Digital Preservation

This course explores how digital information may be stored, maintained, and retrieved over decades or centuries. It examines both the technical and social aspects of preservation, drawing material from both Computer Science and the Digital Library community. Lecture topics will include architectures for long-term archival, data provenance, information representation, metadata semantics, replica maintenance, authenticity and privacy, and business models for sustainable archives. Students will define and execute a research project investigating a hot unsolved problem related to data preservation. The course is suitable for upper-level undergraduates and graduate students from all disciplines that have had an introductory programming course. Prerequisites: 600.107 or equivalent. Short course.

Staff   1 credit

600.412 (E) Security and Privacy in Cloud Computing

This course focuses on the security and privacy issues in Cloud Computing systems. While the cloud computing paradigm gains more popularity, there are many issues related to confidentiality, integrity, and availability of data and computations involving a cloud. In this course, we examine cloud computing models, look into the threat model and security issues related to data and computation outsourcing, and explore practical applications of secure cloud computing. Short course.

Hasan   1 credit

600.415 (E) Databases

Similar material as 600.315, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.315 or 600.415, but not both. Prerequisite: 600.226. [Systems]

Yarowsky   3 credits   fall

600.416 (E) Transaction Processing Systems

Similar material as 600.316, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.316 or 600.416, but not both. Prerequisite: 600.315/415 or equivalent, 600.120. [Systems] [Last offered 2009.]

Burns   3 credits

600.417 (E) Data Stream Processing

Data stream processing has emerged as a model for building computing applications that face tremendous volumes of dynamically changing data, and are required to process such data in a timely fashion. Examples include a variety of web-driven applications, such as web advertising based on Facebook and Twitter status streams, and more generally, monitoring and analysis applications including algorithmic trading on stock ticks and order books, network monitoring for denial of service attacks, and location-based applications working with GPS data streams. This course will study data stream processing from a data management and algorithms perspective. Students will be introduced to the fundamentals of data stream processing systems and architectures, incremental (windowed) stream processing languages, and stream algorithms that embody the principle of "you only get one look" when having to continually deal with data arriving at high rates. This course will provide students with significant implementation experience, in the spirit of a practicum. Students will proceed through a series of homework projects to build a data stream processor from scratch, and will use the resulting stream engine along with stream mining algorithms to analyze Twitter feeds. This course is aimed at upper-level undergraduates with prior programming experience. Graduate students should consider taking 600.617 instead. Students may receive credit for 600.417 or 600.617, but not both. Prerequisites: 600.120, 600.226, and 600.315/415. [Systems]

Ahmad   3 credits

600.418 (E) Operating Systems

Similar material as 600.318, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.318 or 600.418, but not both. Prerequisites: 600.120, 600.211 (or equivalent C experience), 600.226, 600.333. [Systems]

Staff   3 credits   spring

600.419 (E) Storage Systems

Similar material as 600.319, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.319 or 600.419, but not both. Prerequisites: 600.226 and 600.333/433. [Systems] [Last offered 2008.]

Burns   3 credits

600.420 (E) Parallel Programming

Similar material as 600.320, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.320 or 600.420, but not both. Prerequisites: 600.120 or equiv. [Systems]

Burns   3 credits

600.421 (E) Object-Oriented Software Engineering

Similar material as 600.321, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.321 or 600.421, but not both. Prerequisites: 600.226 and 600.120. [Systems or Applications]

Smith   3 credits   fall

600.424 (E) Network Security

Similar material as 600.324, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.324 or 600.424, but not both. Prerequisites: 600.226, 600.344/444 or permission; 600.120 (or equivalent) recommended. [Systems]

Staff   3 credits   fall

600.425 (E) Declarative Methods

Similar material as 600.325, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.325 or 600.425, but not both. Prerequisites: 600.226, Calc II. [Analysis]

Eisner   3 credits   spring

600.426 (E) Principles of Programming Languages

Functional, object-oriented, and other language features are studied independent of a particular programming language. Students become familiar with these features by implementing them. Most of the implementations are in the form of small language interpreters. Some type checkers and a small compiler will also be written. The total amount of code written will not be overly large, as the emphasis is on concepts. The ML programming language is the implementation language used. Prerequisites: 600.226. Freshmen/sophomores by permission only. [Analysis]

Smith   3 credits   spring

600.427 (E) Data Organization: Storage and External Memory Systems

This course will examine the complex relationship between computer architectures and software systems that store, organize, and access data. Storage systems have always co-evolved with technology. But, today's computing landscape places unique demands on next generation storage systems. Technology drivers include: new storage devices, such as solid-state drives and phase-change memory, cloud computing, virtualization, and modern multi-core and manycore processors with steep hierarchies of shared caches. The course will provide an overview of modern storage systems, including parallel file systems, key/value stores, scan engines, in-memory databases, archival storage, and content-based storage. It will cover the techniques used to organize storage in these systems, such as indexes, replication and coding, spatial trees, and space-filling curves. The course will also explore external memory data structures and algorithms that provide a framework for analyzing and costing storage designs. Prerequisites: 600.226, 600.315/415, and 600.333/433 or permission of instructor. [Systems]

Burns   3 credits

600.428 (E) Compilers and Interpreters

Similar material as 600.328, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.328 or 600.428, but not both. Prerequisite: 600.120 and 600.226. [Systems]

Fröhlich   3 credits

600.430 (HQ) Ontologies and Knowledge Representation

Knowledge representation (KR) deals with the possible structures by which the content of what is known can be formally represented in such a way that queries can be posed and inferences drawn. Ontology concerns the hierarchical classification of entities from given domains of knowledge together with the relations between various classes or subclasses. We begin with KR, examining the standard variety of frameworks developed or implemented over the last twenty years, including 1st-order logic and automated theorem proving, networks, frames, and description logics. Then we move on to a study of the problems inherent in ontology development and examine some of the currently prevalent environments, including Universal Modeling Language, OWL and Protege', RDFS and semantic web applications. [Analysis]

Rynasiewicz   3 credits

600.433 (E) Computer Systems

Similar material as 600.333, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.333 or 600.433, but not both. Prerequisite: 600.107 or 600.109. [Systems]

Masson   3 credits   fall/summer

600.435 (E) Artificial Intelligence

Similar material as 600.335, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.335 or 600.435, but not both. Prerequisite: 600.226, 550.171; linear algebra, probability/statistics recommended. [Applications]

Staff   3 credits   spring

600.436 (E) Algorithms for Sensor-Based Robotics
Similar material as 600.336, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.336 or 600.436, but not both. Prerequisite: 600.226, calculus, probability/statistics. [Analysis]
Hager   3 credits

600.437 (E) Distributed Systems
Similar material as 600.337, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.337 or 600.437, but not both. Prerequisites: 600.120 and 600.226. [Systems]
Amir   3 credits   fall

600.438 (E) Advanced Operating Systems
This course is for people who wish to explore operating systems in greater detail in a hands-on fashion. Student partners (pairs) implement a UNIX-inspired thread library and kernel. Prerequisite: 600.318/418, 600.439 or perm. [Systems]
Staff   4 credits

600.442 (E,Q) Modern Cryptography
This course focuses on cryptographic algorithms, formal definitions, hardness assumptions, and proofs of security. Topics include number-theoretic problems, pseudo-randomness, block and stream ciphers, public-key cryptography, message authentication codes, and digital signatures. Prerequisites: 600.271 and 550.171 or equiv, 600.226 and a 300-level or above systems course. [Analysis]
Ateniese   3 credits

600.443 (E) Security and Privacy in Computing
Lecture topics will include computer security, network security, basic cryptography, system design methodology, and privacy. There will be a heavy workload, including written homework, programming assignments, exams and a comprehensive final. The class will also include a semester-long project that will be done in teams and will include a presentation by each group to the class. Prerequisite: a basic course in operating systems and networking, or permission of instructor. [Applications]
Rubin   3 credits   spring

600.444 (E) Computer Networks
Similar material as 600.344, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.344 or 600.444, but not both. [Systems]
Terzis   3 credits   spring

600.445 (E) Computer-Integrated Surgery I
This course focuses on computer-based techniques, systems, and applications exploiting quantitative information from medical images and sensors to assist clinicians in all phases of treatment from diagnosis to preoperative planning, execution, and follow-up. It emphasizes the relationship between problem definition, computer-based technology, and clinical application and includes a number of guest lectures given by surgeons and other experts on requirements and opportunities in particular clinical areas. An optional term project may be undertaken under supervision of the instructor and clinician end users. Although this course is primarily intended for graduate students and advanced undergraduate students interested in doing research in this area, it may also be of interest to medical or qualified premedical students wanting to obtain a broader background in this emerging field. Prerequisites: 600.120, 600.226 (or equivalent programming experience) and linear algebra or permission of instructor; recommended: 600.457, 600.461, image processing. [Applications]
Taylor   4 credits   fall

600.446 (E) Computer-Integrated Surgery II
This weekly lecture/seminar course addresses similar material to 600.445, but covers selected topics in greater depth. In addition to material covered in lectures/seminars by the instructor and other faculty, students are expected to read and provide critical analysis/presentations of selected papers in recitation sessions. Students taking this course are required to undertake and report on a significant term project under the supervision of the instructor and clinical end users. Typically, this project is an extension of the term project from 600.445, although it does not have to be. Grades are based both on the project and on classroom recitations. Students wishing to attend the weekly lectures as a 1-credit seminar should sign up for 600.452. Students may also take this course as 600.646. The only difference between 600.446 and 600.646 is the level of project undertaken. Typically, 600.646 projects require a greater degree of mathematical, image processing, or modeling background. Prospective students should consult with the instructor as to which course number is appropriate. Prerequisite: 600.445 or permission of instructor. [Applications]
Taylor   3 credits   spring

600.450 (E) Network Embedded Systems and Sensor Networks
This course is an introduction to fundamental concepts of networked embedded systems and wireless sensor networks. It is intended for juniors, seniors and first-year graduate students in computer science and other engineering majors with the prerequisite background. Covered topics include embedded systems programming concepts, low power and power aware design, radio technologies, communication protocols for ubiquitous computing systems, and some of the mathematical foundation of sensor behavior. Laboratory work consists of a set of programming assignments that consider a set of the issues described in class. Prerequisites: 600.226, 600.120, and 600.344. [Systems]
Terzis   3 credits   fall

600.451 (E) Performance of Computer-Communication Networks & Protocols
This is an advanced course in networks and protocols that examines the performance evaluation, design, and management of networks, including wireless networks. This course may have additional newer topics such as network

calculus and randomized algorithms as well as other algorithms for networking. The course uses analytical and simulation methods to evaluate, design and manage networks and protocols. Topics include introduction to and application of queuing theory, queueing networks, introduction to and application of graph theory, optimization techniques for routing and flow control; introduction to and application of simulation methods; performance of multiple access, TCP/IP, Wireless Cellular, Ad hoc and Sensor Networks; design of backbone and access networks. Prerequisites: 600.344/444 & 550.310. [Analysis]
Mishra   3 credits

600.452 (E) Computer-Integrated Surgery Seminar
Essentially, 600.452 is identical to 600.446/646 without the term project. Students may receive credit for only one of 600.446/452/646. Prerequisite: 600.445 or permission of instructor. [Applications]
Taylor   1 credit   spring

600.454 (E) Practical Cryptographic Systems
This semester-long course will teach systems and cryptographic design principles by example: by studying and identifying flaws in widely-deployed cryptographic products and protocols. Our focus will be on the techniques used in practical security systems, the mistakes that lead to failure, and the approaches that might have avoided the problem. We will place a particular emphasis on the techniques of provable security and the feasibility of reverse-engineering undocumented cryptographic systems. [Co-listed with 650.445] [Systems]
Green   3 credits   spring

600.457 (E,Q) Computer Graphics
Similar material as 600.357, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.357 or 600.457, but not both. Prerequisites: 600.120, 600.226, linear algebra; or permission of instructor. [Applications
Kazhdan   3 credits   spring

600.461 (E,Q) Computer Vision
Similar material as 600.361, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.361 or 600.461, but not both. Prerequisite: 600.226. [Applications]
Hager   3 credits   fall

600.463 (E,Q) Algorithms I
Similar material as 600.363, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.363 or 600.463, but not both. Prerequisite: 600.226. [Analysis]
Braverman   3 credits   spring

600.464 (E,Q) Randomized Algorithms
The course concentrates on the design and analysis of randomized algorithms. Problems from graph theory, computational geometry and information routing in networks will be treated. Some knowledge of probability

theory and deterministic algorithmic techniques is helpful. Prerequisite: 600.363 or 600.463. [Analysis]
Kosaraju   3 credits   fall

600.465 (E) Introduction to Natural Language Processing
This course is an in-depth overview of techniques for processing human language. How should linguistic structure and meaning be represented? What algorithms can recover them from text? And crucially, how can we build statistical models to choose among the many legal answers? The course covers methods for trees (parsing and semantic interpretation), sequences (finite-state transduction such as morphology, and words (sense and phrase induction), with applications to practical engineering tasks such as information retrieval and extraction, text classification, part-of-speech tagging, speech recognition and machine translation. There are a number of structured but challenging programming assignments. Prerequisite: 600.226; previous exposure to probability or linguistics may be helpful. [Applications]
Eisner   3 credits   fall

600.466 (E) Information Retrieval and Web Agents
An in-depth, hands-on study of current information retrieval techniques and their application to developing intelligent WWW agents. Topics include a comprehensive study of current document retrieval models, mail/news routing and filtering, document clustering, automatic indexing, query expansion, relevance feedback, user modeling, information visualization and usage pattern analysis. In addition, the course explores the range of additional language processing steps useful for template filling and information extraction from retrieved documents, focusing on recent, primarily statistical methods. The course concludes with a study of current issues in information retrieval and data mining on the World Wide Web. Topics include web robots, spiders, agents and search engines, exploring both their practical implementation and the economic and legal issues surrounding their use. Prerequisite: 600.226. [Applications]
Yarowsky   3 credits   spring

600.467 (E) Wireless Networks
This course covers the basics of mobile communication and wireless networking for computer science majors by keeping a balance between communication and networking topics. In this course the students will be exposed to wireless transmission fundamentals (path loss, shadowing, modulation, coding and channel models), wireless cellular networks (cellular concept, channel reuse, capacity limits, and cellular systems such as GSM, GPRS and UMTS), and learn about mobile network and transport layers, medium access control protocols, wireless local area networks (IEEE 802.11), wireless mesh networks (IEEE 802.16), and emerging dynamic spectrum access networks based on cognitive radios. Prerequisites: 600.344/444 recommended. [Systems]
Mishra   3 credits

600.471 (E,Q) Theory of Computation
This is a graduate-level course studying the theoretical foundations of computer science. Topics covered will be

models of computation from automata to Turing machines, computability, complexity theory, randomized algorithms, inapproximability, interactive proof systems and probabilistically checkable proofs. Students may not take both 600.271 and 600.471, unless one is for an undergrad degree and the other for grad. Prerequisite: 550.171 or permission. [Analysis]

Hohenberger   3 credits

600.472 (E, Q) Theoretical Cryptography
The focus of this course is on the definitions and constructions of various cryptographic primitives and protocols, such as one-way functions, pseudo-random generators, digital signature schemes, encryption schemes, zero-knowledge and multiparty computation. We will study how to formulate definitions that capture desired security properties as well as techniques for designing and then proving that a construction realizes these properties. Students should be comfortable with the basics of number theory and proof writing. Prerequisite: 600.471 recommended. [Analysis]

Hohenberger   3 credits

600.475 (E) Machine Learning
This course takes an application driven approach to current topics in machine learning. The course covers supervised learning (classification/structured prediction/regression/ranking), unsupervised learning (dimensionality reduction, bayesian modeling, clustering) and semi-supervised learning. Additional topics may include reinforcement learning and learning theory. The course will also consider challenges resulting from learning applications, such as transfer learning, multi-task learning and large datasets. We will cover popular algorithms (naive Bayes, SVM, perceptron, HMM, winnow, LDA, k-means, maximum entropy) and will focus on how statistical learning algorithms are applied to real world applications. Students in the course will implement several learning algorithms and develop a learning system for a final project. Prerequisite: multi-variate calculus. [Applications]

Dredze   3 credits

600.478 (E) Visual Imaging in Surgery and Medicine
A survey course in visual imaging registration and fusion methods and its applications in surgery and medicine. Such applications are common in medical imaging including integration of CT, MRI, ultrasound, PET, and other sensing. However, compared to these sensing technologies visual imaging requires more efficient computation and stronger emphasis on contextual and temporal information. Key goals for such methods include multi-resolution, and multi-temporal registration and superresolution. A large body of work and practical applications using visual imaging exist in remote sensing, surveillance, and robot vision, but methods for surgical visualization are relatively rare and new. This course aims to provide background on devices, methods, and applications for visual imaging in medicine and surgery including recent work in the field. Students will design and implement registration methods based on data sets provided as part of a semester-long team

project. Prerequisite: 600.226, 600.461; recommended: linear algebra, 600.445. [Applications]

Kumar   3 credits

600.488 (E) Foundations of Computational Biology and Bioinformatics II
This course will introduce probabilistic modeling and information theory applied to biological sequence analysis, focusing on statistical models of protein families, alignment algorithms, and models of evolution. Topics will include probability theory, score matrices, hidden Markov models, maximum likelihood, expectation maximization and dynamic programming algorithms. Homework assignments will require programming in Python. Foundations of Computational Biology I is not a prerequisite. Prerequisites: math through linear algebra and differential equations, 580.221 or equiv., 600.226 or equiv. [Co-listed with 580.488.] [Analysis]

Karchin   4 credits

600.491-492 (E) Computer Science Workshop I, II
An applications-oriented, computer science project done under the supervision and with the sponsorship of a faculty member in the Department of Computer Science. Computer Science Workshop provides a student with an opportunity to apply theory and concepts of computer science to a significant project of mutual interest to the student and a Computer Science faculty member. Permission to enroll in CSW is granted by the faculty sponsor after his/her approval of a project proposal from the student. Interested students are advised to consult with Computer Science faculty members before preparing a Computer Science Workshop project proposal. Prerequisite: consent of faculty supervisor.

Staff   3 credits

600.498 Programming Contest Laboratory
This laboratory course meets for 2.5 hours/week. The intent is to develop the skills needed to achieve victory in programming contests. Prerequisite: permission of instructor. [General]

Smith   1 credit

600.503-504, 576, 597 Independent Study
Individual guided study for undergraduates, under the direction of a faculty member in the department. The program of study, including the credit to be assigned, must be worked out in advance between the student and the faculty member involved. May be taken fall (503), spring (504), intersession (576), summer (597).

600.507-508, 574, 595 Independent Research
Independent research for undergraduates, under the direction of a faculty member in the department. The program of research, including the credit to be assigned, must be worked out in advance between the student and the faculty member involved. May be taken fall (507), spring (508), intersession (574), summer (595).

600.509-510, 550, 599 Computer Science Internship
Individual work in the field with a learning component, supervised by a faculty member in the department. The

program of study must be worked out in advance between the student and the faculty member involved. Students may not receive credit for work that they are paid to do. As a rule of thumb, 40 hours of work is equivalent to one credit. S/U only, 1 credit only. May be taken fall (509), spring (510), intersession (550), summer (599).

600.519-520 (E) Senior Honors Thesis
For computer science majors only. The student will undertake a substantial independent research project under the supervision of a faculty member, potentially leading to the notation "Departmental Honors with Thesis" on the final transcript. Students are expected to enroll in both semesters of this course during their senior year. Project proposals must be submitted and accepted in the preceding spring semester (junior year) before registration. Students will present their work publicly before April 1 of senior year. They will also submit a first draft of their project report (thesis documentation) at that time. Faculty will meet to decide if the thesis will be accepted for honors. Prerequisite: 3.5 GPA in Computer Science after spring of the junior year and permission of faculty supervisor.
Staff   3 credits/semester (taken twice)

600.546 (E) Senior Thesis in Computer Integrated Surgery
The student will undertake a substantial independent research project in the area of computer-integrated surgery, under joint supervision of a WSE faculty advisor and a clinician or clinical researcher at the Johns Hopkins Medical School. This project will typically require background literature research, design, and execution of an experimental study or substantial implementation effort, and write-up of the results. The written reports will be published as reports by the CISST Engineering Research Center and may be used by the students as the basis for further academic publication. Because of the interdisciplinary, team oriented nature of much CIS research, students may work in small groups or with other members of the advisor's research group. Students will be expected to establish a research plan and schedule and may be required by their advisor to provide interim documentation and meet interim deadlines, as appropriate. This requirement will be especially pertinent for two-semester projects. Prerequisite: 600.445 or permission required. [Applications]
Taylor   3 credits/semester (may be taken twice)

Graduate Courses

600.601-602 Computer Science Seminars
This course is offered satisfactory/unsatisfactory each semester. A grade of satisfactory can be attained by attending a minimum of the smallest integer greater than or equal to $2N/3$ seminars in the Department of Computer Science, where N is the total number of seminars which are presented between and including the first and last class days of the semester and which are officially announced at least one week in advance. An email message and/or display of a poster outside the department office describing the seminar will constitute its official

announcement. This course is required for all full-time graduate students in Computer Science. [General]
Staff   fall, spring

600.603-604 Current Topics in Language and Speech Processing
This biweekly seminar will cover a broad range of current research topics in human language technology, including automatic speech recognition, natural language processing and machine translation. The Tuesday seminars will feature distinguished invited speakers, which the Friday seminars will be given by participating students. A minimum of 75% attendance and active participation will be required to earn a passing grade. (Last offered Fall 2010 —students should take 520.701/702 instead.) [General]
Khudanpur   fall, spring

600.615 Big Data, Small Languages, Scalable Systems
This class will study domain-specific data management tools, focusing on extremely scalable system design based on the domain's semantic and structural properties. We will study a variety of data models including stream, graph, array, and probabilistic data, and their processing on modern architectures such as column- and key-value stores, stream, and XQuery engines. Further topics include the use of novel hardware such as solid state disks, phase change memory, GPUs, and FPGAs. The class includes a semester long group project to develop a query processor for an application of the group's choice (e.g. on system log, finance, web, sensor, speech data). Prerequisite: 600.315/415 or equivalent. [Systems]
Ahmad   3 hours

600.619 Advanced Storage and Transaction Processing Systems
In this course, we will examine advanced research topics in storage systems, file systems, transaction processing, and network data management. The readings are taken from the current research literature and articles of historical significance. This course is intended for graduate students interested in conducting research on or related to these topics and for students who face management, availability or performance issues with data in their own research. Students will conduct a semester long research project and present their results to the class. In addition to the scheduled meetings, students will have weekly one-on-one meetings with the professor. Prerequisite: 600.419 or permission of instructor. [Systems]
Burns   3 hours

600.620 External Memory Data Structures and Algorithms
This course will cover data structures and algorithms for managing external memory with applications to file systems, databases, parallel architectures, and high-performance computing. Topics will include cost models for external memory, elementary algorithms (scanning, sorting, permuting), data structures (lists, arrays, B-trees), spatial data structures, algorithms for tree, graph, geometric, and spatial data, and the parallelization of data structures and algorithms. This course is intended for students interested in conducting research on or related to these

topics. Students will conduct a semester long research project and present their results to the class. In addition to the scheduled meetings, students will have weekly one-on-one meetings with the professor. Prerequisite: 600.363/463 and one of 600.315/415, 600.318/418, 600.316/416, 600.319/419 or permission of instructor. [Systems or Analysis]

Burns   3 hours

600.630 Computer Vision Seminar

This seminar course surveys recent research results in algorithms for dynamic vision and their applications. Specific emphasis will be placed on approaches which derive novel and efficient algorithms using generalizable mathematical and/or computational principles. Sample topics include: color and texture, segmentation and grouping, motion and tracking, stereo and structure from motion, image-based modeling, illumination and reflectance modeling, shape reconstruction, object and event recognition, face/gesture/gait modeling, statistical methods and learning, medical imaging, image and video retrieval, etc. Students will be expected to participate in class by reading, presenting, and discussing research papers. Prerequisites: 600.461 or 530.646 or permission of instructor. [Applications]

Hager   3 hours

600.643 Advanced Topics in Computer Security

Topics will vary from year to year, but will focus mainly on network perimeter protection, host-level protection, authentication technologies, intellectual property protection, formal analysis techniques, intrusion detection and similarly advanced subjects. Emphasis in this course is on understanding how security issues impact real systems, while maintaining an appreciation for grounding the work in fundamental science. Students will study and present various advanced research papers to the class. There will be homework assignments and a course project. Prerequisite: any 600.4xx course in computer security or cryptography including 600.442, 600.443 or 600.424; or permission of instructor. [Systems or Applications]

Rubin   3 hours

600.646 Advanced Computer-Integrated Surgery II

(See description under 600.446.)

This is substantially the same course as 600.446, but with an expectation that the term project will be more substantial. Prerequisite: 600.445 or permission of instructor. [Applications]

Taylor   3 hours   spring

600.647 Advanced Topics in Wireless Networks

This class will survey current research in wireless communication networks. These types of networks have been growing exponentially in the past several years and include a host of different network types: ad hoc, cell phone, access point, sensor, etc. The class will build understanding of all layers of wireless networking and the interactions between them (including physical, data link, medium access control, routing, transport, and application). The topics of security, energy efficiency, mobility, scalability, and their unique characteristics in wireless networks will be discussed. Prerequisites: 600.344/444 and 600.363/463. [Systems or Analysis]

Awerbuch, Mishra   3 hours

600.651 Haptic Systems for Teleoperation and Virtual Reality

Open to undergraduates with permission. Graduate-level introduction to the field of haptics, focusing on teleoperated and virtual environments that are displayed through the sense of touch. Topics covered include human haptic sensing and control, design of haptic interfaces (tactile and force), haptics for teleoperation, haptic rendering and modeling of virtual environments, control and stability issues, and medical applications such as tele-surgery and surgical simulation. Course work includes reading and discussion of research papers, presentations, and a final project. Appropriate for students in any engineering discipline with interests in robotics, virtual reality, or computer-integrated surgical systems. (Co-listed with 530.561.) [Applications]

Okamura   3 hours

600.657 Advanced Topics for Computer Graphics

This course will present advanced methodologies and their applications to computer graphics. Topics will vary by semester. Students will be expected to present several papers throughout the semester and to participate in group discussions of the assigned readings. Prerequisite: any 600.4xx course in computer graphics & linear algebra; or permission of instructor. [Applications]

Kazhdan   3 hours

600.660 FFT in Graphics and Vision

In this course, we will study the Fourier Transform from the perspective of representation theory. We will begin by considering the standard transform defined by the commutative group of rotations in 2D and translations in two- and three-dimensions, and will proceed to the Fourier Transform of the non-commutative group of 3D rotations. Subjects covered will include correlation of images, shape matching, computation of invariances, and symmetry detection. Prerequisites: linear algebra and comfort with mathematical derivations. [Applications or Analysis]

Kazhdan   3 hours

600.663 Pattern Matching Algorithms

Pattern matching problems are among the oldest in computer science. Yet, the area is still a fertile ground for very active current research. Part of its appeal is in its many application domains, such as text editing, computer vision, or molecular biology. Another aspect is that pattern matching has produced or incorporated some novel and powerful algorithmic techniques. We will investigate various pattern matching problems with particular emphasis on the techniques employed for their solutions. Prerequisite: 600.363/463 or equivalent. [Analysis]

Amir   3 hours

600.664 Randomized Algorithms

Similar material as 600.464, presented in more depth. Intended for graduate students. Students may receive

credit for 600.464 or 600.664, but not both. Pass/Fail only. Prerequisite: 600.463. [Analysis]

Kosaraju   3 hours   fall

600.666 Information Extraction from Speech and Text
Introduction to statistical methods of speech recognition (automatic transcription of speech) and understanding. The course is a natural continuation of 600.465 but is independent of it. Topics include elementary information theory, hidden Markov models, the Baum and Viterbi algorithms, efficient hypothesis search methods, statistical decision trees, the estimation-maximization (EM) algorithm, maximum entropy estimation and estimation of discrete probabilities from sparse data for acoustic and language modeling. Weekly assignments and several programming projects. Prerequisites: 550.310 or equivalent, expertise in C or C++ programming. (Co-listed with 050.666 and 520.666.) [Applications]

Khudanpur   3 hours

600.667 Advanced Distributed Systems and Networks
The course explores the state of the art in distributed systems, networks and Internet research and practice, trying to see what it would take to push the envelope a step further. The course is conducted as a discussion group, where the professor and students brainstorm and pick interesting semester-long projects with high potential future impact. Example areas include robust scalable infrastructure (distributed datacenters, cloud networking, scada systems), real-time performance (remote surgery, trading systems), hybrid networks (mesh networks, 3-4G/Wifi/Bluetooth). Students should feel free to bring their own topics of interest and ideas. Prerequisite: 600.437 or permission of instructor. [Systems]

Amir   3 hours   spring

600.671 Special Topics on Bio-Nano Computing
This course will cover nanotechnology, bio-nanotechnology, introductory structural biology, molecular bioengineering, DNA computing, molecular electronics, and related fields with a focus on the design, fabrication, use, and development of systems with molecular-scale components. Previous knowledge of chemistry or macromolecular structure is not required. The course is appropriate for graduate and advanced undergraduate students in engineering, computer science, chemistry, and information technology-related fields. This course will be in lecture and discussion format. Students will read and discuss seminal papers in the field. [Applications]

Basu   3 hours

600.681 Advanced Topics in Computer Vision
This course covers state-of-the-art methods in dynamic vision, with an emphasis on segmentation, reconstruction and recognition of static and dynamic scenes. Topics include: reconstruction of static scenes (tracking and correspondence, multiple view geometry, self calibration), reconstruction of dynamic scenes (2-D and 3-D motion sementation, nonrigid motion analysis), recognition of visual dynamics (dynamic textures, face and hand gestures, human gaits, crowd motion analysis), as well as geometric and statistical methods for clustering and

unsupervised learning, such as K-means, Expectation Maximization, and Generalized Principal Component Analysis. Applications in robotics and biomedical imaging are also included. Prerequisite: 600.461 & linear algebra or permission. [Co-listed as 580.681] [Applications]

Vidal   3 hours

600.726 Selected Topics in Programming Languages
This seminar course covers recent developments in the foundations of programming language design and implementation. Topics vary from year to year. Students will present papers orally. Prerequisite: permission of instructor.

Smith   1 hour

600.735 Selected Topics in Machine Learning
This seminar course will look at research in machine learning. Topics will be selected from those of mutual interest between students and the instructor. Sample topics include reinforcement learning, kernel methods, experimental methods in machine learning, computational learning theory, lazy learning, evolutionary computation, and neural networks. Students are expected to select papers and lead discussion. Prerequisite: permission of the instructor.

Sheppard   1 hour

600.742 Advanced Topics in Cryptography
(formerly 600.642)
This course will focus on advanced cryptographic topics with an emphasis on open research problems and student presentations. Prerequisite: 600.442 or 600.471 or permission of the instructor. [Applications]

Ateniese/Hohenberger   3 hours

600.743 Selected Topics in Systems
Weekly discussion based on current topics in the broad systems area. The goal of this effort is to expose all of us to current research and to foster greater communication and cooperation among the different groups doing research in the systems area here at Hopkins. Each student is responsible for reading the papers and participating in the discussion. Furthermore, every week one student will be responsible for creating a short presentation about the paper and leading the discussion. Prerequisite: permission of instructor.

Terzis/Burns   1 hour

600.745 Seminar in Computational Sensing and Robotics
This weekly seminar will focus on research issues in computer integrated surgery and robotics, including subjects such as medical image analysis, statistical modeling, visualization, vision/sensing, surgical planning, medical and non-medical robotics, and clinical applications. The purpose of the course is to widen the knowledge and awareness of the participants in current research in these areas, as well as to promote greater awareness and interaction between multiple research groups within the university and beyond. The format of the course is informal presentation by a pre-eminent invited speaker, followed by free discussion. (Co-listed as 520.744)

Kazanzides   1 hour

600.746 Selected Topics in Medical Image Analysis

This weekly seminar will focus on research issues in medical image analysis, including image segmentation, registration, statistical modeling, and applications. It will also include selected topics relating to medical image acquisition, especially where they relate to analysis. The purpose of the course is to provide the participants with a thorough background in current research in these areas, as well as to promote greater awareness and interaction between multiple research groups within the university. The format of the course is informal. Students will read selected papers. All students will be assumed to have read these papers by the time the paper is scheduled for discussion. Individual students will be assigned on a rotating basis to lead the discussion on particular papers or sections of papers. Co-listed in ECE as 520.746.
Taylor/Prince   1.5 hours

600.754 Selected Topics in Statistical Anatomic Models, Registration, and Reconstruction

This weekly research seminar will focus generally on statistical modeling of anatomic structures, image and model registration, 3D image reconstruction methods, and their interrelationships. We will concentrate primarily, though not exclusively, on x-ray based imaging modalities (x-ray fluoroscopy, CT, cone-beam tomography, "hybrid" reconstruction methods, etc.).
Taylor   1 hour

600.757 Selected Topics in Computer Graphics

This seminar course reviews current research in computer graphics. Prerequisite: permission of instructor.
Kazhdan   1 hour

600.758 Selected Topics in Computational Geometry

This course will provide a rapid and intense introduction to computational geometry. It will cover a number of topics in two- and three-dimensions, including polygon triangulations and partitions, convex hulls, Delaunay and Voronoi diagrams, arrangements, and spatial queries. Students will be expected to complete the assigned reading before class, and the course time will be spent on discussions and exercises.
Kazhdan   1 hour

600.761 Computer Vision Techniques for Multi-Sensor Image Fusion

With the continuing advancement of various sensor technologies, multiple imaging modalities are more often becoming simultaneously available for deriving information from the world. In medical imaging, MRI, CAT, and PET modalities can be separately used to image the same tissue, providing complementary information for visualization and diagnosis. Cameras using objective lenses are now available that image in the visible, Near-infrared, ShortWave-infrared and Thermal Infrared spectrums; in combinations of two or more modalities these can provide vastly enhanced information about the physical world. This seminar will study a variety of computer vision

techniques for both visual image fusion, such as for enhancing human visual perception beyond the visible spectrum, as well as analytic image fusion such as for enhancing the performance of automated object and face recognition. Recommended: 600.641 or equivalent.
Wolff   2 hours

600.762 Selected Topics in Visual Medical Imaging

Visual imaging is used extensively in medical applications, including endoscopy, minimally invasive surgery, and newer systems for stereo imaging and more recent techniques such as NOTES, and capsule endoscopy. This weekly seminar will focus on current research issues in visual imaging for medical applications. The purpose of the course is to allow the participants to develop a deeper understanding of the current research in methods, device, and applications of these technologies as well as to motivate interaction between research groups. Participants will select from a set of papers to summarize from a list of course papers and participate in the discussion.
Kumar   1 hour

600.765 Selected Topics in Natural Language Processing

A reading group exploring important current research in the field and potentially relevant material from related fields. Enrolled students are expected to present papers and lead discussion. Prerequisite: 600.465 or permission of instructor.
Eisner   1 hour

600.766 Selected Topics in Meaning, Translation, and Generation of Text

The weekly reading group will review current research and survey articles on the topics of computational semantics, statistical machine translation, and natural language generation. Enrolled students will present papers and lead discussions. Prerequisite: permission of instructor.
Callison-Burch, VanDurme   1 hour

600.775 Current Topics in Machine Learning

A reading group exploring current research topics in machine learning. Topics will be selected based on interests of the students and the instructor. Papers will include current research and tutorials. Our focus will be on core machine learning methods as opposed to applications. Enrolled students are expected to present papers and lead discussion. Prerequisite: 600.475 or another machine learning course suggested.
Dredze   1 hour

600.801-802 Dissertation Research

600.803-804, 874, 895 Graduate Research

Independent research for master's or pre-dissertation Ph.D. students.

600.809-810, 876, 891 Graduate Independent Study

Individual study in an area of mutual interest to a graduate student and a faculty member in the department.

Robotics Courses

This listing is provided to help graduate students with an interest in robotics choose appropriate courses for their program of study in consultation with their faculty advisor.

Biomedical Engineering

580.631 Biomechanics and Motor Control

Computer Science

600.435 Artificial Intelligence
600.445 Computer-Integrated Surgery I
600.446 Computer-Integrated Surgery II
600.452 Computer-Integrated Surgery Seminar
600.461 Computer Vision
600.630 Computer Vision Seminar
600.646 Advanced Computer-Integrated Surgery II
600.651 Haptic Systems for Teleoperation and Virtual Reality
600.681 Advanced Topics in Computer Vision
600.745 Seminar in Computational Sensing and Robotics
600.746 Selected Topics in Medical Image Analysis
600.754 Selected Topics in Statistical Anatomic Models, Registration, and Reconstruction
600.762 Selected Topics in Visual Medical Imaging

Electrical and Computer Engineering

520.353 Control Systems
520.454 Control Systems Design
520.608 Image Reconstruction and Restoration
520.621 Introduction to Nonlinear Systems

Mechanical Engineering

530.343 Design and Analysis of Dynamic Systems
530.420 Robot Actuators and Sensors
530.421 Mechatronics
530.424 Dynamics of Robots and Spacecraft
530.646 Introduction to Robotics
530.647 Adaptive Systems
530.649 Robot Motion Planning
530.651 Haptic Systems for Teleoperation and Virtual Reality

Courses in Language and Speech Processing

This listing is provided to help graduate students with an interest in language and speech processing choose appropriate courses for their program of study in consultation with their faculty advisor.

Cognitive Science

050.370/670 Formal Methods in Cognitive Science: Language
050.371/671 Formal Methods in Cognitive Science: Inference
050.372/672 Formal Methods in Cognitive Science: Neural Networks
050.317/617 Semantics I
050.320/620 Syntax I
050.321/621 Syntax II
050.325/625 Phonology I
050-327/627 Phonology II
050.333 Psycholinguistics
050.630 Topics in Language Processing

Computer Science

600.465 Introduction to Natural Language Processing
600.466 Information Retrieval and Web Agents
600.765 Selected Topics in Natural Language Processing
600.766 Selected Topics in Meaning, Translation, and Generation of Text
600.775 Current Topics in Machine Learning

Electrical and Computer Engineering

520.419 Theory and Design of Iterative Algorithms
520.447 Introduction to Information Theory and Coding
520.478 Theory and Practice of Large Vocabulary Speech Recognition
520.666 Information Extraction from Speech and Text
520.674 Information Theoretic Methods in Statistics
520.735 Sensory Information Processing

Electrical and Computer Engineering

www.ece.jhu.edu/

The Department of Electrical and Computer Engineering at Johns Hopkins is committed to providing a rigorous educational experience that prepares students for further study and successful careers, and is dedicated to research that contributes to fundamental knowledge in both analytical and experimental aspects of the field. The mission of our undergraduate programs is to provide a stimulating and flexible curriculum in fundamental and advanced topics in electrical and computer engineering, basic sciences, mathematics, and humanities, in an environment that fosters development of analytical, computational, and experimental skills and that involves students in design projects and research experiences. At the graduate level, our mission is to provide advanced training that prepares master's graduates to work at the forefront of knowledge in their chosen specialty, and prepares doctoral students for original research that will advance the frontiers of knowledge in their chosen areas.

The department focuses its teaching and research programs in three major areas: (1) systems, communications, and signal processing; (2) photonics and optoelectronics; and (3) integrated electronics and computer engineering.

The faculty offers undergraduate courses at both the introductory and intermediate levels in these areas, and graduate courses leading to research topics at the forefront of current knowledge. Guided individual study projects available for undergraduates provide opportunities for student participation in activities in the department and in the research programs of the faculty. In the graduate program, original research in close association with individual faculty members is emphasized.

The Faculty

Andreas G. Andreou, Professor: CMOS devices and integrated circuits, bioelectronics, nano-electronics, life science microsystems, natural and synthetic sensory systems, neural computation.

Frederic M. Davidson, Professor (Director of Undergraduate Programs): quantum optics, optical coherence, optical communications.

Mounya Elhilali, Assistant Professor: biological basis of sound and speech perception, neural signal processing, computational neuroscience, cognitive neuromorphic engineering.

Ralph R. Etienne-Cummings, Professor: mixed-signal VLSI, computational sensors, robotics, neuromorphic engineering.

Amy Foster, Assistant Professor: silicon photonics, nonlinear optics, nanophotonics, integrated biophotonics.

Mark Foster, Assistant Professor: ultrafast and nonlinear optics, all-optical signal processing, ultrafast phenomena and measurement, nonlinear dynamics.

John Goutsias, Professor: signal and image processing, computational systems biology, bioinformatics, modeling and analysis of complex networked systems.

Hynek Hermansky, Professor: Emulating and integrating human-like processing strategies into speech engineering systems; neural information processing; human sensory perception; speech and speaker recognition; speech coding and enhancement; and machine learning.

Pablo A. Iglesias, Professor (Director of Graduate Programs): systems biology, mathematical modeling of biological systems, control theory.

Jin U. Kang, Professor (Chair): fiber optic devices and lasers, biophotonics, optical imaging and sensing.

Alexander E. Kaplan, Professor: "extreme" nonlinear optics: super-powerful laser interactions with matter.

Sanjeev P. Khudanpur, Associate Professor: information theory, statistical language modeling.

Jacob B. Khurgin, Professor: quantum electronics, nonlinear optics.

Gerard G. L. Meyer, Professor: parallel computing, computational methods, fault tolerant computing.

Jerry L. Prince, William B. Kouwenhoven Professor: image processing and computer vision with application to medical imaging.

Danielle Tarraf, Assistant Professor: systems and control theory, with emphasis on hybrid systems; automata theory, algebra, and combinatorics as they apply in systems and control.

Trac Duy Tran, Associate Professor: filter banks, wavelets, multirate systems and applications.

Howard L. Weinert, Professor: statistical signal and image processing.

Joint, Part-Time, Visiting, and Emeritus Appointments

Paul Bottomley, Professor (Radiology): magnetic resonance imaging, metabolic MRI.

A. Brinton Cooper III, Associate Research Professor: error control coding, coded wireless and optical communication.

Noah Cowan, Associate Professor (Mechanical Engineering): robotics, computer vision and control, mobile robotics and legged locomotion, biomechanics and bio-inspired robotics.

Yamac Dikmelik, Assistant Research Scientist.

Eric Frey, Professor (Radiology): algorithms for computed tomography, small animal x-ray microcomputed tomography, quantitative PET, SPECT and nuclear medicine imaging, image evaluation, scatter compensation in SPECT, simultaneous dual isotope SPECT and Monte Carlo simulation of radiation transport.

Donald Geman, Professor (Applied Mathematics and Statistics): computer vision, computational biology, statistical learning.

Robert E. Glaser, Lecturer: advanced digital logic systems.

Willis Gore, Professor Emeritus.

Moise H. Goldstein Jr., Professor Emeritus.

Aren Jansen, Assistant Research Professor: automatic speech recognition, sparse representations and models, unsupervised/semi-supervised learning, geometric structure of speech sounds, computational modeling of speech perception, manifold learning algorithms, novel applications of machine learning techniques.

Robert E. Jenkins, Senior Lecturer: digital systems, spacecraft systems and space technology.

Richard I. Joseph, Jacob Suter Jammer Professor Emeritus.

Damianos Karakos, Assistant Research Professor: statistical methods in language and speech, information theory and statistics, digital watermarking, digital image processing.

Junghoon Lee, Assistant Research Professor: 3-D reconstruction algorithms from cone-beam projections, limited angle tomography, computer assisted surgery, computational structural biology, nonlinear optimization, statistical signal & image processing/inverse problems.

Xingde Li, Associate Professor (Biomedical Engineering): medical imaging and MRI.

Elliot R. McVeigh, Professor (Biomedical Engineering): cardiovascular MRI, image guided therapy, novel MRI methods.

Michael I. Miller, Hershel L. Seder Professor of Biomedical Engineering (Director, Center for Imaging Science): image understanding, computer vision, medical imaging, computational linguistics, computational neuroscience.

Nael Osman, Associate Professor (Radiology): image and multi-dimensional signal processing, medical imaging.

C. Harvey Palmer Jr., Professor Emeritus.

Dzung L. Pham, Associate Professor (Radiology): homeomorphic brain image segmentation, neuroanatomical atlases in MIPAV, robust tissue classification, statistical characterization of brain tissue in MRI.

Louis J. Podrazik, Lecturer: parallel computer architectures and algorithms, fault tolerant design.

Theodore O. Poehler, Research Professor: quantum electronics, solid state physics.

Philippe Pouliquen, Assistant Research Scientist: optoelectronic, mixed signal, low power VLSI, CAD tolls for VLSI.

Carey Priebe, Professor (Applied Mathematics and Statistics): computational statistics, kernel and mixture estimates, statistical pattern recognition, statistical image analysis, statistical inference for high-dimensional and graph data.

Wilson J. Rugh, Edward J. Schaefer Professor Emeritus.

Raymond Sova, Assistant Research Professor (Principal Professional Staff APL): laser communications, R-F photonics.

Kim Strohbehn, Assistant Research Professor (Principal Professional Staff APL): radiation hardened electronics.

Nitish Thakor, Professor (Biomedical Engineering): medical instrumentation, medical micro and nanotechnologies, neurological instrumentation, signal processing, and neural prosthesis.

Michael E. Thomas, Research Professor (Principal Professional Staff APL): propagation of light, applied spectroscopy and lasers.

Benjamin M. W. Tsui, Professor (Radiology): quantitative SPECT, PET and CT imaging techniques, image reconstruction methods, computer simulation tools and methods in imaging, image quality assessment, small animal SPECT, PET and CT imaging techniques.

Rene Vidal, Professor (Biomedical Engineering): computer vision (human motion, dynamic scene reconstruction, multiple view geometry, omnidirectional vision), machine learning (generalized component analysis and geometric clustering), robotics (vision-based control), control (identification of hybrid systems).

R. Jacob Vogelstein, Assistant Research Professor (Senior Professional Staff APL) VLSI: systems, neuromorphic engineering, neural prosthesis systems.

James West, Research Professor: electroacoustics, physical acoustics, and architectural acoustics.

C. Roger Westgate, Professor Emeritus.

Raimond Winslow, Professor (Biomedical Engineering): applied statistical learning, computational cell biology, cardiac electrophysiology, grid-based computing and data sharing for collaborative science.

Current Research Activities

Systems, Communications, and Signal Processing

Current research in systems and control includes the development of analysis and design techniques for nonlinear systems; optimization methods in filtering, estimation, and control; efficient implementation and analysis of iterative algorithms on specialized computing structures; design and analysis of robust linear control algorithms. There is also a significant effort in systems biology, particularly the analysis of signaling pathways in biological systems. Research in speech processing involves work in all aspects of language or speech science and technology, with fundamental studies under way in areas such as language modeling, pronunciation modeling, natural language processing, neural auditory processing, acoustic processing, optimality theory, and language acquisition. Image analysis efforts currently concern statistical analysis of restoration and reconstruction algorithms, development of statistical image models for image restoration and segmentation, geometric modeling for object detection and estimation, morphological image analysis, and magnetic resonance imaging. There is opportunity for joint work in image analysis with faculty in the Department of Radiology, School of Medicine.

Photonics and Optoelectronics

Current research activities include work in fiber optic sensors and endoscopic 3-D imaging devices for medical applications, theory of nonlinear waves, optical communications, and quantum well devices. Other areas of interest involve the study of the nonlinear interactions of light with matter and single elementary particles, X-ray sources and lasers, optical bi-stability, radiation protection, laser beam control and steering, the nonlinear optics of semiconductors, nonlinear optics of biological objects as well as research on sub-femtosecond pulses and devices based on single atoms. Semiconductor device studies include optical detectors, VLSI circuit design and modeling and microwave devices and circuits. Study of a laser radar and RF photonics is also being pursued. Theoretical and experimental studies involving linear optical properties of various materials and passive remote sensing of the atmosphere are being investigated.

Integrated Electronics and Computer Engineering

Computer engineering research activities include work on computer structures (with emphasis on microprocessors), parallel and distributed processing, fault-tolerant computing, analysis of algorithms, and VLSI analog architectures for machine vision, associative processing, and micropower computing.

Facilities

The department maintains extensive facilities for teaching and research in Barton Hall and Hackerman Hall. The two main teaching labs (Electrical Engineering Lab and Computer Engineering Lab) make extensive use of state-of-the-art design environments such as CADENCE, Xilinx Tools, TI DSP systems, VHDL, and Verilog. In addition, the department includes the computational sensory motor system lab, the cellular signaling control lab, the parallel computing and imaging lab, the photonics and optoelectronics lab, the semiconductor microstructures lab, and the sensory communication and microsystem lab, adaptive and the sensory communication microsystem lab.

Undergraduate Programs

The Department of Electrical and Computer Engineering offers two bachelor's degree programs: one in Electrical Engineering and one in Computer Engineering (with the close collaboration of the Computer Science Department). Each program is described below.

Bachelor of Science in Electrical Engineering Mission and Educational Objectives

The faculty of the Electrical Engineering Program at Johns Hopkins is committed to providing a rigorous educational experience that prepares students for further study and to professionally and ethically practice engineering in a competitive global environment. The mission of the program is to provide a stimulating and flexible curriculum in fundamental and advanced topics in electrical engineering, basic sciences, mathematics, and humanities, in an environment that fosters development of analytical, computational, and experimental skills and that involves students in design projects and research experiences; and to provide our electrical engineering graduates with the tools, skills and competencies necessary to understand and apply today's technologies and become leaders in developing and deploying tomorrow's technologies.

The Electrical Engineering Program's educational objectives are to educate students to prepare them for what graduates are expected to attain within a few years of graduation. In these endeavors, they will:

- apply their understanding of the fundamental scientific, engineering, and professional principles at the foundation of electrical engineering.

- apply advanced mathematical, computational and experimental techniques to respond to technological demands.

- contribute to society as broadly educated, articulate, and ethical citizens who are at ease in multidisciplinary teams.

Students graduating with a B.S. in electrical engineering will have demonstrated the ability to:

- understand calculus and discrete mathematics, probability and statistics, basic science, and computer science, and apply this knowledge to electrical engineering disciplines.

- design, conduct, evaluate and report experiments, including analysis and statistical interpretation of data.

- identify, formulate and solve electrical engineering problems.

- use basic concepts and modern engineering tools (laboratory instrumentation and computer hardware and software) to design electrical engineering systems, components and processes to meet specifications.

- communicate effectively and work on multidisciplinary teams.

- be aware of professional and ethical responsibilities, and contemporary issues, and appreciate the societal, economic, and environmental impacts of engineering.

- enter professional practice or graduate school with a set of skills to be successful.

Each student and faculty advisor must consider these objectives in planning a set of courses and projects that will satisfy degree requirements. The sample programs and the program checklist are provided in a separate advising manual and illustrate course selections that will help students meet the program objectives.

Faculty and others will assess student performance to ensure that our educational objectives are met. Students will have opportunities to assess their own educational progress and achievements in several ways, including exit interviews and alumni surveys. Through regular review processes, including Academic Council departmental reviews, visits by the departmental external advisory board, course evaluations, and ABET visits, students will have opportunities to discuss their educational experiences and expectations. The outcomes of these assessment processes will be used by the faculty to improve the content and delivery of the educational program.

The success of each student's program will depend on effective faculty advising. Every undergraduate student in the Electrical Engineering Program must follow a program approved by the faculty advisor. The faculty advisor must be a member of the Electrical and Computer Engineering faculty.

Requirements for the Bachelor of Science in Electrical Engineering

The Bachelor of Science degree in electrical engineering requires a minimum of one hundred and twenty-six (126) credits that must include:

- *Forty-five (45) credits of ECE courses* including Circuits (520.213), Signals and Systems (520.214), Fields, Matter and Waves I (520.219), one (1) introductory laboratory course (520.345, 520.349, or 520.372), and at least twelve (12) credits of advanced laboratory, design intensive, or senior design project courses from those given in the degree planning checklist. Up to six (6) credits of computer science courses may be used to satisfy the 45-credit requirement. A GPA of at least 2.0 must be maintained in ECE courses. Courses in this group may not be taken Pass/Fail.

- *Six (6) credits of engineering courses from School of Engineering departments other than ECE or Applied Mathematics and Statistics or General Engineering.* Students must complete enough of the approved non-ECE advanced design labs so that they have at least twelve (12) credits of combined ECE and non-ECE advanced laboratory, design intensive, or senior design project courses. Courses in this group may not be taken Pass/Fail.

- *Twenty (20) credits of mathematics courses taken from the Mathematics Department or the Applied Mathematics and Statistics Department.* Students must take Calculus II (110.109), Calculus III (110-202), Linear Algebra (110.201), Differential Equations (110.302), and Probability and Statistics (550.310/311) or Introduction to Probability (550.420). Courses in this group may not be taken Pass/Fail. Elementary or precalculus courses such as 110.105 or 550.111-112 are not acceptable. (Calculus I may be waived through an examination taken during freshman orientation. If not waived, it must be taken as a prerequisite to Calculus II.)

- S*ixteen (16) credits of basic sciences* (physics, chemistry, biology, earth and planetary sciences), which must include General Physics (171.101-102), General Physics Laboratory (173.111-112), and Introductory Chemistry (030.101). Courses in this group may not be taken Pass/Fail.

- *At least six (6), three-credit courses in humanities and social sciences.* The humanities and social sciences courses are one of the strengths of the academic programs at Johns Hopkins. They represent opportunities for students to appreciate some of the global and societal impacts of engineering, to understand contemporary issues, and to exchange ideas with scholars in other fields. Some of the courses will help students to communicate more effectively, to understand economic issues, or to analyze problems in an increasingly international world. The selection of courses should not consist solely of introductory courses, but should have both depth and breadth. Typically, this means that students should take at least three (3) courses in a specific area with at least one of them at an advanced level.
- A programming language requirement must be met by taking Introduction to Programming in Java (600.107) or Intermediate Programming (600.120).
- *Two (2) writing intensive (W) courses* (at least 3 credits each) are required. The writing intensive courses may not be taken Pass/Fail and require a C- or better grade. Students may wish to consider a course in Technical Communications to fulfill one of the W requirements.

Additional details concerning advising and degree requirements are in the *Electrical Engineering Advising Manual.* The B.S. in electrical engineering is accredited by the Engineering Commission of the Accreditation Board for Engineering and Technology (ABET).

The sample program shown has an emphasis on systems and communications aspects of electrical engineering. Other sample programs can be found in the advising manual.

Freshman Year (30 credits)

110.108-109	Calculus I, II	8
171.101-102	Physics I, II	8
173.111-112	Physics Lab I, II	2
520.137	Intro to ECE	3
520.142	Digital System Fundamentals	3
	H/S Electives	6
	Total	30

Sophomore Year (34 credits)

110.202	Calculus III	4
110.201	Linear Algebra	4
030.101	Chemistry I	3
520.213	Circuits	4
520.214	Signals and Systems	4
520.219	Fields, Matter & Waves I	3
600.107	Intro to Programming in Java	3

520.216	Intro to VLSI	3
	H/S Electives	6
	Total	34

Junior Year (32 credits)

110.302	Differential Equations with Applications	4
550.310	Probability and Statistics for the Physical and Information Sciences and Engineering	4
520.372	Programmable Device Lab	3
520.345	ECE Laboratory	3
	Basic Science Elective	3
520.353	Control Systems	3
	Non-ECE/MathSci Engineering Elective	3
	Elective	3
	H/S Electives	6
	Total	32

Senior Year (31 credits)

520.498-499	Senior Design Project	6
520.435	Digital Signal Processing	4
	ECE Signals/Systems/Comm. Electives	6
	ECE Advanced Lab/Design Elective	6
	Elective	3
	Non-ECE/MathSci Engineering Electives	6
	Total	31

Bachelor of Science in Computer Engineering Mission and Educational Objectives

The Computer Engineering Program at Johns Hopkins is supported by faculty in the Department of Electrical and Computer Engineering and the Department of Computer Science, who are committed to providing a rigorous educational experience that prepares students for further study and to professionally and ethically practice engineering in a competitive global environment. The mission of the program is to provide students with a broad, integrated education in the fundamentals and advanced topics in computer engineering, basic sciences, mathematics, and humanities in an environment that fosters the development of analytical, computational, and experimental skills, and that involves students in design projects and research experiences; and to provide our computer engineering graduates with the tools, skills and competencies necessary to understand and apply today's technologies and become leaders in developing and deploying tomorrow's technologies.

From this mission statement, the Computer Engineering faculty has determined educational objectives for the B.S. in Computer Engineering Program. Consistent with Johns Hopkins' longstanding emphasis on the individual, the Computer Engineering program will provide a high-quality

educational experience that is tailored to the needs and interests of each student. In addition, each student's program of study is planned in consultation with a faculty advisor to educate students to prepare them for what graduates are expected to attain within a few years of graduation. In these endeavors, they will:

- apply their understanding of the fundamental scientific, engineering, and professional principles at the foundation of computer engineering.
- apply advanced mathematical, computational and experimental techniques to respond to technological demands.
- contribute to society as broadly educated, articulate, and ethical citizens who are at ease in multidisciplinary teams.

Students graduating with a B.S. in computer engineering will have demonstrated the ability to

- understand calculus and discrete mathematics, probability and statistics, basic science, and computer science, and apply this knowledge to computer engineering disciplines.
- design, conduct, evaluate and report experiments, including analysis and statistical interpretation of data.
- identify, formulate and solve computer engineering problems.
- use basic concepts and modern engineering tools (laboratory instrumentation and computer hardware and software) to design computer engineering systems, components and processes to meet specifications.
- communicate effectively and work on multidisciplinary teams.
- be aware of professional and ethical responsibilities, and contemporary issues, and appreciate the societal, economic, and environmental impacts of engineering.
- enter professional practice or graduate school with a set of skills to be successful.

Each student and faculty advisor must consider these objectives in planning a set of courses and projects that will satisfy degree requirements. The sample programs and the program checklist included in this advising manual illustrate course selections that will help students meet the program objectives.

Faculty and others will assess student performance to ensure that our educational objectives are met. Students will have opportunities to assess their own educational progress and achievements in several ways, including exit interviews and alumni surveys. Through regular review processes,

including Academic Council departmental reviews, visits by the departmental external advisory board, course evaluations, and ABET visits; students will have opportunities to discuss their educational experiences and expectations. The outcomes of these assessment processes will be used by the faculty to improve the content and delivery of the educational program.

The success of each student's program will depend on effective faculty advising. Every undergraduate student in the Computer Engineering Program must follow a program approved by a faculty advisor.

Requirements for the Bachelor of Science in Computer Engineering

The Bachelor of Science degree in computer engineering requires a minimum of 126 credits, which must include the following:

- *Forty-two (42) credits in Computer Engineering,* which must include:

  a. *Fifteen (15) credits of Electrical and Computer Engineering courses,* which must include Digital System Fundamentals (520.142), and Circuits (520.213).

  b. *Fifteen (15) credits of Computer Science courses* which must include Intermediate Programming (600.120), Data Structure (600.226) and Computer System Fundamentals (600.333).

  c. *The program must also contain a substantial advanced laboratory and design experience component, appropriate for the student's interests.* This requirement can be met by taking twelve (12) credits of advanced laboratory, design intensive, or senior design project courses from those given in the degree planning checklist. At least six (6) of these 12 credits must be from ECE or CS courses. A GPA of at least 2.0 must be maintained in Computer Engineering courses. Courses in this category may not be taken Pass/Fail.

- *Six (6) credits of engineering courses from School of Engineering departments other than Computer Science, ECE, Applied Mathematics and Statistics, or General Engineering.* Students must complete enough of the approved non-CS/ECE advanced design labs so that they have at least twelve (12) credits of advanced laboratory, design intensive, or senior design project courses. Courses in this group may not be taken Pass/Fail.

- *Twenty-four (24) credits in mathematics courses taken from the Mathematics Department or the Applied Mathematics and Statistics Department.* Calculus

II (110.109), Calculus III (110.202), Linear Algebra (110.201) or Linear Algebra and Differential Equations (550.291), Discrete Mathematics (550.171), Probability and Statistics (550.310/311) or Introduction to Probability (550.420) must be taken. Elementary or precalculus courses such as 110.105 or 550.111-112 are not acceptable. (Calculus I may be waived through an examination taken during freshman orientation. If not waived, it must be taken as a prerequisite to Calculus II.) Courses in this category may not be taken Pass/Fail.

- *Sixteen (16) credits of basic sciences* (physics, chemistry, biology, earth and planetary sciences), which must include General Physics (171.101-102), General Physics Laboratory (173.111-112), and Introductory Chemistry (030.101). Courses in this category may not be taken Pass/Fail.

- *At least six (6) three-credit courses in humanities and social sciences.* The humanities and social sciences courses are one of the strengths of the academic programs at Johns Hopkins. They represent opportunities for students to appreciate some of the global and societal impacts of engineering, to understand contemporary issues, and to exchange ideas with scholars in other fields. Some of the courses will help students to communicate more effectively, to understand economic issues, or to analyze problems in an increasingly international world. The selection of courses should not consist solely of introductory courses but should have both depth and breadth. Typically, this means that students should take at least three (3) courses in a specific area with at least one of them at an advanced level.

- *At least two (2) writing intensive (W) courses are required (at least 3 credits each).* These courses may not be taken Pass/Fail and require a grade of C- or better. Students may wish to consider a course in Technical Communications to fulfill one of the W requirements.

Additional details concerning advising and degree requirements are in the *Computer Engineering Advising Manual*. The B.S. in computer engineering is accredited by the Engineering Commission of the Accreditation Board for Engineering and Technology (ABET).

The sample program shown has an emphasis on hardware/device aspects of computer engineering. Other sample programs can be found in the advising manual.

Freshman Year (30 credits)

110.108-109 Calculus I, II	8
171.101-102 Physics I, II	8
173.111-112 Physics Lab I, II	2
520.137 Intro to ECE	3
520.142 Digital Systems Fundamentals	3
600.107 Intro to Programming in Java	3
H/S Elective	3
Total	30

Sophomore Year (35 credits)

110.202 Calculus III	4
550.291 Linear Algebra and Differential Equations	4
030.101 Intro to Chemistry	3
600.226 Data Structures	3
520.213 Circuits	4
520.214 Signals and Systems	4
520.216 Intro to VLSI	3
600.271 Automata and Computation Theory	3
600.120 Intermediate Programming C/C++	4
H/S Elective	3
Total	35

Junior Year (32 credits)

550.171 Discrete Math	4
600.318 Operating Systems	4
600.334 Laboratory for Computer System Fundamentals	3
600.333 Computer System Fundamentals	3
520.372 Programmable Device Lab	3
520.345 ECE Lab	3
Science Elective	3
520.349 Microprocessor Laboratory	3
H/S Elective	6
Total	32

Senior Year (31 credits)

550.310 Intro to Probability and Statistics	4
520.448 Electronic Design Laboratory	3
520.491 CAD of Digital VLSI Systems	3
520.492 Mixed Signal VLSI Systems	3
520.495 Microfabrication Lab	3
520.424 FPGA Synthesis Lab	3
Non-ECE/ECE/MathSci Engineering Electives	6
H/S Elective	6
Total	31

Bachelor of Arts Degree

To meet the requirements for the B.A. degree, the program must include:

- *Eighteen (18) credits of humanities and social sciences courses.*

- *Four writing intensive (W) courses.*

- *Twenty (20) credits of mathematics or mathematical statistics courses.* Typically these include Calculus I (110.108), Calculus II (110.109), and Calculus III (110.202) or equivalent, and Linear Algebra (110.201). Elementary or pre-calculus courses such as 110.105 or 550.111-112 are not acceptable.

- *Thirty (30) credits of ECE courses.* Three credits of computer science courses may be counted toward this 30-credit requirement.

- *Additional credits* giving a total of at least 120 credits.

- Additional information on academic policies and degree requirements, including academic ethics, may be found in the *Undergraduate Academic Manual* of The Johns Hopkins University. Students are urged to read the credit requirements, under the credit requirements section, in the academic manual section of the Compendium.

The student should be aware that the B.A. degree program *is not accredited by the Accreditation Board for Engineering and Technology (ABET)*.

Minor in Robotics

A minor in Robotics is offered by the Laboratory for Computational Sensing and Robotics. Detailed information regarding this program can be found at: https://lcsr.jhu.edu/Robotics_Minor.

Minor in Computer-Integrated Surgery

A minor in Computer-Integrated Surgery is offered by the Department of Computer Science. Detailed information regarding this program can be found at: https://lcsr.jhu.edu/Education/Undergraduate/CISminor.

Bachelor's/Master's Program

At the end of their sophomore year, students who are majors in electrical and computer engineering may apply for admission to a concurrent bachelor's/master's program which combines a B.S. in electrical engineering with a master of science in engineering. If accepted, they must take at least two courses per semester that satisfy the requirements of the M.S.E. program.

Graduate Programs

Every graduate student in the Department of Electrical and Computer Engineering must follow a program approved by a faculty advisor in the department. The advisor assigned to the student upon admission may be changed, subject to the approval of the new advisor. Additional details are in the department's *Graduate Student Advising Manual.*

Requirements for the M.S.E. Degree

The department has M.S.E. degree programs for both full-time and part-time students. A student who has completed a program of study similar to that required for the B.S. in electrical engineering degree must complete the following requirements for the M.S.E. degree:

- At least eight one-semester graduate-level courses approved by the student's advisor.

- One of the following: (1) an original master's essay, (2) a special project report, or (3) two additional one-semester graduate courses.

Ph.D. in Electrical and Computer Engineering

The department admits students into the Ph.D. program directly. Most students working toward the Ph.D. degree are full-time, although a part-time program can be arranged subject to the university residency requirement. A guiding principle behind the department's requirements for the Ph.D. degree is that performance in research, as distinct from course work, should be the primary criterion for assessing the student's progress.

Requirements for the Ph.D. Degree

University requirements for the Ph.D. degree are listed under Academic Information for Graduate Students (see page 51). In addition, the department requires satisfactory completion of the Ph.D. departmental examination and the university Graduate Board oral examination, preparation of a preliminary research proposal, a departmental seminar presentation, and an oral dissertation defense.

The departmental examination is offered twice yearly. Each faculty member prepares a set of questions, and the student must select and complete the sets of questions of three faculty members. This examination must be passed before the beginning of the fifth semester of full-time graduate study. After passing the examination, the student can be accepted by a faculty member who will oversee the student's research. This research sponsor then guides the remainder of the student's program leading to the Ph.D. degree.

The university Graduate Board oral examination is administered by a panel consisting of the

research sponsor, another faculty member in Electrical and Computer Engineering, and three faculty members from other departments. This examination must be taken within one year of passing the departmental examination.

In the course of research leading to the Ph.D. degree, the student must submit a preliminary research proposal to the department, and present a departmental seminar. Finally, a public dissertation defense will be conducted before a panel of readers consisting of at least three Electrical and Computer Engineering faculty members. Further details concerning M.S.E. and Ph.D. degree requirements are published in a manual for graduate students in Electrical and Computer Engineering.

Financial Aid

Financial aid is available for candidates of high promise. Teaching assistantships normally consist of a stipend commensurate with the teaching or grading duties assigned. Research assistantships are available on sponsored research projects directed by members of the faculty.

Undergraduate Courses

520.137 (E,Q) Introduction to Electrical and Computer Engineering
An introductory course covering the principles of electrical engineering including sinusoidal wave forms, electrical measurements, digital circuits, and applications of electrical and computer engineering. Laboratory exercises, the use of computers, and a design project are included in the course. Open to freshman Engineering majors and any Arts and Sciences majors.
Tran   3 credits   fall

520.142 (E,Q) Digital System Fundamentals
Number systems and computer codes, switching functions, minimization of switching functions, Quine-McCluskey method, sequential logic, state tables, memory devices, analysis and synthesis of synchronous sequential devices.
Meyer   3 credits   spring

520.211-212 (E) ECE Engineering Team Project
This course introduces the student to the basics of engineering team projects. The student will become a member of and participate in the different aspects of an ECE team project over several semesters. (Freshmen and Sophomores).
Kang   1 credit

520.213 (E,Q) Circuits
An introductory course on electric circuits covers analysis techniques in time and frequency domains, transient and steady state response, and operational amplifiers. Prerequisites: Differential and Integral Calculus 110.108-109.
Weinert   4 credits   fall, summer

520.214 (E,Q) Signals and Systems
An introduction to discrete-time and continuous-time signals and systems covers representation of signals and linear time-invariant systems and Fourier analysis. Prerequisites: Calculus III 110.202 and Circuits 520.213.
Cooper   4 credits   spring;
Weinert   4 credits   summer

520.216 (E) Introduction to VLSI
This course teaches the basics of switch-level digital CMOS VLSI design. This includes creating digital gates using MOS transistors as switches, laying out and simulating a design using CAD tools, and checking the design for conformance to the Scalable CMOS design rules. Prerequisite: 520.142 and 520.213.
Pouliquen   3 credits   spring

520.219-220 (E) Fields, Matter, and Waves
Vector analysis, electrostatic fields in vacuum and material media, stationary currents in conducting media, magnetostatic fields in vacuum and material media. Maxwell's equations and time-dependent electric and magnetic fields, electromagnetic waves and radiation, transmission lines, wave guides, applications. Prerequisites: 110.108-109, 171.101-102. Corequisite: 110.202.
Kaplan   3 credits

520.222 Computer Architecture
A study of the structure and organization of classical von Neuman computers. Topics include a brief history of modern machines starting from the Turing computer model, instruction sets, addressing, RISC versus CISC, traps and interrupts, twos complement arithmetic, multiplication via Booth's algorithm, Carry Save Adders, control unit design, microprogramming, memory systems, virtual memory and paging, cache hardware, cache organization and replacement policies, segmentation, dynamic versus static linking. Prerequisite: 520.142.
Jenkins   3 credits   fall

520.315 Intro to Information Processing of Sensory Signals
An introductory course covering basic concepts of information processing of sensory communication signals (sounds, images,..) in living organisms and by machine. Prerequisites: 520.214 (or 580.222) or consent of the Instructor.
Hermansky   3 credits

ECE 520.326 (E) Introduction to Optical Instrumentation

This course is intended to serve as an introduction to optics and optical instruments that are used in engineering, physical, and life sciences. The course covers first basics of ray optics with the laws of refraction and reflection and goes on to description of lenses, microscopes, telescopes, and imaging devices. Following that basics of wave optics are covered, including Maxwell equations, diffraction and interference. Operational principles and performance of various spectrometric and interferometric devices are covered including both basics (monochromatic, Fabry-Perot and Michelson interferometers), and advanced techniques of near field imaging, laser spectroscopy, Fourier domain spectroscopy, laser Radars and others.

Khurgin   3 credits   fall

520.345 (E) Electrical and Computer Engineering Laboratory

This course consists of 11 one-week laboratory experiments intended to provide an introduction to analog and digital circuits commonly used in engineering. Topics include phase and frequency response, transistors, operational amplifiers, filters, and other analog circuits. The experiments are done using computer controlled digital oscilloscopes, function generators, and power supplies. Prerequisites: 171.101-102, 520.213.

Kang   3 credits   fall

520.349 (E) Microprocessor Laboratory

This course introduces the student to the programming of microprocessors at the machine level. 68HC08, 8051, and eZ8 microcontrollers are programmed in assembly language for embedded control purposes. The architecture, instruction set, and simple input/output operations are covered for each family. Upon completion, students can use these flash-based chips as elements in other project courses. Prerequisites: 520.142 or equivalent; programming competence in a high-level language such as C.

Glaser   3 credits   fall

520.353 (E,Q) Control Systems

Modeling and analysis of feedback control systems, with emphasis on SISO LTI systems. Topics include state equation and transfer function representations, stability, performance, root locus, and frequency response methods (Nyquist, Bode). Introduction to state-space methods including solutions of state-space equations, reachability and observability. Prerequisites: 520.214 and 110.201 or 550.291.

Tarraf   3 credits   fall

520.372 (E) Programmable Device Laboratory

The use of programmable memories (ROMs, EPROMs, and EEPROMs) as circuit elements (as opposed to storage of computer instructions) is covered, along with programmable logic devices (PALs and GALs). These parts permit condensing dozens of standard logic packages (TTL logic) into one or more off-the-shelf components. Students design and build circuits using these devices with the assistance of CAD software. Topics include programming

EEPROMs; using PLDs as address decoders; synchronous sequential logic synthesis for PLDs; and PLD-based state machines. Prerequisites: 520.142 and 520.345.

Glaser   3 credits   spring

520.391 (E) CAD of Digital VLSI Systems

An introductory course in which students, manually and through computer simulations, design digital CMOS integrated circuits and systems. The design flow covers transistor, physical, and behavioral level descriptions, using SPICE, Layout, and VerilogHD1 VLSI CAD tools. After design computer verification, students can fabricate and test their semester-long class projects. Prerequisites: 520.142, 520.216, or equivalent. Recommended: 600.333, 600.334, 520.349 or 520.372. Class limited to 20 juniors.

Etienne-Cummings   3 credits   fall.

520.401 (E) Basic Communication

This course covers the principles of modern analog and digital communication systems. Topics include amplitude modulation formats (DSB, SSC VSB), exponential modulation formats (PM, FM), superheterodyne receivers, digital representation of analog signals, sampling theorem, pulse code modulation formats (PCM, DPCM, DM, spread-spectrum), signals with additive Gaussian noise, maximum likelihood receiver design, matched filtering, and bit error rate analyses of digital communication systems. Basic concepts will be reinforced through system simulation using TIMS hardware experiments. Prerequisite: 520.214.

Davidson   3 credits   fall

520.407 (E) Introduction to the Physics of Electronic Devices

This course is designed to develop and enhance the understanding of the basic physical processes taking place in the electronic and optical devices and to prepare students for taking classes in semiconductor devices and circuits, optics, lasers, and microwaves devices, as well as graduate courses. Both classical and quantum approaches are used. Specific topics include theory of molecular bonding; basics of solid state theory; mechanical, transport, magnetic, and optical properties of the metals; semiconductors; and dielectrics. Prerequisites: 171.101-102, 520.219.

Khurgin   3 credits   fall

520.410 (E) Fiber Optics and Devices

This course covers light propagation in fiber optic light guides, integrated optic wave guides, photodetectors, and the photon nature of light. Topics include light propagation in step-index and graded-index optical fibers, dielectric slab waveguides, photodetectors, photon shot noise, and photodetector signal-to-noise ratios. Prerequisites: 520.214, 520.219-220 or equivalent.

Kang   3 credits   spring

520.414 (E) Image Processing and Analysis I

The course covers fundamental methods for the processing and analysis of images and describes standard and modern techniques for the understanding of images by humans and computers. Topics include elements of

visual perception, sampling and quantization, image transforms, image enhancement, color image processing, image restoration, image segmentation, and multiresolution image representation. Laboratory exercises demonstrate key aspects of the course. Prerequisite: 520.214.

Goutsias   3 credits   fall

520.415 (E) Image Processing and Analysis II

This course is a continuation of 520.414. It covers fundamental methods for the processing and analysis of images and describes standard and modern techniques for the understanding of images by humans and computers. This second part focuses on nonlinear techniques for image processing and analysis, and more specifically techniques based on Mathematical Morphology. Prerequisite: 520.414.

Goutsias   3 credits   spring

520.419 (E,Q) Theory and Design of Iterative Algorithms

An introduction to the study of the structure, behavior, and design of iterative algorithms. Topics include problem formulations, algorithm description and classification, the deterministic iterative (DI) schema, doubling schema, cluster point sets, periodic points, DI schemas without stop rule, the monotonic DI schema, contractive and affine maps, bounded and Cauchy sequences, asymptotically regular sequences, monotonic sequences. Prerequisites: 110.201, 110.202.

Meyer   3 credits   fall

520.420 (E,Q) Theory & Design of Iterative Algorithms II

This course is a continuation of EN.520.419. It covers information on the non-deterministic schema and cyclic iterative schemas, Jacobians, Hessians and Mean Value Theorems, spectral norm, convex sets, positive definite matrices. Prerequisite: 520.419.

Meyer   3 Credits   spring

520.422 (E) Computer Architecture

A study of the structure and organization of classical von Neuman uniprocessor computers. Topics include a brief history of modern machines starting from the Turing computer model, instruction sets, addressing, RISC versus CICS, traps and interrupt handling, twos complement arithmetic, adders and ALUs, CSA's Booth's algorithm, multiplication and division, control unit design, microprogramming, dynamic versus static linking, memory systems and the memory hierarchy, paging segmentation, cache hardware, cache organizations, and replacement policies. Prerequisite: 520.213.

Jenkins   3 credits   fall

520.424 (E,Q) FPGA Synthesis Laboratory

An advanced laboratory course in the application of FPGA technology to information processing, using VHDL synthesis methods for hardware development. The student will use commercial CAD software for VHDL simulation and synthesis, and implement their systems in programmable XILINX FPGA chips. The lab will consist of a series of digital projects demonstrating VHDL design

and synthesis methodology, building up to final projects at least the size of an 8-bit RISC computer. Projects will encompass such things as system clocking, flip-flop registers, state-machine control, and arithmetic. The students will learn VHDL methods as they proceed through the lab projects, and prior experience with VHDL is not a prerequisite. Prerequisites: 520.142, 520.345, 520.349 or 520.372, 600.333-334 or 520.422 or equivalent advanced competence in digital systems.

Jenkins   3 credits   fall

520.425 (E) FPGA Projects Laboratory

Laboratory course for FPGA based senior projects. Students will work in teams to complete a design project that makes use of embedded FPGAs. The projects will make use of the Spartan2 XSA boards and other resources from the FPGA Synthesis lab course. Possible projects include a 16 or 32 bit RISC processor with student designed ISA architecture, assembler, and mini operating system; or a Spartan2 emulation of an existing microprocessor such as an 8051, an optical communication system to transmit stereo music using various modulation schemes for comparison (this would include FM or AM and at least one digital scheme such as FSK); or a digital receiver for commercial AM or FM radio. Students are expected to complete a demonstration and produce a poster session final report. Prerequisites: 520.424 and senior status, no exceptions.

Jenkins   3 credits   spring

520.427 (E) Product Design Laboratory

This project-based course is designed to help students learn how to turn their ideas into commercial products. In the first half of the course, emphasis will be placed on the product development process: student teams will gradually build up a complete "contract book" including a mission statement, competitive analysis, patent review, product specifications, system architecture, economic analysis, development schedule, etc. In the second half of the course, each team will be expected to implement its design and demonstrate a prototype of their product's core functionality. At the end of the semester, a final written report will be submitted in the form of a utility patent. Students are encouraged to take this course in conjunction with Electronic Design Lab (ECE 520.448) in the Spring semester and leverage the groundwork developed here to enable production of a fully functional and marketable prototype by the end of the academic year.

Etienne-Cummings/Vogelstein   3 credits   fall

520.429 (E) Principles of Parallel Programming

Programming models and languages for current computing platforms. Computational models include shared and distributed memory multiprocessors. Essential techniques of message-passing parallel programming will be based upon MPI (Message Passing Interface); shared memory programming will use the OpenMP standard. Other parallel language extensions will be studied, including Split-C and UPC (unified parallel C). Programming projects will be given for the IBM SP parallel computer and other available departmental multicomputers. Prerequisite:

520.428 Introduction to Algorithms for Parallel Computers and proficiency in programming in the C language.
Podrazik   3 credits   spring

520.432 (E) Medical Imaging Systems
An introduction to the physics, instrumentation, and signal processing methods used in general radiography, Xray computed tomography, ultrasound imaging, magnetic resonance imaging, and nuclear medicine. The primary focus is on the methods required to reconstruct images within each modality, with emphasis on the resolution, contrast, and signal-to-noise ratio of the resulting images. Prerequisite: 520.214. Co-listed as 580.472.
Prince   3 credits   spring

520.433 (E) Medical Image Analysis
This course covers the principles and algorithms used in the processing and analysis of medical images. Topics include, interpolation, registration, enhancement, feature extraction, classification, sementation, quantification, shape analysis, motion estimation, and visualization. Analysis of both anatomical and functional images will be studied and images from the most common medical imaging modalities will be used. Projects and assignments will provide students experience working with actual medical imaging data. Prerequisites: 520.432 or 580.472 (Medical Imaging Systems), 550.310 or 550.311 (Probability and Statistics).
Prince   3 credits   fall

520.434 (E) Modern Biomedical Imaging Instrumentation and Techniques
An intermediate biomedical imaging course covering modern biomedical imaging instrumentation and techniques as applied to diagnostic radiology and other biomedical applications. It includes recent advances in various biomedical imaging modalities, multi-modality imaging and molecular imaging. The course is team taught by experts in the respective fields and provides a broad based knowledge of modern biomedical imaging to prepare students for graduate studies and research in biomedical imaging. Also, the course will offer tours and practical experience with modern biomedical imaging equipments in clinical and research settings. Prerequisites: 520.432 or 580.472 (Medical Imaging Systems).
Tsui and Staff   3 credits   spring

520.435 (E) Digital Signal Processing
Methods for processing discrete-time signals. Topics include signal and system representations, z-transforms, sampling, discrete Fourier transforms, fast Fourier transforms, digital filters. Prerequisite: 520.214.
Weinert   4 credits   fall, summer

520.443 (E) Digital Multimedia Coding and Processing
An introduction to the coding and processing of digital multimedia. The course covers current popular techniques for processing, storage, and delivery of media such as speech, audio, images and video. The emphasis will be on the theoretical basis as well as efficient implementations. Topics include transform and subband coding, motion estimation and compensation, international compression standards (AC3, JPEG, MPEG, H.263, HDTV), and emerging techniques. Prerequisites: 520.435, C/C++ programming and Matlab are required.
Tran   3 hours

520.445/580.445 (E) Introduction to Speech and Audio Processing
This course gives a foundation in current audio and speech technologies, and covers techniques for sound processing by humans and machines. Topics include fundamentals of signal processing and pattern recognition, acoustics, auditory perception, speech production and synthesis, speech estimation. The course will explore applications of speech and audio processing in human computer interfaces such as speech recognition, speaker identification, coding schemes (e.g. MP3), music analysis, noise reduction.
Elhilali   3 credits   fall

520.447 (E,Q) Introduction to Information Theory and Coding
This course will address some basic scientific questions about systems that store or communicate information. Mathematical models will be developed for (1) the process of error-free data compression leading to the notion of entropy, (2) data (e.g., image) compression with slightly degraded reproduction leading to rate-distortion theory and (3) error-free communication of information over noisy channels leading to the notion of channel capacity. It will be shown how these quantitative measures of information have fundamental connections with statistical physics (thermodynamics), computer science (string complexity), economics (optional portfolios), probability theory (large deviations), and statistics (Fisher information, hypothesis testing). Prerequisite: 550.310.
Staff   3 credits   fall

520.448 (E) Electronics Design Laboratory
An advanced laboratory course in which teams of students design, build, test, and document application specific information processing microsystems. Semester long projects range from sensors/actuators, mixed signal electronics, embedded microcomputers, algorithms and robotics system design. Demonstration and documentation of projects are important aspects of the evaluation process. Prerequisites: 520.216, 520.345 or equivalent. Recommended: 600.333, 600.334, 520.349, 520.372, 520.490 or 520.491.
Staff   3 credits   spring

520.450 (E) Advanced Microprocessor Laboratory
This course covers the usage of common microcontroller peripherals. Interrupt handling, timer operations, serial communication, digital to analog and analog to digital conversions, and flash ROM programming are done on the 68HC08, 8051, and eZ8 microcontrollers. Upon completion, students can use these flash-based chips as elements in other project courses. Prerequisite: 520.349 Microprocessor Laboratory.
Glaser   3 credits   spring

520.452 (E) Advanced ECE Engineering Team Project

This course introduces the student to running an ECE engineering team project. The student will participate in the team project as a leading member and is expected to manage both the team members and the different aspects of the project over several semesters. (Juniors and Seniors).

Kang   3 credits

520.454 (E,Q) Control Systems Design

Classical and modern control systems design methods. Topics include formulation of design specifications, classical design of compensators, state variable and observer based feedback. Computers are used extensively for design, and laboratory experiments are included. Prerequisites: 520.353, 110.201.

Iglesias   3 credits   spring

520.457 (E,Q) Basic Quantum Mechanics for Engineers

Basic principles of quantum mechanics for engineers. Topics include the quantum theory of simple systems, in particular atoms and engineered quantum wells, the interaction of radiation and atomic systems, and examples of application of the quantum theory to lasers and solid-state devices. Prerequisites: 171.101-102, 520.219-220.

Kaplan   3 credits   fall

520.465 (E) Digital Communications I

This course is a continuation of 520.401, Basic Communications. The course will focus on optimal and suboptimal receivers for a variety of digital modulation formats corrupted by AWGN and transmitted through band-limited channels. The emphasis will be on M-ary digital formats using amplitude, phase, and frequency modulation. Fading channels and simple error correction coding will be included. Basic concepts will be reinforced through system simulation using TIMS hardware experiments. (3 credit hours) Prerequisites: 520.401, Basic Communications and either 550.310 or 550.420, Introduction to Probability.

Davidson   3 credits   spring

520.466 (E) Digital Communications II

Achieving reliable and efficient digital communications over noisy channels is studied. Shannon's Noisy Channel Coding Theorem provides the basis and the goal. Bounds on code performance in noisy channels are developed. Important block and convolutional codes and codes on graphs are examined jointly with their respective decoders. Prerequisite: 520.465.

Staff   3 credits   fall

520.481 (E) Microwaves and High Speed Circuits

This course will introduce key concepts important to Microstrip circuits and will include: Propagation of waves in transmission lines with emphasis on microstrip circuits and design and analysis of couplers, matching circuits, amplifiers, filters, oscillators and high speed digital circuits. Extensive use is made of CAD tools. Prerequisites: 520.219-220.

Staff   3 credits   spring

520.482 (E) Introduction to Lasers

This course covers the basic principles of laser oscillation. Specific topics include propagation of rays and Gaussian beams in lenslike media, optical resonators, spontaneous and stimulated emission, interaction of optical radiation and atomic systems, conditions for laser oscillation, homogeneous and inhomogeneous broadening, gas lasers, solid state lasers, Q-switching and mode locking of lasers.

Staff   3 credits

520.483 (E) Bio-Photonics Laboratory

This laboratory course involves designing a set of basic optical experiments to characterize and understand the optical properties of biological materials. The course is designed to introduce students to the basic optical techniques used in medicine, biology, chemistry, and materials science.

Kang   3 credits   spring

520.485 (E) Advanced Semiconductor Devices

This course is designed to develop and enhance the understanding of the operating principles and performance characteristics of the modern semiconductor devices used in high speed optical communications, optical storage, and information display. The emphasis is on device physics and fabrication technology. The devices include heterojunction bipolar transistors, high mobility FET's,semiconductor lasers, laser amplifiers, light-emitting diodes, solar cells, and others.

Khurgin   3 credits

520.487 (E) Introduction to Micro-electromechanical Systems (MEMS)

A first course on the principles and engineering of micro-electromechanical systems. An introduction to materials and basic devices with examples of applications for sensing and actuation. Lectures will be complemented with a set of laboratory experiments and a project where students design a simple MEMS device in the MUMPS process.

Andreou   4 credits   spring

520.491 (E) CAD of Digital VLSI Systems

An introductory course in which students, manually and through computer simulations, design digital CMOS integrated circuits and systems. The design flow covers transistor, physical, and behavioral level descriptions, using SPICE, Layout, and VerilogHD1 VLSI CAD tools. After design computer verification, students can fabricate and test their semester-long class projects. Prerequisites: 520.142, 520.216, or equivalent. Recommended: 600.333, 600.334, 520.349 or 520.372.

Etienne-Cummings   3 credits   fall

520.492 (E) Mixed-Signal VLSI Systems

This is a course on the design of integrated mixed signals and domain Microsystems. The emphasis is in biomedical micro-power electronics, sensor interfaces for instrumentation and automation in the life sciences. The course comprises weekly lab lectures, laboratory sessions where students make measurements on fabricated devices and circuits and CAD laboratory assignments. There will be a final group project.

Andreou   4 credits   spring

520.495 (E) Microfabrication Laboratory
This laboratory course is an introduction to the principles of microfabrication and microengineering of devices and structures for medicine, biology and the life sciences. Course comprises of laboratory work and accompanying lectures that cover photolithography, soft-lithography, silicon oxidation, physical deposition, electrochemical deposition, etching, packaging, design and analysis CAD tools, and foundry services. Co-listed as 580.495 and 530.495. Permission of instructor is required. Due to the popularity of this course registration is first-come, first-served to undergraduates with senior standing only.
Andreou, Wang   4 credits   fall

520.498-499 (E) Senior Design Project
Capstone design project, in which a team of students engineers a system and evaluates its performance in meeting design criteria and specifications. Example application areas are microelectronic information processing, image processing, speech recognition, control, communications, and biomedical instrumentation. The design needs to demonstrate creative thinking and experimental skills, and needs to draw upon knowledge in basic sciences, mathematics, and engineering sciences. Interdisciplinary participation, such as by biomedical engineering, mechanical engineering, and computer science majors, is strongly encouraged.
Staff   3 credits

520.501-502 Independent Study
Individual, guided study under the direction of a faculty member in the department. The program of study or research, including the credit to be assigned, must be worked out in advance between the student and the faculty member involved. May be taken either term by freshmen or sophomores.
Staff   1-3 credits   501–fall; 502–spring

520.503-504 Independent Study
Individual study, including participation in research, under the guidance of a faculty member in the department. The program of study or research time required, and credit assigned must be worked out in advance between the student and the faculty member involved. May be taken either term by juniors or seniors.
Staff   1-3 credits   503–fall; 504–spring

520.505 Summer Independent Research
Independent study or research over the summer under the direction of a faculty member in the department. The program of research, including the credit to be assigned, must be worked out in advance between the student and the faculty member involved.
Staff   1-3 credits

520.545-546 Research
Independent study or research over the summer under the direction of a faculty member in the department. The program of research, including the credit to be assigned, must be worked out in advance between the student and the faculty member involved.
Staff   1-3 credits   545–fall; 546–spring

520.550 Electrical and Computer Engineering Internships
Staff   1-3 credits

520.574 Research (Intersession)

520.576 Independent Study (Intersession)

520.590 Senior Design Project (Summer)

520.595 Independent Study (Summer)

520.596 Independent Research

520.597 Research (Summer)

520.599 ECE Internships (Summer)

Graduate Courses

520.608 Image Reconstruction and Restoration
This course covers the principles and methods used to reconstruct images from remotely sensed data and to restore images from blurred and noisy observations. General variational and stochastic regularization methods for ill-posed inverse problems are covered. Those specific methods used in imaging problems where the amount of data is typically huge are presented in detail. Prerequisite: 520.651.
Prince   3 hours   spring

520.610 Computational Functional Genomics
This course provides an introduction to mathematical and computational techniques for functional genomics, a growing area of research in cell biology and genetics whose objective is to understand the biological function of genes and their interactions. Computational functional genomics focuses on the problems of collecting, processing, and analyzing data related to genome-wide patterns of gene expression with the objective to discover mechanisms by which a cell's gene expression is coordinated. Topics to be covered include: an introduction to cell biology (cells, genome, DNA, transcription, translation, control of gene expression, DNA and RNA manipulation), DNA microarray technology and experimental design, processing and analysis of microarray data (data reduction and filtering, clustering), and computational models for genetic regulatory networks (Boolean networks, Bayesian networks, ODE-based networks). Prerequisite: working knowledge of elementary probability and statistics. Co-listed with 580.610.
Goutsias   3 hours   spring

520.611 Ultrafast Optical Phenomena
This course will give and introduction to the field of ultrafast phenomena which studies processes in nature and engineering occurring on the shortest of time scales. Topics will include the complex representation of ultrafast optical signals, nonlinear optics, pulse propagation effects resulting from dispersion and nonlinearities, the fundamentals of ultrafast sources including mode locking and amplification, ultrafast measurement techniques, and the wide range of cutting-edge applications of ultrafast sources.
Foster, Mark   2.5 hours   spring

520.612 Advanced Fiber Optics and Devices

This course covers light propagation in fiber optic light guides, integrated optic wave guides, photodetectors, and the photon nature of light. Topics include light propagation in step-index and graded-index optical fibers, dielectric slab wave-guides, photodetectors, photon shot noise, and photodetector signal-to-noise ratios. Prerequisites: 520.214, 520.219-220 or equivalent.

Kang   3 credits   fall

520.618 Hybrid Systems

This graduate level seminar style class focuses on the emerging field of hybrid systems. Topics covered include mathematical models of hybrid systems, analysis and controller synthesis techniques, and model complexity reduction.

Tarraf   3 credits   spring/offered alternate years.

520.619 Optical Communications

Fundamentals of direct and coherent (heterodyne) detection optical communication receivers. Topics include Poisson nature of photon detection; estimation and detection for photon counting receivers; marked, filtered, and doubly stochastic Poisson processes; and information theory for the photon communication channel.

Davidson   3 hours

520.621 Introduction to Nonlinear Systems

Nonlinear systems analysis techniques; phase-plane, limit cycles, harmonic balance, expansion methods, describing function. Liapunov stability. Popov criterion. Prerequisite: 520.601 or equivalent.

Staff   3 hours

520.622 Principles of Network Systems

By employing fundamental concepts from diverse areas of research, such as statistics, signal processing, biophysics, bio-chemistry, cell biology, and epidemiology, this course introduces a multidisciplinary and rigorous approach to the modeling and computational analysis of complex interaction networks. Topics to be covered include: overview of complex nonlinear interaction networks and their applications, graph-theoretic representations of network topology and stoichiometry, stochastic modeling of dynamic processes on complex networks and master equations, Langevin, Poisson, Fokker-Plank, and moment closure approximations, exact and approximate Monte Carlo simulation techniques, time-scale separation approaches, deterministic and stochastic sensitivity analysis techniques, network thermodynamics, and reverse engineering approaches for inferring network models from data.

Goutsias

520.624 Integrated Photonics

This course gives an introduction to integrated photonics. Topics include: material platforms, fabrication approaches, devices and device operation, numerical modeling, nonlinear processes, and applications. Devices discussed include wave-guides, resonators, sensors, modulators, detectors, lasers and amplifiers.

Foster, Amy   2.5 hours   spring

520.633 Introduction to Robust Control

An introduction to robust analysis and control of multivariable systems. Topics include modeling of systems, uncertainty and noise; system analysis using small gain arguments and integral quadratic constraints; parametrization of stabilizing controllers; H_{∞} optimization based robust control design; and LTI model order reduction (balanced truncation, Hankel reduction). Prerequisites: Solid background in linear algebra, graduate level Linear Systems.

Tarraf   3 hours   spring

520.636 Feedback Control in Biological Signaling Pathways

Signal transduction pathways in biological systems need to be precisely regulated. This control is done through feedback regulatory loops. In this course we formulate mathematical models of signaling pathways and analyze their behavior using engineering control theory. Prerequisites: Differential Equations, Control Theory.

Iglesias   3 hours   fall

520.646 Wavelets and Filter Banks

This course serves as an introduction to wavelets, filter banks, multirate signal processing, and time-frequency analysis. Topics include wavelet signal decompositions, bases and frames, QMF filter banks, design methods, fast implementations, and applications. Prerequisites: 520.435 DSP, C/C++ and Matlab programming experience, 110.201 Undergraduate Linear Algebra.

Tran   3 hours   spring

520.648 Compressed Sensing and Sparse Recovery

Sparsity has become a very important concept in recent years in applied mathematics, especially in mathematical signal and image processing, as in inverse problems. The key idea is that many classes of natural signals can be described by only a small number of significant degrees of freedom. This course offers a complete coverage of the recently emerged field of compressed sensing, which asserts that, if the true signal is sparse to begin with, accurate, robust, and even perfect signal recovery can be achieved from just a few randomized measurements. The focus is on describing the novel ideas that have emerged in sparse recovery with emphasis on theoretical foundations, practical numerical algorithms, and various related signal processing applications.

Tran/Chin   2.5 hours   fall

520.651 Random Signal Analysis

A course covering second-order properties of random processes with applications in estimation and detection. A foundation course for further work in stochastic systems, signal processing, and communications. Prerequisites: elementary courses in probability, signals, and linear systems.

Staff   3 hours   fall

520.652 Filtering and Smoothing

A course on extracting information from inaccurate data, using both deterministic and statistical models. The focus is on developing high speed, low memory algorithms by exploiting matrix structure. The term project takes a

specific problem from theoretical formulation to Matlab implementation. Prerequisite: 520.651.

Weinert   3 hours   spring

520.666 Information Extraction from Speech and Text
Introduction to statistical methods of speech recognition (automatic transcription of speech) and understanding. The course is a natural continuation of 600.465 but is independent of it. Topics include elementary information theory, hidden Markov models, efficient hypothesis search methods, statistical decision trees, the estimation-maximization (EM) algorithm, maximum entropy estimation, finite state transducers, context-free grammars, parsing, and the Baum, CYK, and Viterbi algorithms. Weekly assignments and several programming projects. Prerequisites: 550.310 or equivalent, expertise in C or C++ programming. Co-listed with 050.666 and 600.666.

Khudanpur   3 hours   spring

520.671 Brain Computer Interfaces
In this course, students will learn state-of-the-art techniques in Brain-Computer Interfaces (BCI) through readings and hands-on work with multi-channel electroencephalographic (EEG) neural recordings systems. The class will meet once a week to review a paper or book chapter about BCI technologies, but the bulk of the work will be conducted in the lab, where each student team will be provided with an EEG hardware/software package and design, develop and demonstrate a BCI application. A competition will be held at the end of the semester to judge the best and most innovative projects. There are no formal prerequisites, but students are expected to be proficient in software programming (C and Matlab), signal processing, machine learning and experimental design. Knowledge of neuroscience is not required but may be useful. Graded on a pass/fail basis.

Vogelstein, Tenore   3 hours   fall

520.673 Magnetic Resonance in Medicine
This course is an introduction to the field of magnetic resonance imaging. All of the basic principles of magnetic resonance imaging necessary to understand current literature and research are covered. Topics include: Bloch equations, imaging principles, excitation, image contrast mechanisms and instrumentation. Prerequisites: 520.214 or 580.222 or consent of instructors. Co-listed with 580.673.

Bottomley/Edelstein   3 credits   fall

520.674 Information Theoretic Methods in Statistics
Applications of information theory to probability theory and statistics will be discussed: entropy, mutual information and K-L divergence, data compression and channel coding, information geometry, maximum entropy methods, the E-M algorithm and alternating minimization, Sanov's theorem and large deviations, redundancy, MDL and universal data compression. Prerequisite: 550.420 or equivalent.

Khudanpur   3 hours   spring

520.682 (E) Computational and Systems Neuroscience
The field of computational neuroscience explores the neural code that allows the brain to solve various problems such as information representation, learning, and decision making. In this course, we will survey modeling techniques from systems theory and machine learning, and investigate their use in exploring diverse brain functions including information processing and neural computations in sensory networks, behavioral and cognitive networks, as well as development and plasticity functions. In addition to introductory lectures, the course will take a seminar-style format, reviewing and critiquing current papers on computational neuroscience.

Elhilali   3 credits   spring

520.691 Optoelectronic Microsystems
Design and analysis of integrated optoelectronic Microsystems for telecommunications, biomedical imaging and life science technologies. Course material includes fundamentals of phototransduction, photodiodes, avalanche photodiodes, single photon avalanche detectors. At the system level we discuss, CMOS imagers, CMOS and BiCMOS high speed OE receiver and transmitter arrays, CMOS compatible liquid crystal (LC) arrays. The course will begin with basic device physics, fundamental limitations of noise and bi-weekly laboratory work. Course will include final project; permission of instructor.

Andreou   3 hours

520.701/600.603 (fall)

520.702/600.604 (spring)
Current Topics in Language and Speech Processing
This biweekly seminar will cover a broad range of current research topics in human language technology, including automatic speech recognition, natural language processing and machine translation. The Tuesday seminars will feature distinguished invited speakers, while the Friday seminars will be given by participating students. A minimum of 75% attendance and active participation will be required to earn a passing grade. Grading will be S/U.

Khudanpur

520.735 Sensory Information Processing
Analysis of information processing in biological sensory organs and in engineered microsystems using the mathematical tools of communication theory. Natural or synthetic structures are modeled as microscale communication networks implemented under physical constraints, such as size and available energy resources and are studied at two levels of abstraction. At the information processing level we examine the functional specification, while at the implementation level we examine the physical specification and realization. Both levels are characterized by Shannon's channel capacity, as determined by the channel bandwidth, the signal power, and the noise power. The link between the information processing level and the implementation level of abstraction is established through first principles and phenomenological otherwise, models for transformations on the signal, constraints on the system, and noise that degrades the signals. Prerequisite: permission of instructor.

Andreou   3 hours

520.736 Seminar on Control and Systems Biology

This weekly seminar will focus on research issues in the use of control theory to study biological signal transduction pathways. The purpose of this course is to provide the students with background in research areas in computational, mathematical and systems biology. Each week, the participants will be assigned selected papers in these areas. While one student will lead the discussion, all students will be expected to have read the papers and to contribute to the discussion. Prerequisites: 520/580.636 or permission of instructor.

Iglesias   1.5 hours

520.738 Advanced Electronics Design Lab

This course is the graduate expansion of the 520.448 Electronic Design Lab, which is an advanced laboratory course in which teams of students design, build, test and document application specific information processing microsystems. Semester long projects range from sensors/actuators, mixed signal electronics, embedded microcomputers, algorithms and robotics systems design. Demonstration and documentation of projects are important aspects of the evaluation process. For this graduate expansion, all projects will be based on recently published research from *IEEE Transactions*. The students will be required to fully research, analyze, implement and demonstrate their chosen topic. The emphasis will be on VLSI microsystems, although other topics will also be considered. Prerequisite: graduate standing.

Etienne-Cummings   3 hours

520.746 Seminar on Medical Image Analysis

This weekly seminar will focus on research issues in medical image analysis, including image segmentation, registration, statistical modeling, and applications. It will also include selected topics relating to medical image acquisition, especially where they relate to analysis. The purpose of the course is to provide the participants with a thorough background in current research in these areas, as well as to promote greater awareness and interaction between multiple research groups within the university. The format of the course is informal. It will meet weekly for approximately one hour. Students will read selected papers. All students will be assumed to have read these papers by the time the paper is scheduled for discussion. Individual students will be assigned on a rotating basis to lead the discussion on particular papers or sections of papers. Co-listed as 600.746.

Taylor/Prince   1 credit

520.748 Seminar on Advanced Topics in MRI Research

This course builds on the Magnetic Resonance in Medicine course (520/580.473) and introduces current applications. The students will be exposed to existing research topics and become aware of the need for engineering knowledge for the research. Topics covered include, but are not limited to, new imaging methods, signal and image processing, RF coil design, and challenging applications, such as imaging of the heart. Prerequisite 520/580.473 or permission of instructor. Co-listed with 580.748 .

Staff   2 hours

520.753 Free Space Atmospheric Optical Communication

This course covers the basics of laser beam propagation through the turbulent atmosphere. The effects of turbulence induced refractive index fluctuations on direct detection and coherent optical communications systems will be discussed. Topics covered include Gaussian optical beams, refractive index fluctuation structure functions, second order spatial coherence functions, turbulence induced beam wander, intensity scintillations, and propagation of partially coherent optical beams in atmospheric turbulence. Prerequisite: 520.619, Optical Communications.

Davidson   3 hours

520.761-762 Seminar on Large-Scale Analog Computation

Research seminar devoted to current research in the engineering of large-scale integrated analog systems. Topics include models for vision and auditory processing as well as implementation constraints and limitations.

Andreou/Etienne-Cummings   3 hours

520.763 Seminar on Solid State, Quantum Electronics and Nonlinear Optics

Research seminar on current research in the area of interaction of light with matter.

Kaplan   1.5 hours

520.765 Nonlinear Waves and Interactions in Optics and Electrodynamics

Nonlinear phenomena in optics and electrodynamics and their applications are discussed, with emphasis on the basic theory (classical and quantum) of the phenomena.

Kaplan   3 hours

520.766 Seminar in Error Control Coding

A seminar on emerging error control codes and decoding algorithms is held when requested, meeting weekly for approximately two hours. Each participant prepares one or more talks on topics of interest, in consultation with the other participants. Frequently, a student focuses on one topic throughout the semester, making several presentations and submitting a 20-40 page report summarizing the topic. Prerequisite: Error Control Coding 520.460.

Cooper   2 hours

520.771-772 Advanced Integrated Circuits

Study of devices, circuits and design methodology for analog computing systems, both MOS and bipolar. Students will use CAD tools to design and test circuits fabricated through the MOSIS service with special emphasis on bioinspired integrated sensors and sensory systems and on micropower integrated circuits for biomedical devices and instrumentation.

Andreou Etienne-Cummings   3 hours

520.773 Advanced Topics in Fabrication and Microengineering

Graduate-level course on topics that relate to microsystem integration of complex functional units across different physical scales from nano to micro and macro. Topics will include emerging fabrication technologies, micro-

electromechanical systems, nanolithography, nanotechnology, soft lithography, self-assembly, and soft materials. Discussion will also include biological systems as models of microsystem integration and functional complexity. Prerequisite: permission of instructor required.
Andreou

520.800 Independent Study
Individual guided study under the direction of a faculty member in the department. May be taken either term by graduate students.

520.801-802 Dissertation Research

520.809-810 Special Studies
Individual study in an area of mutual interest to a student and a faculty member in the department.

Master of Science in Engineering Management

The Master of Science in Engineering Management (MSEM) degree program combines advanced course work in highly-specialized technical fields with a professional education in contemporary business, entrepreneurship, and management practices. Graduates of the program will be provided with the educational background to pursue professional management roles in industry.

Requirements

Students in the MSEM program will take ten courses to fulfill degree requirements, with the following guidelines:

- Five advanced courses in the engineering/technical concentration
- Five advanced courses in the management concentration, including a capstone course intended to integrate and apply knowledge gained throughout the MSEM program
- Students must graduate with a 3.0 GPA in the management courses and also in the technical courses
- Courses must be at the 400-level or higher
- Departments sponsoring technical concentrations may impose stricter requirements for course work within the concentration

At the discretion of the student's advisors, an MSEM student may be permitted to double-count up to two JHU courses (one for the technical concentration and one for the management concentration) or apply undergraduate or graduate courses taken at JHU or elsewhere but not applied to a degree, in accordance with conditions in the WSE Policy on Double-Counting Courses.

Advising

MSEM students will receive advising on the engineering/technical concentration from a designated faculty member affiliated with that concentration. MSEM students will be advised regarding the management concentration by members of the Center for Leadership Education faculty.

Faculty

Faculty members teaching the technical concentration courses are listed in their respective engineering departments elsewhere in this catalog. Faculty members teaching the management concentration courses are listed in the Center for Leadership Education section of this catalog.

Management Concentration

The Center for Leadership Education has constructed a five-course program tailored to the needs of future engineering managers. MSEM students will participate in a cohort program, which begins each fall, where all students in an entering class will take the following five management courses together:

662.611 Finance and Accounting (fall)
662.651 Marketing Communications and Strategy (fall)
662.632 Law and Entrepreneurship (spring or Intersession)
662.642 Management and Leadership (spring)
662.692 Venture Planning (spring)

In addition, all MSEM students are required to attend the MSEM Seminar (662.801/662.802) course while enrolled in the program. This will meet weekly and addresses three important content areas: Innovation and design thinking; personal skills and development especially in the communication arena; and talks with practicing engineering managers. The Engineering Management program reserves the right to change the list of eligible courses at its discretion.

Technical Concentrations

In addition to fulfilling the management concentration requirements, MSEM students must complete the requirements for one of twelve technical concentrations. These are:

- Biomaterials
- Civil Engineering
- Communications Science
- Computer Science
- Fluid Mechanics
- Materials Science and Engineering
- Mechanical Engineering
- Mechanics and Materials
- Nano-Biotechnology
- Nanomaterials and Nanotechnology
- Probability and Statistics
- Smart Product and Device Design
- Environmental Systems Analysis, Economics and Public Policy

Biomaterials

(Sponsored by the Department of Materials Science & Engineering)

Prerequisites

- UG calculus, chemistry, biology, physics and introductory biomaterials course equivalent to 510.316

Required Courses (3)

510.602 Thermodynamics of Materials
510.606 Chemical and Biological Properties of Materials
510.607 Biomaterials II

Electives (2)

- Electives should be related to Materials Science and Engineering and must be approved by the DMSE graduate committee
- See list of pre-approved elective courses or courses off list by petition

Recommended Structure

Fall Semester
- Required: 510.602 Thermodynamics of Materials
- Electives: suggest two

Spring Semester
- Required: 510.606. Chemicals and Biological Properties of Materials, 510.607 Biomaterials II
- Electives: suggest none

List of Pre-approved Electives

510.400 Introduction to Ceramics
510.403 Materials Characterization
510.405 Energy Engineering: Fundamentals and Future
510.422 Micro- and Nano-structured Materials and Devices
510.426 Biomolecular Materials
510.428 Materials Science Laboratory I
510.429 Materials Science Laboratory II
510.430 Biomaterials Lab
510.431 Biocompatibility of Materials
510.456 Introduction to Surface Science
510.604 Mechanical Properties of Materials
510.605 Electronic, Optical and Magnetic Properties of Materials
510.606 Chemical and Biological Properties of Materials
510.607 Biomaterials II
510.608 Electrochemistry

510.611 Solid State Physics
510.612 Solid State Physics
510.617 Advanced Topics in Biomaterials
510.619 Biopolymer Synthesis
510.620 Metallic Glasses
510.622 Micro- and Nano-Structured Materials and Devices
510.624 Theory of X-ray Diffraction
510.650 Principles of Quantum Physical Interactions
510.657 Materials Science of Thin Films
510.665 Advanced Topics in Thermodynamics and Kinetics of Materials

Civil Engineering

(Sponsored by the Department of Civil Engineering)

The Civil Engineering concentration for the Master of Science in Engineering Management consists of five courses, with the following guidelines:

Required Courses

560.729 Structural Mechanics
560.730 Finite Element Methods

Elective Courses

- Any two courses from 560.4xx or above, or 565.4xx or above (excluding seminar)
- One course from 560.7xx (excluding seminar)

Communications Science

(Sponsored by the Department of Electrical & Computer Engineering)

Students may select any combination of 5 courses in communications and related fields from the list below. The concentration advisor retains the right to approve courses not on this list.

520.401 Basic Communication
520.410 Fiber Optics and Devices
520.435 Digital Signal Processing
520.447 Introduction to Information Theory and Coding
520.465 Digital Communications I
520.619 Optical Communications
520.646 Wavelets and Filter Banks
520.651 Random Signal Analysis
520.652 Filtering and Smoothing
520.666 Information Extraction from Speech and Text
520.674 Information Theoretic Methods in Statistics
520.735 Sensory Information Processing
520.753 Free Space Optical Communications

Computer Science

(Sponsored by the Department of Computer Science)

Curricular Requirements

- Any five regular graduate courses approved by the advisor, 400-level or higher, from the Department of Computer Science, not including the senior thesis. Three 1-credit graduate courses may be combined to constitute one regular graduate course.

Fluid Mechanics

(Sponsored by the Department of Mechanical Engineering)

Any five courses in Fluid Mechanics or closely related discipline, at the 400 level or higher, as approved by the Faculty advisor. At least two of the required technical courses must be at the 600-level or higher.

Materials Science & Engineering

(Sponsored by the Department of Materials Science & Engineering)

Prerequisites

- UG calculus, chemistry and physics; biology is recommended

Required Courses (3)

510.601 Structures of Materials
510.602 Thermodynamics of Materials
510.603 Kinetics and Phase Transformations in Materials

Electives (2)

- Electives should be related to Materials Science and Engineering and must be approved by the DMSE graduate committee
- See list of pre-approved elective courses or courses off list by petition

Recommended Structure

Fall Semester
- Required: 601 and 602
- Electives: suggest one

Spring Semester
- Required: 603
- Electives: suggest one

List of Pre-approved Electives

510.400 Introduction to Ceramics
510.403 Materials Characterization
510.405 Energy Engineering: Fundamentals and Future

510.422 Micro- and Nano-structured Materials and Devices
510.426 Biomolecular Materials
510.428 Materials Science Laboratory I
510.429 Materials Science Laboratory II
510.430 Biomaterials Lab
510.431 Biocompatibility of Materials
510.456 Introduction to Surface Science
510.604 Mechanical Properties of Materials
510.605 Electronic, Optical and Magnetic Properties of Materials
510.606 Chemical and Biological Properties of Materials
510.607 Biomaterials II
510.608 Electrochemistry
510.611 Solid State Physics
510.612 Solid State Physics
510.619 Biopolymer Synthesis
510.620 Metallic Glasses
510.622 Micro- and Nano-Structured Materials and Devices
510.624 Theory of X-ray Diffraction
510.657 Materials Science of Thin Films

Mechanical Engineering

(Sponsored by the Department of Mechanical Engineering)

Required Courses

530.621 Fluid Dynamics I
530.646 Introduction to Robotics

Elective Courses

Any two 530.4xx or 530.6xx courses listed in the JHU catalog.

Mechanics and Materials

(Sponsored jointly by the Department of Mechanical Engineering and the Department of Materials Science & Engineering)

Required Courses

510.601 Structures of Materials
510.604 Mechanical Properties of Materials

Elective Courses

Any two (2) of the following courses, approved by the faculty advisor:

510.403 Materials Characterization
510.428 Materials Science Laboratory I
530.405 Mechanics of Solids and Structures
530.414 Computer-Aided Design
530.418 Aerospace Structures and Materials
530.454 Manufacturing Engineering
510.602 Thermodynamics of Materials
510.603 Phase Transformations in Materials
530.612 Computational Solid Mechanics

Nano-Biotechnology

(Sponsored by the Department of Materials Science & Engineering)

Prerequisites
• UG calculus, chemistry, biology, physics and introductory biomaterials course equivalent to 510.316

Required Courses (3)
530.422 Micro and Nano-Structured Materials and Devices
510.607 Biomaterials II (PR: 510.316 Biomaterials I or permission)

Electives (2)
• Electives should be related to Materials Science and Engineering and must be approved by the DMSE graduate committee
• See list of pre-approved elective courses or courses off list by petition

Recommended Structure

Fall Semester
• Required: 510.619 Biopolymers Synthesis
• Electives: suggest two

Spring Semester
• Required: 510.422 Nano-Structured Materials and Devices
• Electives: suggest none

List of Pre-approved Electives
510.400 Introduction to Ceramics
510.403 Materials Characterization
510.405 Energy Engineering: Fundamentals and Future
510.422 Micro- and Nano-structured Materials and Devices
510.426 Biomolecular Materials
510.428 Materials Science Laboratory I
510.429 Materials Science Laboratory II
510.430 Biomaterials Lab
510.431 Biocompatibility of Materials
510.456 Introduction to Surface Science
510.604 Mechanical Properties of Materials
510.605 Electronic, Optical and Magnetic Properties of Materials
510.606 Chemical and Biological Properties of Materials
510.607 Biomaterials II
510.608 Electrochemistry
510.611 Solid State Physics
510.612 Solid State Physics

510.617 Advanced Topics in Biomaterials
510.619 Biopolymer Synthesis
510.620 Metallic Glasses
510.622 Micro- and Nano-Structured Materials and Devices
510.624 Theory of X-ray Diffraction
510.650 Principles of Quantum Physical Interactions
510.657 Materials Science of Thin Films
510.665 Advanced Topics in Thermodynamics and Kinetics of Materials

Nanomaterials and Nanotechnology

(Sponsored by the Department of Materials Science & Engineering)

Prerequisites
• UG calculus, chemistry, and physics

Required Courses (3)
510.601 Structures of Materials
510.602 Thermodynamics of Materials
510.619 Biopolymers Synthesis

Electives (2)
• Electives should be related to Materials Science and Engineering and must be approved by the DMSE graduate committee
• See list of pre-approved elective courses or courses off list by petition

Recommended Structure

Fall Semester
• Required: 601, 602 and 619
• Electives: suggest none

Spring Semester
• Required: none
• Electives in Spring: suggest two

List of Pre-approved Electives
510.400 Introduction to Ceramics
510.403 Materials Characterization
510.405 Energy Engineering: Fundamentals and Future
510.422 Micro- and Nano-structured Materials and Devices
510.426 Biomolecular Materials
510.428 Materials Science Laboratory I
510.429 Materials Science Laboratory II
510.430 Biomaterials Lab
510.431 Biocompatibility of Materials
510.456 Introduction to Surface Science
510.604 Mechanical Properties of Materials
510.605 Electronic, Optical and Magnetic Properties of Materials

510.606 Chemical and Biological Properties of Materials

510.607 Biomaterials II

510.608 Electrochemistry

510.611 Solid State Physics

510.612 Solid State Physics

510.617 Advanced Topics in Biomaterials

510.619 Biopolymer Synthesis

510.620 Metallic Glasses

510.622 Micro- and Nano-Structured Materials and Devices

510.624 Theory of X-ray Diffraction

510.650 Principles of Quantum Physical Interactions

510.657 Materials Science of Thin Films

510.665 Advanced Topics in Thermodynamics and Kinetics of Materials

Probability and Statistics

(Sponsored by the Department of Applied Mathematics & Statistics)

Admissions Requirements

• One upper-division undergraduate course in probability (equivalent to 550.420 Introduction to Probability)

• One upper-division undergraduate course in mathematical statistics (equivalent to 550.430 Introduction to Statistics)

Curricular Requirements

Any five (5) of the following courses, approved by the faculty advisor:

550.413 Applied Statistics and Data Analysis

550.426 Introduction to Stochastic Processes

550.432 Linear Statistical Models

550.433 Monte Carlo Simulation and Reliability

550.434 Nonparametric and Robust Methods

550.435 Bioinformatics and Statistical Genetics

550.436 Data Mining

550.437 Statistical Learning with Applications

550.438 Statistical Methods in Computer Intrusion Detection

550.439 Time Series Analysis

550.620 Probability Theory I

550.630 Statistical Theory I

550.631 Statistical Theory II

550.632 Multivariate Statistical Theory

550.633 Time Series Analysis

550.634 Nonparametric and Robust Inference

550.635 Topics in Bioinformatics

550.730 Topics in Statistics

550.731 Case Studies in Applied Statistics

Additional Requirements

• Students must satisfy the department's graduate student computing requirement.

• With advisor's approval, one non-departmental course containing appropriate mathematical or statistical content can be counted to satisfy the five course requirement.

Smart Product and Device Design

(Sponsored jointly by the Department of Mechanical Engineering and the Department of Electrical & Computer Engineering)

Required Courses

530.646 Introduction to Robotics

530.414 Computer-Aided Design *or*

520.491 CAD of Digital VLSI Systems

530.421 Mechatronics *or*

520.448 Electronics Design Laboratory *or*

Elective Courses

Any two (2) of the following courses, approved by the faculty advisor:

520.691 Optoelectronic Microsystems

Systems Analysis, Management & Environmental Policy

(Sponsored by the Department of Geography & Environmental Engineering)

Required Courses (3)

At least one course from each of the three following groups:

• **Economics** (with calculus)—acceptable courses include 570.493 Economic Foundations for Public Decision Making or equivalent. (This requirement may be waived if the student has already had an intermediate microeconomics course accepted by their advisor)

• **Mathematics of Decision Making**—acceptable courses include 570.495 Foundations of Optimization for Planning and Policy and 570.497 Risk and Decision Analysis

• **Policy**—acceptable courses include 570.659 Environmental Policy Analysis, 570.427 Natural Resources, Society, and Environment, 570.607 Energy Planning and Policy Modeling, and 570.616 Readings in Environmental Economics

Elective Courses (2)

Any of the courses listed in the Mandatory list (see Part A above)

570.496 Mathematical Models for Managing Urban and Env. Systems

570.611 Natural Resource Economics

570.618 Multi-objective Programming and Planning

570.676 Stochastic Programming

Other courses in environmental economics, systems, or policy, as approved by the advisor.

Additional Notes

- All courses must be approved by the student's advisor.

- Students with a background in quantitatively rigorous economics sufficient for the economics requirement to be waived must still take five (5) courses in this area of concentration.

- No more than one course in environmental engineering may be used to fulfill the area of concentration and only with careful consultation with the student's advisor. Candidate courses in environmental engineering include: 570.446 Biological Processes for Water and Wastewater Treatment, 570.490 Solid Waste Engineering and Management, 570.491 Hazardous Waste Engineering and Management, 570.647 Mass Transfer Processes in Environmental Engineering, 570.657 Air Pollution, etc.

Management Concentration Courses

662.611 Finance and Accounting
The course includes a review of financial accounting with an emphasis on the managerial implications of financial statements and their application to financial analysis. Course material will also encompass cost accumulation, cost allocation, product costing, and variance analysis, and their impact on financial forecasting and capital budgeting. Students will also explore valuation techniques for new technologies.
Leps   2 hours   fall

662.632 Law and Entrepreneurship
Law and Entrepreneurship introduces participants to the fundamental aspects of law associated with developing and bringing new products to the marketplace. Arranged in modules and taught largely through the case method, the course features the following topics: creating and forming businesses; contracts; intellectual property; principal-agent relations; and product liability. Not only will participants learn the principles associated with each topic, but also they will master the questions and concerns to use when working with legal counsel on these issues in the future.
Staff   2 hours   spring (evening)

662.642 Management and Leadership
Management and Leadership is a case, experiential and research based course intended to introduce participants to issues and solutions related to growing and managing businesses with an emphasis on entrepreneurial enterprises. The course focuses on managerial decision making and organization building through topics that include planning and managing strategic change; finding competitive advantage; making informed decisions; dealing with uncertainty; negotiating collaborative settlements; managing/leading projects, teams and professionals; networking and forming strategic alliances; valuing differences; creating and maintaining organizational cultures; and devising performance measures. Additionally, participants master aspects of management communication as they address course content.
Rice   2 hours   spring

662.651 Marketing Communications and Strategy
This course is designed to introduce students to key marketing, communications, and strategic issues surrounding the process of bringing new products to the marketplace. Through cases, readings, discussion and hands-on team projects, students develop a flexible approach to thinking about marketing problems, maximizing resources and creating strategic solutions. Written and oral work focuses on communicating effectively with target audiences using integrated media and developing interpersonal skills essential for managers, including presenting to a hostile audience, running meetings, listening, and contributing to group decision-making.
Sheff   2 hours   fall

662.692 Venture Planning
Venture Planning requires participants to work in groups to address, design and plan a business solution for an engineering problem with social implications. More specifically, students will work on cross-disciplinary teams to determine the commercial viability of a new technology. They must select a problem amenable to an engineering solution, investigate the problem, research the issues and potential, develop a design for the technology, investigate the competitive advantage, and create and present a business plan for the idea. Course content will address many of the issues that will be encountered during the process of bringing an idea to fruition.
Aronhime   2 hours   spring

662.811/812 MSEM Seminar
Professional development seminar for engineering management students featuring outside speakers with engineering management experience.
Staff   fall/spring

The W. P. Carey Minor in Entrepreneurship and Management

The minor in entrepreneurship and management focuses on business and management from a multi-disciplinary viewpoint, with a quantitative emphasis. The program, part of the Center for Leadership Education (page 545), offers students a diversified learning experience that emphasizes the concepts, practices, and skills necessary for effective leadership as manage rs and entrepreneurs in the public and private sectors.

The primary goal of the program is to provide Hopkins students with the knowledge and skills to become effective leaders and entrepreneurs. Individuals with excellent technical training and abilities often move into management positions or start new ventures. As their careers progress, they will be better prepared for success if they have the ability to understand financial reports, interpret statistical data, organize and effectively lead a team, design strategy, analyze and correct problems in the firm's operations, and understand the dynamics of the marketplace.

The minor is purposely designed to serve different types of students. The program will help prepare students for entrance to law school, an MBA program, or other graduate school. After graduation, other students will start working in engineering or technical positions, then later move into management or start their own businesses. A third group of students is primarily interested in gaining knowledge to follow more generalized careers in finance and business.

Courses that may be used to satisfy requirements for the minor are grouped into four categories: accounting/finance, business law, management/leadership, and marketing/communications. Lists of acceptable courses are regularly updated and may be obtained at the Center for Leadership Education office or on the center's website: **http://web.jhu.edu/leadership**.

The Faculty

Lawrence Aronhime, Associate Director and Senior Lecturer: accounting, finance, entrepreneurship, technology commercialization.

Leslie Kendrick, Senior Lecturer: marketing strategy, integrated marketing communications and international marketing.

Annette Leps, Senior Lecturer: accounting, finance, management.

Julie Reiser, Senior Lecturer: technical communication, oral presentations, research writing, American literature and critical theory.

Eric Rice, Associate Director and Senior Lecturer: organizational behavior, social entrepreneurship, management, negotiation and conflict management, leadership, public speaking, and professional writing.

Pamela Sheff, Senior Lecturer: business and technical communication, marketing, public relations, science and scientific writing, oral presentations, higher education in prisons, community-based learning.

Part-time Faculty

Marci DeVries, Lecturer: marketing.

David Fisher, Lecturer: business law.

Mark Franceschini, Senior Lecturer: business law, business ethics, Internet law.

Theresa Jones, Lecturer: marketing.

Illysa Izenberg, Lecturer: engineering management.

Aida Lebbos, Lecturer: business law.

Jack L. Powell, Senior Lecturer: accounting, finance.

Joshua J. Reiter, Lecturer: business process management, total quality management, information technology management, Internet-based business applications, creativity and innovation, entrepreneurship.

Douglas Sandhaus, Senior Lecturer: business law, business ethics, Internet law.

William Smedick, Lecturer: leadership.

Judy Smylie, Lecturer: business law, business ethics.

Facilities

The CLE Faculty offices and Faculty Support Staff offices are located in Whitehead Hall, suites 102, 104 and 105. Updated office space provides a comfortable environment for informal discussions among faculty and students. Faculty and course assistants' office hours are held in the main office.

Minor in Entrepreneurship and Management

The requirements of the minor in entrepreneurship and management can be downloaded from the Center for Leadership Education's website under the "W.P. Carey Program in Entrepreneurship and Management" tab (**http://web.jhu.edu/Leadership/html/em/coursepacket.html**). Students wishing to complete a minor in entrepreneurship and management may also obtain more information from the CLE Faculty Support Staff office located in Whitehead 105.

Courses

Core Offerings

660.105 (S,W) Introduction to Business

This course is designed as an introduction to the terms, concepts, and values of business and management. The course comprises three broad categories: the economic, financial, and corporate context of business activities; the organization and management of business enterprises; and, the marketing and production of goods and services. Topic specific readings, short case studies and financial exercises all focus on the bases for managerial decisions as well as the long and short-term implications of those decisions in a global environment.
Aronhime   4 credits   fall and spring

660.203 Financial Accounting

The course in Financial Accounting is designed for anyone who could be called upon to analyze and/or communicate financial results and/or make effective financial decisions in a for-profit business setting. No prior accounting knowledge or skill is required for successful completion of this course.

Because accounting is described as the language of business, this course emphasizes the vocabulary, methods, and processes by which all business transactions are communicated. The accounting cycle, basic business transactions, internal controls, and preparation and understanding of financial statements including balance sheets, statements of income and cash flows are covered.
Aronhime, Leps, Powell   3 credits
fall and spring

660.250 Principles of Marketing

This course explores the role of marketing in society and within the organization. It examines the process of developing, pricing, promoting and distributing products to consumer and business markets and shows how marketing managers use the elements of the marketing mix to gain a competitive advantage. Through interactive, application-oriented exercises, case videotapes, a guest speaker (local marketer), and a group project, students will have ample opportunity to observe key marketing concepts in action. The group project requires each team to research the marketing plan for an existing product of its choice. Teams will analyze what is currently being done by the organization, choose one of the strategic growth alternatives studied, and recommend why this alternative should be adopted. The recommendations will include how the current marketing plan will need to be modified in order to implement this strategy and will be presented to the instructor in written form and presented to the class.
Kendrick, Jones, DeVries, Williams   3 credits
fall and spring

Upper Level Electives

660.300 Managerial Finance

This course is designed to familiarize the student with the basic concepts and techniques of financial management practice. The course begins with a review of accounting, securities markets, and the finance function. The course then moves to discussion of financial planning, financial statement analysis, time value of money, interest rates and bond valuation, stock valuation, and concludes with capital budgeting and project analysis. A combination of classroom discussions, problem sets, and case studies will be used. Prerequisites: 660.203 Financial Accounting. Note: not open to students who have taken 660.302 Corporate Finance.
Powell   3 credits   fall

660.303 Managerial Accounting

This course serves as an introduction to cost accounting, emphasizing the application of accounting concepts to managerial control and decision making. Major topics include relevant costs, product costing, standard costing, cost behavior, cost allocation, budgeting, and variance analysis.
Aronhime, Leps, Powell   3 credits   spring

660.304 Financial Statement Analysis

This course is designed to increase a student's ability to read and interpret financial statements and related information under both GAAP and IFRS (International Financial Reporting Standards). In addition to a review of the basic financial statements and accounting principles, the course will use industry and ratio analysis in addition to benchmarking and modeling techniques to encourage students to think in a more creative way when analyzing historic information or when forecasting financial statements. Students will access firm profitability and risk, value assets and use spreadsheet models for financial forecasting and decision making. Prerequisite: 660.203 Financial Accounting.
Leps   3 credits   fall

660.308 (S) Business Law I

This course is designed to provide students an introduction to legal reasoning and analysis. Content distinguishes forms of business, civil versus criminal law, and agency principles; intellectual property concepts, contract Law, the UCC (Uniform Commercial Code) and consumer protection are explored and discussed in the context of assigned legal cases which are intended to develop a student's ability to analyze and apply law. Prerequisite: 660.105 Intro to Business.
Fisher, Franceschini, Sandhaus, Smylie   3 credits
fall and spring

660.310 (H) Case Studies in Business Ethics

This course is designed as a workshop using case studies to introduce students to the ethical concepts that are relevant to resolve moral issues in contemporary business and social settings—both global and personal in nature. Students will learn the reasoning and analytical skills needed to apply ethical concepts to their own decision making, to identify moral issues involved in the management of specific problem areas in business and society, and to understand the social and natural environments

which give rise to moral issues. The course focus is on performance articulated by clear reasoning and effective verbal and written communication concerning ethical issues in business and society.
Franceschini, Sandhaus, Smylie   3 credits
fall and spring

660.311 (S) Law and the Internet
Sometimes called "Cyber law," this course uses the case study method to examine some of the most significant and compelling legal aspects, issues, and concerns involved with operating a business enterprise in an Internet environment. Some of the issues likely to be covered include jurisdiction, resolution of online disputes, trademarks, copyright, licenses, privacy, defamation, obscenity, the application of traditional concepts of tort liability to an Internet context, computer crime, information security, taxation, international considerations, and an analysis of other recent litigation and/or statutes. Prerequisite: 660.308 Business Law I.
Franceschini, Sandhaus   3 credits   fall and spring

660.321 (W) Managing Social Enterprises
This course focuses on preparing students to engage in and lead social enterprises as we explore the options for realizing social entrepreneurship initiatives. Using a combination of lecture, case study and project work, we investigate the nonprofit and benefits corporation environment with emphasis on its culture and role in society, particular management challenges, options for dealing with finances, relationships within communities, and methods for building constituencies. Additionally, we address critical issues such as measures of success, scale, replication and failure. Prerequisite: 660.105 Introduction to Business, 660.333 Leading Change or 660.340 Principles of Management.
Rice   3 credits   spring

660.332 (S,W) Leadership Theory
Students will be introduced to the history of Leadership Theory from the "Great Man" theory of born leaders to Transformational Leadership theory of non-positional learned leadership. Transformational Leadership theory postulates that leadership can be learned and enhanced. The course will explore the knowledge base and skills necessary to be an effective leader in a variety of settings. Students will assess their personal leadership qualities and develop a plan to enhance their leadership potential. Recommended prerequisite: Introduction to Business 660.105 or 660.340 Principles of Management.
Smedick   3 credits   fall and spring

660.333 Leading Change
In this course, we use a combination of presentation, discussion, experiential learning, research and self-reflection to investigate issues surrounding leadership and change in organizations, communities and the economy. While considering both for-profit and nonprofit entities, we pursue topics including understanding and using theories of change; finding competitive advantage and creating strategic plans; making decisions, even in uncertain times; valuing differences; employing leadership styles; creating

guiding coalitions; managing the message; understanding employee relations; creating performance measures; developing organizational cultures; and using the dynamics of influence.
Rice   3 credits   fall

660.335 Negotiation and Conflict Management
The focus of this class is the nature and practice of conflict resolution and negotiation within and between individuals and organizations. The primary format for learning in this class is structured experimental exercises designed to expose students to different aspects of negotiation and to build tangible skills through interpersonal exchange. While some class time is devoted to presentations on theories and approaches, the class method primarily relies on feedback from fellow classmates on their observations of negotiation situations and on personal reflections by students after each structured experience. Topics include conflict style, negotiation, and group conflict. Prerequisite: Introduction to Business 660.105. Recommended: an additional course in the Entrepreneurship and Management Program or in the social sciences.
Rice   3 credits   fall

660.340 Principles of Management
This course introduces the student to the management process. The course takes an integrated approach to management by examining the role of the manager from a traditional and contemporary perspective while applying decision making and critical-thinking skills to the challenges facing managers in today's globally diverse environment. The course examines the techniques for controlling, planning, organizing resources and leading the workforce. Prerequisite: 660.105 Introduction to Business.
Izenberg, Niewoehner, Rice   3 credits   fall and spring

660.341 (W) Business Process and Quality Management
This course focuses on both quantitative and qualitative analytical skills and models essential to operations process design, management, and improvement in both service and manufacturing oriented companies. The objective of the course is to prepare the student to play a significant role in the management of a world-class company which serves satisfied customers through empowered employees, leading to increased revenues and decreased costs. The material combines managerial issues with both technical and quantitative aspects. Practical applications to business organizations are emphasized. Prerequisites: 660.105 Introduction to Business.
Reiter   3 credits   fall

660.350 (W) Marketing Strategy
This writing intensive course helps students develop skills in formulating, implementing, and controlling a strategic marketing program for a given product-market entry. Using a structured approach to case analysis, students will learn how to make the kinds of strategic marketing decisions that will have a long-term impact on the organization and support these decisions with quantitative analyses. Through textbook readings, students will learn how to identify appropriate marketing strategies for new, growth, mature, and declining markets and apply these

strategies as they analyze a series of marketing cases. The supplementary readings, from a broad spectrum of periodicals, are more applied and will allow students to see how firms are addressing contemporary marketing challenges. In addition to analyzing cases individually, each student will be part of a team that studies a case during the latter half of the semester, developing marketing strategy recommendations, including financial projections, and presenting them to the class. Prerequisite: 660.250 Principles of Marketing.
Kendrick   3 credits   spring

660.355 Sports Marketing
This course will allow students to apply marketing principles and concepts to the sports marketing environment while gaining an understanding of how event sponsorships, endorsements, licensing and naming rights are used to achieve business objectives. Through case studies and a group project, students will be exposed to a broad range of sports entities including professional sports teams, governing organizations and sports media. Prerequisite: 660.250 Principles of Marketing.
Kendrick   3 credits   fall

660.358 International Marketing
This course covers product, pricing, promotion, distribution, market research, organization and implementation and control policies relating to international marketing. It also explores the economic, cultural, political and legal aspects of international marketing. Through interactive and application-oriented assignments and cases, students will gain hands-on experience in analyzing and developing marketing strategies for organizations that market both consumer and business products/services internationally. A group project will involve the development of an international marketing plan for a specific product. One or more local international marketers will be invited to speak to the class. Prerequisite: 660.250 Principles of Marketing.
Kendrick   3 credits   fall

660.401 Advanced Corporate Finance
The advanced course in corporate finance is designed to provide the upper level business student with a background in the more complex applications of financial management practice. Students will be exposed to advanced financial management concepts through a pedagogy combining classroom instruction, problem solution, business case analysis and work on a group project with coverage of the topics of capital markets, risk and portfolio theory, cost of capital, raising capital, capital structure, corporate dividend policy, real property valuation, merger and acquisition analysis, working capital management, commercial leasing strategies, international finance and derivatives analysis. Prerequisite: 660.300 Managerial Finance or 180.366 The Art and Science of Economic Forecasting.
Powell   3 credits   spring

660.404 (S) Business Law II
Building on the material from Business Law I, topics examined include entrepreneurship, business entities and business formation, principles of agency, real prop-

erty, personal property, bailments, bankruptcy, secured transactions, employment discrimination, business financing, investor protection, antitrust and environmental law. Prerequisite: 660.308 Business Law I.
Fisher   3 credits   fall and spring

660.405 (S) Intellectual Property Law
This course explores the acquisition, protection and commercialization of intellectual property, such as patents, trademarks, copyrights and trade secrets, and its impact on businesses and organizations. The course addresses critical issues such as the various types of intellectual property, the protection and commercialization of intellectual property by business and legal means, and the valuation of intellectual property. In addition, the tension between exclusive rights in intellectual property and free competition will be discussed throughout this course. Through interactive class discussions and a group project, students will have ample opportunity to develop a better understanding pertaining to the different types of intellectual property and to develop an intellectual property strategic plan for protecting an intellectual property portfolio. Specifically, the group project requires each team to research a selected Maryland based company's intellectual property, its plan for protection and commercialization and its business goals, products and services. Each team will then analyze how well the company's current business goals relate to its intellectual property portfolio, and recommend changes to better meet these company's goals. Prerequisite: 660.308 Business Law.
Lebbos   3 credits   fall

660.450 Advertising and Promotion
This course builds on the promotional mix concepts covered in Principles of Marketing (660.250)—advertising, public relations, sales promotion and personal selling. Students will learn how marketers are changing the ways they communicate with consumers and the ways in which promotional budgets are allocated—and how this impacts the development of marketing strategies and tactics. Working with a client (provided by EdVenture Partners) that has chosen this JHU class as its "advertising agency" and an actual budget provided by the firm, the class will form small teams to mirror the functional organization of an actual ad agency market research, advertising/multimedia, public relations, events, etc. Student teams will then develop a promotional plan and corresponding budget to reach the desired target market (JHU undergrads who meet the client's criteria), implement the plan and then evaluate its effectiveness through pre- and post-campaign market research conducted on the target consumer.
Kendrick   3 credits   spring

660.460 Entrepreneurship
This course provides students with a solid introduction to the entrepreneurial process of creating new businesses. Students will gain an appreciation for the investors' perspective in assessing opportunities, evaluating strategies, and valuing the new enterprise. The course will cover the principal components of building a successful venture including management, market analysis, intellectual

property protection, legal and regulatory issues, operations, entrepreneurial financing, and the role of the capital markets. The course will feature several guest speakers including venture capitalists, entrepreneurs, and leading service providers. Course work will include case studies and creation of investor marketing materials. Prerequisite: 660.105 Intro to Business or 660.250 Principles of Marketing, junior or senior standing.
Aronhime   3 credits   fall

660. 461 (E) Engineering Business and Management
An introduction to the business and management aspects of the engineering profession, project management, prioritization of resource allocation, intellectual property protection, management of technical projects, and product/production management. Cross-listed with Mechanical Engineering.
Izenberg, Niewoehner   3 credits   fall

660.500 Business Internship
Applications are available in 104 Whitehead Hall and must include a resume, transcript, and written essay. Applications are evaluated on the basis of work experience, grades, essay, and course work.
Kendrick   1 credit   fall and spring

660.501 Practicum in Entrepreneurship and Management
Students work on an existing business or marketing plan/case project under the close supervision of a CLE faculty member. Students must apply by submitting a cover letter, resume, unofficial transcript, and essay describing the business concept/marketing plan. Applications must be approved by both the faculty member and director of CLE. Students are expected to meet regularly with the faculty member and complete assigned readings and projects. S/U only.
Aronhime, Kendrick, Sheff   3 credits   fall and spring

662.611 Accounting and Finance
This course includes a review of financial accounting with an emphasis on the implications of GAAP selections and other managerial decisions on the financial statements. Historic financial performance is assessed using ratio analysis. Relevant cash flows are used in capital budgeting situations; projects are analyzed using discounted cash flow techniques as a measure of valuation. Managerial accounting topics of financial forecasting, cost accumulation, cost allocation, product costing, and variance analysis are used in decision making. For M.S. in Engineering Management only; graded (not P/F); no audits.
Leps   2 hours   fall

662.632 Law and Entrepreneurship
Law and Entrepreneurship introduces participants to the fundamental aspects of law associated with developing and bringing new products to the marketplace. Arranged in modules and taught largely through the case

method, the course features the following topics: creating and forming businesses; contracts; intellectual property; principal-agent relations; and product liability. Not only will participants learn the principles associated with each topic, but also they will master the questions and concerns to use when working with legal counsel on these issues in the future.
Lebbos, Thompson   2 hours   spring

662.642 Management and Leadership
Management and Leadership is a case, experiential and research based course intended to introduce participants to issues and solutions related to growing and managing businesses with an emphasis on entrepreneurial enterprises. The course focuses on managerial decision making and organization building through topics that include planning and managing strategic change; finding competitive advantage; making informed decisions; dealing with uncertainty; negotiating collaborative settlements; managing/leading projects, teams and professionals; networking and forming strategic alliances; valuing differences; creating and maintaining organizational cultures; and devising performance measures. Additionally, participants master aspects of management communication as they address course content.
Rice   2 hours   spring

662.651 Marketing Communications and Strategy
This course is designed to introduce students to key marketing, communications, and strategic issues surrounding the process of bringing new products to the marketplace. Through cases, readings, discussion and hands-on team projects, students develop a flexible approach to thinking about marketing problems, maximizing resources and creating strategic solutions. Written and oral work focuses on communicating effectively with target audiences using integrated media and developing interpersonal skills essential for managers, including presenting to a hostile audience, running meetings, listening, and contributing to group decision making.
Sheff   fall

662.692 Venture Planning
Venture Planning requires participants to work in groups to address, design and plan a business solution for an engineering problem with social implications. More specifically, students will work on cross-disciplinary teams to determine the commercial viability of a new technology. They must select a problem amenable to an engineering solution, investigate the problem, research the issues and potential, develop a design for the technology, investigate the competitive advantage, and create and present a business plan for the idea. Course content will address many of the issues that will be encountered during the process of bringing an idea to fruition.
Aronhime   2 hours   spring

Courses by Category

Accounting/Finance

660.203 Financial Accounting
660.300 Managerial Finance
660.303 Managerial Accounting
660.304 Financial Statement Analysis
660.401 (S) Advanced Corporate Finance

Business Law

660.308 (S) Business Law I
660.310 (H) Case Studies in Business Ethics
660.311 (S) Law and the Internet
660.404 (S) Business Law II
660.405 (S) Intellectual Property Law

Management/Leadership

660.105 (S,W) Introduction to Business
660.321 (W) Managing Social Enterprises
660.332 (S,W) Leadership Theory
660.333 Leading Change
660.335 Negotiation and Conflict Management
660.340 Principles of Management
660.341 (W) Business Process and Quality Management
660.460 Entrepreneurship
660.461 (E) Engineering Business and Management
660.500 Business Internship
660.501 Practicum in Entrepreneurship

Marketing/Communications

660.250 Principles of Marketing
660.350 (W) Marketing Strategy
660.355 Sports Marketing
660.358 International Marketing
660.450 Advertising and Promotion

M.S. in Engineering Management

662.611 Accounting and Finance
662.632 Law and Entrepreneurship
662.642 Management and Leadership
662.651 Marketing Communication and Strategy
662.692 Venture Planning
662.811 MSEM Seminar

General Engineering

The General Engineering program offers both a B.A. with a major in general engineering and a number of non-departmental courses.

The Faculty

Edward Scheinerman, Professor (Applied Mathematics and Statistics) and Vice Dean for Education. Primary Advisor to the General Engineering Program and Chair of the General Engineering Faculty Oversight Committee.

Marc Donohue, Professor (Chemical and Biomolecular Engineering) and Vice Dean for Research.

Andrew Douglas*, Professor (Mechanical Engineering) and Vice Dean for Faculty.

Kalina Hristova*, Assistant Professor (Materials Science and Engineering).

Mike Karweit, Research Professor (Chemical and Biomolecular Engineering).

Daniel Naiman*, Professor (Applied Mathematics and Statistics).

Ben Schafer*, Associate Professor (Civil Engineering).

Erica Schoenberger*, Professor (Geography and Environmental Engineering).

Howard Weinert, Professor (Electrical and Computer Engineering).

David Yarowsky*, Professor (Computer Science).

*members of the Faculty Oversight Committee for General Engineering.

Bachelor of Arts in General Engineering

The bachelor of arts in general engineering is a liberal arts degree that is designed to provide students with both a concentration in some area of humanities or social sciences and the fundamental engineering principles needed to understand the basics of modern technology, innovations and engineering practices. It is intended for undergraduate students who desire a background in engineering and technology yet have neither the desire nor the intention to become professional engineers. These students may, for example, plan to pursue graduate or professional study in architecture, business, law (e.g., intellectual property, patent law), or medicine. They may wish to work in areas which relate to engineering and technology or to thrive in the global industrial economy. The bachelor of arts in general engineering is a true liberal arts degree with a concentration in engineering.

This degree is not an engineering degree, and is not suitable for employment as a professional engineer. This program is not accredited by the Accreditation Board for Engineering and Technology. Students desiring careers as professional engineers should complete a B.S. degree in one of the engineering disciplines offered by the Whiting School.

The distinctive features of the bachelor of arts in general engineering include:

- *Breadth.* Course requirements for the bachelor of arts in general engineering encourage breadth, including mathematics, natural sciences, humanities and/or social sciences, international studies (language or other courses and experience in a foreign country) and in engineering. The curriculum also allows for many free electives.

- *Flexibility.* This program is designed to allow students, in consultation with their advisor, the flexibility to choose a program of study that matches their interests. The engineering concentration and the humanities and social science requirements may be departmentally based or may follow a theme designed by the student and his/her advisor. Students are encouraged to minor in any area of their choosing.

- *Interdisciplinary Study.* The distribution requirements are ideal for students who seek to understand areas at the interface between technical fields (such as robotics, nanotechnology and biomaterials) or the connections between a technical area and a discipline in the humanities or social sciences (for example environment issues and international trade or ethics and biotechnology).

- *International Dimensions of Engineering.* Students are required to develop knowledge of the international dimensions of engineering. They may do this by studying abroad or by taking a combination of language and other classes that develop an understanding of the culture, technology or society in a foreign country.

Requirements for the B.A. Degree

All undergraduate students majoring in the bachelor of arts in general engineering must follow a program approved by their advisor. Candidates must fulfill the overall requirements for the B.A. degree as described in this catalog (see page 48). These include the university writing requirement, distribution requirement and 120 credit minimum.

Details of these requirements are also provided in the Undergraduate Student Handbook. Sample curricula and details on concentrations can be found in the Advising Manual for general engineering (**www.engineering.jhu.edu/academics**).

Mathematics (20 credits)

Mathematics is at the core of modern science and technology and a solid foundation is required to understand how contemporary engineering problems are solved. Students are required to take five courses including:

> 110.108 Calculus I
> 110.109 Calculus II
> One course in statistics
> One course at the 200-level or above in either statistics or mathematics
> One mathematics or statistics elective.

Natural Sciences (15 credits)

Students are required to take four courses and two laboratory courses including:

> 171.101 General Physics I and at least one course chosen from
> - 030.101 Introductory Chemistry,
> - 510.101 Introduction to Materials Chemistry, *or*
> - 020.151 General Biology,
> two terms of laboratory course; and
> two elective courses (area code N).

Humanities and Social Sciences (24 credits)

Writing Requirement. Students must complete at least four (minimum of 12 credits) writing intensive courses (catalog code W) and one of these courses must specifically develop writing skills, such as Technical Communication or Basic Expository Writing.

Humanities or Social Science Concentration. A minimum of four courses (12 credits) must be taken as a coherent group in either the humanities or social sciences, of which two are at the advanced (300+) level.

Humanities or Social Science Elective. Three additional courses (9 credits) in either the humanities or social sciences. These electives are typically used to take courses in economics and the history of science and technology, depending on the courses chosen to fulfill the concentration requirements detailed above.

International Dimensions of Engineering

Because of the importance of the globalization of technology, all students completing the B.A. in general engineering are required to demonstrate competence in being able to address technical issues within the context of another society. This can be done in one of three different ways.

First, students are encouraged to study abroad for a minimum of one fall or one spring semester in any foreign country (except Canada). In that country, they must take the equivalent of a minimum of 12 credits which are transferred to their Hopkins transcript. In this case, these credits can satisfy any degree requirements (Humanities or Social Sciences, Engineering Concentration, Mathematics, Free Electives, etc.).

Second, students may complete the equivalent of two semesters of the same foreign language (students may not use language courses in their native language to satisfy this requirement) and one additional course which relates to the culture, economy, social structure or politics of a country to which uses this foreign language (9 credits).

Third, students may demonstrate proficiency in a foreign language by taking an intermediate course in a foreign language (this can include their native tongue) and two additional courses which relate to the culture, economy, social structure, or politics of a country which uses this foreign language (9 credits).

Engineering Core (15 credits)

One course (3 credits) that is an introduction to an engineering discipline such as: What is Engineering?; Energy and the Environment; Perspectives on the Evolution of Structures; From the Stone Age to the Age of Silicon: Materials and Their Influence on Technology; Introduction to Electrical and Computer Engineering; Introduction to Environmental Engineering; and Freshman Experiences in Mechanical Engineering.

One course (3 credits) in a computer language. Examples include Introduction to Programming in Java and Computing for Engineers and Scientists.

Three courses in the fundamentals of engineering science (at least one course from three of the following four areas).

1. Circuits,

2. Statics and Mechanics of Materials,

3. either Introduction to Engineering Materials or Structure of Materials, and

4. either Mechanical Engineering Thermodynamics or Engineering Thermodynamics.

Engineering Concentration (20 credits)

The concentration in engineering must consist of at least six courses (minimum of 20 credits) that

are related thematically or departmentally; at least three (3) of which must be at the advanced level (300 or above). While examples of concentrations are provided in the Advising Manual, students are encouraged to develop their own concentrations in consultation with their faculty advisor.

Free Electives

Between five and nine full courses (at least 3 credits each) to ensure a minimum of 120 credits in total. The number of courses required will depend on how the International Dimensions requirement is satisfied and on the courses chosen in other areas. Students must select these courses in consultation with their advisor. These free electives are designed to allow students to develop a curriculum of study uniquely suited to their interests.

Students are required to have a minimum cumulative GPA of 2.0 to graduate. Further, a maximum of 12 "D" credits may be counted toward degree requirements. There is a maximum limit of six "D" credits in any combination of courses used to satisfy the Humanities or Social Sciences concentration, the Engineering Core and the Engineering Concentration (47 total credits). No more than 12 credits completed prior to matriculation or in summer sessions at other accredited colleges or universities may be accepted.

Transfer students are not subject to the 12-credit limit on transfer credit. They must obtain credit for courses they wish to transfer during their first year at Hopkins. University regulations require a minimum of four consecutive full-time semesters and 60 credits earned at JHU for a Hopkins degree.

Undergraduate Courses

General Engineering Courses

500.100 (E) Archimedes' Lever: How Engineers Move the World

This course is an introduction to the world of engineering as a creative endeavor that reshapes the world. This course will give students multiple perspectives on engineering, including historical, ethical, societal, commercial, legal, environmental, and interpersonal. The soul of engineering is invention and students will enjoy opportunities to express their creativity. Weekly meetings will feature presentations and hands-on activities led by the Dean and Vice Deans of engineering as well as other faculty from our campus. Freshmen only, S/U grading only.
Scheinerman   1 credit

500.101 (E) What is Engineering?

This is a course of lectures, laboratories, and special projects. Its objective is to introduce students not only to different fields of engineering but also to the analytic tools and techniques that the profession uses. Assignments include hands-on and virtual experiments, oral presentations of product design, and design/construction/testing of structures. Open to freshmen only.
Karweit   3 credits

500.111 (E,N) Energy and the Environment

Energy generation, transmission, and use are presented, with particular emphasis on the environmental consequences. Topics include the nature of energy, the types of energy sources (e.g., electricity, hydrogen), the greenhouse effect, conversation, and projected needs, both in the U.S. and worldwide.
Katz   3 credits

500/560.141 (E,N,W) Perspectives on the Evolution of Structures

Why do buildings and bridges look the way they do today? Students will be provided the tools to answer this question for themselves through a study of the history of the design of buildings and bridges throughout the world from both the engineering and architectural/aesthetic perspectives. Only simple mathematics is required (no calculus). Students will participate in individual and group critique of structures from engineering, architectural, and social points of view.
Schafer   3 credits

500.200 (E,Q) Computing for Engineers and Scientists

This course introduces a variety of techniques for solving problems in engineering and science on a computer using MATLAB. Topics include structure and operation of a computer, the programming language MATLAB, computational mathematics, and elementary numerical analysis. Prerequisite: 110.109.
Karweit   3 credits

500.301 (E,Q) Computational Techniques in Engineering and Science

Beginning with a review of structured programming languages (C, FORTRAN), this course develops the numerical tools needed to solve basic engineering and science problems. Topics include numerical solutions of equations, interpolation, approximation, numerical differentiation and integration, root finding, and solutions to linear systems. Accuracy and stability are emphasized throughout. Engineering problems requiring the use of algorithms from Press, et al., Numerical Recipes are assigned weekly. Prerequisites: 110.202, 550.291, and a cursory knowledge of C or FORTRAN, or instructor's permission.
Karweit   4 credits

500.410 (E,N) Surgery for Engineers
Surgery for Engineers is a laboratory experience that teaches the fundamental skills and operative procedures for general surgery. This hands-on course is designed for engineers tasked with development of computer-integrated surgical systems and associated technologies. Students are exposed to both traditional and innovative operating room (OR) environments and are taught basic techniques used during surgery. Limit: 12.
Brown   3 credits

Graduate Courses

500.603 Academic Ethics
This course introduces all first-year Engineering graduate students to their academic and ethical responsibilities as members of the Johns Hopkins University community. All new students are required to complete this online tutorial within a certain timeframe following initial matriculation. Students are automatically enrolled in this course and are not permitted to withdraw from it. NOTE: This does not count as a full course toward minimum requirements for federal financial aid purposes.

500.781 Preparation for University Teaching
Full-time EN Graduate Students only. This course will prepare graduate students to teach at the university level. Topics covered include large and small class teaching, characteristics of student learning, syllabus construction, grading students, and developing a teaching portfolio. Co-listed as 360.781

500.851 Engineering Research Practicum
This course is for Whiting School graduate students who spend a semester or summer working off-campus conducting scientific research at a sponsoring corporation. The research conducted for the practicum must be related to the student's academic program in some way. Before the practicum is begun, the sponsoring faculty member and the student's faculty advisor (this may be the same person) must sign a form which states the number of credits to be received by the student, verifies the nature of the work to be performed by the student, and explains how the practicum is related to the student's program. Once the practicum is completed, the sponsoring faculty member submits a grade (P/F) for the student. This course may be used for Curricular Practical Training (CPT) purposes.

Geography and Environmental Engineering

The Department of Geography and Environmental Engineering is concerned with the improved understanding and description of environmental problems including questions of pollutant fate and transport, water resources engineering, environmental chemistry, geomorphology, drinking water and wastewater treatment, ecosystem dynamics, and technology, society, and environmental change. Drawing from a number of disciplines and approaches, elements within these systems are examined, and interconnections among elements are explored. The department represents a unique opportunity for undergraduate education through our environmental engineering major and minor, a geography major, and for advanced graduate education, research, and interdisciplinary collaboration. Some broadly defined examples of the subjects collaboratively studied by our faculty and students are listed below;

- Engineering processes to alleviate environmental problems. This requires knowledge of both natural processes and engineering design. The former addresses phenomena that are basic to understanding how engineering can help solve environmental problems. The latter involves the application of such understanding to problem solutions.

- Surficial, atmospheric and subsurface processes involving interactions of chemical, biological, and hydrological processes in the environment.

- Application of engineering solutions in the context of the public decision making process including economic, social, and administrative factors.

- Analysis of interrelationships between engineering and administrative decisions and cultural, institutional, and governmental sectors of society, especially in the urban environment.

Engineering designs and public decisions must rest upon a sound knowledge of fundamental scientific processes as well as economic policy and social science. Research and study are focused on both basic, and the applied aspects of environmental problems. Interdisciplinary work is necessary, combining, for example, the basic sciences, engineering, and environmental economics. Because of its diversity of interests and association with other departments of the university, the department can offer a broad range of graduate programs based on the natural, social, and engineering sciences.

Several study areas of the department are further described below. These do not represent closed systems of study or programs that students must fol-low to the exclusion of work in related areas. They identify major foci of research and teaching in the department and directions which students may wish to pursue. The department encourages its students to cross these obviously artificial boundaries.

The Faculty

Hedy V. Alavi, Graduate Part-Time Program in Environmental Engineering and Science (Program Chair): environmental engineering, hazardous waste management, solid waste management.

William P. Ball, Professor: environmental engineering, contaminant fate and transport.

David Berry, Professor: environmental biotechnology, water quality engineering, health-related water microbiology.

John J. Boland, Professor Emeritus: environmental economics and policy.

Edward J. Bouwer, Abel Wolman Professor of Environmental Engineering (Department Chair): environmental engineering, environmental microbiology, waste treatment.

Grace S. Brush, Professor: ecology, plant geography.

Kai Loon Chen, Assistant Professor: physiochemical processes, particle interaction.

J. Hugh Ellis, Professor: environmental systems.

Seth Guikema, Assistant Professor: Probabilistic systems modeling techniques, risk analysis, uncertainty modeling, infrastructure modeling, and decision making under uncertainty.

Steve H. Hanke, Professor: applied micro- and macroeconomics and finance.

Ciaran Harman, Assistant Professor: watershed hydrology, geomorphology.

Markus Hilpert, Associate Professor: environmental flow and transport processes.

Benjamin F. Hobbs, Theodore K. and Kay W. Schad Professor of Environmental Management: energy and environmental systems, engineering and economics.

A. Lynn Roberts, Professor: environmental chemistry.

Erica J. Schoenberger, Professor: economic geography, environment, society and technology, environmental history.

Eugene D. Shchukin, Research Professor Emeritus: colloid and surface science.

Alan T. Stone, Professor: environmental and aquatic chemistry.

Peter R. Wilcock, Professor: mechanics of earth surface processes, applied geomorphology.

Justin C. Williams, Associate Research Professor: environmental and urban systems.

Joint, Part-Time, and Visiting Appointments

Joseph Katz, Professor (Mechanical Engineering): experimental fluid mechanics, development of advanced diagnostics techniques.

Charles Meneveau, Professor (Mechanical Engineering): environmental fluid mechanics, engineering, turbulence.

Marc B. Parlange, Adjunct Professor: hydrology, environmental fluid mechanics, atmospheric interactions.

Andrea Prosperetti, Professor (Mechanical Engineering): fluid mechanics, bubble mechanics, numerical simulations.

Kellogg Schwab, Associate Professor (Environmental Health Engineering, Bloomberg School of Public Health): environmental public health, pathogen microbiology.

Study Areas

The following study areas help illustrate the depth and breadth of academic and research opportunities available through the Department of Geography and Environmental Engineering.

Please note:

• This list is far from complete. The interests and expertise of students and faculty within the department are continually expanding and changing.

• Interdisciplinary activities, often involving two or more of these study areas, are at the core of the department's academic and research programs. Notice there is strong overlap between the study areas.

• Students are encouraged to look beyond these classifications and construct a program that best suits their interests and professional goals. Unique combinations of course work and research experience make it possible for students to identify and address issues in new, imaginative ways. Academic advisors work with students to ensure that each program of study includes sufficient depth and rigor.

Environmental Engineering

The Environmental Engineering study area is concerned with issues that involve water and wastewater treatment, transport and fate of contaminants in natural and engineered environments, hazardous and solid waste management, hydrology, and environmental fluid dynamics. Current research efforts are directed to 1) applying biological, chemical, and physical processes to treatment of contaminants in drinking water or wastewaters; 2) evaluating colloidal stability in natural and engineered systems; 3) exploring contaminant transport and interphase transfer, and the influence of these processes on chemical or biological transformations; and 4) examining heat and mass transport and scaling mechanics at the land-atmosphere interface.

Water and Air Resources Engineering

Water and Air Resources Engineering is concerned with the occurrence, movement, and management of water and air through and above the surface of the Earth. This study area involves many faculty in the department and has close interactions with faculty and students throughout Hopkins including those in the Center for Environmental and Applied Fluid Mechanics. Research in this group currently deals with 1) surface hydrology and groundwater; 2) the dispersion of pollutants in the atmosphere and surface and subsurface waters; 3) water supply, distribution, and risk analysis; 4) measurement and modeling of turbulent environmental flows; 5) mathematical modeling of subsurface and atmospheric transport phenomena; 6) movement of water and chemicals in the vadose zone and in water supply aquifers; 7) the impact of climate change on water resources; and 8) river system dynamics.

Environmental Chemistry

The Environmental Chemistry study area is devoted to understanding the chemical and biological reactions and mobility of contaminants in natural environments and engineered aquatic systems. Research is focused on 1) identifying chemical and biological constituents of aquatic environments that catalyze, inhibit, or react with organic and inorganic contaminants; 2) exploring how protonation, complex formation, sorption, and partitioning affect rates of contaminant transformation; 3) examining interconnections between physical, chemical, and biological phenomena affecting contaminants; and 4) developing structure-property and structure-reactivity relationships that provide a basis for predicting transformation and fate.

Systems Analysis and Economics for Public Decision Making

The goal of the study area in Systems Analysis and Economics for Public Decision Making is to develop competence in the modeling and analysis of public policy alternatives and private sector responses to those policies. To achieve this goal, students typically emphasize economics or systems analysis or a blend of these two disciplines. Those emphasizing economics undertake specialized training in

resource economics, microeconomic theory, cost-benefit analysis, public finance, and econometrics. Example applications include the economics of public works, water and energy pricing and regulation, demand forecasting, natural resource valuation, and public utility financing. Students focusing on systems analysis take courses in the mathematics of optimization and decision analysis, including linear and non-linear programming, integer programming, stochastic programming, simulation, Bayesian analysis, and multiobjective decision making. Example applications include water resources management, siting of urban and regional facilities for services and/or distribution, pollution management, simulation of market responses to environmental policies, and integrated assessment of climate policy and impacts.

Geomorphology, Hydrology, and Ecology

Geomorphology, Hydrology, and Ecology promotes the fundamental understanding of processes at the Earth's surface. Research is presently focused on 1) physical dynamics of tidal freshwater wetland evolution; 2) land use impacts on forest dynamics; 3) sediment transport, channel dynamics, and benthic ecology in rivers; 4) acquisition of metals by plants, fungi, and bacteria; 5) estuarine paleoecology; and 6) maintenance and flushing flows in mountainous rivers.

Human Geography—Technology, Society, and Environmental Change

The graduate study area in Technology, Society, and Environmental Change focuses primarily on the relationships among social organization, technological and industrial change, the production of space and place, government policy and environmental outcomes. Substantive domains of inquiry include 1) globalization and regional/local processes of economic, political, and cultural change. In particular, this entails grappling in particular with the behavior of multinational corporations and governments and the regional/local consequences of technological changes and institutional activities and decision making. Comparative studies of industrial transformations and their social and environmental consequences are emphasized. 2) urbanization and regional growth and decay. This involves the study of spatial differentiation in population distributions and their well-being arising out of the spatial mobilities of capital and labor, shifts in industrial structure, and processes of technological and cultural change. Comparative studies of urbanization processes—particularly Baltimore's—are encouraged; and 3) the dynamics of environmental and social change. This requires consideration of philosophic, economic, and broad-based cultural backgrounds to environmental problems. Issues such as environmental justice, environmental ethics, and a critical application of appropriate knowledge (scientific, economic, cultural) for environmental decision making are strongly emphasized.

Facilities

Student and staff offices and laboratories are located in Ames and Krieger halls. A large teaching laboratory is equipped for biological and chemical examination of water and wastewater. Laboratories for research and teaching provide opportunities for research involving chemistry and microbiology. These include a number of environmental control rooms along with research opportunities involving sediment transport as well as pilot scale process investigations. Excellent facilities and instrumentation for atmospheric field studies exist, including laser radar for aerosols, fast response turbulence instruments, and radiation meters. Students also have access to treatment plants and other municipal and state facilities that may be useful in conducting research, as well as to vehicles and boats for field trips and field research of all types. Extensive computer facilities are available both in the department and in the university as a whole.

Financial Aid

The department maintains a large and continuing program of financial aid for graduate students, including tuition scholarships, fellowship awards, research assistantships, and teaching assistantships. Financial aid is granted on the basis of merit, and criteria for consideration for these awards include academic excellence, professional or research experience, and career commitment to the field. Continued support is subject to the student's performance, availability of research or TA funds, and requisite staffing of current projects. Ph.D. students often receive priority for full financial support. Pending available funding, partial tuition fellowships are offered to qualified master's students. Ph.D. applicants are nominated by the department for consideration for fellowships. The department often can offer one or more departmental fellowships to help support the most qualified Ph.D. applicants for their first year of study.

Futhermore, many students within the department have been awarded graduate research fellowships available to Ph.D. and M.S. students through programs administered by the National Science Foundation and the Environmental Protection Agency. Graduate fellowships are also available for

underrepresented minority students in the engineering and natural science fields through the GEM Consortium. Qualified students are strongly recommended to apply for these fellowships during the fall of the final year prior to beginning graduate studies, as many programs have November or December deadlines.

Undergraduate Programs

Programs in Environmental Engineering

The Department of Geography and Environmental Engineering offers an undergraduate degree in environmental engineering along with five-year B.S./M.S. and B.S./M.S.E. programs.

Students may also wish to consider enrolling in one of two minor programs offered by the department: (1) a minor in environmental engineering or (2) a minor in environmental sciences. As part of these minor programs, or as part of other programs of the student's own design, the department offers electives in such areas as ecology, geomorphology, water and wastewater pollution treatment processes, environmental systems analysis, and environmental policy studies. The major and minor programs are described below.

Bachelor of Science in Environmental Engineering

The field of environmental engineering is dedicated to the study and especially to the amelioration of environmental problems. Such problems are complex and multifaceted, and successful solutions must operate within the constraints imposed by societal concerns. As a result, the discipline of environmental engineering is a highly interdisciplinary endeavor. The mission of our undergraduate program is to provide students with a broadly based yet rigorous education in the fundamental subjects central to the field, in a milieu that fosters development of a spirit of intellectual inquiry and the problem-solving skills required to address the open-ended issues characteristic of the real world.

Our B.S. program provides a strong foundation in the physical, chemical, and biological sciences, as well as in mathematics, engineering science, and engineering design. It is broad and flexible enough to accommodate students with a variety of interests in environmental engineering. This training should provide an ideal preparation for future employment in business or industry or for subsequent training at the graduate level, either in environmental engineering or in a field such as environmental law, public health, or medicine.

Program Education Objectives

The general objectives of the undergraduate program in environmental engineering are to prepare graduates who are able to:

- Apply the fundamental scientific principles of engineering to multifaceted environmental problems.
- Communicate, collaborate, and think critically.
- Continue to obtain and synthesize new knowledge.
- Appreciate the importance of professional ethics and service.
- Apply their talents as practicing professionals or continue their education at the best graduate and professional schools.

Course Curriculum

Students may select between four different concentration areas:

- Environmental Management and Economics
- Environmental Engineering Science
- Environmental Transport
- Environmental Health Engineering

With the assistance of a faculty advisor, each student will plan a curriculum suited to his or her ultimate career goals. The program also encourages individual study and research and is ABET (Accreditation Board for Engineering and Technology) accredited. Advanced training through participation in a senior design project involves synthesizing information from more than one field to solve real-world problems.

Program requirements total 124 credits.

Mathematics with a focus on applications (19 credits)

Required courses:

110.108 Calculus I (Physical Sciences and Engineering)

110.109 Calculus II (Physical Sciences and Engineering)

110.202 Calculus III (Physical Sciences and Engineering) *or*

110.211 Honors Multivariable Calculus and Linear Algebra

550.291 Linear Algebra and Differential Equations *or*

110.302 Differential Equations with Applications

A 300-level or higher course in probability and statistics (The Departments of Applied Mathematics and Statistics and Civil Engineering offer a number of suitable courses.)

Basic Science (24 credits)

Required courses:
171.101 General Physics for Physical Science Majors I
171.102 General Physics for Physical Science Majors II
173.111 General Physics Lab I
173.112 General Physics Lab II

One year of introductory chemistry (e.g., 030.101 Intro Chemistry I and 030.102 Intro Chemistry II)
030.105 Introductory Chemistry Laboratory I
030.106 Introductory Chemistry Laboratory II
570.205 Ecology

An additional course in the biological sciences, such as
020.151 General Biology I, *or*
570.328 Geography and Ecology of Plants

Note: Premedical students could substitute
020.305 Biochemistry
020.315 Biochemistry Lab
020.306 Cell Biology
020.316 Cell Biology Lab

Premedical students should also take additional chemistry courses as electives, such as
030.205 Intro Organic Chemistry I,
030.206 Intro Organic Chemistry II, and
030.225 Organic Chemistry Lab

Humanities and Social Sciences (18 credits)
A minimum of six courses totaling 18 credits in Humanities or Social Sciences (catalog code H or S). The six courses must include 1) one course that specifically develops writing skills (e.g., a how-to-write class) 2) 570.334 Engineering Microeconomics and 3) four additional H&S courses with at least two at the 300 level or higher. Courses 570.404 and/or 570.406 can be taken as part of these requirements. Please note that the writing course will fulfill one of the two writing intensive courses required by the university (W courses). (**Note:** Most medical schools require a year of English literature and/or composition.)

Required course:
570.334 Engineering Microeconomics

Additional elective examples from DoGEE:
570.406 Environmental History
570.427 Natural Resources, Society, and Environment

Writing course examples:
220.146 (H,W) Introduction to Science Writing
220.202 (H,W) Introduction to Nonfiction: Matters of Fact
060.113 or 060.114 Expository Writing (either one; both cannot be counted for H/S credit)
220.105 or 220.106 Introduction to Fiction and Poetry I
661.110 Professional Communication for Science, Business, and Industry

General Engineering (16 credits)

Required courses:
570.108 Introduction to Environmental Engineering
An introductory course in computing (570.210 Introduction to Computation and Mathematical Modeling or an equivalent course)
A course in thermodynamics (e.g., 540.203 Engineering Thermodynamics, 510.312 Physical Chemistry of Materials I: Thermodynamics, or 530.231 Mechanical Engineering Thermodynamics)
A course in statics (either 560.201 Statics and Mechanics of Materials or 530.201 Statics and Mechanics of Materials)
570.351 Introduction to Fluid Mechanics

Design Experience and Engineering Laboratory (8 credits)
570.305 Environmental Engineering Systems Design
570.419, 570.421 Environmental Engineering Design I, II

This is a four credit project course (1 credit fall semester, 3 credits spring semester) and involves a comprehensive study of the engineering design process from problem definition to final design. The course involves team projects that include written and oral presentations. Students will form small teams that will work with local companies or government agencies in executing the project. Prerequisite: senior standing in Environmental Engineering.

Environmental Engineering Requirements (26 credits)

Required courses (14 credits):
570.239 Current and Emerging Environmental Issues
570.301 Environmental Engineering I: Fundamentals

570.302 Environmental Engineering II:
Water and Wastewater Treatment

570.304 Environmental Engineering and
Science Laboratory

570.353 Hydrology

Environmental Engineering Electives (12 credits)

Students take at least two courses from one of the following focus areas, and at least one course from two of the other focus areas. Courses to be selected in consultation with advisor. Any changes in courses must be approved by the advisor. These courses will include numerous open-ended problems.

- Environmental Management and Economics (**Note:** 600-level courses require permission of instructor)
  570.496 Mathematical Models for Managing Urban and Environmental Systems
  570.497 Risk and Decision Analysis
  570.618 Multiobjective Programming and Planning
  570.659 Environmental Policy Analysis

- Environmental Engineering Science
  570.411 Environmental Microbiology
  570.443 Aquatic Chemistry
  570.442 Environmental Organic Chemistry

- Environmental Transport
  270.375 Groundwater
  530.328 Fluid Mechanics II
  570.432 Sediment Transport and River Mechanics
  570.424 Air Pollution

- Environmental Health Engineering
  570.600 Engineering Aspects of Public Health Crises
  182.625 Principles of Industrial Hygiene
  187.610 Principles of Toxicology
  340.601 Principles of Epidemiology

Technical Electives (minimum of 12 credits)

(selected in consultation with an advisor)

At least three (E), (Q), or (N) courses totaling at least 12 credits. (For ABET requirements at least one from Solid Waste Engineering and Management; Hazardous Waste Engineering and Management; Air Pollution; Environmental Health Engineering, if not satisfied as part of the Environmental Engineering electives). Up to six credits of independent study or research may be applied toward engineering requirements (e.g., 570.501/502 Undergraduate Research, 570.505 Undergraduate Independent Study or 570.499 Senior Thesis). Note earlier comments for pre-med majors.

It is strongly recommended that students take additional advanced classes in computing and numerical methods. Environmental Engineering Science students are strongly encouraged to take at least one course in organic chemistry (e.g., 030.205 Introductory Organic Chemistry I) which, however would not count toward the TE 300 level requirement.

Sample Program:

This program satisfies the Environmental Engineering B.S. degree requirements with a concentration area in environmental engineering science. This program is based on the assumption that students have not previously completed A.P. courses in calculus, physics, chemistry, etc.

- **Year 1**

Fall

110.108	Calculus I (Physical Sciences and Eng)	4
570.107	Intro to Geography (H/S elective 1)	3
030.101	Intro Chemistry I	3
030.105	Intro Chemistry Lab I	1
570.108	Intro to Environmental Eng	3
	Subtotal	14

Spring

110.109	Calculus II (Physical Sciences and Eng)	4
030.102	Intro Chemistry II	3
030.106	Intro Chemistry Lab II	1
	H/S Elective 2	3
570.210	Intro to Computation and Math Modeling	3
	Subtotal	14
		(Annual 28)

- **Year 2**

Fall

560.201	Statics and Mechanics of Materials	4
171.101	General Physics for Physical Science Majors I	4
173.111	General Physics Lab I	1
570.205	Ecology	3
550.291	Linear Algebra and Differential Equations	4
	Subtotal	16

Spring

570.239	Current and Emerging Environmental Issues	3
110.202	Calculus III (Calculus of Several Variables)	4
171.103	General Physics for Physical Science Majors II	4
173.112	General Physics Lab II	1

H/S Elective 3 <u>3</u>
Subtotal 15
(Annual 31)

- **Year 3**

Fall

570.305 Environmental Engineering 4
    Systems Designs
570.334 Engineering Microeconomics 3
570.301 Environmental Engineering I: 3
    Fundamentals
570.351 Intro Fluid Mechanics 3
570.422 Math Models for Managing 3
    Environmental Systems
540.203 Engineering Thermodynamics <u>3</u>
Subtotal 19

Spring

570.302 Environmental Engineering II 3
570.304 Environmental Engineering 2
    and Science Lab
360.349 Cities Under Stress: The 3
    Baltimore Case
570.328 Geography and Ecology of Plants 3
Probability/Statistics course
    (300-level or higher) <u>3</u>
Subtotal 14
(Annual 33)

- **Year 4**

Fall

570.353 Hydrology 3
570.419 Environmental Eng Design I 1
270.375 Groundwater 3
570.411 Environmental Microbiology 4
570.443 Aquatic Chemistry 3
570.424 Air Pollution <u>3</u>
Subtotal 17

Spring

570.421 Environmental Eng Design II 3
570.432 Sediment Transport and River 3
    Mechanics
530.328 Fluid Mechanics II 3
570.491 Hazardous Waste Engineering 3
    and Management
H/S Elective 3
Subtotal <u>15</u>
(Annual 32)

Total **124**

Math (19 credits); Humanities and Social Sciences (18 credits); Basic Science (24 credits); General Engineering (16 credits); Environmental Engineering Requirement (14 credits); Environmental Engineering Electives (13 credits); Technical Electives (12 credits); Design (8 credits). Total credits are 124.

Minor in Environmental Engineering

Environmental engineers play particularly pivotal roles as professionals who bridge the gap between understanding complex scientific concepts and helping to formulate public policies that affect the environment. Environmental engineering has become an important aspect of engineering practice in most engineering fields, and the discipline spans the professional spectrum from the private sector through governmental agencies to academia. An undergraduate minor in environmental engineering allows engineering students to pursue an interest in this field and to incorporate aspects of environmental engineering into careers in other engineering disciplines.

Students in any undergraduate major in the Whiting School of Engineering are eligible for admission to the environmental engineering minor program. Students in the program are assigned an advisor in the Department of Geography and Environmental Engineering to work with them in developing a program that meets the requirements for the minor and is consistent with the educational requirements of their major field of engineering study. Requirements of the minor program consist of: (1) a set of required core science and mathematics courses, already common to civil and chemical engineering majors; (2) four required courses in environmental engineering (total of 12 credits, listed below); and (3) two elective courses, one taken at the freshman or sophomore level, and the other taken at the junior or senior level. Specific requirements are further described below.

Core Courses

Advanced placement credits and/or equivalent courses in other schools or departments are acceptable, subject to advisor approval.

	credits
110.108 Calculus I	4
110.109 Calculus II	4
110.202 Calculus III	4
550.291 Linear Algebra and	4
Differential Equations	
030.101 Intro Chemistry I	3
030.102 Intro Chemistry II	3
030.105 Intro Chemistry Lab I	1
030.106 Intro Chemistry Lab II	1
171.101 General Physics I	4
171.172 General Physics II	4
173.111 General Physics Lab	1
173.112 General Physics Lab	1

Required Courses (total of 12 credits)

A total of 18 credits is required in addition to the previously specified core.

570.301 Environmental Engineering I: Fundamentals
Mass and energy transfer, water quality, hazardous substances and risk analysis, water and wastewater treatment, air pollution, and global environmental issues. Prerequisites: Calculus and one year of chemistry. Corequisite: Fluid mechanics or equivalent.

570.302 (N,E) Environmental Engineering II: Water and Wastewater Treatment
Theory and design of water and wastewater treatment processes including coagulation, sedimentation, filtration, adsorption, gas transfer, aerobic and anaerobic biological treatment processes, disinfection, and hydraulic profiles through treatment units. Prerequisites: 570.351 and 570.301 or permission of instructor.
Ball   3 credits   spring

570.304 Environmental Engineering and Science Laboratory
Introduction to laboratory measurements relevant to water supply and wastewater discharge, including pH and alkalinity, inorganic and organic contaminants in water, reactor analysis, bench testing for water treatment, and control of disinfection by-products. Prerequisite: 570.301 Environmental Engineering I: Fundamentals. Corequisite or prerequisite: 570.302 Environmental Engineering II: Water and Wastewater Treatment.

570.305 Environmental Engineering Systems Design
Techniques from systems analysis applied to environmental engineering design and management problems: reservoir management, power plant siting, nuclear waste management, air pollution control, and transportation planning. Design projects are required. Prerequisites: 500.200 Introduction to Computing for Engineers and Scientists or equivalent.

Note: 500.200 is not strictly required for students who are willing to undertake additional effort toward obtaining basic skills in these areas; see the instructor if you have specific concerns.

Elective Courses (total of 6 credits) one course from each of two groups is required.

Group A**
Introductory courses at the freshman and sophomore level. One course required.*
   570.107 Intro to Geography
   570.108 Intro to Environmental Engineering
   570.205 Ecology
   570.239 Current and Emerging
        Environmental Issues
   570.317 Paleoecology
   570.328 Geography and Ecology of Plants
   020.151 General Biology I
   270.220 The Dynamic Earth: An Intro to Geology
   500.111 Energy and the Environment

Group B**
Engineering science courses that are developed for juniors and seniors and also introductory graduate-level courses. One course is required. Double counting of these courses with specified required courses in the student's major is not allowed.

   570.303 The Environment and Your Health
   570.353 Hydrology
   570.411 Environmental Microbiology
   570.420 Mechanics for Earth and
        Environmental Science
   570.423 Principles of Geomorphology
   570.431 Open-Channel Hydraulics
   570.432 Sediment Transport and River
        Mechanics
   570.442 Environmental Organic Chemistry
   570.443 Aquatic Chemistry
   570.445 Physical/Chemical Processes in
        Environmental Engineering I
   570.460 Environmental Colloidal Phenomena
   570.490 Solid Waste Engineering and
        Management
   570.491 Hazardous Waste Engineering and
        Management
   570.600 Eng Aspects of Public Health Crises
   030.204 Intermediate Chemistry
   030.205 Intro Organic Chemistry
   030.301 Physical Chemistry I
   270.375 Groundwater
   270.369 Geochemistry of the Earth and
        Environment
   270.410 Remote Sensing of the Environment
   540.301 Kinetic Processes
   540.303 Transport Phenomena I
   550.310 Probability and Statistics for the
        Physical and Information Sciences and
        Engineering
   560.435 Probability and Statistics in Civil Eng

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 * *Substitution for one required course may be possible under special circumstances, with explicit approval of the environmental engineering minor advisor.*
 **Additional course electives are possible but require approval of the environmental engineering minor advisor.*

For further information, contact Dr. William P. Ball, Coordinator, 308 Ames Hall (DOGEE), 410-516-5434, bball@jhu.edu, or contact Adena Rojas, Senior Academic Program Coordinator, 313 Ames Hall (DOGEE), 410-516-5533, arojas@jhu.edu.

Minor in Environmental Science
The environmental science minor has been developed to encourage and facilitate studies in environmental science by students completing degrees in the other science and engineering disciplines. The minor requires completion of a set of courses in the core sciences, two introductory courses dealing with

the environment, and three or more upper-level environmental sciences courses, as described below.

Core Sciences

Because of the interdisciplinary nature of environmental science, it is important that professionals from various areas of expertise acquire a common language and set of core concepts to make discussion and cooperation possible. The following courses represent the minimum set of requirements:

- **Mathematics (12 credits)**
  110.108 Calculus I
  110.109 Calculus II

At least one of these four courses:
  110.201 Linear Algebra
  110.202 Calculus III
  110.302 Differential Equations with
      Applications
  550.291 Linear Algebra and Differential
      Equations

- **Biology (3 credits)**
  One course, such as
  020.151 General Biology

- **Physics (10 credits)**
  171.101 Physics I
  171.102 Physics II
  173.111 General Physics Lab I
  173.112 General Physics Lab II

- **Chemistry (13 credits)**
  030.101 Intro Chemistry
  030.104 Intro Organic Chemistry
  030.105 Intro Chemistry Lab
  030.106 Intro Chemistry Lab

Environmental Sciences:

Students must take two introductory courses dealing with the environment and three or more of the upper-level environmental science courses on the following lists:

- **Introductory Courses (6 credits)**
  570.110 Introduction to Engineering for
      Sustainable Development
  570.205 Ecology
  570.239 Current and Emerging
      Environmental Issues
  270.110 Freshman Seminar: Sustainable and
      Non-Sustainable Resources
  270.220 The Dynamic Earth: An Introduction
      to Geology
  270.221 The Dynamic Earth Lab

- **Upper-Level Courses (9 credits)**
  570.239 Current and Emerging
      Environmental Issues
  570.301 Environmental Eng I: Water and
      Wastewater Treatment
  570.302 Environmental Eng II: Water and
      Wastewater Treatment
  570.317 Paleoecology
  570.328 Geography and Ecology of Plants
  570.353 Hydrology
  570.411 Environmental Microbiology
  570.420 Mechanics for Earth and
      Environmental Science
  570.423 Principles of Geomorphology
  570.424 Air Pollution
  570.431 Open-Channel Hydraulics
  570.432 Sediment Transport and
      River Mechanics
  570.441 Environmental Inorganic Chemistry
  570.442 Environmental Organic Chemistry
  570.443 Aquatic Chemistry
  570.445 Physical and Chemical Processes in
      Environmental Eng I
  570.446 Biological Processes for Water and
      Wastewater Treatment
  570.460 Environmental Colloidal Phenomena
  570.465 Water Resource Development:
      History and Principles
  570.491 Hazardous Waste Engineering and
      Management
  270.302 Aqueous Geochemistry
  270.321 Intro Oceanography
  270.350 Sedimentary Geology
  270.311 Geobiology
  270.313 Isotope Geochemistry
  270.314 Field Course in Soil Formation
  270.369 Geochemistry of the Earth and
      Environment
  270.375 Groundwater
  270.394 Global Geochemical Cycles and
      Climate Change

Choice of a Major

Many of the most creative and productive advances in environmental sciences in recent years have come from scientists trained in traditional disciplines (biology, chemistry, geology, physics, and engineering) who have devoted themselves to the study of environmental problems. Completion of the degree requirements of a traditional discipline

provides depth and rigor that, when supplemented with additional academic training in environmental science, can be applied to professional work in a variety of environmental subjects, as the following examples show:

Biological Processes:

Response of ecosystems to change, microbial degradation of pollutants, biogeochemical cycling of greenhouse gases. Illustrative departments: Biology, Biomedical Engineering, Biophysics, Biochemical Engineering.

Physical Processes:

Erosion of hillslopes, rivers, and coastlines; sediment production, transport, and fate; groundwater, movement of contaminant plumes; oceanography; atmospheric physics; aerosol formation; global warming. Illustrative departments: Civil Engineering, Chemical and Biomolecular Engineering, Mechanical Engineering, Physics, Earth and Planetary Sciences.

Environmental Chemistry:

Environmental fate of pollutants, water and waste water treatment, geochemistry, atmospheric chemistry, ozone depletion, acid rain. Illustrative departments: Chemistry, Chemical and Biomolecular Engineering, Earth and Planetary Sciences, Materials Science and Engineering.

Environmental Systems:

Environmental modeling, risk assessment, environmental systems design, pollution control strategies. Illustrative departments: Civil Engineering, Applied Mathematics and Statistics.

Faculty Advising:

A faculty advisor is assigned to each student in the environmental science minor program to assist in planning his/her academic program and to approve the choice of courses to satisfy the minor. Faculty advisors are available in the following areas:

Biological Processes: Edward J. Bouwer

Physical Processes: Peter R. Wilcock

Environmental Chemistry: Alan T. Stone

Environmental Systems: Ben Hobbs

Human Geography: Erica J. Schoenberger

Further information is available from Professor Peter Wilcock, coordinator of the environmental science minor or Adena Rojas, Senior Academic Program Coordinator.

Minor in Engineering for Sustainable Development

Engineers will be increasingly called upon to help devise solutions to the tremendous problems of poverty, inequality, and social and environmental dislocation that afflict major parts of the globe in the 21st century. Working as an engineer in this context involves negotiating highly complex social, economic, and political realities and dealing with a wide range of institutions and actors, including national and local governments, multilateral lenders such as the World Bank, diverse non-governmental organizations (NGOs), and local communities. It also increasingly involves working in interdisciplinary teams with social scientists, public health and medical workers, humanitarian aid workers, bankers, politicians, and the like. "Sustainable" development implies a development path that is socially equitable, culturally sensitive, and environmentally appropriate over a multi-generational time frame. The minor in Engineering for Sustainable Development exposes engineering students to some of the key issues related to development, methods of information-gathering in diverse and difficult settings, and working effectively with non-engineers on complex problems.

The minor encompasses seven courses. The core course is 570.110 Introduction to Engineering for Sustainable Development. Five additional courses will be selected in a program devised in consultation with the minor advisor. Students are also required to take 570.4xx Seminar in Engineering for Sustainable Development: Theory, Practice, Experience after completing the other requirements for the minor (under development).

Of the five additional courses:

- Three must be grouped around a specific theme, region or within a specific discipline. Themes might include, for example, public health, environment, or economic development. Regions include Africa, Latin America or Asia. Disciplinary concentrations might be in Anthropology, Economics, Geography, History, Political Science, Public Health, or Sociology.

- Three of the courses must be at the 300 level or above.

- One of the courses must cover methods for gathering and evaluating information in a development context. Examples include:
  070.319 The Logic of Anthropological Inquiry
  070.219 Anthropology and Public Action
  070.347 Discourse Analysis: Human
      Foregatherings and Comminglings
  280.345 Biostatistics in Public Health

280.350 Introduction to Epidemiology
230.202 Research Methods for the Social
Sciences

Bachelor of Arts in Geography

Geographical knowledge constitutes a vital store of information concerning the distribution over the earth's surface of those environmental conditions (both naturally occurring and anthropogenic) essential to support an immense diversity of human life and activity.

The study of Geography focuses on understanding how physical, biotic, social, and economic processes are perpetually reshaping environments and landscapes in ways either favorable or unfavorable for different life forms in general and for different and distinctive kinds of human occupancy and culture in particular. Geographical education seeks to instill a deep appreciation of the grand diversity of ways in which the peoples of the earth have learned to use and modify their environments creatively. It also focuses on the environmental problems that arise in association with such processes of modification. While geography in general looks to maintain a strong bond between physical and human dimensions of landscape formation, specialization within that general framework is also encouraged.

Human Geography is primarily concerned with the detailed specification of the economic, social, political, and cultural processes that lead to the substantive modification of natural environments through the draining of marshes, the damming of rivers, the development of agriculture, mining, and industry, and the construction of human settlements. It is also crucially concerned with the forms of interaction (trade, communications, capital flows, and migrations) between people over space and the effects of such interactions upon the people of the world. The barriers to interaction (political boundaries, for example, and the acquisition by human populations of strong senses of local, regional, and territorial identity) are likewise a key topic for examination.

Physical geography is primarily concerned with those physical processes—climatic, ecological, geological, hydrological—which have shaped and which continue to shape the earth's surface, creating distinctive physical and ecological conditions for different life forms. Training in physical geography aims to build sufficient technical expertise to handle a wide range of environmental problems concerning the atmosphere, the earth, and the hydrosphere, with special emphases upon water, surficial processes, and ecology.

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors and Writing Requirement sections.)

The B.A. in geography offers a broad background in the sciences (particularly biological and ecological), the social sciences, and the humanities. All majors must fulfill the general university requirements and take *four* fundamental courses in geography. They may then choose a concentration in *either* physical or human geography. In addition to these courses focused on their special interest, they may freely select electives to fill the 120 credit hours required for the B.A. degree.

All programs must be developed in close association with a faculty advisor selected by the student in accordance with his/her academic objectives. The department's undergraduate advising manual includes a more extensive list of appropriate courses in selected areas.

Concentration in Human Geography

A concentration in human geography must include AS 230.202 Research Methods for the Social Sciences and 230.205 Introduction to Social Statistics, or EN.550.111-112, Statistical Analysis I and II (or the equivalent) and knowledge of one foreign language at the intermediate level. At least four appropriate introductory courses (12 or more credits) are also required in such fields as anthropology, economics, humanities, political science, and sociology. Beyond this, students should elect, in consultation with the geography advisor, a minimum of nine courses (about 27 credits) at or above the intermediate level in their field of major interest. The aim here is to enable students to build their own combination of departmental courses and courses from relevant cognate disciplines.

Someone specializing in economic geography, for example, might include courses on natural resources, society and environment, environmental economics, and political ecology combined with courses in anthropology, political science, sociology, or economics. A student interested in urban geography might combine course work in the department with courses in the humanities (e.g., 300.603-604 Literature of the City), in political science, or in urban economics, while taking advantage of the seminar-internship on urban policy in a government department or with a community organization. A student interested in environmental issues could work across the physical-human divide and combine course work in ecology and geology with seminars on environmental policy, ethics, and philosophy. Someone specializing in cultural geography could combine work on the

social and geographical landscape with courses in social and cultural anthropology.

Concentration in Physical Geography

A concentration in physical geography must include 110.202 Calculus III and 550.310 Probability and Statistics (or the equivalent). At least four appropriate introductory courses (12 or more credits) are also required in such fields as chemistry, biology, geology, or physics. Beyond this, students should elect a minimum of eight courses (about 24 credits) at the intermediate level in their field of major interest. The major with a concentration in physical geography consists of four parts: (1) mathematics, (2) the basic natural sciences, (3) those sciences directly related to the student's area of specialization, such as environmental chemistry, physical geography, or biogeography, and (4) courses which focus on the environment itself: the atmosphere, earth, and hydrosphere.

Undergraduates with an interest in environmental chemistry, for example, would take fundamental courses such as organic chemistry, biochemistry, and thermodynamics, while those oriented toward the earth sciences would take courses in petrology, thermodynamics, fluid mechanics, and other aspects of geology. For a student interested in biogeography—dealing with the spatial pattern of plants, the role of environmental factors in influencing those distributions, and the effect of changes in vegetation on the landscape—the department offers courses in plant geography, ecology, and paleoecology.

Program in Public Decision Making

Undergraduates majoring in geography may satisfy departmental requirements through the program in Systems Analysis and Economics for Public Decision Making. In addition to prerequisites from other departments (e.g., 550.361-362 Introduction to Optimization and 180.101-102 Elements of Economics), students in this program take at least four courses from the public decision making curriculum, including 570.495 Foundations of Optimization for Planning and Policy and 570.493 Economic Foundations for Public Decision Making.

Graduate Programs

(See also Admissions and Finances, page 20.)

The department welcomes applicants with backgrounds in the sciences, engineering, or in the liberal arts interested in applying their specialized knowledge to the pressing problems of human interaction with the environment. These fundamental backgrounds can be enlarged upon while students develop their special interests in the department. Students can select courses suited to a particular field of interest. Once they have mastered fundamentals, they have complete freedom to study in related fields. Independent study and vigorous exchange of ideas in seminars and laboratory are indispensable parts of each student's program. The department emphasizes study in related fields of natural and social sciences because of the importance of adapting the latest scientific information and methods for research and practice, and because the fundamental sciences are most effectively mastered at an educational institution. Research and teaching are integral parts of the graduate training program.

Graduates of the department have found jobs in university departments of civil and environmental engineering, economics, biology, chemistry, geography, and geology; in federal, state, and municipal government; in private industry; and in private research and consulting organizations.

Requirements for Advanced Degrees

Course work requirements for the master's degree and doctorate are generally flexible. Former training and experience and the special field of interest influence the development of each student's program of advanced study.

No 100-level or 200-level courses can be counted toward the credit requirements for master's degrees.

Proficiency in one foreign language is required for all degree candidates in Human Geography. Based on the nature and need of students' educational and research programs, faculty advisors may require proficiency in one foreign language for an M.A. or a Ph.D. degree. There is no language requirement for the M.S.E. degree.

Ph.D. Degree

The goals for students in the Ph.D. program are 1) to develop reasoning skills that can be applied to new and unanticipated issues; 2) learn how to pose questions and answer them in a logical manner; 3) acquire a depth of understanding and technical knowledge in a particular study area, on par with others worldwide; and 4) make a significant contribution to our understanding in this particular study area. The emphasis in the Ph.D. degree is upon a sound foundation in the fundamentals required in a given area with considerable flexibility in course selection determined by the interests and background of each graduate student. The doctoral student must take the equivalent of about two full academic years of formal course work. Roughly half of this is done in the principal subject, and the rest is cho-

sen from allied fields. The minimum residence requirement is two consecutive semesters registered as a full-time student.

All students must pass departmental and Graduate Board oral examinations for the doctorate. Usually these examinations are taken after two years of academic work. Research leading to the dissertation should make an original contribution to the chosen field of specialization, and the result must be worthy of publication. A final oral examination will either be a dissertation defense or an open seminar.

M.A. Degree

The M.A. degree is open to students with undergraduate degrees in social sciences or the humanities. It requires a minimum of 30 credits that include no more than one credit of seminar. In addition to these course credits, M.A. students have the option to complete an independent research project, submitted as a formal essay. Students can focus on one of the study areas that have been listed or construct their own program that complements and expands their undergraduate experience; three semesters are typically required to complete the degree. Each program of study is planned by the student in consultation with department faculty and must be approved by the faculty advisor.

M.S. Degree

The M.S. degree is open to students with undergraduate degrees in engineering, mathematics, biology, chemistry, physics, geology, and other scientific disciplines. It requires a minimum of 30 credits that include no more than 1 credit of seminar. In addition to these course credits, M.S. students have the option to complete an independent research project, submitted as a formal essay. The M.S. program is well suited for students intending to continue their studies and obtain a Ph.D. Students can focus on one of the study areas that have been listed or construct their own program that complements and expands their undergraduate experience. At least two semesters are needed to complete the M.S. degree without the research project. Three to four semesters are typically required to complete the degree with a research project. Each individual's program of study is planned by the student in consultation with department faculty and must be approved by the faculty advisor. At least half of the required 30 credits must come from courses within the department.

M.S.E. Degree

The M.S.E. degree is open to students with an ABET-accredited undergraduate engineering degree or demonstrated equivalent. The M.S.E. degree is typi-cally a nine month program based on course work alone and generally intended for those students planning to work in engineering practice. However, M.S.E. students have the option to complete an independent research project, submitted as a formal essay or group project report. The M.S.E. program requires a minimum of 30 credits that include no more than 1 credit of seminar and no more than 6 credits of independent research. A degree with significant research components will usually require three or four semesters for completion.

Master's Degree Program Descriptions

The **contaminant fate and transport program** emphasizes understanding of physical, chemical, and biological phenomena that affect the movement and transformation of pollutants in the environment. The emphasis of the **program in environmental process engineering** is on the analysis and design of processes of water treatment, waste treatment, and environmental remediation, and includes a solid grounding in the chemical, biological, and physical principles underlying treatment and remediation technologies. The **water resources engineering program** combines a solid grounding in environmental fluid mechanics and hydrology with electives in modeling, water development planning, policy, and contaminant fate and transport. The **environmental management and economics program** focuses on using models of physical and economic systems to analyze and improve the design of public policies and environmental control systems. The master's **program in environmental science** provides a broad yet rigorous background for environmental professionals. The **environmental science and policy program** has that same flavor but also includes economics and systems courses. Described next are the required courses and recommended electives for the concentrations presented above.

*Recommended Electives Note: It is strongly advised to select elective courses from the list of recommended electives appropriate for each concentration. In order to substitute an alternate course for a recommended elective, students must receive written approval from their advisor.

Contaminant Fate and Transport

Required courses:
  570.411 Environmental Microbiology
  570.442 Environmental Organic Chemistry
  570.443 Aquatic Chemistry
  570.445 Physical and Chemical Processes in
      Environmental Engineering I
  570.452 Experimental Methods in
      Environmental Engineering and Chemistry

Recommended electives* include:
- 270.375 Ground Water
- 570.444 Colloid Chemistry
- 570.446 Biological Processes for Water and Wastewater Treatment
- 570.459 Organic Geochemistry
- 570.656 Environmental Transport Phenomena
- 570.657 Air Pollution
- 570.686 Multiscale Flow and Transport in Porous Media

Environmental Process Engineering

Required courses:
- 570.411 Environmental Microbiology
- 570.443 Aquatic Chemistry
- 570.445 Physical and Chemical Processes in Environmental Engineering I
- 570.446 Biological Processes for Water and Wastewater Treatment
- 570.448 Physical and Chemical Processes in Environmental Engineering II
- 570.452 Experimental Methods in Environmental Engineering and Chemistry

Recommended electives* include:
- At least one course in Geomorphology, Hydrology, or Ecology
- At least one course in Systems Analysis and Economics
- 570.442 Environmental Organic Chemistry
- 570.444 Colloid Chemistry
- 570.491 Hazardous Waste Management

Water Resources Engineering

Required courses:
- 570.395 Principles of Estuarine Environment: Chesapeake Bay
- 570.353 Hydrology
- 570.375 Ground Water
- 570.426 Geomorphic and Ecologic Foundations of Stream Restoration
- 270.405 Modeling the Hydrological Cycle

Recommended electives* include:
At least one course in Systems Analysis or Economics [e.g., 570.493, 570.497]
- 570.423 Principles of Geomorphology
- 570.431 Open-Channel Hydraulics
- 570.432 Sediment Transport and River Mechanics
- 570.443 Aquatic Chemistry
- 570.445 Physical and Chemical Processes in Environmental Engineering I
- 570.686 Multiscale Flow and Transport in Porous Media

Prerequisites for the M.S. and M.S.E. programs include mathematics through differential equations and computing skills. Contaminant Fate Transport, Environmental Process Engineering, Environmental Management and Economics, and Water Resources Engineering require one course in applied mathematics, numerical analysis, or engineering mathematics (e.g., 570.495, 570.496, 570.487, 570.661, or an appropriate course from another department that is approved by your advisor). Contaminant Fate and Transport, Environmental Process Engineering, and Water Resources Engineering require, as prerequisite, an introductory fluid mechanics course. The program in Contaminant Fate and Transport also requires one semester each of general and organic chemistry. If any of these prerequisites are lacking, they can be taken as part of the course of study, but the credits will not be counted toward the 30 credit requirement.

Environmental Management and Economics

Required courses:
- 570.493 Economic Foundations for Public Decision Making
- 570.495 Foundations of Optimization for Planning and Policy
- 570.608 Uncertainty Modeling for Policy Analysis and Management
- 570.496 Mathematical Models for Managing Urban and Environmental Systems
- 570.497 Risk and Decision Analysis
- 570.659 Environmental Policy Analysis

Recommended electives* include:
At least one course in physical, chemical, or biological processes
- 570.607 Energy Planning and Policy Modeling
- 570.618 Multiobjective Programming and Planning
- 570.676 Stochastic Programming
- 570.611 Natural Resources Economics (or other environmental economics course)

Environmental Science

The master's program in environmental science is open to students with undergraduate degrees in biology, chemistry, physics, geology, and other scientific disciplines. The program requires a minimum of 30 credits (at least half must be from courses within the department), to include no more than 1 credit of seminar. In addition to these course credits, candidates have the option to complete an independent research project, submitted as a formal essay. Students are encouraged to develop a course program that complements and expands their under-

graduate experience; three or four semesters are typically required to complete the degree. Each individual's program of study is planned by the student in consultation with department faculty and must be approved by the faculty advisor.

Environmental Science and Policy

Four courses are required in environmental science, including the following:

> 570.445 Physical and Chemical Processes in Environmental Engineering I
> 570.446 Biological Processes for Water and Wastewater Treatment
> 570.448 Physical and Chemical Processes in Environmental Engineering II

M.A. and M.S. students pursuing this program who do not have prior background in environmental engineering can substitute 570.301 and 570.302 in lieu of the courses suggested above. The other environmental science courses should be chosen from 270.375, 570.306, 570.319, 570.411, 570.442, 570.443, and 570.491.

Four courses are required in environmental policy, including:

> 570.493 Economic Foundations for Public Decision Making
> 570.495 Foundations of Optimization for Planning and Policy

The remaining environmental policy courses should be chosen from 195.477-478, 195.607, 195.609, and 570.659. The final two courses would be a project or electives in environmental science, engineering, policy, or systems that are appropriate to the student's goals.

Undergraduate Courses

570.107 (S) Introduction to Geography
The spatial distribution of human uses of the earth is related to the distribution of natural environments and to cultural and historical factors which influence the way the earth is perceived and used. An attempt is made to explain the present distribution of diverse activities such as agriculture, industry, trade, and resource use. In turn, current issues related to population growth, famine, environmental change, and urbanization are considered within this broad geographic format.
Schoenberger   3 credits

570.108 (E) Introduction to Environmental Engineering
This course provides an overview of environmental engineering including water and air quality issues, water supply and wastewater treatment, hazardous and solid waste management, pollution prevention, global environmental issues, public health considerations and environmental laws, regulations and ethics. Numerous current and timely illustrative examples are presented through the course.
Alavi   3 credits   fall/summer

570.109 (E,N) Environment & Society: Toward Sustainability
An introduction to understanding sustainability, with a focus on identifying and implementing solutions for a world of increasing needs and limited resources.
Norman   3 credits

570.110 (H,S) Introduction to Engineering for Sustainable Development
A survey of the earth's surface and near-surface environments, with an emphasis on current environmental problems. Climate, landforms, energy and water cycles, soils and ecosystems. Human interaction with the environment and problems of population, pollution, sustainability, natural hazards, and environmental change.
Wilcock   3 credits

570.147 (H,S) (W) Adam Smith and Karl Marx
Freshmen only. Smith and Marx are often treated as icons in debates about capitalism and their thinking is reduced to sound bites. In this course we read them closely to see what they really said. You may be surprised.
Schoenberger   3 credits

570.205 (N) Ecology
An introduction to processes governing the organization of individual organisms into populations, communities, and ecosystems. Interactions between individual organisms, groups of organisms, and the environment, including adaptation, natural selection, competition. The role of climate on biodiversity, migrations, and extinctions. The effect of acidification, deforestation, soil erosion, and other human activities on atmospheric, hydrologic, and soil processes and the resulting impact on species diversity, community structure, and ecosystem sustainability. Problems related to the effect and mitigation of environmental pollution on different ecosystems will be assigned. Students are required to participate in one of five all-day field trips. These trips are to specific ecosystems, e.g., a saltwater marsh, tidal freshwater marsh, and man-made marsh, a dune (wind-dominated) ecosystem, a pine barrens (fire-dominated), where the effect of human activities on different ecosystems will be demonstrated. Graduate students must register for 570.403.
Brush   3 credits   fall

570.210 (E,Q) Introduction to Computation and Mathematical Modeling
An introduction to the use of computers in developing mathematical models. A structured approach to problem definition, solution, and presentation using spreadsheets and mathematical software. Modeling topics include elementary data analysis and model fitting, numerical modeling, dimensional analysis, optimization, simula-

tion, temporal and spatial models. Prerequisite: 110.108 or equivalent
Wilcock   3 credits   spring

570.239 (E,N) Current and Emerging Environmental Issues

Scientific principles underpinning environmental issues, with an emphasis on potential impacts of anthropogenic activities on human and ecological health. Prerequisite: second semester Chemistry.
Roberts   3 credits   spring

570.301 (N,E) Environmental Engineering I: Fundamentals

Mass and energy transfer, hazardous substances and risk analysis, water quality modeling, water and wastewater treatment, air pollution. Prerequisites: calculus, one year of chemistry. Corequisite: fluid mechanics or equivalent.
Chen   3 credits   fall

570.302 (N,E) Environmental Engineering II: Water and Wastewater Treatment

Theory and design of water and wastewater treatment processes including coagulation, sedimentation, filtration, adsorption, gas transfer, aerobic and anaerobic biological treatment processes, disinfection, and hydraulic profiles through treatment units. Prerequisites: 570.351 and 570.301 or permission of instructor.
Ball   3 credits   spring

570.304 (E, N, W) Environmental Engineering and Science Laboratory

Introduction to laboratory measurements relevant to water supply and wastewater discharge, including pH and alkalinity, inorganic and organic contaminants in water, reactor analysis, bench testing for water treatment, and measurement and control of disinfection by-products. Prerequisite or corequisites: 570.301-302.
Stone   2 credits   spring

570.305 (N,E) Environmental Engineering Systems Design

Techniques from systems analysis applied to environmental engineering design and management problems: reservoir management, power plant siting, nuclear waste management, air pollution control, and transportation planning. Design projects are required. Prerequisites: 110.302, 500.200 Intro to Computing or equivalent, 560.435 Probability and Statistics in Civil Engineering or equivalent, or permission of instructor.
Ellis   4 credits   fall

570.320 (E,S) Topics on Appropriate and Sustainable Technology for Developing Communities

Lectures, readings and discussions on general and location-specific issues related to collaborative student projects about appropriate technology-based interventions. Focus is on improving student understanding about some of the environmental, social, health, and economic issues relevant to the development of sustainable technical interventions for under developed communities and about the role of engineers in designing, planning, implementing, and evaluating such interventions.
Ball, Schoenberger   1 credit   fall

570.321 (E) Practicum on Appropriate and Sustainable Technology for Developing Communities

Academic and practical support for students working on engineering projects in developing countries. Students prepare written and oral presentations related to their activities on the development, planning, and/or implementation of project activities conducted in collaboration with Engineers Without Borders or other similar organizations. Prerequisite or corequisite: 570.110 or 570.320. Permission required.
Ball, Karweit,   2 credits   fall

570.312 (E) Practicum on Appropriate and Sustainable Technology for Developing Communities

Academic and practical support for students working on engineering projects in developing countries through Engineers Without Borders or other organizations. All students prepare written and oral presentations related to their activities on the development, planning, and/or implementation of project activities. Prerequisite 570.110 or 570.320.
Ball, Karweit   2 credits   spring

570.317 (N) Paleoecology

The history of land, water, atmospheric processes, and ecosystem dynamics recorded in the fossil archives of organisms and materials preserved in lake and estuarine sediments. A comparison of human and natural disturbance, including climate, on the evolution of ecosystems. Designs for restoration and maintenance of ecosystems within the context of climate change and societal organizations. Field and laboratory techniques include coring of sediments and extraction of paleoecological indicators such as pollen, seeds, and diatoms from sediments. Prerequisite: 570.205 or permission of instructor.
Brush   3 credits   spring/alternate years

570.328 (N) Geography and Ecology of Plants

Patterns of aquatic and terrestrial plant species; historical changes in patterns using paleobotanical techniques; emphasis on biological and physical mechanisms controlling the patterns; the role of climate and man on plant distributions; several field trips; project required.
Brush   3 credits   spring

570.334 (S) Engineering Microeconomics

The financial and economic implications of engineering designs and control policies are critical to their success. This course uses a calculus-based approach to introduce principles of engineering economics and microeconomics (demand and production theory) and their uses in engineering decision making. Example applications include civil infrastructure design; communications network expansion; and environmental policy evaluation. Prerequisite: Calculus III.
Norman   3 credits   fall

570.351 (E) Introduction to Fluid Mechanics

Introduction to the use of the principles of continuity, momentum, and energy to fluid motion. Topics include hydrostatics, ideal-fluid flow, laminar flow, turbulent flow, form and surface resistance with applications to fluid measurement, flow in conduits and channels, pumps and

turbines. Selected laboratory exercises are included. Prerequisites: statics, differential equations. *Alternating years with Civil Engineering.*
Wilcock   3 credits   fall

570.353 (E) Hydrology
The occurrence, distribution, movement, and properties of the waters of the Earth. Topics include precipitation, infiltration, evaporation, transpiration, groundwater and streamflow. Analyses include the frequency of floods and droughts, time-series analyzes, flood routing, and hydrologic synthesis and simulation. Prerequisites: differential equations, fluid mechanics.
Hilpert   3 credits   fall

570.395 (N) Principles of Estuarine Environment: The Chesapeake Bay
Topics include the physical, chemical, and biological components of the Chesapeake Bay ecosystem from the time it started to form some 10,000 to 12,000 years ago, when sea level began to rise as the continental glaciers receded; the geology, geomorphology, and biology of the watershed drained by the estuary; relationships between the watershed and the estuary through the millennia and the effect of climate, geomorphology, and humans on the ecology of the ecosystem and its economic productivity. Included in the course are discussions of the various models used to diagnose the health of the Bay, the institutions established to manage the Bay, and policies recommended to restore its productivity. The Chesapeake ecosystem will be compared with other estuaries throughout the world. There will be two field trips—one on the University of Maryland's Research Vessel Aquarius and the other to a series of fresh and brackish marshes adjacent to and part of the Bay ecosystem.
Brush   3 credits   fall

570.403 (N, W) Ecology
An introduction to processes governing the organization of individual organisms into populations, communities, and ecosystems. Interactions between individual organisms, groups of organisms, and the environment, including adaptation, natural selection, competition. The role of climate on biodiversity, migrations, and extinctions. The effect of acidification, deforestation, soil erosion, and other human activities on atmospheric, hydrologic, and soil processes and the resulting impact on species diversity, community structure, and ecosystem sustainability. Problems related to the effect and mitigation of environmental pollution on different ecosystems will be assigned. Students are required to participate in one of five all-day field trips. These trips are to specific ecosystems, e.g., a saltwater marsh, tidal freshwater marsh, and man-made marsh, a dune (wind-dominated) ecosystem, a pine barrens (fire-dominated), where the effect of human activities on different ecosystems will be demonstrated.
Brush   3 credits   fall

570.404 (H,S) Political Ecology
The study of how and why people use or abuse their environment in the context of complicated local social and economic histories and how they are situated in a global economic order. Combines analysis of political economic and environmental processes. Themes include rural development, gender relations.
Schoenberger 3 credits

570.406 (H, S, W) Environmental History
Environmental history explores long-term interactions between social change and environmental transformation, or the ways in which societies modify landscapes and are themselves affected by geological, climatologic, and changing ecological conditions. This reading seminar considers classic and more recent contributions to this endeavor.
Schoenberger   3 credits   spring

570.411 Engineering Microbiology
Fundamental aspects of microbiology and biochemistry as related to environmental pollution and water quality control processes, biogeochemical cycles, microbiological ecology, energetics and kinetics of microbial growth, and biological fate of pollutants. Five laboratory experiments.
Bouwer   4 credits   fall

570.418 (E) Multiobjective Programming and Planning
Public sector problems are typically characterized by a multiplicity of objectives and decision makers. This course presents a relatively new area of systems analysis which is useful for such problems: multiobjective programming or vector optimization theory. The fundamental concepts are developed and various methods are presented, including multiattribute value and utility theory. Prerequisite: 570.495 or permission required.
Hobbs, Williams   3 credits

570.419 (E) Environmental Engineering Design I
Through general lectures and case study examples, this course will expose students to some of the non-technical professional issues that they will face as professional engineers and in their second semester senior design project. The understanding developed in this course will be subsequently reinforced in the second course in this series (570.421), which will involve a comprehensive design of an open-ended environmental engineering project by a team (or teams) of students. In this first semester, students will be exposed to important aspects of professional practice and the design process, will form project teams, and will be introduced to the specific issues related to the design problem that they will subsequently tackle. Prerequisite: senior standing in environmental engineering.
Alavi, Ball, Bouwer, Hobbs, Wilcock   2 credits   fall

570.420 (N) Mechanics for Earth and Environment Science
The physical properties and behavior of fluids, soil, and rock relevant to problems in earth and environmental science. The course is intended for students whose studies require a working knowledge of, but not a concentration in, mechanics. Topics include stress and strain; groundwater flow; dimensional analysis and modeling; fluids and fluid motion; transport of mass and momentum in viscous and turbulent flows; consolidation, strength, and failure of soils and rocks. Applications are drawn from environ-

mental science, geology, and geotechnical engineering. Prerequisites: one year each of calculus and physics.

Wilcock   3 credits   fall

570.421 (E) Environmental Engineering Design II

This course involves a comprehensive design of an open ended environmental engineering project by a team (or teams) of students. The design will require an integrated application of the knowledge acquired in prior course and will involve principles of engineering design, professional ethics, and engineering economics. Written reports and oral presentation about the design will be made to faculty, student peers, and an external board composed of practitioners in the environmental engineering profession. Prerequisites: 570.302, 570.352, and 570.419.

Alavi, Ball, Bouwer, Hobbs,Wilcock   3 credits   spring

570.423 (N) Principles of Geomorphology

Analysis of the factors responsible for the form of the landscape. The concept of the cycle of erosion is discussed primarily in terms of the principles that govern the processes of erosion. Climate, conditions of soil formation, and the distribution of vegetation are considered as they relate to the development of land forms. Prerequisite: 270.220 The Dynamic Earth or permission of instructor. (3 hours lecture, 3 hours lab)

Wilcock   4 credits   spring

570.424 (E) Air Pollution

This course consists of an introduction to the fundamental concepts of air pollution. Major topics of concern are aspects of atmospheric motion near the Earth's surface; basic thermodynamics of the atmosphere; atmospheric stability and turbulence; equations of mean motion in turbulent flow, mean flow in the surface boundary layer; mean flow, turbulence in the friction layer; diffusion in the atmosphere, statistical theory of turbulence; plume rise. Emphasis is placed upon the role and utility of such topics in a systems analysis context, e.g., development of large and mesoscale air pollution abatement strategies. Comparisons of the fundamental concepts common to both air and water pollution are discussed.

Ellis   3 credits   fall

570.426 (E,N) Geomorphic and Ecological Foundations of Stream Restoration

Principles from hydrology, sedimentation engineering, geomorphology, and ecology applied to design and assessment of stream restoration. Watershed context, design alternatives, uncertainty, ecological response. Field trips, design exercises, and project assessment.

Wilcock   3 credits

570.427 (S) Natural Resources, Society, and Environment

How do we produce and consume natural resources and what are the social and environmental impacts of our patterns of resource use? Technological and social determinants of resource use and their consequences will be examined.

Schoenberger   3 credits   fall

570.428 Applied Economics Research

Course given in conjunction with private business and financial institutions, governmental entities and economic research institutes. Requirements include 120 hrs of internship time, participation in a weekly seminar and a research paper on an applied economics topic. Cross-listed with Economics and Interdepartmental. Prerequisite: 180.101-102, permission required.

Hanke   3 credits

570.431 (E) Open-Channel Hydraulics

Application of the principles of fluid mechanics to flow in open channels. Topics include uniform flow, flow resistance, gradually varied flow, flow transitions, unsteady flow. Flow in irregular and compound channels. Applications to channel design and stability. Backwater and 2D flow modeling. Prerequisite: fluid mechanics.

Wilcock   3 credits   spring/alternate years

570.432 (E,N) Sediment Transport and River Mechanics

Sediment entrainment, transport, and deposition; the interaction of flow and transport in shaping river channels. Review of boundary layer flow; physical properties of sediment; incipient, bed-load, and suspended-load motion; bed forms; hydraulic roughness; velocity and stress fields in open channels; scour and deposition of bed material; bank erosion; size, shape, planform, and migration of river channels. Techniques of laboratory, theoretical, and numerical modeling are developed and applied to problems of channel design, restoration, and maintenance. Prerequisite: fluid mechanics.

Wilcock   3 credits   spring/alternate years

570.441 (N) Environmental Inorganic Chemistry

Advanced undergraduate/graduate course that explores the chemical transformations of elements of the periodic table. Thermodynamic, kinetic, and mechanistic tools needed to address the multiple chemical species and interfaces that are present in natural waters and water-based technological processes are emphasized. Ligand exchange, metal ion exchange, adsorption/desorption, precipitation/dissolution, electron and group transfer reactions, and other concepts from coordination chemistry will be covered. Applications include elemental sources and sinks in ocean waters, reactive transport in porous media, weathering and soil genesis, nutrient and toxic element uptake by organisms, water treatment chemistry, and rational design of synthetic chemicals. Prerequisites: 570.443 and 030.449 or permission of instructor.

Stone   3 credits   spring

570.442 (E,N) Environmental Organic Chemistry

Advanced undergraduate/graduate course focusing on examination of processes that affect the behavior and fate of anthropogenic organic contaminants in aquatic environments. Students learn to predict chemical properties influencing transfers between hydrophobic organic chemicals, air, water, sediments, and biota, based on a fundamental understanding of intermolecular interactions and thermodynamic principles. Mechanisms of important thermochemical, photochemical, and biochemical transformation reactions are also investigated, leading to

development of techniques (such as structure-reactivity relationships) for assessing environmental fate or human exposure potential. Prerequisite: introductory organic chemistry or permission of instructor.

Roberts   3 credits   fall

570.443 (E,N) Aquatic Chemistry

Thermodynamics and equilibrium applied to processes in natural waters and water and wastewater treatment systems. Chemistry of electrolyte solutions, acids and bases, complex formation precipitation and dissolution, oxidation and reduction. Prerequisites: one year each of chemistry and calculus.

Stone   3 credits   fall

570.444 (E,N) Colloid Chemistry

Dispersed, i.e., microheterogeneous, state of matter and predominant influences of various surface phenomena in disperse systems are regarded as universal in nature and technology: these are rocks and soils, materials, suspensions, emulsions, foams and aerosols, and living tissues. This course considers formation and general colloid-chemical properties of such systems, the principal role of high dispersity, problems of stability, and ways to control them in industry and environment. Prerequisites: general chemistry and physics.

Shchukin   3 credits   spring

570.445 (E) Physical and Chemical Processes in Environmental Engineering I

The application of basic physical and chemical concepts to the analysis of environmental engineering problems. Principles of chemical equilibrium and reaction, reaction engineering, interphase mass transfer, and adsorption are presented in the context of process design for unit operations in common use for water and wastewater treatment. Topics addressed include mass balances, hydraulic characteristics of reactors, reaction kinetics and reactor design, gas transfer processes (including both fundamentals of mass transfer and design analysis), and adsorption processes (including both fundamentals of adsorption and design analysis). Prerequisites: 570.301-302 or permission of the instructor.

Ball   3 credits   fall

570.446 (E,N) Biological Processes for Water and Wastewater Treatment

Fundamentals and application of aerobic and anaerobic biological unit processes for the treatment of municipal and industrial wastewater. Prerequisite: 570.411.

Bouwer   3 credits   spring

570.448 (E) Physical and Chemical Processes in Environmental Engineering II

Fundamentals and applications of physical and chemical processes used in water and wastewater treatment. This class will cover particle interactions, coagulation, flocculation, granular media filtration, membrane processes, and emerging water treatment processes. Prerequisite: 570.445 or permission required.

Chen   3 credits   spring

570.452 (W) Experimental Methods in Environmental Engineering and Chemistry

An advanced laboratory covering principles of modern analytical techniques and their applications to problems in environmental sciences. Topics include electrochemistry, spectrometry, gas and liquid chromatography. The course is directed to graduate students and advanced undergraduates in engineering and natural sciences. Prerequisite: 570.443 or permission of instructor.

Stone, Roberts   4 credits   spring

570.457 (S) Seminar on International Competitiveness

The U.S. economy appears increasingly beleaguered in the face of intensifying international competition. A number of manufacturing sectors, from the traditional to "high tech," are undergoing a dramatic process of restructuring with equally dramatic effects on manufacturing regions in the U.S. The course considers a range of arguments concerning the causes of declining industrial competitiveness and proposed remedies.

Schoenberger   3 credits

570.459 (E,N) Organic Geochemistry

A multidisciplinary survey course that examines the origin and fate of organic matter in sediments and sedimentary environments. Prerequisite: Inorganic and Organic Chemistry.

Goldstein   3 credits   spring

570.460 Environmental Colloidal Phenomena

Introduces fundamental concepts of colloidal and interfacial phenomena and apply them to natural and engineered aquatic systems. Includes topics related to the environmental applications and implications of nanotechnology. Modern measurement techniques employed in the laboratory to study colloidal behavior and interfacial interactions will be discussed.

Chen   3 credits   spring

570.470 (S) Applied Economics and Finance

This course focuses on the workings of equity markets. It includes an analytical review of valuation models and their application to data contained in financial statements. Research reports are required. Prerequisite: permission of instructor.

Hanke   3 credits   spring/fall/intersession/summer

570.487 (S) Futures Market Research

An investigation of some futures market problems and preparation of a research report. Research is focused on developing and testing hypotheses about price behavior in futures markets. Prerequisite: permission of instructor.

Hanke   3 credits

570.490 (E) Solid Waste Engineering and Management

This course covers advanced engineering and scientific concepts and principles applied to the management of municipal solid waste (MSW) to protect human health and the environment and the conservation of limited resources through resource recovery and recycling of waste material. Topics include regulatory aspects and hierarchy of integrated solid waste management; charac-

terization and properties of MSW; municipal wastewater sludge utilization; hazardous waste found in MSW; collection, transfer, and transport of solid waste; separation, processing, combustion, composting, and recycling of waste material; the landfill method of solid waste disposal which encompasses guidelines for design, construction, operation, siting, monitoring, remedial actions, and closure of MSW landfills. Permitting and public participation processes, current issues, and innovative approaches are also addressed.

Alavi   3 credits   fall

570.491 (E) Hazardous Waste Engineering and Management

This course addresses traditional and innovative technologies, concepts, and principles applied to the management of hazardous waste and site remediation to protect human health and the environment. Topics include regulatory requirements; fate and transport of contaminants; physical, chemical, and biological treatment; land disposal restrictions; guidelines for design, construction, and closure of hazardous waste landfills; environmental monitoring systems; management of medical waste and treatment options; management of underground and aboveground storage tanks; toxicology and risk assessment; pollution prevention and waste minimization; hazardous waste generators and transporters; permitting and enforcement of hazardous waste facilities; closure and financial assurance requirements; and RCRA Subtitle C Corrective Action and CERCLA/Superfund remediation processes.

Alavi   3 credits   spring

570.492 Department Seminar

Undergraduate Course Number for the Departmental Seminar. Visiting speakers, faculty, and students. Reports and research on topics of current interest.

Staff   0.5-1 credit

570.493 (Q,S) Economic Foundations for Public Decision Making

This course includes an exposition of intermediate level price theory, combined with a survey of applications to the analysis of public sector decisions. Theoretical topics include demand, supply, the function and behavior of the market, and introductory welfare economics. Applications include forecasting, benefit-cost analysis, engineering economics, economic modeling, etc. Prerequisites: 180.101-102 and Calculus III, or equivalents.

Norman   3 credits   fall

570.494 (E,S,) Ecological Management Decision Models

Implementation of decision analysis and optimization methods for managing ecosystems. Problems addressed are selected from dynamic systems control (fisheries, forestry), nature reserve design, ecosystem restoration, and adaptive management under uncertainty.

Hobbs, Williams 3 credits

570.495 (E,Q) Foundations of Optimization for Planning and Policy

Optimization techniques that are frequently used in the study of environmental systems, infrastructure manage-

ment, and public policy are presented. These include linear programming, integer and mixed-integer programming, nonlinear programming and multiobjective programming. Prerequisites: Calculus I, II.

Hobbs   3 credits   fall

570.496 (E,Q) Mathematical Models for Managing Urban and Environmental Systems

The mathematical techniques learned in 570.305 and 570.495 (alternate prerequisite: a course in linear programming) are applied to realistic problems in environmental management. Examples of such problems include management of water resources and water quality; natural areas management and restoration; solid waste collection, disposal, and recycling; public health; air quality management; pollution prevention in energy and transportation systems; and cost allocation in environmental infrastructure development.

Hobbs, Williams   3 credits   spring

570.497 (E,Q) Risk and Decision Analysis

This course introduces the methods of probabilistic risk and decision analysis. Topics will include risks in daily life, public attitudes toward risk, fault trees, event trees, decision trees, utility functions, risk attitude, Bayesian probability methods, and value of information calculations. Prerequisite: Intro to Statistics.

Guikema   3 credits

570.499 Senior Thesis

Preparation of a substantial thesis based upon independent student research, supervised by at least one faculty member in Geography and Environmental Engineering. Open to seniors, with permission of instructor.

Staff   3 credits

570.501 Undergraduate Research

Credits determined by faculty advisor

Staff   1-3 credits   fall

570.502 Undergraduate Research

Credits determined by faculty advisor

Staff   1-3 credits   spring

570.505 Undergraduate Independent Study

Credits determined by faculty advisor

Staff   1-3 credits   fall/spring

570.506 Maryland Department of the Environment Independent Study

This independent study within the MDE's Water Management Administration (WMA) will engage the student in scientific/policy literature and data research and management, field investigations, or evaluation of emerging issues and innovative approaches to surface and ground water protection and drinking water management, wastewater management, wetlands and non-point source pollution control. Each independent course will focus on a scientific, regulatory or policy topic designed to further the mission of the administration, which is to protect the public health and the aquatic environment. The student will be assigned to a WMA engineer, scientist or project

manager to develop a course of study. Hours can be tailored to accommodate student's schedule. Credits determined by faculty advisor. Permission required.

Bouwer 1-3 credits

570.509 Independent Study: Geography and Environmental Engineering

Staff   1-3 credits   fall/spring

Interdepartmental

360.147 (H,S,W) Adam Smith and Karl Marx

Freshmen only. Smith and Marx are often treated as icons in debates about capitalism and their thinking is reduced to sound bites. In this course we read them closely to see what they really said. You may be surprised.

Schoenberger, Jelavich   3 credits

360.349 (H,S) Cities Under Stress: The Baltimore Case

An interdisciplinary course that uses Baltimore as a case study to look at the history of urbanization in the United States and a wide range of recent and contemporary problems both in Baltimore in general as well as in particular neighborhoods. Students will be expected to engage in project work, for the most part at the neighborhood level, and they will be expected, through field excursions and other means, to familiarize themselves with the city and its problems.

Leslie, Hertz, Crenson, Newman, Bone

360.381 (H,S) Working the Great American City: Chicago and Los Angeles

Cross-Listed with Economics

195.477-478 Introduction to Urban Policy: Seminar and Internship

This is a 6 credit one semester undergraduate course on urban problems and policy in the U.S. The weekly seminar considers the major challenges and opportunities facing cities, and the effectiveness of urban and related policies. Students also work at part-time internships in the City Council, a government agency, or community organization in Baltimore. Course requirements include two term papers—one for the seminar portion of the program, the other for the internship. Admission is by permission of the instructor. Undergraduates must take the seminar and internship concurrently. Graduate students may take the seminar only.

Newman   3 credits (seminar)   3 credits (internship)

270.320 Global Change and Human Health

Ellis, Fisher, Patz   3 credits

270.375 (E,N) Groundwater

Staff   3 credits

Graduate Courses

570.607 Energy Planning and Policy Modeling

Methods for optimizing operation and design of energy systems and for analyzing market impacts of energy and environmental policies are reviewed, emphasizing both theory and solution of actual models. Review of linear and nonlinear programming and complementarity methods for market simulation. Prerequisites: 570.493 and 570.495 or equivalent.

Hobbs   3 hours   alternate years

570.608 Uncertainty Modeling for Policy and Management Decision Making

This course will present different paradigms for uncertainty modeling including Bayesian and Frequentist approaches. It will then the cover main approaches within these paradigms, including parametric, semi-parametric, and non-parametric regression as well as data mining techniques. The focus will be on how these methods are used to draw inferences from data and build accurate predictive models based on data. Modeling will be done using several different software packages. Prerequisites: Probability and Statistics at the level of 550.420 and 550.430.

Guikema   3 hours   spring

570.609 Facility Location Systems Analysis

Goods-oriented and consumer-oriented location formulations are analyzed from the standpoint of several criteria. Goods-oriented models focus on minimum cost or maximum profit objectives. Consumer-oriented models consider aggregate and individual proximity in objectives and constraints. The vehicle of discourse and problem statement is mathematical programming. Applications of models to public sector problems include the location of schools, fire stations, ambulance dispatch stations, and solid wastes transfer points. Prerequisite: a course in linear programming or equivalent.

Staff   3 hours   fall

570.610 Political Ecology

Political ecology analyzes social and institutional "rules of the game" concerning use of ecological resources and adaptations to environmental conditions. Reading seminar covering classic works in the field and emerging trends.

Schoenberger   fall

570.611 Natural Resource Economics

Development of the economic theory of depletable and renewable private and common property natural resources, including those which may be recyclable or storable. Prerequisites: microeconomic theory (180.601, 570.493, or equivalent) and Calculus III.

Boland   fall

570.612 Public Utility Economics

This course will be a mix of seminar-style guided discussions and student presentations and lectures on specific topics. It will give an overview of the infrastructure systems that form the basis for health, security, and economic prosperity in the developed world and give an overview of some of the most pressing infrastructure challenges in the

developing world. The focus will be on quantitative modeling of infrastructure performance, sustainability, and resilience for supporting infrastructure management and policy decision-making, and most of the semester will be devoted to a study of the research literature on this topic.
Guikema   spring/every other year

570.615 Environmental Law

The course presents the constitutional principles involved in U.S. environmental issues. It explores the function of statutes, regulations, and judicial decisions in societal efforts to prevent or control pollution. It discusses the roles of politics and science in the formulation of environmental rules. The 11 major federal environmental statutes are surveyed with particular emphasis on the Clean Water Act (CWA), the Clean Air Act (CAA), the Safe Drinking Water Act (SDWA), the Resource Conservation and Recovery Act (RCRA), and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund). The three principal modes of enforcement are also presented. Finally, the legal status of international conventions on such issues as acid rain, ozone depletion, and rain forest preservation, as well as the U.S. government's legal position thereon, are also presented and discussed.
Staff   fall

570.616 Readings in Environmental Economics

This course covers recent topics in environmental economics including the theory of economic instruments for pollution control and measurement of intrinsic benefits. Independent meetings.
Boland

570.618 Multiobjective Programming and Planning

Public sector problems are typically characterized by a multiplicity of objectives and decision makers. This course presents a relatively new area of systems analysis which is useful for such problems: multiobjective programming or vector optimization theory. The fundamental concepts are developed and various methods are presented, including multiattribute value and utility theory. Prerequisite: 570.495 or permission of instructor.
Hobbs, Williams   spring

570.622 Topics in Human Geography

Advanced reading seminar considering major contributions in the contemporary geography literature. Prerequisite: permission of instructor.
Schoenberger   3 hours

570.633 Stochastic Simulation and Game Theory

This course provides an introduction to stochastic simulation and game theory. It covers a mix of the theoretical background and the practical use of these two methods. The stochastic simulation portion covers both discrete even and continuous methods. It also covers random number generators, analysis of output, comparison of systems, variance reduction techniques, and linkages between simulation and optimization. The game theory portion of the course provides an introduction to the basic types of games: static games of complete informa-

tion, dynamic games of complete information, static games of incomplete information, and dynamic games of incomplete information. The use of simulation within the game theory setting is then covered via a case study.
Guikema   spring/every other year

570.639 Topics in Environmental Economics

This seminar is based on recent contributions to environmental economics literature. Students analyze and discuss assigned papers/reports and prepare a survey of the literature on a specific topic. Prerequisite: 570.493 or 180.301 Microeconomic Theory.
Boland   2 hours

570.645 Reaction Mechanisms in Environmental Organic Chemistry

Detailed investigation of mechanisms of abiotic and biochemical transformations of organic pollutants in natural and engineered environments. Prerequisite: 570.442.
Roberts   3 hours   spring/on demand

570.647 Mass Transfer Processes in Environmental Engineering

Principles of adsorption, phase-partitioning, diffusion, and interphase mass transfer are developed and applied to processes of contaminant fate and treatment in aqueous systems. Emphasis is on fundamentals of mass transfer in heterogeneous and complex systems, and as applied in recent environmental engineering research and practice. Examples from the literature are studied in accordance with student interests. Prerequisite: 570.445.
Ball   3 hours   fall/alternate years

570.657 Air Pollution

The course consists of an introduction to the fundamental concepts of air pollution. Major topics of concern are aspects of atmospheric motion near the earth's surface; basic thermodynamics of the atmosphere; atmospheric stability and turbulence; equations of mean motion in turbulent flow; mean flow in the surface boundary layer; mean flow, turbulence in the friction layer; diffusion in the atmosphere; statistical theory of turbulence; plume rise. Emphasis is placed upon the role and utility of such topics in a systems analysis context, e.g., development of large and mesoscale air pollution abatement strategies. Comparisons of the fundamental concepts common to both air and water pollution are discussed.
Ellis   spring

570.659 Environmental Policy Analysis

This course explores the problems of making choices about environmental quality and the management of common property resources in the American economic and political system. A different environmental management issue of current interest is chosen each year. Students are expected to plan and execute individual research projects which demonstrate the use of quantitative and/or economic tools in designing and evaluating responses to the environmental management problem. Prerequisites: 570.493 and 570.495, or equivalents.
Norman   spring

570.661 Applied Math for Engineering
This course presents a broad survey of the basic mathematical methods used in the solution of ordinary and partial differential equations; linear algebra, power series, Fourier series, separation of variables, integral transforms.
Hilpert   3 hours   fall

570.676 Stochastic Programming
The course deals with computationally tractable methodologies for incorporating risk/uncertainty into mathematical programming (optimization) models. Focal topics include chance-constrained programming, stochastic linear programming, two-stage programming under uncertainty and stochastic dynamic programming. Some of these techniques may result in the creation of nonlinear models thus nonlinear/nonseparable optimization techniques are presented as well. Numerous applications are presented involving, for the most part, environmental (i.e., water and air resources) problems. Prerequisites: linear programming or equivalent, and introductory probability and statistics.
Ellis   spring

570.680 Environment and Society
This class addresses a range of questions, including: Why do we not act in our own best interests in the environment? How are environmental discourses developed and how do they relate to environmental policies? How do environmental politics and policy in the US compare with other countries?
Schoenberger   fall

570.686 Multiscale Flow and Transport in Porous Media
The scope of this course is to quantitatively describe flow and transport processes in porous media on a variety of length scales ranging from the molecular to the field scale. Phenomena investigated include single-phase and multiphase flow, solute transport, and chemotaxis. We will derive and/or motivate the governing dynamic equations and discuss mathematical and computational methods to solve these equations. This course addresses audiences from environmental and chemical engineering as well as the hydrological sciences. The course will give an introduction to the necessary mathematical and computational methods.
Hilpert   3 hours   spring

570.800 Graduate Independent Study: Geography and Environmental Engineering
Staff

570.801 Doctoral Research
This course provides the means for showing on a student's academic record the time devoted to research activities. Each three hours weekly for a semester is considered equivalent to one credit hour. These credits do not count toward the degree. It is the successful completion of research and the preparation of an essay or dissertation, regardless of the time required, which fulfills the degree requirements. The research can be on any problem in a field related to the varied interests of the department. Hours assigned to suit individual situations.
Staff

570.803 Master's Research
Investigation of an environmental engineering and chemistry problem and preparation of project report.
Staff

570.805 Master's Internship
Limit 2, Permission Required
Ball

570.813 Seminar in Geomorphology: Soils and Plants
Analysis and discussion of current research in the field.
Wilcock, Brush, Wolman   2 hours

570.841 Department Seminar
Graduate Course Number for the Departmental Seminar. Visiting speakers, faculty, and students. Reports and research on topics of current interest.
Staff   2 hours

570.873 Seminar in Public Systems Analysis
An advanced seminar in the application of operations research and economics to public systems problems. Guest speakers and seminar research projects. Prerequisite: permission of instructor.
Ellis, Hobbs

570.881 Environmental Engineering and Chemistry Seminar
Broad coverage of environmental engineering and science problems. Guest speakers, assigned reading, and critical analysis of journal articles.
Ball, Bouwer, Chen, Roberts, Stone

Cross-Listed

270.676 Numerical Methods in Hydrogeology
Staff   3 hours

Interdepartmental

360.620 Research Regions in Historical and Geographical Perspectives
This course explores the historical and geographical origins and dynamics of technology-intensive, research-based industrial complexes. Particular attention is devoted to the interrelationship of universities, government, and industry. Prerequisite: permission of instructor.
Schoenberger, Kargon, Leslie   spring

Note: A broad number of courses offered in the Department of Environmental Health Sciences, Bloomberg School of Public Health, are of interest to students in environmental engineering and in the environmental sciences. Examples are Epidemiology, Biostatistics, Air Pollution Control, Principles of Industrial Hygiene, Vector Control, and Toxicology. A complete listing may be found in the Bloomberg School of Public Health catalog. Students at the doctoral level, particularly, are encouraged to take these courses.

Information Security Institute

The Johns Hopkins University Information Security Institute (JHUISI) is the University's focal point for research and education in information security, assurance and privacy. Securing cyberspace and our national information infrastructure is more critical now than ever before, and it can be achieved only when the core technology, legal and policy issues are adequately addressed. JHUISI is committed to a comprehensive approach that includes input from academia, industry and government. The University, through JHUISI's leadership, has thus been designated as a Center of Academic Excellence in Information Assurance Education and Research by the National Security Agency and leading experts in the field. Through our broad range of educational opportunities including a ground-breaking graduate program and leading edge research in foundational science and applied technologies, JHUISI is having a significant impact in the region and nationwide.

Our research in networking, wireless, systems evaluation, medical privacy and electronic voting, among other areas is widely circulated among academics and policymakers. Moreover, JHUISI is instrumental in homeland security efforts across Hopkins, including emergency health preparedness, bio-terrorism and national defense. JHUISI is involved in a collaborative effort to protect privacy of medical records as a participant in the ONC SHARP program. Johns Hopkins, is working on applying attribute-based encryption (ABE) to electronic medical records to achieve role based access control with several efficiency improvements.

The SHARP Security (SHARPS) grant consists of over $15 million spread across twelve universities, and Johns Hopkins is playing a leadership role in several of the key components of the project. The Johns Hopkins team is leading the Electronic Health Records (EHR) thrust. The EHR project focuses on issues related to the security and privacy of health records within a single enterprise, such as a hospital or doctor's office.

The EHR project includes three components: (1) Self-Protecting EHRs addresses defense-in-depth protection of records within an enterprise or in outsourcing by using attribute-based encryption to enforce SHARPS-developed protection requirements; (2) Policy Terrain and Implications of HIT addresses the inadequacy of existing frameworks for formulating and understanding privacy policies by developing contextual integrity underpinnings for application-enabling privacy practices; and (3) Privacy-Aware Health Information Systems meets needs for highly assured conformance to privacy policies by developing new strategies for building such systems based on trust management systems.

More information can be found at **http://www.sharps.org**.

The Johns Hopkins University Information Security Institute based in the Whiting School of Engineering provides a broad and holistic perspective to the information security and assurance field relative to both research and education. In addition to a comprehensive collection of programs related to information technology, a range of management, governance, and policy issues are integrated into the Information Security Institute agenda. The breadth of focus provided represents a strength and distinction of the Johns Hopkins University Information Security Institute. Through the involvement of the faculty and resources from the Whiting School of Engineering, the Krieger School of Arts and Sciences, the Nitze School of Advanced International Studies, the Bloomberg School of Public Health, the School of the Carey Business School and the School of Education, and the Applied Physics Lab, a variety of innovative as well as international research and educational initiatives in information security and assurance are supported within the Information Security Institute.

The flagship educational experience offered by Johns Hopkins University in the area of information security and assurance is represented by the master of science in security informatics degree. Over 30 courses are available in support of this unique and innovative graduate program. Over 18 full-time, part-time, or adjunct faculty deliver these courses at multiple sites spanning the Homewood campus in northern Baltimore, the medical and health facilities in eastern Baltimore, the part-time graduate program operations at APL and the Montgomery County Campus, and the SAIS and KSAS facilities in Washington, D.C.

JHUISI MSSI and CS MSECS—Dual Master's Program

The Johns Hopkins University Information Security Institute (JHUISI) and the Department of Computer Science (CS) in the Whiting School of Engineering have approved the establishment of a two-year Dual Master's Program (DMP) combining the master of science in security informatics (MSSI) offered by JHUISI and the master of science in engineering in computer science (MSECS) offered by

CS. Admission into the DMP is approved on a case-by-case basis. DMP students are able to complete all the requirements for each of the two master's degrees (receiving two diplomas upon graduation) within a two-year period by double counting as many as two courses toward the requirements of both degrees.

Study and research within the field of information security and assurance (IS&A) represents an extraordinary opportunity for students in the WSE. The availability of the JHUISI MSSI and CS MSECS within the WSE is distinguishing and represents an enormous opportunity. The DMP is attractive to students who are interested in building upon the fundamental relationships between the JHUSI MSSI program and the CS MSECS program. The commingling of courses and projects within the Dual Master's Program provides a platform for a unique graduate educational experience with both breadth and depth, particularly relevant as preparation for research and development initiatives of interest in both government and industry.

Dual Master's Program

A student can be concurrently enrolled in both the MSSI and MSECS degree programs while satisfying each of the sets of degree requirements.

A maximum of two courses (approved by the advisor(s)) can each be double counted so as to be usable in satisfying both sets of course requirements, thereby facilitating the feasibility of completing the DMP in two academic years plus the in-between summer.

MSSI and MSECS Program Requirements

The requirements for the MSSI and the MSECS programs are inherently complementary, and therefore have some foundational similarities that serve as a framework for the proposed DMP. A brief overview of these two master's programs is provided in the following. Students interested in the DMP should discuss the details of the requirements more fully with an appropriate academic advisor in JHUISI and the CS Department.

Dual Master's Program Advising

Regarding academic advising, it is anticipated that a student in the proposed DMP will have a MSSI advisor affiliated with JHUISI and an MSECS advisor approved by the CS Department. In some cases it might be possible for that to be the same person as there are numerous CS faculty with JHUISI affiliations. In the more common cases where two advisors are involved, the advisors are expected to interact sufficiently with the student so as to coordinate the course work, project, and essay (thesis)

components of the programs such that completion within two academic years is feasible.

Double Counting of Courses

Two courses (approved by the advisor(s)) can be double counted so as to be usable in satisfying of course requirements of the MSSI and MSECS. Obviously, any double-counted course would have to be acceptable in both master's programs. Accordingly, courses that have been developed to support the JHUISI MSSI program in the policy, privacy, law, management, or health areas would not in general be expected to fall into this double counting category.

Application to the Dual Master's Program

An application to the proposed DMP can consist of separate applications to the MSSI program in JHUISI and the MSECS program in CS. It is anticipated that some of the students who decide to pursue the DMP will actually have initially entered either the MSSI program or the MSECS program, and then elected to seek both degrees in the DMP at a later point. In such cases, the designation of the double counted courses would be done in conjunction with both advisors and the CS graduate coordinator and the JHUISI Academic Program Manager.

Dual Master's Program with the Department of Applied Math and Statistics in the WSE

A similar DMP has been initiated regarding the JHUISI MSSI and the master's program in the Department of Applied Math and Statistics in the WSE. The details of this DMP are similar in principle to those for the MSSI/MSECS, but there are some significant differences. Each program should be contacted if a student is interested.

Dual Master's Program with the School of Public Health

A similar DMP has been initiated regarding the JHUISI MSSI and the Master of Health Sciences (MHS) program in the Bloomberg School of Public Health (BSPH). The details of this MSSI/MHS DMP are similar in principle to those for the MSSI/MSECS, but there are some significant differences. Each program should be contacted if a student is interested.

For additional information regarding the academic program and seminars, consult the JHUISI website at **http://jhuisi.jhu.edu** or the Information Security Institute Office at 3400 N. Charles Street, Maryland Hall Rm 216, Baltimore, Maryland 21218.

JHUISI Affiliated Faculty

William Agresti, Associate Professor (Information Technology): system design and development, information systems architecture, and IT integration for business, software engineering, IT measurement and knowledge management.

Guiseppe Ateniese, Associate Professor (Computer Science): topics in applied cryptology, cryptology and network security, security and privacy in computing, applied cryptography and network security, DNSSEC and medical information privacy protection.

David Berstein, Lecturer (Entegra Systems): public-key infrastructure, high assurance platforms, cryptography, network communications, signal processing.

Matthew Green, Assistant Research Scientist (Computer Science): applied cryptography, cryptographic protocol design, analysis of practical security systems, privacy-preserving storage and identification technologies.

Susan Hohenberger, Assistant Professor (Computer Science): theory, cryptography, computer security, algorithms, complexity theory, balancing privacy and accountability in information systems.

Michael Jacobs, JD, Lecturer: computer ethics, digital rights management, intellectual property protection.

George Kalb, Lecturer, Information Security Institute; Adjunct Professor, Lecturer, Part-time Programs in Engineering and Applied Science: embedded computer systems-vulnerabilities, intrusions and protection mechanisms, embedded systems security, software engineering.

Michael Kociemba, Instructor, Carey Business School: information security, management, and infrastructure protection.

Darren Lacey JD, Chief Information Security Officer, Johns Hopkins University.

Michael Lavine, Assistant Research Professor, Information Security Institute: computer forensics, computer information systems, information systems and security, electronic commerce, financial aspects of electronic commerce, systems analysis and design.

Harold Lehmann, Associate Professor (Medicine): medical informatics, evidence-based medicine, web-based publishing relative to medical science and healthcare.

Thomas Llanso, Lecturer (Applied Physics Laboratory): multi-level security, assured information sharing, applied cryptography, public-key infrastructure, high assurance platforms, java security.

Gerald Masson, Professor (Computer Science); Director, Information Security Institute: reliable computing, computer networking, real-time monitoring of software operations, computer architecture, computer networking, security informatics relative to networks and software operations.

Amitabh Mishra, Assistant Research Professor (Computer Science): wireless cellular, ad hoc and sensor networks, dynamic spectrum access networks, telecommunications.

Anna Orlova, Associate Professor (Health Policy and Management): medical informatics.

Aviel Rubin, Professor (Computer Science): Technical Director, Information Security Institute: network and systems security, applied cryptography, cryptographic key distribution, anonymity and computer privacy, electronic commerce, firewalls and network perimeter defenses, security issues in e-voting, applying security to applications such as medical information systems, intellectual property protection.

Andrew Siegel, Associate Director for Academic Programs, Phoebe R. Berman Bioethics Institute: political philosophy, constitutional law, justice and health, ethical and legal issues in human stem cell research.

Sam Small, Assistant Research Scientist (Computer Science): systems and network security.

Andreas Terzis, Associate Professor (Computer Science): network security, malware detection and containment, wireless sensor networks, computer networks.

JHUISI COURSES

Core Technology Courses
650.412 Java Security
600.443 Security and Privacy in Computing
650.457 Computer Forensics
600.424 Network Security
600.442 Modern Cryptography
650.471 Cryptography and Coding
650.633 Computer Security Architectures
600.742 Advanced Cryptographic Protocols
600.643 Advanced Topics in Computer Security
600.471 Theory of Computation
550.438 Statistical Methods in Computer Intrusion Detection

Elective Technology Courses
650.737/738 Information Security Project
650.433 Embedded Computer Systems

600.444 Computer Networks

600.488 Foundations of Computational
Biology and Bioinformatics II

605.434 WWW Security

605.731 Network Security

605.732 Cryptology

Core Policy Courses

650.414 Rights in the Digital Age

650.430 Moral and Legal Foundations of
Privacy

650.632 Law and Policy of Information
Assurance

Core Health Courses

650.452 Healthcare Security Management

306.655 Ethical Issues in Public Health

309.701 Health Informatics Data Information
and Knowledge

309.702 Health Informatics Decision Support

309.703 Health Informatics Design and
Evaluation

309.641 HIPAA Implications for Public Health

280.340 Intro to Health Policy and
Management

280.350 Intro to Epidemiology

Core Management Courses

774.715 Financial Issues in Managing a Secure
Operation

774.717 Implementing Effective Information
Security Programs

Elective Management Courses

776.754 E-Commerce Security

605.431 Principles of Enterprise Security and
Privacy

605.432 Public Key Infrastructure and
Managing E-Security

Elective Policy Courses

406.665 Art and Practice of Intelligence

406.666 Contemporary Terrorism and the
American Response

406.669 Homeland Security: Threats
Challenges and Solutions

406.681 Technology of Weapons of Mass
Destruction

Foundational Courses

600.418 Operating Systems

600.421 Object Oriented Systems

600.433 Computer Systems

600.437 Distributed Systems

600.444 Computer Networks

600.466 Information Retrieval and Web Agents

Facilities

The computing facilities include over 60 Sun Solaris workstations and servers for research; a laboratory of an additional 18 Sun Ultra5 workstations running Solaris and 30 PC workstations running Windows; and multiple high-speed laser printers. The various focused research laboratories have significant resources that provide greater specialization than the general department resources. The facilities are all tied together via a high speed network, which allows access to specialized hardware in other departments and institutions. The Information Security Institute and Department of Computer Science cooperate in the use of some of these facilities.

Graduate Program

The master of science in security informatics is offered by the Information Security Institute of the Whiting School of Engineering. The candidates work closely with faculty, and curriculum is arranged through consultation with a faculty advisor and the graduate coordinator of the institute.

Application Requirements for the MSSI degree

• Application to the MSSI degree is open to outstanding candidates who hold a bachelor's degree with sufficient technical exposure to computer science that serves as preparation for the core technology courses.

• All US citizens and US permanent residents are obligated to take and submit the results of the Aptitude Test of the Graduate Record Examination as one of the requirements for admission. Students who have completed a Master degree in another discipline are waived from the requirement to take the GRE.

• International students are obligated to take either the TOEFL test or the IELTS test.

The preferred scores are as follows:

GRE General Test

Verbal	600
Quantitative	600
Analytical	4.0
TOEFL Paper based	550
Internet based	79
Computer based	215
IELTS	7.0

The institution code for both the GRE and TOEFL is 5332.

The department code for the GRE is 0404. The department code for TOEFL is 78.

These scores serve as general guidelines for admission. The Admissions Committee in making its final decisions will consider the combination of professional knowledge, academic excellence, letters of recommendation, and the statement of purpose, as well as GRE, TOEFL, and IELTS scores of the applicants.

- Please check the JHUISI website at **www.jhuisi .jhu.edu** for information about the master of science degree in security informatics and the Information Security Institute. JHUISI does not accept paper applications. A student can apply online at **https://app.applyyourself.com/?id=jhu-grad**.

- A $25 fee is required.

- The MSSI deadline for US citizens and permanent residents for Fall 2012 is April 15, 2011. The deadline for Spring 2012 is December 15, 2011.

- The MSSI deadline for international students for Fall 2012 is March1, 2011. The deadline for Spring 2012 is November 1, 2011.

Please mail your supporting documents to:

Johns Hopkins University
The Graduate Admissions Office
Full time Graduate Studies in Arts and Sciences
28 Shriver Hall
3400 North Charles Street
Baltimore, MD 21218

Course Requirements for the MSSI

Upon admission to the Master of Science in Security Informatics, a student is assigned a graduate advisor from the Information Security Institute who must approve the courses to be applied to the MSSI.

The Master of Science in Security Informatics program has a course requirement of a minimum of 10 courses (30 semester credits), plus a project including a report and presentation. It is possible with the permission of your advisor to take the project for credit as your 10th course or you may take an elective as your 10th course and complete the project as a non-credit course.

All courses supporting the MSSI are categorized as one of four types: (i) Technology; (ii) Policy; (iii) Health; (iv) Management. All MSSI course programs must satisfy the following distribution requirements:

- A minimum of four courses (12 semester credits) in the Technology category, of which at least three courses (nine semester credits) must be designated as core Technology courses/ credits. One core technology course (3 semester credits) must be a core cryptography course.

- A minimum of four core courses (12 credits) in Non-Technology categories, of which at least six credits must come from Policy courses and at least three credits of which must come from a Health course or a Management course.

Project Requirement

In addition to the 10 courses, all MSSI programs must include a project involving a research and development oriented investigation focused on an approved topic addressing the field of information security and assurance from the perspective of relevant applications. In general, the project will include both technology and non-technology components, and will be conducted within a team-structured environment comprised of students and advisors. A successful project will be expected to result in the development of a so-called "deliverable" and an associated report suitable for online distribution. The completed project must be jointly presented and defended by the project team student members. Projects will generally be sponsored by government/industry partners and affiliates of the Information Security Institute, and can also be related to faculty research programs supported by grants and contracts.

Course Requirement Details

- The overall grade point average of the courses counted toward the MSSI course work requirements must be a 3.0 or higher (B average).

- A grade of D or F for a course results in probation from the MSSI program. A second D or F grade is cause for being dropped from the program. At most, two independent study courses can be counted toward the course requirements.

- Other than independent study courses and the Information Security and Assurance Seminar (650.733/734), no courses with grades for P can be counted toward the course work requirement. Courses with a grade of P will not be included in the grade point average calculation.

- At most, two courses can be transferred from the graduate programs of other institutions to be counted toward the degree requirements. Such transfer courses must be approved by the student's faculty advisor and the director of the institute. It is the obligation of the student to provide all necessary data to the Information Security Institute regarding the course(s) for which transfer credit is being requested.

MSECS Requirements Details

The MSECS program has an eight course requirement plus completion of one of the following:

- Two additional courses;
- Master's project supervised by a CS approved faculty member (resulting in a publicly available report).
- Master's essay (thesis) advised by a CS approved faculty member.

The Department of Computer Science classifies each upper-level course into one of three categories:

- Analysis
- Applications
- Systems

MSECS students must complete at least two graduate courses (400-level and above, minimum total of 6 credit hours) from each of these three areas. Multiple area classified courses can only be counted toward one area requirement. The MSECS course work program must be approved by the CS assigned MSECS advisor and the department/center.

Concurrent Bachelor's/Master's degree Program in Conjunction with the MSSI

A concurrent bachelor's/master's degree program including the MSSI is also available to Johns Hopkins University students. In this program, by the conclusion of the undergraduate sophomore/junior academic year, a student can apply for concurrent admission into the MSSI program. If accepted, the student during each subsequent semester partitions her/his course load into courses that will count for the undergraduate degree and courses that will count for the MSSI degree. Usually with one additional year of study, the student can simultaneously satisfy both sets of degree requirements.

Tuition Support

Students applying for the MSSI degree may be eligible for partial tuition support in the Information Security Institute. There are also hourly paid teaching assistant positions available for qualified students. Those interested must apply at the start of each semester for specific courses in need.

Financial Aid

Financial aid is available for candidates of high promise who have completed at least one semester as MSSI students. Fellowships provide a student with a stipend plus tuition. Teaching assistantships normally consist of tuition plus a stipend commensurate with the teaching or grading duties assigned. Research assistantships are available on sponsored research projects directed by members of the faculty. A student determined to have significant deficiency in spoken English may be required to take one or more semesters of English as a Second Language in order to qualify for employment as a teaching or research assistant. There is no Information Security Institute financial aid available to international students.

Graduate Courses Supporting the MSSI

Core Technology Courses

650.412 (E,Q) Java Security

This course provides a comprehensive coverage of the security aspects of the Java platform. Java's security model and the VM and language features that support security are covered. Java APIs relevant to development of secure software are discussed. The course concentrates on the practical aspects of using these APIs. Use of the Java Cryptography APIs is addressed and material on security in J2EE (Java 2 Enterprise Edition) is presented. Topics covered include the java security packages, the Java Cryptography Architecture and Java Cryptography Extension (JCA and JCE), Java Secure Sockets Extension (JSSE), Java Authentication and Authorization Service (JAAS), Java Generic Security Services (Java GSS-API), and the Java Certification Path API.
Llanso, Bernstein   3 credits

650.457 (E) Computer Forensics

This course introduces students to the field of computer forensics and it will focus on the various contemporary policy issues and applied technologies. Topics to be covered include: legal and regulatory issues, investigation techniques, data analysis approaches, and incident response procedures for Windows and UNIX systems. Homework in this course will relate to laboratory assignments and research exercises. Students should also expect that a group project will be integrated into this course.
Casey   3 credits

650.471 Cryptography and Coding

A first course in the mathematical theory of secure and reliable electronic communication. Topics include finite field arithmetic, error ciphers, one-time pads, the Enigma machine, one way functions, discrete logarithm, primality testing, secret key exchange, public key cryptosystems, digital signatures, and key escrow. Prerequisites: 550.171 (110.204 with permission of the instructor) linear algebra, computing experience.
Fishkind   3 credits

650.633 Computer Security Architectures

CSA addresses applications of information security and assurance methodologies and concepts by means of various implementations in the context of microcontrollers. A range of issues including performance and efficiency are considered. A project together with a report and associated presentation is required.

Masson   3 credits

600.424 Network Security

This course focuses on network security including network authentication protocols, firewalls, domain naming service (DNS) security, anonymity and privacy, accessing unrusted repositories, secure auditing, denial of service and other topics. Students gain knowledge about the most important network security defensive techniques, their strengths and weaknesses as well as attacks. Deployment considerations for various security defense.

Mishra/Small   3 credits

650.442 Modern Cryptography

This course focuses on cryptographic algorithms, formal definitions, hardness assumptions, and proofs of security. Topics include number-theoretic problems, pseudo-randomness, block and stream ciphers, public-key cryptography, message authentication codes, and digital signatures. [Analysis]

Hohenberger   3 credits

600.443 (E) Security and Privacy in Computing

This course focuses on practical aspects of information security and privacy protection. Emphasis will be placed on current security issues and challenges. Topics include analysis and design of security protocols, security policies, secure e-commerce, privacy technology, anonymous networks, medical information privacy, and anonymous computation.

Rubin   3 credits

600.471 Theory of Computation

This is a graduate-level course studying the theoretical foundations of computer science. Topics covered will be models of computation from automata to Turing machines, computability, complexity theory, randomized algorithms, inapproximability, interactive proof systems and probabilistically checkable proofs.

Hohenberger   3 credits

600.642 Advanced Cryptographic Protocols

This course will focus on advanced cryptographic protocols with an emphasis on open research problems. Prerequistie: 600.442 or 600.443 or permission of the instructor.

Ateniese   3 credits

600.643 (E) Advanced Topics in Computer Security

Topics may vary but focus mainly on network perimeter protection, hos-level protection, authentication technologies, intellectual property protection, formal analysis techniques, intrusion detection and similarly advanced topics.

Rubin   3 credits

Elective Technology Courses

650.433 (E) Embedded Computer Systems—Vulnerabilities, Intrusions, and Protection

This ONLINE COURSE examines the potential for computer crime and the protection mechanisms employed in conjunction with the embedded computers that can be found within non-networked products (e.g., vending machines, automotive on-board computers, etc.). This course provides a basic understanding of embedded computer systems: differences with respect to network-based computers, programmability, exploitation methods, and current intrusion protection techniques along with material relating to computer hacking and vulnerability assessment. The course materials consist of a set of eight study modules and five case-study experiments (to be completed at a rate of one per week) and are augmented by online discussion forums moderated by the instructor. This course also includes online discussion forums that support greater depth of understanding of the materials presented within the study modules.

Kalb   3 credits

600.444 Computer Networks

This course considers intersystem communications issues. Topics covered include layered network architectures; the OSI model; bandwidth, data rates, modems, multiplexing, error detection/correction; switching; queuing models, circuit switching, packet switching; performance analysis of protocols, local area networks; and congestion control. [Systems]

Terzis   3 credits

600.456 (E,Q) Protocols and Systems for Internet and Web Security

This course focuses on the most widely used systems and protocols for security on the Internet and on the Web. The Internet refers to the infrastructure—the underlying protocols and routing. The Web refers to the applications that run on the Internet. Some of the questions addressed in the course are: How are secure network protocols designed, and how are vulnerabilities discovered? What are the effects of system vulnerabilities, and how may they be minimized? We will look at browsers, web servers, and communication protocols on the Internet, as well as how to deal with viruses and distributed denial of service attacks. Some of the protocols/systems covered in detail are TCP/IP, SSUTLS, IPsec, SSH, PGP, firewalls, IDS systems, and Kerberos.

Rubin   3 credits

600.488 Algorithms for Information Security

This course will concentrate on presenting and analyzing algorithms for security. This includes algorithms for generating crypto-quality randomness, algorithms for generating large primes, and digital watermarking algorithms as well as various cryptographic methods such as algorithms based on prime numbers, discrete logarithm, shortest vector problems in lattices, and elliptic curves. Also, an introduction to quantum computing and quantum cryptography will be given.

Staff   3 credits

605.731 Network Security

The purpose of this course is to discuss concepts, issues, and concerns in network security; examine methods and technologies for securing computer/communication network systems; and survey network security standards. Topics include the OSI Reference Model and network security architecture; applied cryptography; public and secret key management technology, such as public key infrastructure (PKI); CAPIs (Cryptographic Application Programming Interfaces); client authentication using one-time passwords; secure messaging standards; and Internet/intranet firewall and intrusion detection system (IDS) security issues. An introduction to selected network security technologies is presented that includes wired/wireless PKI issues; DCE security; CORBA; IBM z/OS and WebSphere; BEA Tuxedo/WebLogic; Microsoft Windows 2000 and XP; and VPN (virtual private network) technology. Selected examples of current technology issues that impact network security will be discussed. Prerequisite: A graduate course on computer communications networks (605.471, 605.771, or 605.472) or a graduate course on enterprise security and privacy (605.431).
Podell   3 credits

605.732 Cryptology

This course provides an introduction to current research in cryptology. It begins with a survey of classical cryptographic techniques and a discussion of the Data Encryption Standard. It then develops the concepts from complexity theory and computational number theory that provide the foundation for much of the contemporary work in cryptology. The remainder of the course focuses on this recent work. Topics include public key cryptography, the RSA system, digital signatures, cryptographic protocols, zero-knowledge proofs, probabilistic encryption, and quantum cryptography. All background in theoretical computer science is developed as needed in the course.
Zaret   3 credits

Core Policy Courses

650.414 (S) Rights in the Digital Age

This course will examine various legal and policy issues presented by the tremendous growth in computer technology, especially the Internet. The rights that various parties have with respect to creating, modifying, using, distributing, storing, and copying digital data will be explored. The concurrent responsibilities, and potential liabilities, of those parties will also be addressed. The course will focus on intellectual property issues, especially copyright law, and other legal and economic considerations related to the use and management of digital data. Copyright law and its role within the framework of intellectual property law will be presented in a historical context, with an emphasis on its applicability to emerging-technology issues. Specifically, the treatment of various works, such as music, film, and photography, that were traditionally analog in nature, will be analyzed with respect to their treatment in the digital domain; works that are by their nature digital, such as computer software,

will also be analyzed. The current state of U.S. copyright law will be presented, as will relevant international treaties and foreign laws. The goal of the course is to provide those involved or interested in digital rights management with a general awareness of the rights and obligations associated with maintaining and distributing digital data.
Jacobs   3 credits

650.430 (S) Moral and Legal Foundations of Privacy

This course explores the ethical and legal underpinnings of the concept of privacy. It examines the nature and scope of the right to privacy by addressing fundamental questions such as: What is privacy? Why is privacy morally important? How is the right to privacy been articulated in constitutional law?
Seigel   3 credits

650.432 Law and Policy of Information Assurance

This course introduces information assurance as a response to changes in technology, asymmetric threats and computer crime. It traces the concepts through civilian applications as OMB and NIST standards as well as private sector issues related to privacy, contingency response, and reliable infrastructures. It examines these concepts from a risk assessment and standards based approach central to government planning and the private sector.
Lavine   3 credits

Core Health Courses

650.418 (S) Informatics in Public Health

The creation of rational health policy depends on a profound understanding of data found in multiple sources of information. This course is designed to provide public health professionals with an understanding of the knowledge infrastructure, functions, tools and systems comprising the field of public health informatics. This is the rapidly developing scientific field that integrates the practice of medicine and public health with information technology. Public health informatics deals with optimizing the collection, verification and utilization of data that relates to a population for the purpose of generating knowledge to support public health practices, policy decisions, research development and public communication. The intended audience comprises public health professionals responsible or advocating for information systems used in providing service or performing research.
Lehmann, Orlova   3 credits

650.452 (E,S) Healthcare Security Management

This course will address information security in the public health and medical fields with special emphasis on clinical care, research and the role of the academic medical center. In many respects the course builds on 650.651 Health Information, Privacy, and Law's treatment of privacy and how such privacy in protected in the health and medical arena including but not limited to HIPAA. It will also focus on disaster recovery and response, anonymization of records and billing, communication of public health information to communities, electronic health records and physical and administrative security.
Lacey   3 credits

309.641 HIPAA Implications for Public Health

Modern public health response systems are based on the coordination and communication between various public health agencies and health care organizations. This course focuses on the administrative simplification provisions of the Health Insurance Portability and Accountability Ace of 1996 (HIPAA) which mandates adoption of a variety of administrative and financial health care standards as well as rules for electronic transactions and code sets. The material covered addresses transactions sequences and connectivity between various stakeholders, privacy and security rules, use of direct data entry services, standards for data editing and codes sets. Discussions consider approaches to provisions that will provide impetus for more comparable and secure data across the spectrum of health and health care. This course is designed to provide system implementers in the public health field with an understanding and hands-on experience with the HIPAA regulations, associated implementation implications, and a perspective to the impact on the future of the health care information infrastructure regarding the use of information technologies for providing services as well as performing research.

Orlova   2 credits

309.701 Health Informatics Data Information and Knowledge

The creation of rational health policy depends on a profound understanding of data found in multiple sources of information. This course is designed to provide practitioners within the public health profession with an understanding of the knowledge infrastructure, security and privacy issues, domain functions, tools, and systems comprising the field of public health informatics. This is the rapidly developing scientific field that integrates the practice of medicine and public health with information technology. Public health informatics deals with optimizing the collection, verification, and utilization of data that relates to a population for the purpose of generating knowledge to support public health practices, policy decisions, research development, and public communication.

Lehmann   2 credits

309.702 Health Informatics Decision Support

This course addresses issues related to decision modeling based on health sciences data in terms of analysis, construction, and evaluation. Clinical decision support architectures are examined. An array of decision support tools is considered, and the knowledge representations employed in these tools are discussed. The course takes advantage of an availability of current related health sciences projects.

Lehmann   2 credits

309.703 Health Informatics Design and Evaluation

This course continues the review of health information systems through case studies in the design and evaluation processes. It will present a framework for design of systems based on user needs, functions, performed related information activities, available technology, etc. Skills taught will include the use of measures and methods for qualitative and quantitative evaluation of information systems, including cost, performance, effectiveness, and benefit/outcome determination.

Lehmann   2 credits

280.350 Introduction to Epidemiology

This course introduces principles and methods of epidemiologic investigation of both infectious and noninfectious diseases. Some of the methods by which properly conducted studies of distribution and dynamic behavior of disease in the population can contribute to an understanding of etiologic factors, modes of transmission, and pathogenesis of disease are illustrated. Instruction is by lectures, laboratory problems, and seminar discussions. Required for Public Health option students.

Alberg   3 credits

Core Management Courses

774.715 Financial Issues in Managing a Secure Operation

This course addresses the risks (financial, reputation, business, and third party), costs, ROI, and other business issues concerned in planning and managing a secure operation. Topics include disaster recovery, outsourcing issues; service level agreements; evaluating external security service providers; assessing security total cost of ownership; audit procedures; financial integrity; cost/benefit analyses; back-up and recovery provisions; insurance protection; contingency and business continuity plans; qualitative and quantitative risk analysis; monitoring the security of the enterprise; information economics; performance reporting; automated metrics reporting; responses to threats; effects of security policies and practices on business and customers; preparing a business case for information security investments; and developing cost-effective solutions given constraints in money, assets, and personnel. Case studies and exercises will be used to illustrate financial planning and evaluation of security operations.

Agresti   3 credits

774.717 Implementing Effective Information Security Programs

This course focuses on the personnel, legal, regulatory, organizational, and privacy issues that constitute many of the basic management considerations in developing and implementing an effective information security program. It also emphasizes the need for reasonable policies and procedures to ensure compliance, including relating current industry best practices. The course discusses many domestic and international laws and regulations that affect what can and cannot be done legally to secure systems. Specific topics include enterprise security management; establishing and maintaining organizational security policies; developing and maintaining a security plan; GASSP; computer crime, fraud, ethical issues, data and Web privacy, and employee rights; managing incident response; law enforcement interests; laws and regulations on electronic funds transfer, digital signatures, privacy; impact of HIPAA; principles and guidelines from the financial sector and other domains; security as part of

critical infrastructure protection; organizational and political issues; implementation strategies for enterprise-wide security programs; establishing institutional control boards; applying security program assessment frameworks; security management tool suites; role of the chief security officer (CSO); and the organization, roles, staffing responsibilities, and training issues of an information security program. Case studies will be used to illustrate information security plans, policies, and practices for various organizations.

Kociemba   3 credits

776.754 E-Commerce Security

This course discusses the fundamental issues in e-commerce security, problems encountered in migrating from legacy to web-based e-commerce models, and Internet security and Web privacy from both client and server perspectives. Topics include security of business transactions, basic cryptography, SSL, SET, active content security issues (PKI, JAVA, ActiveX, JavaScript, VB Script), Web privacy, secure UNIX and Windows NT server configuration (hardening, access controls, encryption), CGI scripting, remote authoring and administration, firewalls, security issues in e-commerce (e.g., authentication, non-repudiation); security issues in e-business partnering arrangements, extranets, supply chain management (SCM), and customer relationship management (CRM); Internet security and Web privacy from both client and server perspectives; role of VPNs; active content security issues (e.g., Java, ActiveX); role of PKI and certificate authorities. Case studies and exercises in the information security laboratory will be used to illustrate e-commerce security problems and solution approaches.

Kociemba   3 credits

605.431 Principles of Security and Privacy

This course surveys the broad fields of enterprise security and privacy, concentrating on the nature of enterprise security requirements by identifying threats to enterprise information technology (IT) systems, access control and open systems, and product and system evaluation criteria. Policy considerations are examined with respect to the technical nature of enterprise security as represented by government regulations for software with cryptographic capability. The course develops the student's ability to assess enterprise security risk and to formulate technical recommendations in the areas of hardware and software. Aspects of security-related topics to be discussed include network security, cryptography, IT technology issues, and database security. The course addresses involving Internet, Intranet, and Extranet security issues that affect enterprise security. Additional topics include access control (hardware and software), communications security, and the proper use of system software (operating system and utilities). The course addresses the social and legal problems of individual privacy in a data processing environment, as well as the computer "crime" potential of such systems. The class examines several data encryption algorithms.

DeMott, Podell   3 credits

Management Electives

605.432 Public Key Infrastructure and Managing E-Security

This course describes public key technology and related security issues. Public Key Infrastructure (PKI) components are explained, and support for e-business and strong security services required by various applications is described. The role of digital certificates, the importance of certificate policy and certification practices, and essential aspects of key management that directly impact assurance levels and electronic services are addressed. The capabilities of PKI and digital signatures are examined in the context of the business environment, including applicable laws and regulations. The essential elements for successful PKI planning and rollout are discussed, and the state of PKI and interoperability issues are presented.
Kumar   3 credits

605.434 WWW Security

This course examines issues associated with making Web applications secure. The principal focus is on server-side features such as CGI security, proper server configuration, and firewalls. The course also investigates protection of the connection between client and server via encrypting the data stream (e.g., with SSL) or by keeping certain data private from the server system (e.g., via third-party transaction protocols like SET or digital cash). Finally, the course explores client-side vulnerabilities associated with browsing the Web, such as system penetration, information theft, identity spoofing, and denial of service attacks. Labs are included to enable students to probe more deeply into security issues and to develop and test potential solutions.
Ching   3 credits

Elective Policy Courses

406.669 Homeland Security: Threats, Challenges and Solutions

This course will explore Homeland Security Threats, Challenges and Solutions by first reviewing historic United States Domestic Security practices and then studying the recent monumental undertaking of creating new national policy and procedures defining how the United States protects itself from threats. Finally, focusing on future challenges the Federal Government will need to address in planning, integrating and operating against the apocalyptic threat of radical terrorism and preparing for domestic disasters. Specific issues such as Border Security, Aviation Security, Emergency Management, Critical Infrastructure Protection, Cyber Security, Privacy; and Federal and State budgets used to pay for future domestic security will be key topics in this course.

406.681 Technology of Weapons of Mass Destruction

Students gain the foundational knowledge behind WMD (both weapons of mass destruction and weapons of mass disruption) and about how these weapons threaten U.S. homeland security. Weapons of mass destruction traditionally include nuclear, biological, and chemical weapons, while weapons of mass disruption include radio-

logical weapons, such as "dirty bombs." In addition, the course covers the technology behind three WMD delivery vehicles: ballistic missiles, cruise missiles, and unmanned aerial vehicles. In assessing each WMD threat, the course first examines the science and technology for each type of weapon and then applies this theory to real world threats emanating from state and non-state actors. Students apply this knowledge by engaging in red team exercises to identify options for preventing and reducing vulnerabilities from WMD. Please note that students do not have to have prior technical knowledge about WMD issues to succeed in this course.

406.683 Weapons of War: The Technology and Uses of Weapons

Modern warfare utilizes advanced weapons systems. This course will examine various weapon systems ranging from artillery, cruise missiles, aircraft, aircraft launched weapons, ships, submarines and unmanned systems. We will also examine strategic and tactical nuclear weapons. In the examination we will look at capabilities, concepts of operation, and issues surrounding their procurement and use. The course will also involve students working through a crisis scenario utilizing various weapon systems.

Foundation Courses

600.418 Operating Systems

This course covers in more depth than 600.318 the fundamental topics related to operating systems theory and practice. Topics include processor management, storage management, concurrency control, multi-programming and processing, device drivers, operating system components (e.g., file system, kernel), modeling and performance measurement, protection and security, and recent innovations in operating system structure. Course work includes the implementation of operating systems techniques and routines, and critical parts of a small but functional operating system. Students may receive credit for 600.318 or 600.418, but not both. Prerequisites: intermediate programming, 600.211 (or equiv. C exp.), 600.226, 600.333/433; 600.111 recommended.
Shapiro   3 credits

600.421 Object-Oriented Systems

The main goal of this course is to gain expertise in object-oriented design and implementation in more depth then the course 600.321. The primary course work is a large team programming project. Students will learn how to work as a team to produce well-structured designs and implementations. Course topics include Object-Oriented Design, The Unified Modeling Language (UML), and use of Computer-Aided Software Engineering (CASE) tools in programming. Advanced features of Java are also cov-

ered, such as graphical user interface (GUI) programming with Swing, Remote Method Invocation (RMI), reflection, Java database connectivity (JDBC), and the Java security architecture. Similar material as 600.321, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.321 or 600.421, but not both. Prerequisites: 600.226 and Intermediate Programming.
Smith   3 credits

600.433 Computer Systems

Analysis and design of subsystems of computers together with their interconnection and utilization in computing systems: basic logic circuits, combinational and sequential modules, computer arithmetic, registers and register-transfer logic, arithmetic units, memory, processor units, bus interconnections, control logic design and micro-programming, instruction set implementation, computer architecture. Similar material as 600.333, covered in more depth. Intended for upper-level undergraduates and graduate students. Students may receive credit for 600.333 or 600.433, but not both. Prerequisite: 600.107 or 600.109.
Masson   3 credits

600.437 Distributed Systems

This course teaches how to design and implement protocols that enable processes to exchange information, cooperate, and coordinate efficiently in a consistent manner over a computer network. Topics include communication protocols, group communication, distributed databases, distributed operating systems, and security. The course gives hands-on experience as well as some theoretical background. Prerequisites: intermediate programming and 600.226; 600.111 recommended.
Amir   3 credits

600.466 Information Retrieval and Web Agents

An in-depth, hands-on study of current information retrieval techniques and their application to developing intelligent WWW agents. Topics include a comprehensive study of current document retrieval models, mail/news routing and filtering, document clustering, automatic indexing, query expansion, relevance feedback, user modeling, information visualization and usage pattern analysis. In addition, the course explores the range of additional language processing steps useful for template filling and information extraction from retrieved documents, focusing on recent, primarily statistical methods. The course concludes with a study of current issues in information retrieval and data mining on the World Wide Web. Topics include web robots, spiders, agents and search engines, exploring both their practical implementation and the economic and legal issues surrounding their use. Prerequisite: 600.226.
Yarowsky   3 credits

Center for Leadership Education

The Center for Leadership Education (CLE) at Johns Hopkins is comprised of two academic programs as well as experiential activities, programs, and events. The academic programs, the W. P. Carey Program in Entrepreneurship and Management (E & M) and the Professional Communication Program (PCP), offer challenging business-related courses with practical applications. Students may take classes in management, marketing, law, finance, accounting, leadership, social enterprises, creativity and innovation, technical communication, oral communication, research writing, and other contemporary topics in professional communication.

The W. P. Carey Program was established in 1996 as an opportunity for undergraduate students to learn management and leadership skills. Students may complete a minor in Entrepreneurship and Management, or they may choose instead to take a few courses of interest. The E & M minor is now the largest and most popular minor at Hopkins, as students from both Engineering and Arts and Sciences greatly benefit from practical and interesting business courses. (See our website for more information at web.jhu.edu/leadership.)

In addition to the academic programs, the Center for Leadership Education sponsors experiential programs designed to give students real-world business and leadership experience. These learning experiences help students make career choices or select among fields for graduate and professional studies.

CLE experiential programs include:

- **The Annual JHU Business Plan Competition:** Students compete for cash prizes for best business plans in several different categories.

- **The Marshal L. Salant Student Investment Program:** Students manage an investment portfolio of $100K donated by JHU alumnus Marshal L. Salant. Profits exceeding 5 percent are donated to student scholarships.

- **Internships:** Students can apply for sponsorship of business-related internships during the spring, summer, or fall semesters.

- **CLE Speaker Series:** Prominent and successful business professionals and entrepreneurs speak on campus.

- **Hopkins Student Enterprises:** Hopkins students start and manage businesses that provide services to the campus and community.

- **Alpha Kappa Psi:** JHU students run a chapter of this national business fraternity.

- **American Marketing Association Student Chapter:** JHU students run a chapter of this national marketing organization.

- **Intersession Courses:** including Public Relations and Media in the Big Apple, featuring a two-day trip to visit P.R. firms in NYC.

- **Save the Future:** Save the Future leverages the brainpower of business-savvy, socially-minded college undergraduates from Hopkins to teach personal money management skills to high school students. It is an intensive, twelve week financial literacy course that exposes high school students to a college campus while they take advantage of 15+ hours of classroom instruction.

- **Building Bright Ideas:** This intensive 10-week course is taught by hand-selected and trained Hopkins students. It strives to teach entrepreneurship and business related concepts to approximately thirty students from Baltimore City High Schools including Y0! Baltimore Academy, The National Academy Foundation and Baltimore Civitas.

- **Social Investment Outreach:** The purpose of Social Investment Outreach is to provide people of underprivileged communities and developing countries with a means of helping themselves escape poverty through microcredit and sustainable community development. By providing entrepreneurs with non-collateral loans, education, and support, we hope to initiate a sustainable and independently manageable flow of money throughout their communities. In this way, Social Investment Outreach provides impoverished individuals with the opportunity to improve their living conditions and thus contribute toward the greater goal of alleviating international poverty. Additionally, the program will allow Hopkins students to give back to various communities and develop business skills through social entrepreneurship.

The Faculty

Lawrence Aronhime, Associate Director and Senior Lecturer: accounting, finance, entrepreneurship, technology commercialization.

Leslie Kendrick, Senior Lecturer: marketing strategy, integrated marketing communications and international marketing.

Annette Leps, Senior Lecturer: accounting, finance, management.

Julie Reiser, Senior Lecturer: technical communication, oral presentations, research writing, American literature and critical theory.

Eric Rice, Associate Director and Senior Lecturer: organizational behavior, social entrepreneurship, management, negotiation and conflict management, leadership, public speaking, professional writing.

Pamela Sheff, Senior Lecturer: business and technical communication, marketing, public relations, science and scientific writing, oral presentations, higher education in prisons, community-based learning.

Part-time and Visiting Appointments

Marci DeVries, Lecturer: principles of marketing.

Kevin Dungey, Senior Lecturer: oral presentations.

David Fisher, Lecturer: business law.

Mark Franceschini, Senior Lecturer: business law, business ethics, Internet law.

Nora Frenkiel, Lecturer: professional communication.

Kathleen Havey, Lecturer: marketing.

Jason Heiserman, Lecturer: oral presentations.

Theresa Jones, Lecturer: marketing.

Illysa Izenberg, Lecturer: engineering management.

Andrew Kulanko, Senior Lecturer: oral presentations.

Aida Lebbos, Lecturer: business law.

Emily Manus, Lecturer: professional communication.

Don McNeily, Lecturer: research writing, professional communication for ESOL.

Charlotte O'Donnell, Lecturer: oral presentations.

Jack L. Powell, Senior Lecturer: accounting, finance.

Joshua J. Reiter, Lecturer: business process management, total quality management, information technology management, Internet-based business applications, creativity and innovation, entrepreneurship.

Douglas Sandhaus, Senior Lecturer: business law, business ethics, Internet law.

William Smedick, Lecturer: leadership.

Judy Smylie, Lecturer: business law, business ethics.

Eric Vohr, Lecturer: technical communication.

Courses

660.105 (S,W) Introduction to Business

660.150 Media and PR in the Big Apple (Intersession Course)

660.152 Branding—Shaping the Way Consumers view Products (Intersession Course)

660.154 The Art of the Pitch (Intersession Course)

660.160 Location, Location, Location or Is there more? Principles and Practices of Real Estate Development (Intersession Course)

660.203 Financial Accounting

660.250 Principles of Marketing

660.300 (S) Managerial Finance

660.303 Managerial Accounting

660.304 Financial Statement Analysis

660.308 (S) Business Law I

660.310 (H) Case Studies in Business Ethics

660.311 (S) Law and the Internet

660.321 (W) Managing Social Enterprises

660.332 (S,W) Leadership Theory

660.333 Leading Change

660.335 Negotiation and Conflict Management

660.340 Principles of Management

660.341 (W) Business Process and Quality Management

660.350 (W) Marketing Strategy

660.355 Sports Marketing

660.358 International Marketing

660.401 (S) Advanced Corporate Finance

660.404 (S) Business Law II

660.450 Advertising and Promotion

660.460 Entrepreneurship

660.461 (E) Engineering Business and Management

660.500 Business Internship

660.501 Practicum in Entrepreneurship

661.110 (W) Professional Communication for Business, Science, and Industry

661.150 (W) Oral Presentations

661.310 (W) Writing about Science and Engineering

661.315 The Culture of the Engineering Profession

661.390 (W) Advanced Professional Communication Workshop: Creating Jay Street: The JHU Journal of Entrepreneurship and Technology

661.410/610 Research Writing

661.425 Ethics of Biomedical Innovation

661.453/653 Social Media & Marketing

661.454 Blogging, Editing and Copywriting

661.478 Advanced Communications Skills for Science, Business, and Industry

661.488 Communicating Decisions in a Crisis

662.611 Finance and Accounting

662.632 Business Law and Intellectual Property

662.642 Management and Leadership

662.651 Marketing Communications and Strategy

662.653 Communicating, Marketing, and Working on the Web

662.687 Advanced Communications Skills for Science, Business, and Industry

662.688 Communicating Decisions in a Crisis

662.692 Venture Planning

662.811 MSEM Seminar

662.815 CAD for MSEM

Materials Science and Engineering

Materials are essential to the construction of any engineering structure, from the smallest integrated circuit to the largest bridge. In almost every technology, the performance, reliability, or cost is determined by the materials used. As a result, the drive to develop new materials and processes (or to improve existing ones) makes *materials science and engineering* one of the most important and dynamic engineering disciplines.

The central theme of materials science and engineering is that the relationships among the structure, properties, processing, and performance of materials are crucial to their function in engineering structures. *Materials scientists* seek to understand these fundamental relationships, and use this understanding to develop new ways for making materials or to synthesize new materials. *Materials engineers* design or select materials for particular applications and develop improved processing techniques. Since materials scientists and engineers must understand the properties of materials as well as their applications, the field is inherently interdisciplinary, drawing on aspects of almost every other engineering discipline as well as physics, chemistry, and, most recently, biology. Because the field encompasses so many different areas, it is often categorized according to types of materials (metals, ceramics, polymers, semiconductors) or to their applications (biomaterials, electronic materials, magnetic materials, or structural materials).

The department prepares students for successful careers in materials science and engineering, for advanced study in science or engineering, and for professional education in other fields. The goal of the undergraduate program is to provide a rigorous and comprehensive curriculum in materials science and engineering as well as in mathematics, basic sciences, humanities, and social sciences. Our low student-to-faculty ratio allows students close contact with faculty in both classroom and research environments, as well as with other students and researchers in the department. The student is encouraged to proceed at his or her own rate, and to participate in interdisciplinary, interdepartmental, and interschool programs. In the tradition of Johns Hopkins, all of our undergraduate students participate in research, often beginning in their sophomore year, working closely with faculty and graduate students.

In recognition that biomaterials and nanotechnology represent two of the most rapidly developing areas of materials science and engineering, the Department of Materials Science and Engineering offers challenging specializations in biomaterials or nanotechnology within its undergraduate program.

The field of *biomaterials* is concerned with the science and engineering of materials in biology and medicine. Engineering materials are increasingly used in applications such as drug delivery and gene therapy, scaffolds for tissue engineering, replacement body parts, and biomedical and surgical devices. Biomaterials are an inherently interdisciplinary field that requires deep understanding of the properties of materials in general, and the interactions of materials with the biological environment. The Biomaterials Track is designed to provide a firm grounding in the physics, chemistry, and biology of materials, as well as breadth in general engineering, mathematics, humanities, and social science. In addition, students are encouraged to gain hands-on experience in biomaterials research laboratories. The program seeks to educate students to reach the forefront of leadership in the field of biomaterials engineering. While the fundamental principles of materials science still apply, a complete understanding of biomaterials and their interactions with biological environments requires a greater degree of specialization than the standard undergraduate curriculum provides. In recognition of completion of the Biomaterials Track, a student may elect to have his or her academic transcript annotated to indicate a specialty in biomaterials.

Nanotechnology advances the utilization of materials and devices with extremely small dimensions. Nanotechnology is a visionary field, as micro and nanostructured devices impact all fields of engineering, from microelectronics (smaller, faster computer chips) to mechanical engineering (micromotors and actuators) to civil engineering ("smart", self-healing nanocomposite materials for buildings and bridges) to biomedical engineering (biosensors and tissue engineering). Materials science is central to nanotechnology because the properties of materials can change dramatically when things are made extremely small. This observation is not simply that we need to measure such properties or develop new processing tools to fabricate nanodevices. Rather, our vision is that the wide (and sometimes unexpected!) variety of phenomena associated with nanostructured materials allow us to envision radically new devices and applications that can only be made with nanostructured materials. The Nanotechnology Track encompasses a curriculum designed to train students in the fundamental interdisciplinary principles of materials science including physics and chemistry, and also to expose students to the fore-

front of nanomaterials research through elective classes as well as research laboratories. Students in the Nanotechnology Track will be well-prepared for successful careers in materials engineering across a wide range of disciplines. In recognition of completion of the Nanotechnology Track, a student may elect to have his or her academic transcript annotated to indicate a specialty in nanotechnology.

The graduate curriculum provides students with a broad yet thorough grounding in the fundamentals of materials science and engineering. After completing the core curriculum, students pursuing master's and Ph.D. degrees take advanced courses that will allow them to work at the forefront of knowledge in their chosen specialty. Those desiring to conduct original research and advance the frontiers of knowledge pursue a master's essay and/or Ph.D. thesis. To this end, the department has an outstanding and wide-ranging research program, with particular emphasis on nanomaterials, thin films, metastable materials, biomaterials, computational materials science, and materials characterization.

The Faculty

Robert C. Cammarata, Professor: structure, properties, and processing of thin films and nanostructured materials, thermodynamics and mechanics of surfaces, mechanical behavior of materials, nanoindentation testing, stresses in thin films, novel electrochemical deposition methods, computer simulations, transport and assembly of nanowires in solution.

Jonah Erlebacher, Professor: nanostructured materials, self-organization and pattern formation, computational materials science, kinetics of shape change, ion beam interactions with surfaces, ultra-high vacuum processing, nanoporous metals, fuel cells.

Michael Falk, Associate Professor: Theoretical and computational research investigating materials processes far from equilibrium: deformation, failure and fracture in non-crystalline materials such as metallic glasses; reactive materials, interactions of stress and diffusion in energy storage materials; mixing processes that accompany frictional sliding and wear.

Robert E. Green Jr., Professor Emeritus: materials science, nondestructive characterization, ultrasonics, acoustic emission, X-ray diffraction, radiography, topography and tomography, synchrotron radiation, electro-optical systems, light-sound interactions, mechanical properties, thermography, sensors, process control.

Margarita Herrera-Alonso, Assistant Professor: Structure-property relationships of biodegradable polymers, polymer synthesis, graft copolymers, nanoparticles and nanomaterials, kinetics of self-assembly, delivery of drugs and imaging agents.

Kalina Hristova, Professor: biomolecular materials, structure and function of cellular membranes, membrane proteins, self-assembly of biological amphiphiles, protein-lipid interactions, protein synthesis, X-ray diffraction, fluorescence.

Todd C. Hufnagel, Professor: structure and properties of amorphous alloys; mechanical behavior of metals, polymers, and biomaterials; use of synchrotron radiation for in situ studies of deformation and phase transformations in materials; electron microscopy.

Howard E. Katz, Professor and Chair: organic, hybrid, nanostructured, and interfacial materials in electronic and photonic devices; organic materials synthesis, thin film fabrication and patterning; novel architectures for devices, sensors, and circuits; host-guest chemistry, material responses to high electric fields; organic nonlinear optics; nanoparticles in biosystems; materials for physical science education.

Jerome Kruger, Professor Emeritus: corrosion science and engineering, oxidation and passivation, ellipsometry, economics of corrosion.

Evan Ma, Professor: nonequilibrium processing and metastable materials, thermodynamics and kinetics of phase transformations, atomic level structures and polymorphs in metallic glasses and chalcogenide glasses, mechanical properties of amorphous and nanocrystalline metals, mechanics of small-volume materials, in situ TEM, phase-change alloys for data storage and memory applications.

Hai-Quan Mao, Associate Professor: Nanomaterials, electrospinning, nanofibers, biomimetic matrix, stem cell expansion and differentiation, nerve regeneration, micellar nanoparticle, therapeutic delivery, biodegradable polymers.

Patricia M. McGuiggan, Associate Research Professor: adhesion, tribology, tribocharging, atomic force microscopy, interfacial phenomena, wetting, interferometry, polymer and ceramic materials.

Theodore O. Poehler, Research Professor: electronically conducting polymers, organic charge transfer compounds, materials for optical Information processing, and semiconductors.

Peter C. Searson, Professor: Biomaterials, nanomedicine.

James B. Spicer, Professor: ultrafast phenomena, laser interactions with materials, nanostructured composite materials, sensor physics, laser-based materials processing, elastic and anelastic materials properties, intelligent materials processing, near-field optical and microwave techniques.

Timothy P. Weihs, Professor: the study of exothermic reactions in layered materials and their applications, processing and characterization of thin films, mechanical testing of metals and biological materials, nanoindentation studies.

Orla Wilson, Lecturer: Synthesis of nanostructured materials, specifically metallic and bimetallic nanoparticles in the 2-20 nm size range; electron, confocal and scanning-probe microscopies as characterization tools; applications of nano-structured materials as homogeneous and heterogeneous catalysts, novel optical security devices, and nanovectors for targeted drug delivery.

William L. Wilson, Associate Research Professor: Optical and electronic materials, Photonics, Bio-inspired nanomaterials, Nonlinear Microscopy, Time and spatially resolved Spectroscopies, Optical Data Storage materials and devices.

Michael (Seungju) Yu, Associate Professor: polymer chemistry, synthesis and application of protein-based materials, piezoelectric biopolymers, biomaterials for tissue engineering, nano-scale self-assembly of soft materials, biosynthesis of artificial proteins, liquid crystals.

Joint, Part-Time, and Visiting Appointments

Kit Bowen, Professor (Chemistry) E. Emmet Reid Professor: experimental chemical physics-photoelectron spectroscopy of negative ions, structure and dynamics of gas phase, weakly bound molecular clusters.

Chia-Ling Chien, Jacob L. Hain Professor of Physics: Fabrication of experimental studies of structural, electronic, magnetic, and superconducting properties of nanostructured solids; magneto-electronics, manipulation of small entities in low Reynolds number regime; biosensing.

Michael Edidin, Professor (Biology): membrane organization and dynamics, and immunology studied with nanoparticles and advanced microscopy.

D. Howard Fairbrother, Professor (Chemistry): surface chemistry, electron induced deposition of nanostructured materials, environmental health and safety of nanomaterials.

Kevin J. Hemker, Professor (Mechanical Engineering): mechanical behavior of materials, transmission on electron microscopy, high temperature alloys, thermal barrier coatings, nanocrystalline materials and materials for MEMS.

Joseph L. Katz, Professor (Chemical and Biomolecular Engineering): nucleation processes, formation of ceramic powders in flames, inhibiting scale formation.

Lynne Jones, Associate Professor (Orthopaedic Surgery, School of Medicine).

Gerald Meyer, Professor: inorganic chemistry-photochemistry and electrochemistry of metal complexes and inorganic solids, light-induced electron and energy transfer, environmental science, biomaterials, artificial photosynthesis.

John D. Tovar, Assistant Professor (Chemistry): Materials-oriented synthetic organic chemistry, electrochemistry, pi-conjugated and conducting polymers, supramolecular chemistry, organic electronics, biomimetic electronic materials.

David R. Veblen, Professor (Earth and Planetary Sciences): crystallography, transmission electron microscopy, X-ray diffraction, mineralogy.

Denis Wirtz, Professor (Chemical and Biomolecular Engineering) Theophilus Halley Smoot Professor: cell adhesion and migration, cell mechanics, cystoskeleton physics, receptor-ligand interactions, cancer bioengineering, progeria, particle tracking methods.

Facilities

The teaching and research facilities of the Department of Materials Science and Engineering are located in Maryland and Krieger halls on the Homewood campus. Our central facilities include the Surface Analytical Laboratory, with advanced tools for the chemical characterization of solid surfaces; the Scanning Electron Microscopy Laboratory; the Laboratory for Thin Film Deposition; and facilities for sample preparation, optical microscopy, and mechanical testing. Individual research groups have established laboratories with advanced facilities for materials processing, nanotechnology, and materials characterization. Through collaboration with other departments and national laboratories, students and faculty also have access to a variety of other facilities necessary for world-class research.

Undergraduate Program

Mission Statement and Program Objectives

The Materials Science and Engineering faculty strives to maintain the Johns Hopkins University tradition: to train a small number of students of highest quality who can make great impact on the scientific and engineering community that is large compared with the size of the department and the university. This institutional aspiration can only be realized with the success of our students as they

pursue career directions beyond their time at Hopkins. Our degree program is designed to provide an optimum starting point for students with a diversity of career aspirations providing a solid foundation for future career development. Graduates of the Materials Science and Engineering Program:

- Pursue careers that include advanced graduate studies in materials science and engineering or begin careers in related areas of science and engineering or professional disciplines that benefit from an understanding of materials science such as medicine, business or law.
- Employ elements of the research process in their careers including:
  - a the use of critical reasoning to identify fundamental issues and establish directions for investigation,
  - b the ability to define specific plans for problem solution,
  - c the use of analytical thought to interpret results and place them within a broader context.

Requirements for the B.S. Degree

The Department of Materials Science and Engineering offers a program leading to the Bachelor of Science Degree. The B.S. for the Materials Science and Engineering degree program is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org. The student must meet the general university requirements for the chosen degree as well as the departmental requirements, and must complete the program approved by the student's advisor.

An anticipated individual program of study designed to meet the university and department requirements for the B.S. degree, as well as to reflect the student's interest, should be filed as early as possible during the student's residence. The faculty advisor's signature is required on all course registration and course change forms. As changes are made in the program, it shall be the student's responsibility to see that a revised program is filed with the advisor. Each student must have an approved program on file no later than the semester before he/she expects to graduate.

General university requirements include (see also *General Requirements for Departmental Majors* for more information):

- Complete program of study outlined by concentration (standard, biomaterials or nanotechnology).
- Fulfill the university writing requirement two writing intensive (W) courses, at least 3 credits each.
- Fulfill 75 credits earned in courses coded (E), (Q), (N).

- At least 30 credits of this must be counted (N) or (Q) with no course counted twice.
- At least 30 additional credits must be taken outside of (E) area, excluding prerequisites for the major.
- Fulfill a minimum of six courses coded (H) or (S) at least 3 credits each for a minimum of 18 credits.
- Take a minimum of 128 credits.

To meet the course requirements for the B.S. degree in Materials Science and Engineering, the student must complete a minimum of 128 credits, distributed as follows: 42 credits in materials science, 25 credits in basic natural sciences, 20 credits in mathematics, 18 credits in humanities and social sciences, 11 credits in basic engineering and computer programming, and 12 credits of electives. Of these electives, 6 credits must be in natural sciences, mathematics, or engineering, and 6 credits are open electives to be chosen by the student. All courses must be passed with a letter grade of D or higher with the exception of open electives, which may be taken satisfactory/unsatisfactory. The 42 credits of materials science courses must be passed with a letter grade of C or higher.

In addition to the degree program in Materials Science and Engineering, students may elect complete specialized tracks in Biomaterials or Nanotechnology. Whether a student chooses to pursue studies following the standard program, the Biomaterials Track or the Nanotechnology Track, the course work specified for the degree will provide a firm grounding in the principles of materials science and engineering.

Students majoring in Materials Science and Engineering:

- are well prepared for professional scientific and engineering practice, as well as for advanced study in materials science and engineering or other scientific, engineering or professional areas;
- acquire a solid grounding in the mathematics, chemistry, biology and the physics that are required for the solution of materials problems related to the structure, properties, processing and performance of materials;
- can utilize modern scientific, engineering and computer tools to analyze problems in materials science and engineering;
- can identify important scientific and engineering problems related to materials and design systems and processes as well as perform and complete relevant experiments to aid the solution of these problems within the constraints

provided by social, economic, environmental and cultural factors;

- learn to work both independently and in teams;

- obtain extensive experience in oral and written communication including science and engineering—specific forms of communication such as technical reports, scientific notebooks and technical presentations of research;

- are instilled with an appropriate appreciation of the broad need for life-long learning, the scope and meaning of professional responsibility and the relevance of engineering practice to contemporary economic, environmental and societal issues on local and global levels.

Three B.S. degree tracks are offered by the Department of Materials Science and Engineering.

Standard Track. The Standard Track is intended for those students with general materials science interests. It permits the student to tailor the degree program to specific interests by allowing a broad range of choices for upper-level science and engineering electives.

Biomaterials Track. Our biomaterials curriculum covers a variety of topics including biomimetic materials and natural materials, host responses to biomaterials and biocompatibility, and applications of biomaterials, particularly to tissue engineering, drug delivery, and medical devices and implants. The goal of the Biomaterials Track in the Department of Materials Science and Engineering is to train students in the basic principles of materials science and engineering as these principles are applied to develop novel materials that benefit human health.

Students of the Biomaterials Track will be well-prepared for successful careers in biomaterials engineering or any biomedical-related field.

Successful completion of the Biomaterials Track will be noted on the student's transcript. To receive commendation for completion of the Biomaterials Track, the student must complete two electives whose subject matter is some aspect of biomaterials and complete a biomaterials-related senior design project. Approval of electives must be made by a student's academic advisor prior to taking the courses, and approval of the senior design project must be pre-approved by the senior design instructor.

An intent to follow the Biomaterials Track in Materials Science and Engineering must be made by the student's fifth semester (first semester junior year). Students should express their intent in writing or by email to their department advisors and copy the academic coordinator. Students intending to follow the Biomaterials Track must complete a biomaterials-related senior design project.

Nanotechnology Track. It is with the goal of developing a broad vision for the application of nanostructured materials that the Department of Materials Science offers a Nanotechnology Track.

The Nanotechnology curriculum covers the preparation, imaging, capabilities and detailed physical understanding of materials as nanoscale objects. Successful completion of the Nanotechnology Track will be noted on the student's transcript.

The Nanotechnology Track is intended for those students with a focused interest in nanomaterials. To satisfy the requirements of the Nanotechnology Track, students must complete two electives whose subject matter is some aspect of nanotechnology, and complete a nanotechnology-related senior design project. Approval of electives must be made by a student's academic advisor prior to taking the courses, and approval of the senior design project must be pre-approved by the senior design instructor.

Students must declare their intent to satisfy the requirements of the Nanotechnology Track in Materials Science and Engineering by their fifth semester (first semester junior year). Students should declare their intent in writing or by email to their department advisors and copy the academic coordinator.

Students who wish to pursue both the biomaterials and nanotechnology track are permitted to do so, as long as they complete all requirements, and the subject matter of their senior design project fall within the scope of both programs (as approved by the instructor of senior design).

Detailed description of the B.S. program (course credits in parenthesis):

Materials Science (42 credits)

- **Ten core courses:**

- Must be passed with a letter grade of C or higher.

510.311 Structures of Materials (3)
510.312 Physical Chemistry of Materials I: Thermodynamics (3)
510.313 Mechanical Properties of Materials (3)
510.314 Electronic Properties of Materials (3)
510.315 Physical Chemistry of Materials II: Kinetics and Phase Transformations (3)
510.316 Biomaterials I (3)
510.428-429 Materials Science Lab I, II (3 ea.)
510.433-434 Senior Design/Research (3 ea.)

Four upper-level materials science electives

- each 300-level or higher.

Courses in other departments with an emphasis on the structure, properties, or processing of materials may be counted as materials science electives. A list of approved electives appears in the department's Undergraduate Advising Manual (available from a student's academic advisor). All 400-level or higher classes required in the Biomaterials and Nanotechnology Tracks will be counted toward satisfying the upper-level materials science electives requirement.

Basic Sciences (22 credits)

- Must be passed with a letter grade of C- or higher

  171.101-102 Physics (4 ea.)

  173.111-112 Physics Lab (1 ea.)

  510.101 Intro to Materials Chemistry (3)*

  or

  030.101 Intro Chemistry (3) *and*

      030.102 Intro Chemistry II (3)

  030.105-106 Intro Chemistry Lab (1 ea.)

  030.205 Organic Chemistry I (4)

  030.225 Organic Chemistry Lab (3)

* Students may take 510.101 Introduction to Materials Chemistry to fulfill the Intro. Chem (030.101/030.102) requirement. In this case, the student needs to make up the balance of the credits with 3 credits of free electives.

Mathematics (20 credits)

- Must be passed with a letter grade of C- or higher

  110.108, 109, 202 Calculus I, II, III (4 ea.)

  110.201 Linear Algebra (4)

  110.302 Differential Equations (4)

Basic Engineering (11 credits)

Students must complete two of the following (8):

- Must be passed with a grade of C- or higher

  520.213 Circuits (4)

  530.201 Statics and Mechanics of Materials (4)

  580.221 Molecules and Cells (4)

For the Biomaterials Track, 580.221 Molecules and Cells must be passed with a grade of C or higher.

Computer Programming (3)

- 510.202 Computation and Programming for Materials Scientists and Engineers (offered spring)

Humanities (18 credits)

- 18 credits of (H) or (S) electives

- Letter grade of C- or higher.

Science and Engineering Electives (6 credits)

- Two courses of 200-level or above in engineering, natural sciences, or mathematics

- Letter grade of D or higher required

Unrestricted Electives (9 credits)

- 9 credits of unrestricted electives

- Letter grade of D or higher is required

Sample Undergraduate Programs for Materials Science and Engineering: Standard Track

(For a student beginning with Calculus I)

• Year 1

Fall

510.101 Introduction to Materials Chemistry*	3
110.108 Calculus I	4
030.105 Intro. Chem. Lab I	1
171.101 General Physics I	4
173.111 General Physics Lab I	1
Unrestricted Elective	3
Total	16

Spring

510.202 Comp. and Prog. for Mats. Sci. & Engineers	3
030.106 Intro. Chem. Lab II	1
171.102 General Physics II	4
173.112 General Physics Lab II	1
110.109 Calculus II	4
Unrestricted Elective	3
Total	16

• Year 2

Fall

510.311 Structure of Materials	3
030.205 Intro. Organic Chem. I	4
030.225 Organic Chem. Lab I	3
110.202 Calculus III	4
520.213 Circuits	4
Total	18

Spring

510.313 Mechanical Properties of Materials	3
510.314 Electronic Properties of Materials	3
110.201 Linear Algebra	4
Math/Sci/Eng elective	3
H/S elective	3
Total	16

• **Year 3**

Fall

510.312 Physical Chemistry of Materials I: 3 Thermodynamics	
510.316 Biomaterials I	3
510.428 Materials Science Lab I	3
530.201 Statics and Mechanics of Materials	4
H/S elective	3
Total	16

Spring

510.315 Physical Chemistry of Materials. II: 3 Kinetics and Phase Transformations	
510.429 Materials Science Lab II	3
110.302 Differential Equations	4
H/S Elective	3
Math/Sci/Eng elective	3
Total	16

• **Year 4**

Fall

510.433 Senior Design I	3
510.4xx MSE elective	3
510.4xx MSE elective	3
Math/Sci/Eng elective	3
H/S Elective	3
Total	15

Spring

510.434 Senior Design II	3
510.4xx MSE elective	3
510.4xx MSE elective	3
H/S elective	3
H/S elective	3
Total	15
Grand Total	**128**

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* Students may take 510.101 Introduction to Materials Chemistry or both 030.101/030.102 Intro Chem/ I & II to fulfill the introductory chemistry lecture requirement.

Sample Undergraduate Program for Materials Science and Engineering: Biomaterials Track

(For a student beginning with Calculus I).

• **Year 1**

Fall

510.101 Introduction to Materials Chemistry*	3
110.108 Calculus I	4
030.105 Intro. Chem. Lab I	1
171.101 General Physics I	4
173.111 General Physics Lab I	1
Unrestricted Elective	
Total	16

Spring

510.202 Comp. and Prog. for Mats. Sci. & Engs.	3
030.106 Intro Chem. Lab II	1
171.102 General Physics II	4
173.112 General Physics Lab II	1
110.109 Calculus II	4
Unrestricted Elective	3
Total	16

• **Year 2**

Fall

510.311 Structure of Materials	3
030.205 Intro Organic Chem. I	4
030.225 Organic Chem. Lab I	3
110.202 Calculus III	4
H/S Elective	3
Total	17

Spring

510.313 Mechanical Properties of Materials	3
510.314 Electronic Properties of Materials	3
110.201 Linear Algebra	4
Math/Sci/Eng Elective	3
H/S elective	3
Total	16

• **Year 3**

Fall

510.312 Physical Chemistry of Materials. I: Thermodynamics	3
510.316 Biomaterials I	3
510.428 Materials Science Lab I	3
580.221 Molecules and Cells	4
H/S elective	3
Total	16

Spring

510.315 Physical Chemistry of Materials II: 3 Kinetics and Phase Transformations	
510.429 Materials Science Lab II	3
510.407 Biomaterials II	3
110.302 Differential Equations	4
H/S Elective	3
Total	16

• **Year 4**

Fall

510.433 Senior Design I	3
510.4xx MSE elective	3
510.4xx MSE elective	3
H/S Elective	3
530.201 Statics and Mechanics of Materials	4
Total	16

Spring

510.434	Senior Design II	3
510.431	Biocompatibility of Materials	3
	Math/Sci/Eng elective	3
	H/S elective	3
	Unrestricted Elective	3
	Total	15
Grand Total		**128**

* Students may take 510.101 Introduction to Materials Chemistry or both 030.101/030.102 Intro Chemistry I & II to fulfill the introductory chemistry lecture requirement.

Financial Aid

Scholarships and other sources of financial assistance for undergraduates are described under Admissions and Finances (see page 23). In addition, the faculty employs a number of undergraduates as laboratory assistants to help with various aspects of their individual research programs.

Graduate Programs

The Department of Materials Science and Engineering (DMSE) offers three graduate degrees: the Ph.D., the M.S.E. (master of science in engineering), and the M.M.S.E. (master of materials science and engineering). The Ph.D. and the M.S.E. can be completed on either a full-time or part-time basis. Financial aid is available only for students admitted to the full-time Ph.D. program. The M.S.E. degree may be completed either with or without an essay, as described below.

Hopkins undergraduate students are encouraged to consider completing both the B.S. degree and the M.S.E. degree in a total of five years. This five-year, dual degree option offers additional preparation for the pursuit of Ph.D. programs and careers in Materials Science and Engineering. Students are encouraged to consult their undergraduate advisors to gain information on M.S.E. programs at Hopkins, as well as third- and fourth-year course selections that are best suited to the pursuit of the M.S.E. degree.

The M.M.S.E. is a terminal master's degree offered through the Johns Hopkins Engineering for Professionals (EP) of the Whiting School of Engineering. The degree program consists of 10 courses offered primarily in the evening. Students interested in this program should apply through the EP Office, 410-516-8728 or **www.ep.jhu.edu**.

Admission

To be admitted to graduate study in the Department of Materials Science and Engineering, students must submit credentials sufficient to convince the faculty that they have the potential to successfully complete the program requirements. Under the new GRE test, applicants should take the General Test package containing the Mathematical Reasoning test.

Hopkins undergraduate students who plan to pursue a M.S.E. degree in a fifth year, are encouraged to submit an application early in their fourth year of study.

A graduate student pursuing a Ph.D. degree with the Department of Materials Science and Engineering who is funded by the department as a teaching assistant or research assistant may not enroll simultaneously in a master's program in another department, unless he or she receives written approval from his/her advisor, the DMSE Graduate Program Committee, and the department chairman.

Advising and review of student performance

Each graduate student will normally have one or more faculty advisors. Students who are entering the M.S.E. program and plan to pursue a degree without an essay will be assigned an academic advisor. Students who are entering the M.S.E. program and plan to pursue a degree with an essay will be advised by their research advisor. Students who are entering the Ph.D. program will be advised by their research advisor. Students with a research advisor in another department will be assigned an academic advisor from among the full-time faculty in the department. Student progress will be assessed regularly by the faculty advisor(s) and the Graduate Program Committee. Students are expected to remain in regular communication with their faculty advisor(s).

Each student's progress will be reviewed annually by the Graduate Program Committee, in consultation with the student's advisor(s). To assist in this evaluation, students are required to submit a form (available from the academic program coordinator) detailing progress toward completion of the degree requirements. This form must be signed by the student's advisor(s) and filed with the Graduate Program Committee each year. The department must be convinced that all academic requirements have been satisfied by the candidate before a recommendation to confer a graduate degree is passed on to the University Graduate Board.

Grade requirements for graduate course work differ according to the degree program, as described below. All graduate students are required to maintain an overall grade point average of 3.0 or higher; failure to do so will ordinarily be cause for dismissal from the program. Independent research courses

will not be counted toward completion of course requirements.

The department believes that teaching experience is important to professional growth; therefore, a student may be required to serve as a teaching assistant during his or her academic career.

Requirements for the M.S.E. degree with Essay (8 courses)

The degree of Master of Science in Engineering (M.S.E.) with Essay is awarded subject to the recommendation of the student's advisor and departmental approval, based on satisfactory completion of the following requirements:

- Three core courses in Materials Science and Engineering:
  - 510.601 Structures of Materials
  - 510.602 Thermodynamics of Materials
  - 510.603 Phase Transformations in Materials
- Any one of the following:
  - 510.604 Mechanical Properties of Materials
  - 510.605 Electronic, Optical, and Magnetic Properties of Materials
  - 510.606 Chemical and Biological Properties of Materials
- Four advanced (400 level or higher) elective courses in materials science and engineering or related fields, subject to the following rules:
  - Up to two of the elective courses may be taken from within the Engineering for Professionals (EP) program.
  - Up to two of the elective courses can be business courses.
  - Any elective taken from outside the department (including EP courses) requires prior approval of the Graduate Program Committee.
  - With approval of the Graduate Program Committee, the student can transfer up to two graduate courses from another institution. Students desiring such credit must make the request in writing to the Graduate Program Committee by the end of the first semester after matriculation. This request must include a description of the course, a course syllabus, and documentation of the grade received.
  - With approval of the Graduate Program Committee, current or former Hopkins undergraduates can count two courses (400 level or higher) to both their B.S. and M.S.E. requirements.
  - A grade of C or better must be achieved in each course to obtain credit.
  - A overall grade point average of 3.0 must be maintained, and a grade point average of a 3.0

is required to earn the degree at the end of the program.
  - Attendance is required at the weekly Graduate Student Seminar and the Department of Materials Science and Engineering Seminar.
- A master's essay or journal publication is required. A Master's essay must be approved by one faculty reader and confirm to the requirements of the Graduate Board. For a journal publication a student must submit to the Graduate Program Committee an article describing his or her original research that has been published (or accepted for publication) in an archival, peer-reviewed technical journal. The student must be the primary author of the article.

Admission to the M.S.E. program is through the standard graduate admissions process. The typical duration of the program is 21 months. The student's transcript will reflect a "Master of Science in Engineering with Essay".

Requirements for the M.S.E. degree without thesis (10 courses)

The degree of Master of Science in Engineering (M.S.E.) is awarded subject to the recommendation of the student's advisor and departmental approval, based on satisfactory completion of the following requirements:

- Three core courses in Materials Science and Engineering:
  - 510.601 Structures of Materials
  - 510.602 Thermodynamics of Materials
  - 510.603 Phase Transformations in Materials
- Any one of the following:
  - 510.604 Mechanical Properties of Materials
  - 510.605 Electronic, Optical, and Magnetic Properties of Materials
  - 510.606 Chemical and Biological Properties of Materials
- Six advanced (400-level or higher) elective courses in materials science and engineering or related fields, subject to the following rules:
  - Up to two of the elective courses may be taken from within the Engineering for Professionals (EP) program.
  - Up to two of the elective courses can be business courses.
  - Any elective taken from outside the department (including EP courses) requires prior approval of the Graduate Program Committee.
  - With approval of the Graduate Program Committee, the student can transfer up to two

graduate courses from another institution. Students desiring such credit must make the request in writing to the Graduate Program Committee by the end of the first semester after matriculation. This request must include a description of the course, a course syllabus, and documentation of the grade received.

– All electives will need prior approval from the Graduate Program Committee.

• A grade of C or better must be achieved in each course to obtain credit.

• A overall grade point average of 3.0 must be maintained, and a grade point average of 3.0 is required to earn the degree at the end of the program.

• Attendance is required at the weekly Graduate Student Seminar and the Department of Materials Science and Engineering Seminar.

• Up to two of the elective courses may be Graduate Research in Materials Science (510.807-808), which may be taken In any session (Fall, January, Spring or Summer). Note that 117 hours or research per course are required for credit.

Admission to the M.S.E. program is through the standard graduate admissions process. The typical duration of the program is 12 months. The student's transcript will reflect a "Master of Science in Engineering".

Requirements for the Ph.D. degree
To receive the degree of Ph.D., the candidate must fulfill the requirements below. The department must be satisfied that all academic requirements have been satisfied by the candidate before a recommendation will be made to the University Graduate Board to confer the Ph.D. degree.

1. Successful completion of four required courses in materials science and engineering.

– 510.601 Structure of Materials

– 510.602 Thermodynamics of Materials

– 510.603 Phase Transformations in Materials

– 510.615 Physical Properties of Materials

Each of the four required courses must be passed with a letter grade of B- or higher. If a student receives a grade of C+ or lower in a required course, the student may re-take the course once to achieve a grade of B- or higher. Receipt of grades of C+ or lower in two or more required courses will ordinarily be cause for dismissal from the program without the opportunity to re-take those courses.

In addition, the student must maintain an overall grade point average (GPA) of 3.0 or better in the four required courses. If the student's GPA falls below 3.0, the student must re-take one or more of the required courses and earn higher grade(s). Upon doing so the prior grade(s) in those course(s) are replaced and not counted towards the GPA.

The four required courses must be successfully completed (meeting the grade and GPA requirements above) no later than the start of the student's third year after matriculation; failure to do so will result in dismissal from the program. Exception: A student who fails to meet the requirements above due to a low grade in a single required course, and who has not had an opportunity to re-take that course during the first two years, will be permitted to re-take that one course in the third year.

Students who have completed prior graduate-level coursework similar to 510.601, 510.602 or 510.603 may petition the Graduate Program Committee to waive one of these required courses. Alternatively, students with undergraduate degrees in Materials Science may petition the Graduate Program Committee to waive the Physical Properties course. However, only one of the four required courses can be waived. If approved, the course that has been waived will not be counted towards calculation of the GPA as described above. Written requests for such waivers must be submitted to the Graduate Program Committee no later than the end of the first semester after matriculation.

2. Successful completion of three advanced (600-level or higher) elective courses in materials science and engineering or a related field.

Elective courses must be completed with a grade of C or higher, but there is no cumulative GPA requirement. A list of approved electives is available from the Academic Program Coordinator. Students wishing to use a course not on this list must submit a request to the Graduate Program Committee no later than the end of the first week of the semester in which the course is taken. Students who have completed prior graduate-level coursework may petition the Graduate Program Committee to waive one of the required elective courses.

Graduate research (510.807-808), part-time graduate courses (from Engineering for Professionals in WSE or Advanced Academic Programs in KSAS), and seminars (courses with less than three contact hours per week) will not be counted toward completion of PhD course requirements. Undergraduate courses (400-level or lower) will not be counted (unless they are cross-listed as graduate level, 600- or higher). Independent study courses (510.805-806) may be used with prior approval of the Graduate Program Committee.

Students who have completed prior graduate-level coursework may petition the Graduate Program Committee to waive one of the required elective courses. Written requests for such waivers must be submitted to the Graduate Program Committee no later than the end of the first semester after matriculation.

In some cases an advisor may require a student to complete additional coursework, beyond the four required courses and three electives described above.

3. Teaching Assistant Requirement: Students in their second year in the department will be required to act as teaching assistant for two courses.

4. Successful completion of a comprehensive oral examination covering fundamentals of materials science and engineering. The comprehensive examination tests knowledge in each of the subjects listed below:

- Structure of materials
- Thermodynamics of materials
- Phase transformations in materials

In each of the three subject areas, students may be asked questions related to the properties of materials. The depth of required knowledge regarding properties of materials will match the level of knowledge presented in the Physical Properties of Materials class.

Successful completion of the comprehensive exam requires satisfactory performance on all areas tested; there are no partial or conditional passes.

The comprehensive exam is offered semiannually, usually immediately prior to the fall and spring semesters. A student who fails the exam on the first try may make a second attempt, but the exam must be successfully completed no later than the start of the third year following matriculation. Failure to do so will result in dismissal from the program.

5. An oral presentation of a proposal for a research project to form the basis of the candidate's dissertation.

The dissertation proposal must be presented at a department seminar no later than the end of the third year following matriculation. A written version of the dissertation proposal must be submitted to a faculty committee consisting of the student's faculty advisor and two other faculty members (to be selected in consultation with the advisor) no later than two weeks prior to the oral presentation.

A brief closed session between the student and the committee shall follow the presentation, at which the committee members will ask questions about and provide comments on the proposed plan of research. Additional private discussions may be required by one or more committee members. The thesis proposal is also an examination, with the committee testing the candidate's depth of knowledge in his/her area of specialization (and not simply on the specific proposed research).

6. Completion of an original research project, documented in a dissertation that is defended by the candidate in a public presentation.

Candidates must write a dissertation conforming to university requirements that describes their work and results in detail. A public defense of the dissertation is required, and will be followed by a closed examination session. The committee for the closed examination shall consist of five faculty members, approved by the Graduate Program Committee, with at least two members being from outside the department. The outcome of the closed examination will be decided by majority vote of the committee. Because the closed examination session fulfills the university Graduate Board Oral (GBO) examination requirement, all procedures pertaining to GBOs as established by the University Graduate Board must be followed.

The committee may impose certain conditions (e.g. changes to the dissertation) for the candidate to meet prior to final certification that he or she has passed the exam. For this reason, the thesis defense must be scheduled for a date at least two months prior to any personal or university deadline for graduation. A complete draft of the dissertation must be submitted to all committee members no later than two weeks prior to the defense.

The dissertation in its final form must be read and approved in writing by two members of the committee (the advisor and one other member to be chosen by the committee as a whole).

Financial Aid

Fellowships of various forms are available for full-time graduate students, including tuition remission fellowships, teaching fellowships, and additional stipend fellowships.

Research assistantships are available to support full-time graduate students who work with individual professors on their research contracts and grants.

Undergraduate Courses

Introductory

510.101 (N) Introduction to Materials Chemistry
Basic principles of chemistry and how they apply to the behavior of materials in the solid state. The relationship between electronic structure, chemical bonding, and crystal structure is developed. Attention is given to characterization of atomic and molecular arrangements in crystalline and amorphous solids: metals, ceramics, semiconductors, and polymers (including proteins). Examples are drawn from industrial practice (including the environmental impact of chemical processes), from energy generation and storage (such as batteries and fuel cells), and from emerging technologies (such as biomaterials).
Wilson   3 credits   fall

510.103 Foundations of Nanotechnology
This course will be a survey of the rapidly developing field of nanotechnology from an interdisciplinary point of view. Topics covered will include a general introduction to the nanoworld, fabrication, characterization and applications of hard and soft nanomaterials, as well as examining nanotechnology in terms of its societal, ethical, economic and environmental impact.
Wilson   3 credits   spring

510.107 (N) Modern Alchemy
Can you really turn lead into gold? Converting common substances into useful materials that play important roles in today's technologies is the goal of modern scientists and engineers. In this course, we will survey selected topics related to modern materials, the processes that are used to make them as well as the inspiration that led to their development. Topics will include the saga of soft armor, the sticky stuff of gecko feet, and the stretchy truth of metal rubber.
Spicer   3 credits   fall

510.201 (E,N) Introduction to Engineering Materials
An introduction to the structure, properties, and processing of materials used in engineering applications. After beginning with the structure of materials on the atomic and microscopic scales, this course explores defects and their role in determining materials properties, the thermodynamics and kinetics of phase transformations, and ways in which structure and properties can be controlled through processing. All major classes of materials (metals, ceramics, polymers, and semiconductors) are considered. Recommended for all engineering majors. Prerequisites: introductory calculus, chemistry, and physics, or permission of instructor.
Staff   3 credits   spring

510.202 (E,N) Computation and Programming for Materials Scientists and Engineers
This course will introduce students to the basics of programming in the MATLAB environment. Students will build skills in algorithmic problem solving by programming assignments regarding a range of biological and non-biological materials systems. Students will learn to write function definitions and deploy basic operations of selection and iteration as well as MATLAB specific vectorization methods and the construction of graphical user interfaces. Applications may include materials structure, phase equilibrium, propagating reactions, and other relevant scientific and engineering applications.
3 credits   spring

The following ten course series, 510.311-316 + Labs 510.428-429 + Senior Design 510.433-434, is devoted to the fundamental principles and engineering applications of materials and the concepts necessary for the design of materials systems. This series is required for all majors in Materials Science and Engineering.

510.311 (E,N) Structure of Materials
First of the Introduction to Materials Science series, this course is devoted to study of the structure of materials. Lecture topics include bonding, atomic packing, crystal structure, imperfections in crystals, noncrystalline solids, and composite materials. Among the techniques treated are X-ray diffraction, stereographic projection, and optical and electron microscopy. Prerequisites: Calculus I, freshman/sophomore chemistry and physics, or permission of instructor.
Staff   3 credits   fall

510.312 (E,N) Physical Chemistry of Materials I: Thermodynamics
Second of the Introduction to Materials Science series, this course examines the principles of thermodynamics as they apply to materials. Topics include fundamental principles of thermodynamics, equilibrium in homogeneous and heterogeneous systems, thermodynamics of multicomponent systems, phase diagrams, thermodynamics of defects, and elementary statistical thermodynamics. Prerequisites: Calculus I and II, freshman/sophomore chemistry and physics, or permission of instructor.
Staff   3 credits   fall

510.313 (E,N) Mechanical Properties of Materials
Third of the Introduction to Materials Science series, this course is devoted to a study of the mechanical properties of materials. Lecture topics include elasticity, anelasticity, plasticity, and fracture. The concept of dislocations and their interaction with other lattice defects is introduced. Among the materials studied are metals, polymers, ceramics, glasses, and composites. Prerequisite: 510.311.
Staff   3 credits   spring

510.314 (E,N) Electronic Properties of Materials
Fourth of the Introduction to Materials Science series, this course is devoted to a study of the electronic, optical and magnetic properties of materials. Lecture topics include electrical and thermal conductivity, thermoelectricity, transport phenomena, dielectric effects, piezoelectricity, and magnetic phenomena. Prerequisite: 510.311.
Staff   3 credits   spring

510.315 (E,N) Physical Chemistry of Materials II: Kinetics and Phase Transformations

Fifth of the Introduction to Materials Science series, this course covers diffusion and phase transformations in materials. Topics include Fick's laws of diffusion, atomic theory of diffusion, diffusion in multicomponent systems, solidification, diffusional and diffusionless transformations, and interfacial phenomena. Prerequisite: 510.312.

Staff   3 credits   spring

510.316 (E,N) Biomaterials I

Sixth of the Introduction to Materials Science series, this course offers an overview of principles and properties of biomedical materials. Topics include properties of materials used in medicine, synthesis and properties of polymeric materials, polymeric biomaterials, natural and recombinant biomaterials, biodegradable materials, hydrogels, stimuli-sensitive materials, and characterizations of biomaterials. Prerequisites: Organic Chemistry I, Organic Chemistry Lab I.

Staff   3 credits   fall

510.428 (E,N,W) Materials Science Laboratory I

This course focuses on characterizing the microstructure and mechanical properties of structural materials that are commonly used in modern technology. A group of Al alloys, Ti alloys, carbon and alloy steels, and composite materials that are found, for example, in actual bicycles will be selected for examination. Their microstructures will be studied using optical metallography, scanning elec-tron microscopy, X-ray diffraction, and transmission electron microscopy. The mechanical properties of these same materials will be characterized using tension, compression, impact, and hardness tests. The critical ability to vary microstructure and therefore properties through mechanical and heat treatments will also be demonstrated and investigated in the above materials. Prerequisites: 510.311, 510.313.

Wilson   3 credits   fall

510.429 (E,N,W) Materials Science Laboratory II

This laboratory concentrates on the experimental investigation of electronic properties of materials using basic measurement tech-niques. Topics include thermal conductivity of metal alloys, electrical conductivity of metals/metal alloys and semiconductors, electronic behavior at infrared wavelengths, magnetic behavior of materials, carrier mobility in semiconductors, and the Hall effect in metals and semiconductors. Additional topics considered include basic processing of electronic materials and electronic device construction. Prerequisite: 510.311 or permission of instructor.

Wilson   3 credits   spring

510.433 (E,W) Senior Design/Research Experience in Materials Science and Engineering I

This course is the first half of a two-semester sequence required for seniors majoring or double majoring in materials science and engineering. It is intended to provide a broad exposure to many aspects of planning and conducting independent research. During this semester, students join ongoing graduate research projects for a typical 10-12 hours per week of hands-on experiences in design and research. Classroom activities include discussions, followed by writing of research pre-proposals (white papers), proposals, status reports and lecture critiques of the weekly departmental research seminar. Prerequisites: 510.311-312, 510.428-429.

Wilson   3 credits   fall

510.434 (E,W) Senior Design/Research Experience in Materials Science and Engineering II

This course is the second half of a two-semester sequence required for seniors majoring or double majoring in materials science and engineering. It is intended to provide a broad exposure to many aspects of planning and conducting independent research. During this semester, verbal reporting of project activities and status is emphasized, culminating in student talks presented to a special session of students and faculty. Students also prepare a written final report summarizing their design and research results. Prerequi-sites: 510.311-312, 510.428-429, 510.433.

Wilson   3 credits   spring

Advanced Materials Undergraduate Electives. Not all electives are offered each academic year.

510.400 Introduction to Ceramics

This course will examine the fundamental structure and property relationships in ceramic materials. Areas to be studied include the chemistry and structure of ceramics and glasses, microstructure and property relationships, ceramic phase relationships, and ceramic properties. Particular emphasis will be placed on the physical chemistry of particulate systems, characterization, and the surface and colloid chemistry of ceramics. Prerequisites: 510.311, 510.312 or permission of the instructor.

Staff   3 credits   spring

510.403 (N) Materials Characterization

This course will describe a variety of techniques used to characterize the structure and composition of engineering materials, including metals, ceramics, polymers, composites, and semiconductors. The emphasis will be on microstructural characterization techniques, including optical and electron microscopy, X-ray diffraction, and acoustic microscopy. Surface analytical techniques, including Auger electron spectroscopy, secondary ion mass spectroscopy, X-ray photoelectron spectroscopy, and Rutherford backscattering spectroscopy. Real-world examples of materials characterization will be presented throughout the course, including characterization of thin films, surfaces, interfaces, and single crystals.

McGuiggan   3 credits   fall

510.405 (E,N) Energy Engineering: Fundamentals & Future

This course examines the science and engineering of contemporary and cutting-edge energy technologies. Materials Science and Mechanical Engineering fundamentals in this area will be complemented by case studies that include fuel cells, solar cells, lighting, thermoelectrics, wind turbines, engines, nuclear power, biofuels, and catal-

ysis. Students will consider various alternative energy systems, and also to research and engineering of traditional energy technologies aimed at increased efficiency, conservation, and sustainability. Prerequisite: undergraduate course in thermodynamics.

Erlebacher   3 credits   fall

510.407 (E,N) Biomaterials II

This course focuses on the interaction of biomaterials with the biological system and applications of biomaterials. Topics include host reactions to biomaterials and their evaluation, cell-biomaterials interaction, biomaterials for tissue engineering applications, biomaterials for controlled drug and gene delivery, biomaterials for cardiovascular applications, biomaterials for orthopedic applications, and biomaterials for artificial organs. Prerequisite: 510.316 (also listed as 510.607).

Mao   3 credits   spring

510.409 (E,N) Melting, Smelting, Refining and Casting

This is a laboratory class on metal formation, an area that underlies almost all other technologies. We will examine extraction of metals from ore, refining of metals. The kinetics of melting and solidification will be explored in the context of casting and forming.

Erlebacher   3 credits   spring

510.410 (E.N) Simulation of Materials and Biological Systems

This course will review basics of programming in MATLAB environment. Students will build their MATLAB skills by programming assignments regarding a range of biological and materials systems. Integration of time-dependent ODEs and PDEs, solution of egenvalue problems, Monte Carlo calculations and molecular dynamics simulations will be explored in the context of problems that may include chemical reactions, band structure, phase equilibrium, disease progression, waves in heart tissue, glycolysis, and other relevant scientific and engineering applications.

Falk   3 credits   spring

510.413 (E,N) Statistical Mechanicals of Materials

This course will present the basic principles of statistical mechanics and apply them to problems concerning the behavior of materials. Topics include: basic principles of statistical mechanics; time averages and ensembles; connection to macroscopic thermodynamics; fluctuations; classical and quantum particles statistics; lattice statistics; statistical thermodynamic models of gases, liquids, crystals, crystalline defects, linear chain polymers, and surfaces; phase transitions and critical phenomena; kinetic and transport phenomena; thermodynamics of irreversible processes. Prerequisites: 510.312 or undergraduate course in thermodynamics.

Cammarata   3 hours   fall

510.415 (E, N) The Chemistry of Materials Synthesis

Many of the latest breakthroughs in materials science and engineering have been driven by new approaches to their synthesis, which has allowed the preparation of materials with fanciful structures and fascinating properties. This advanced course will explore synthetic approaches to multifunctional and nanostructured materials, ranging from opals to complex polymers to nanowires and quantum dots. Applications include electronics, energetics, and drug delivery. Participants will gain sufficient familiarity with synthesis options to be able to design research programs that rely on them. Emphasis will be placed on broad strategies that lead to material functionality, rather than detailed step-by-step sequences. Some topics will be selected "on the fly" from the most exciting current literature. Prerequisites: 030.205 Organic Chemistry I, and 510.312 or equivalent thermodynamics course.

Katz   3 credits   fall

510.416 (E, N) Applications of X-Ray Diffraction

Practical aspects of structural characterization with x-ray diffraction. Topics include orientation of single crystals; lattice parameter measurement; phase identification; quantitative phase analysis; crystallographic texture determination; stress measurement; diffraction from long-period structures including superlattices, multilayers, and layered molecular solids; and scattering from liquids and amorphous solids. The course will combine lectures with several laboratory exercises intended to give students experience in data collection and analysis for a variety of diffraction techniques.

Hufnagel   3 credits   fall

510.418 (E,N) Electronic and Photonic Processes & Devices

This course is intended for advanced undergraduates and graduate students and will cover the fundamentals and properties of electronic and optical materials and devices. Subject matter will include a detailed and comprehensive discussion of the physical processes underlying modern electronic and optical devices. Detailed descriptions of modern semiconductor devices such as lasers and detectors used in optical communications and information storage and processing will be presented.

Poehler   3 credits   spring

510.419 (E,N) Physical Metallurgy

This course examines the relationship between microstructure and mechanical properties of metals and alloys. Starting from fundamentals (phase diagrams and phase transformation kinetics), we will explore how the structure of metals and alloys can be manipulated by thermo-mechanical processing to achieve desired properties. Detailed examples will be drawn from several alloy systems, including steels, aluminum, and titanium. A theme of the course will be the impact of materials processing and materials selection on the environment, including considerations of lightweight materials and processing techniques for minimizing energy consumption. Prerequisites: 510.311-312, 510.314-315.

Hufnagel   3 credits   fall

510.422 (E,N) Micro- and Nano-Structured Materials and Devices

Almost every material's property changes with scale. We will examine ways to make micro- and nano-structured materials and discuss their mechanical, electrical, and

chemical properties. Topics include the physics and chemistry of physical vapor deposition, thin film patterning, and microstructural characterization. Particular attention will be paid to current technologies including computer chips and memory, thin film sensors, diffusion barriers, protective coatings, and microelectromechanical (MEMS) devices (also listed as 510.622). Prerequisites: 510.311, 501.312 and 510.315.
Ma   3 credits   spring

510.423 Mechanical Properties of Thin Films and Nanostructured Materials
The mechanical properties of thin films on substrates and nanomaterials will be discussed. Topics include: elastic, plastic, and diffusional deformation of thin films and nanomaterals; effects of temperature, microstructure, and capillarity on mechanical behavior; mechanical characterization techniques; mechanics of thin film stresses that develop during thin film growth; experimental methods for measuring thin film stresses; thin film adhesion; strengthening processes in nanomaterials. Prerequisite: 510.313 or equivalent.
Cammarata   3 credits

510.426 (E,N) Biomolecular Materials
Structure and function of cellular molecules (lipids, nucleic acids, proteins, and carbohydrates). Structure and function of molecular machines (enzymes for biosynthesis, motors, pumps). Protein synthesis using recombinant nucleic acid methods. Advanced materials development. Interactions of biopolymers, lipid membranes, and their complexes. Mean field theories, fluctuation and correlation effects. Self-assembly in biomolecular materials. Biomedical applications. Characterization techniques (also listed as 510.626).
Hristova   3 credits spring

510.430 (E,N,W) Biomaterials Lab
This laboratory course concentrates on synthesis, processing and characterization of materials for biomedical applications, and characterization of cell-materials interaction. Topics include synthesis of biodegradable polymers and degradation, electrospinning of polymer nanofibers, preparation of polymeric microspheres and drug release, preparation of plasmid DNA, polymer-mediated gene delivery, recombinant protein synthesis and purification, self-assembly of collagen fibril, surface functionalization of biomaterials, cell culture techniques, polymer substrates for cell culture, and mechanical properties of biological materials. Prerequisite: 510.407. Lab fee: $100.
Mao   3 credits   spring

510.431 (E,N) Biocompatibility of Materials
This course provides a detailed examination of the interaction of surgical implant materials (i.e., metals, polymers, ceramics, and composites) with the body. The effect of the physiological environment on the properties of implant materials is described as well as the cellular, tissue response to the implant. Concepts dealing with the design of materials with improved biocompatibility are explored. Prerequisite: 510.104 or 510.316, or permission of instructor.
Yu   3 credits   spring

510.435 Mechanical Properties of Biomaterials
This course will focus on the mechanical properties of biomaterials and the dependence of these properties on the microstructure of the materials. Organic and inorganic systems will be considered through a combination of lectures and readings and the material systems will range from cells to bones to artificial implants.
Weihs   3 credits   spring

510.436 The Foundations of Information Technology
The revolutionary technologies of the Information age have been driven by an array of physics and materials science advances which have served as the foundation for their development. In this course we will explore the developments in solid-state devices, photonics, optical communications, and storage that serve as the underpinnings of the revolution with focus on the enabling materials innovations. The fundamental physical principles, i.e., the basic science of the devices and concepts will be reviewed. In addition, next generation concepts and devices, (such as holographic storage, quantum computing, etc.), will be discussed.
Wilson, W.   3 credits   spring

510.443 Chemistry & Physics of Polymers
The course will describe and evaluate the synthetic routes, including condensation and addition polymerization, to macromolecules with varied constituents and properties. Factors that affect the efficiencies of the syntheses will be discussed. Properties of polymers that lead to technological applications will be covered, and the physical basis for these properties will be derived. Connections to mechanical, electronic, photonic, and biological applications will be made. Prerequisites: Organic Chemistry I and one semester of thermodynamics.
Katz   3 credits   spring

510.456 (E,N) Introduction to Surface Science
Introduction to the structure and properties of solid surfaces. Topics include Gibbsian and gradient thermodynamics of surfaces; crystallography and structure of free solid surfaces; characterization methods; surface mobility and phase transitions; gas-solid interactions; crystal growth; electronic structure; solid-solid surfaces; thin film epitaxy. Prerequisites: 510.311-315 or permission of instructor. (also listed as 510.656).
Cammarata   3 credits   fall

510.457 (E,N) Materials Science of Thin Films
The processing, structure, and properties of thin films are discussed emphasizing current areas of scientific and technological interest. Topics include elements of vacuum science and technology; chemical and physical vapor deposition processes; film growth and microstructure; chemical and microstructural characterization methods; epitaxy; mechanical properties such as internal stresses, adhesion, and strength; and technological applications such as superlattices, diffusion barriers, and protective coatings.
Staff   3 credits

510.501-502 Research in Materials Science

Student participation in ongoing research activities. Research is conducted under the supervision of a faculty member and often in conjunction with other members of the research group.

Staff   1-3 credits   fall/spring

510.503-504 Independent Study in Materials Science

Individual programs of study are worked out between students and the professor supervising their independent study project. Topics selected are those not formally listed as regular courses and include a considerable design component. Prerequisite: permission of instructor.

Staff   1-3 credits   fall/spring

510.574 Intersession Research in Materials Science

Staff   1-3 credits

510.576 Intersession Independent Study

Staff   1-3 credits

510.597 Summer Research in Materials Science

Staff   1-3 credits

510.599 Summer Independent Study in Materials Science

Staff   1-3 credits

Cross-Listed

500.404/644 (E) Interfacial Phenomena in Nanotechnology

Nanotechnology is a new field that is still being defined, with concepts ranging from nanorobotics to nanomaterials. Whatever the outcome, engineering at the nanoscale will be dominated by surface science, as surface to volume ratios become large. Furthermore, self-assembly techniques, with which molecules can spontaneously assemble in ordered structures with nanometer length scales are ripe for exploitation to create new materials. In this class, the fundamentals of interfacial thermo-dynamics, interfacial interactions (e.g., van der Wall's interactions, electrostatics, steric interactions), adsorption, self-assembly, and specific interactions will be covered with an emphasis on how to exploit these ideas in application in nanotechnology.

Erlebacher   3 credits

570.429 (E,N) Surface Effects in Technological Processes and Materials

Mechanical properties and stability of disperse systems and materials are considered in dependence on real microheterogeneous structure and physical/chemical surface phenomena determining particles cohesion. Concepts of modern physical/chemical mechanics are applied to achieving two cardinal goals: high stability and durability of materials including natural and living tissues, and low resistance during deformation and treatment, independence upon surrounding media and other environmental conditions. Prerequisites: 570.444 or general physics and chemistry.

Shchukin   3 credits   fall

Graduate Courses

510.601 Structures of Materials

An introduction to the structure of inorganic and polymeric materials. Topics include the atomic scale structure of metals, alloys, ceramics, and semiconductors; structure of polymers; crystal defects; elementary crystallography; tensor properties of crystals; and an introduction to the uses of diffraction techniques (including X-ray diffraction and electron microscopy) in studying the structure of materials. Prerequisites: undergraduate chemistry, physics, and calculus or permission of instructor.

Staff   3 hours   fall

510.602 Thermodynamics of Materials

An introduction to the classical and statistical thermodynamics of materials. Topics include the zeroth law of thermodynamics; the first law (work, internal energy, heat, enthalpy, heat capacity); the second law (heat engines, Carnot cycle, Clausius inequality, entropy, absolute temperature); equilibrium of single component systems (free energy, thermodynamic potentials, virtual variations, chemical potential, phase changes); equilibrium of multicomponent systems and chemical thermodynamics; basics of statistical physics (single and multiple particle partition functions, configurational entropy, third law; statistical thermodynamics of solid solutions); and equilibrium composition-temperature phase diagrams. Prerequisites: undergraduate calculus, chemistry and physics or permission of instructor.

Staff   3 hours   fall

510.603 Kinetics and Phase Transformations in Materials

This course presents a unified treatment of the thermodynamics and kinetics of phase transformations from phenomenological and atomistic viewpoints. Phase transformations in condensed metal and nonmetal systems are discussed. Topics include absolute reaction rate theory, thermodynamics of irreversible processes, thermodynamics of surfaces and interfaces, chemical kinetics, nucleation and growth, spinodal decomposition, order-disorder transformations, diffusional transformations, martensitic transformations, cobarsening, glass transition. Prerequisites: 510.601 and 510.602 or permission of instructor.

Staff   3 hours   spring

510.604 Mechanical Properties of Materials

An introduction to the properties and mechanisms that control the mechanical performance of materials. Topics include mechanical testing, tensor description of stress and strain, isotropic and anisotropic elasticity; plastic behavior of crystals, dislocation theory, mechanisms of microscopic plasticity, creep, fracture, and deformation and fracture of polymers. Prerequisite: 510.601 or permission of instructor.

Staff   3 hours   spring

510.605 Electronic, Optical, and Magnetic Properties of Materials

An overview of electrical, optical, and magnetic properties arising from the fundamental electronic and atomic structure of materials. Continuum materials properties are developed through examination of microscopic pro-

cesses. Topics to be covered include quantum mechanical structure of solids including electronic band structure; electrical, thermal, and ionic conduction; response of materials to electromagnetic fields including dielectric permittivity, ferroelectric materials, and piezoelectricity; magnetic behavior including paramagnetism and ferromagnetism, magnetic permeability, magnetic domains, and magnetostriction; interactions of electromagnetic radiation with materials (absorption, reflection, refraction, and scattering, electro- and magneto-optic effects); and superconductivity. Emphasis will be placed on both fundamental principles and applications in contemporary materials technologies. Prerequisite: 510.601.
Staff   3 hours   spring

510.606 Chemical and Biological Properties of Materials
An introduction to the chemical and biological properties of organic and inorganic materials. Topics include an introduction to polymer science, polymer synthesis, chemical synthesis, and modification of inorganic materials, biomineralization, biosynthesis, and properties of natural materials (proteins, DNA, and polysaccharides), structure-property relationships in polymeric materials (synthetic polymers and structural proteins), and materials for biomedical applications. Prerequisites: undergraduate chemistry and biology or permission of instructor.
Staff   3 hours   spring

510.607 (E,N) Biomaterials II
This course focuses on the interaction of biomaterials with the biological system and applications of biomaterials. Topics include host reactions to biomaterials and their evaluation, cell-biomaterials interaction, biomaterials for tissue engineering applications, biomaterials for controlled drug and gene delivery, biomaterials for cardiovascular applications, biomaterials for orthopedic applications, and biomaterials for artificial organs. Prerequisite: 510.316 (also listed as 510.407).
Mao   3 credits   spring

510.608 Electrochemistry
Thermodynamics of electrochemical interfaces, including electrochemical potential, the Nernst equation, ion-solvent interactions, and double layer theory. Charge transfer kinetics for activation and diffusion controlled processes. Analysis of kinetics at various electrodes, including redox reactions, metal-ion electrodes, and semiconductor electrodes. Electroanalytical techniques are discussed, including those related to bioelectrochemistry and semiconductor electrochemistry. Selected reactions of technological importance are evaluated, including the hydrogen evolution reaction, oxygen reduction, electrodeposition, and energy generation and storage. Undergraduate prerequisite: introductory chemistry or permission of instructor.
Searson   3 hours   spring

510.609 Electrochemistry Lab
A series of laboratory experiments is used to illustrate the principles of electrochemistry. Prerequisite: 510.608 or permission of instructor.
Searson   3 hours

510.610 Chemistry and Physics of Semiconductor Surfaces
Basic principles of bonding, thermodynamics of crystals, surface energy, space charge effects, and potential distributions at phase boundaries are reviewed. Processes related to solid/liquid interfaces including electron transfer, photoeffects, adsorption, catalysis, etching, and oxide formation are covered. Relevant experimental methods including surface analytical techniques are reviewed. Examples of applications, including photovoltaic devices and solar cells, are discussed.
Searson   3 hours

510.611-612 Solid State Physics
An introduction to solid state physics for advanced undergraduates and graduate students in physical science and engineering. Topics include crystal structure of solids; band theory; thermal, optical, and electronic properties; transport and magnetic properties of metals, semiconductors, and insulators; and superconductivity. The concepts and applications of solid state principles in modern electronic, optical, and structural materials are discussed.
Poehler   3 hours

510.613 Statistical Mechanicals of Materials
This course will present the basic principles of statistical mechanics and apply them to problems concerning the behavior of materials. Topics include: basic principles of statistical mechanics; time averages and ensembles; connection to macroscopic thermodynamics; fluctuations; classical and quantum particles statistics; lattice statistics; statistical thermodynamic models of gases, liquids, crystals, crystalline defects, linear chain polymers, and surfaces; phase transitions and critical phenomena; kinetic and transport phenomena; thermodynamics of irreversible processes.
Cammarata   3 hours

510.615 Physical Properties of Materials
A detailed survey of the relationship between materials properties and underlying microstructure. Structure/property/processing relationships will be examined across a wide spectrum of materials including metals, ceramics, polymers and biomaterials, and properties including electrical, magnetic, optical, thermal, mechanical, chemical and biocompatibility.
Staff   3 hours

510.616 Applications of X-ray Diffraction
Practical aspects of structural characterization with x-ray diffraction. Topics include orientation of single crystals; lattice parameter measurement; phase identification; quantitative phase analysis; crystallographic texture determination; stress measurement; dif-fraction from long-period structures including superlattices, multilayers, and layered molecular solids; and scattering from liquids and amorphous solids. The course will combine lectures with several laboratory exercises intended to give students experience in data collection and analysis for a variety of diffraction techniques.
Staff   3 hours

510.617 Advanced Topics in Biomaterials

This course reviews recent advances in biomaterials focusing on the design principles in polymeric materials and scaffolds. It will cover topics from molecular designs of polymeric biomaterials, materials surface engineering, processing of polymeric scaffolds, to manipulation of cellular behaviors through materials engineering. Specific examples in cell and tissue engineering, and drug and gene delivery will be discussed.

Mao   3 hours

510.618 Electronic and Photonic Processes & Devices

This course is intended for advanced undergraduates and graduate students and will cover the fundamentals and properties of electronic and optical materials and devices. Subject matter will include a detailed and comprehensive discussion of the physical processes underlying modern electronic and optical devices. Detailed descriptions of modern semiconductor devices such as lasers and detectors used in optical communications and information storage and processing will be presented.

Poehler   3 hours

510.619 Biopolymers Synthesis

In this course, we will review the current synthetic methods for preparing biopolymers of both synthetic and natural origin. The class will focus mainly on polypeptides and polysaccharides, but natural polyesters and polynucleotides (DNA and RNA) will be covered as well. Some of the main topics are; solid phase peptide synthesis, ring-opening polymerization for polypeptide synthesis, recombinant DNA and bacterial protein synthesis, bacterial production of biodegradable polyester, and chemical and biological engineering of polysaccharides.

Yu   3 hours

510.620 Metallic Glasses

Fundamentals of the structure and properties of amorphous and nanocrystalline metals. Models for structure of metallic glasses, structural characterization by scattering, EXAFS, and TEM; processing; glass-forming ability and crystallization kinetics; mechanical properties and deformation mechanisms; magnetic properties.

Hufnagel   3 hours

510.621 (E, N) Structure and Thermodynamics of Biomolecules

Structure and function of cellular molecules (lipids, nucleic acids, proteins, and carbohydrates). Structure and func-tion of molecular machines (enzymes for biosynthesis, motors, pumps). Protein synthesis using recombinant nucleic acid methods. Advanced materials development. Interactions of biopolymers, lipid membranes, and their complexes. Mean field theories, fluctuation and correlation effects. Self assembly in biomolecular materials. Biomedical applications. Characterization techniques.

Hristova   3 hours

510.622 Micro- and Nano-Structured Materials and Devices

Almost every material's property changes with scale. We will examine ways to make micro- and nano-structured materials and discuss their mechanical, electrical, and chemical properties. Topics include the physics and chemistry of physical vapor deposition, thin film patterning, and microstructural characterization. Particular attention will be paid to current technologies including computer chips and memory, thin film sensors, diffusion barriers, protective coatings, and microelectromechanical (MEMS) devices. (also listed as 510.422).

Erlebacher   3 hours

510.623 Mechanical Properties of Thin Films and Nanostructured Materials

The mechanical properties of thin films on substrates and nanomaterials will be discussed. Topics include: elastic, plastic, and diffusional deformation of thin films and nanomaterals; effects of temperature, microstructure, and capillarity on mechanical behavior; mechanical characterization techniques; mechanics of thin film stresses that develop during thin film growth; experimental methods for measuring thin film stresses; thin film adhesion; strengthening processes in nanomaterials.

Cammarata   3 hours

510.624 Theory of X-ray Diffraction

An introduction to diffraction theory and the uses of diffraction in structural characterization of materials. Topics include X-ray scattering by atoms, kinematic theory, Fourier series methods, diffraction from single crystals and polycrystalline materials, diffraction from multilayers, scattering by liquids and amorphous solids, small-angle scattering, dynamic theory. Prerequisite: 510.601.

Hufnagel   3 hours

510.625 Nano-Bio Laboratory

This course introduces students to concepts and laboratory techniques in nanobiotechnology. The focus of the laboratory is on nanoparticle carriers for drug delivery and markers for imaging. The laboratory involves the synthesis of nanoparticles using solution phase techniques and characterization by optical techniques such as dynamic light scattering and absorbance spectroscopy. Strategies for functionalization of nanoparticles are covered with focus on methods for attaching biomolecules. The basic aspects of cell culture and optical microscopy techniques will be covered. Nanoparticles functionalized with a drug or gene will be used to perform transfection experiments and compared to standard techniques. Prerequisite: permission of instructor.

Staff

510.626 Biomolecular Materials

Structure and function of cellular molecules (lipids, nucleic acids, proteins, and carbohydrates). Structure and function of molecular machines (enzymes for biosynthesis, motors, pumps). Protein synthesis using recombinant nucleic acid methods. Advanced materials development. Interactions of biopolymers, lipid membranes, and their complexes. Mean field theories, fluctuation and correlation effects. Self-assembly in biomolecular materials. Biomedical applications. Characterization techniques. (Also listed as 510.426.)

Hristova   3 hours

510.628 Organics, Polymers and Hybrids for New Electronics

This will be an advanced course on material alternatives to those used in conventional silicon electronics. We will begin with a review of the materials associated with silicon, then introduce alternative materials such as organic semiconductors, composite dielectrics, and carbon nanotubes being contemplated for high performance displays and high-throughput printed circuits. We conclude with a discussion of nanomaterials in circuits and solar cells.

Katz   3 hours   spring

510.629 Advanced Transport Processes in Condensed Matter

This course develops parallel treatments of photon, electron, phonon, and atomic/molecular transport in condensed matter. With emphasis on fundamental descriptions as well as the mathematical tools used to model energy transfer processes, systems ranging from the nanoscale up to macroscopic length scales where continuum approaches apply are considered. Topics include energy states of material systems, energy transport in the forms of waves and particles, particle and wave scattering using weak and strong scattering descriptions, thermal conversion processes, the Boltzmann transport equation and derivation of classical laws, deviation from continuum/classical behavior for na-noscale systems and energy transport applications in nano- and microtechnology.

Spicer   3 hours   spring

510.630 Molecular Simulation of Materials

Learn the fundamentals necessary to design and implement computer simulations on the molecular level. This course focuses on two widely used techniques: molecular-dynamics and Monte Carlo simulation. Both are introduced in the context of a review of the basic theoretical background. This class will cover the specifics of handling molecular interactions using empirical potentials, applying proper boundary conditions and simulating various equilibrium ensembles and non-equilibrium systems. Lectures will address how to extract transport coefficients, atomic scale correlations and local stresses and strains from simulation data, and computational issues such as algorithmic complexity and efficiency. The final weeks of the course will focus on new and cutting-edge advances in these methods.

Falk   3 hours   spring

510.632 Introduction to and Applications of Scanning Probe Microscopy

Scanning Probe Microscopy has emerged as one of the premier techniques to characterize surfaces. This course will give an overview of the family of SPM techniques including scanning tunneling microscopy (STM), atomic force microscopy (AFM), scanning near field optical microscopy (SNOM) and Kelvin probe microscopy. In each of these applications, the theory of operation, measurement and imaging techniques, and experimental limitations will be discussed.

McGuiggan   3 hours   spring

510.635 Mechanical Properties of Biomaterials

This course will focus on the mechanical properties of biomaterials and the dependence of these properties on the microstructure of the materials. Organic and inorganic systems will be considered through a combination of lectures and readings and the material systems will range from cells to bones to artificial implants.

Weihs   3 hours   spring

510.636 Electronic Materials Science

Introduction to semiconductor device physics: band structure, current flow, capacitance, and recombination. Barriers and junctions, transistors, crystallography and crystalline defects. Processing: ion implantation, thermal oxidation, metallization, reaction kinetics, and diffusion barriers. Heterostructures and heteroepitaxy. Assembly and packaging.

Searson   3 hours

510.643 Chemistry & Physics of Polymers

The course will describe and evaluate the synthetic routes, including condensation and addition polymerization, to macromolecules with varied constituents and properties. Factors that affect the efficiencies of the syntheses will be discussed. Properties of polymers that lead to technological applications will be covered, and the physical basis for these properties will be derived. Connections to mechanical, electronic, photonic, and biological applications will be made. Prerequisites: Organic Chemistry I and one semester of thermodynamics.

Katz   3 hours   spring

510.650 Principles of Quantum Physical Interactions

Foundational quantum-mechanical study of nanometer-scale electronic and optoelectronic materials structures. Principles of quantum physics, stationary-state eigenfunctions and eigenvalues for one-dimensional potentials, interaction with the electromagnetic field, electronic conduction in solids, surface and interface effects, tunneling microscopy and spectroscopy. Prerequisites: 110.201 and 110.302 or equivalent, 510.311.

Spicer   3 hours

510.656 (E,N) Introduction to Surface Science

Introduction to the structure and properties of solid surfaces. Topics include Gibbsian and gradient thermodynamics of surfaces; crystallography and structure of free solid surfaces; characterization methods; surface mobility and phase transitions; gas-solid interactions; crystal growth; electronic structure; solid-solid surfaces; thin film epitaxy. Prerequisites: 510.311-315 or permission of instructor.

Cammarata   3 hours

510.657 Materials Science of Thin Films

The processing, structure, and properties of thin films are discussed emphasizing current areas of scientific and technological interest. Topics include elements of vacuum science and technology; chemical and physical vapor deposition processes; film growth and microstructure; chemical and microstructural characterization methods; epitaxy; mechanical properties such as internal stresses,

adhesion, and strength; and technological applications such as superlattices, diffusion barriers, and protective coatings.

Weihs   3 hours

510.661 Alloy Stability and Phase Diagrams

This course examines the fundamentals of alloy theory and phase diagram modeling to understand the formation, stability, and evolution of alloy phases and microstructures. Topics to be covered include structures of intermediate alloy phases such as electron phases, Laves phases, interstitial phases, valency compounds, and superlattices; stability criteria of solid solutions and intermediate alloy phases, including Hume-Rothery rules, theories of ordering, electronic theories of solid solubility and alloy stability, and elastic instability; thermodynamic and kinetic analysis of phase and microstructural instability due to different driving forces: chemical, strain, interfacial, gradient, etc.; balance of kinetic stability and thermodynamic instability: formation of highly metastable or unstable phases far from equilibrium; and calculations of the phase stability ranges in terms of equilibrium or metastable binary or multi-component phase diagrams using CALPHAD modeling.

Ma   3 hours

510.665 Advanced Topics in Thermodynamics and Kinetics of Materials

Selected areas of thermodynamics and kinetics will be examined in depth with the aim of understanding the ideas and assumptions underlying results central to materials science. Attempts will be made to be as rigorous as possible without losing sight of the physical meanings. The theories and models obtained will be evaluated critically to determine their validity and limitations. Topics to be covered include classical formulations of the laws of thermodynamics, Carathéodory's formulation, relation of thermodynamics to statistical mechanics, Gibbs' thermodynamics of heterogeneous systems and of surfaces, thermodynamics of phase transitions, glass transition, theory of absolute reactions rates and thermodynamics of irreversible processes developed generally and applied to the chemical kinetics and diffusion, theory of nucle-

ation (Volmer-Weber, Becker-Dùoring, Fisher-Turnbull), theory of growth (including instabilities during growth), Johnson-Mehl-Avrami kinetics of phase transformations, Lifshitz-Slyzov-Wagner kinetics of coarsening, spinodal decomposition. Prerequisite: 510.312 or 510.602 (or similar course covering thermodynamics).

Cammarata   3 hours

510.731 Physical Metallurgy Seminar

Topics in physical metallurgy are discussed with extensive reference to both current and classic papers. Examples of possible topics include grain boundary structure and energetics (papers of Read and Shockley, Bollman), epitaxy and thin film growth (papers of van der Merwe, Matthews), spinodal decomposition (papers of Cahn, Hilliard, Hillert), thermodynamics of surfaces and interfaces (papers of Gibbs, Herring, Brooks, Cahn).

Cammarata   1 hour

510.733-734 Special Topics in Electronic/Optical-Material Interactions

Topics in this course concentrate on the understanding of interactions of electromagnetic fields with materials. These interactions range from the absorption of optical frequency waves to the excitation of materials using low frequency electromagnetic waves in the sub-megahertz regime. Emphasis is on studying representations and the corresponding analytical techniques used to model electromagnetic interactions with materials. Additionally, transduction techniques for the measurement of these interactions are discussed.

Spicer   3 hours

510.801-802 Materials Research Seminar

Staff   1 hour

510.803-804 Materials Science Seminar

Staff   1-2 hours

510.805-806 Selected Topics in Materials Science

Staff   3 hours

510.807-808 Graduate Research in Materials Science

Staff   3 hours

Mechanical Engineering

The Department of Mechanical Engineering offers undergraduate and graduate programs of instruction and research. Undergraduate programs are offered in Mechanical Engineering and in Engineering Mechanics. The B.S. in the Mechanical Engineering and Engineering Mechanics degree programs are accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org. Graduate programs are offered leading to the M.S.E. and the Ph.D. degrees. A five-year accelerated B.S./M.S.E. program is also available.

Mechanical Engineering is of great importance in most contemporary technologies. Examples include aerospace, power generation and conversion, fluid machinery, design and construction of mechanical systems, transportation, manufacturing, production, biomechanics, and others. This wide range of applications is reflected in the four main stems of the undergraduate curriculum-thermal and fluid systems, mechanics and materials, robotics and control systems, and biomechanics. Engineering Mechanics is a more flexible program that enables students to pursue particular interests while centering around a smaller core of courses. Students may use this flexibility to follow specific interests in physics, mathematics, economics, and other disciplines while receiving an engineering degree.

Design is a major component of both undergraduate programs. In the two-semester Engineering Design Project course taken by undergraduates during their senior year, students work in teams of three or four to design, construct, and test a mechanical device or system for an industrial sponsor.

A major effort of the department is directed toward the creation of a stimulating intellectual environment in which both undergraduate and graduate students can develop to their maximum potential. Faculty members encourage undergraduate students to participate in both fundamental and applied research along with the graduate students. In most junior and senior undergraduate classes, and in graduate classes, small enrollments permit close contact with faculty members. Students have excellent opportunities to participate actively in the classroom and laboratories and to follow special interests within a subject area.

The Faculty

Gregory S. Chirikjian, Professor: computational structural biology (in particular, computational mechanics of large proteins), conformational statistics of biological macromolecules, developed theory for 'hyper- redundant' (snakelike) robot motion planning, designs and builds hyper-redundant robotic manipulator arms, applied mathematics (applications of group theory in engineering), self-replicating robotic systems.

Noah J. Cowan, Associate Professor: robotics, computer vision and control, mobile robotics and legged locomotion, biomechanics and bio-inspired robotics.

Andrew S. Douglas, Professor (Vice Dean for Academic Affairs, Whiting School of Engineering): dynamic fracture of ductile materials, mechanics of active materials, mechanics of soft tissue.

Jaafar El-Awady, Assistant Professor: damage and fracture mechanisms of materials under high-temperature for aerospace and nuclear applications, materials degradation, microstructure evolution, impact dynamics and wave propagation, nano- and micro-mechanics, nanomaterials, continuum theory of dislocations, multiscale materials modeling.

Kevin J. Hemker, Professor (Chair), Alonzo G. Decker, Jr. Chair in Mechanical Engineering: research aimed at identifying the microstructural details that govern the macroscopic mechanical response of metals, alloys and advanced structural materials. Traditional interests include: high temperature mechanical behavior, transmission electron microscopy, deformation behavior of intermetallic alloys, experimental characterization of dislocation core structure, and microsample testing. Relatively new research topics include the characterization and modeling of bond coat layers for thermal barrier coatings, deformation behavior of nanocrystalline materials, and characterization of materials for MEMS applications.

Cila Herman, Professor: experimental heat transfer and fluid mechanics, optical measurement techniques, image processing. Thermoacoustic refrigeration, influence of electric fields on boiling in terrestrial conditions and microgravity, heat exchangers, heat transfer in boiling, optical tomography, holographic interferometry, cooling of electronic equipment, digital image processing, heat transfer augmentation.

Joseph M. Katz, Professor, Whiting School Mechanical Engineering Chaired Professor, Gilman Scholar: cavitation phenomena, attached partial cavitation, cavitation in turbulent shear flows, jets and wakes. Multiphase flows: interaction between bubbles and flow structure, mixing

mechanisms and droplet formation in water-fuel stratified shear flows, transport of microscopic particles and droplets in turbulent flows. Development of optical flow diagnostics techniques, including Particle Image Velocimetry (PIV) and Holographic Particle Image Velocimetry (HPIV). Applications of PIV and HPIV for measuring the characteristics of turbulence and addressing turbulence modeling issues. Complex flow structure and turbulence within turbomachines: Wake-wake and blade-wake interactions in multistage axial turbomachines, flow and rotating stall in centrifugal pumps, development of optical diagnostics techniques for measurements in turbomachines. Oceanography: flow structure and turbulence in the bottom boundary layer of the coastal ocean; measurement of spatial distributions of plankton, particles and bubbles in the ocean; development of optical instrumentation, including submersible holography and PIV systems. Prevention of nozzle wear in abrasive water suspension jets (AWSJ) using porous lubricated nozzles. Flow-induced vibrations and noise, mechanisms of noise generation in turbulent separated flows and in turbomachines.

Omar M. Knio, Professor: computational fluid mechanics, turbulent flow, chemically-reacting flow, energetic materials, oceanic and atmospheric flows, dynamical systems, physical acoustics, multiscale methods, asymptotic and stochastic techniques.

Charles Meneveau, Professor, Louis M. Sardella Chair in Mechanical Engineering, Director of the Center for Environmental and Applied Fluid Mechanics: theoretical, experimental, and numerical studies in turbulence, large-eddy-simulation, turbulence modeling, fractals and scaling in complex systems, small-scale structure of turbulence and velocity gradient dynamics, applications of LES to environmental flows, wind energy, development of data-intensive science tools to study turbulence.

Rajat Mittal, Professor: computational fluid dynamics, low Reynolds number aerodynamics, biomedical flows, active flow control, LES/DNS, immersed boundary methods, fluid dynamics of locomotion (swimming and flying), biomimetics and bioinspired engineering, turbomachinery flows.

Thao (Vicky) Nguyen, Assistant Professor: biomechanics: mechanical behavior, growth and remodeling of fibrous soft tissues. Constitutive Modeling: thermomechanics, viscoelasticity, viscoplasticity of shape memory polymers and

polymer composites. Fracture Mechanics: fracture and failure of rate dependent materials.

Allison M. Okamura, Professor: virtual and teleoperated environments: haptic feedback in virtual environments, prosthetics, rehabilitation robotics, human-machine collaborative systems, reality-based modeling, robotic fingers and hands; tactile sensing, medical robotics and surgical assistance, education and learning using haptics.

Andrea Prosperetti, Professor, Charles A. Miller Jr. Chair in Mechanical Engineering: multiphase flow; theoretical and computational fluid mechanics and acoustics; gas and vapor bubbles.

K. T. Ramesh, Professor, Alonzo G. Decker, Jr. Chair in Mechanical Engineering, Director of the Center for Advanced Metallic and Ceramic Systems (CAMCS): Nanomaterials, planetary impact, dynamic failure mechanisms, shock, impact, and wave propagation, high-strain-rate behavior of materials, injury biomechanics, constitutive and failure modeling.

William N. Sharpe Jr., Professor Emeritus: experimental solid mechanics; microelectro-mechanical systems (MEMS), microsample testing.

Sean Sun, Associate Professor: biomechanics and biophysics, molecular motors, proteins and membranes, cell motility, statistical mechanics.

Jeff Tza-Huei Wang, Associate Professor: bioMEMS and microfluidics, single molecule manipulation and detection, nano/micro scale fabrication, conformational dynamics of biomolecules.

Louis L. Whitcomb, Professor, Director of the Laboratory for Computational Sensing and Robotics: dynamics and control of nonlinear systems, nonlinear control, adaptive identification and control, force control, robotics, medical robotics, underwater robot vehicles, industrial robotics, advanced electro-mechanical design, sensor and actuator design.

Joint, Part-Time, and Research Appointments

Mehran Armand, Associate Research Professor (Applied Physics Laboratory).

Juan I. Arvelo Jr., Assistant Research Professor (Applied Physics Laboratory).

Stephen Belkoff, Associate Professor (Orthopedic Surgery): biomechanics, orthopaedic implants, fracture fixation in osteoporotic bone, mechanism of injury, vertebroplasty.

Alan Brandt, Research Scientist, (Applied Physics Laboratory): ocean physics including internal waves, turbulence, mixing, and bio-physical interactions. Coastal, estuarine, and environmental fluid dynamics.

Ilene Busch-Vishniac, Research Professor.

Robert C. Cammarata, Professor (Materials Science and Engineering): structure, properties, and processing of thin films and nanostructured materials, thermodynamics and mechanics of surfaces, mechanical behavior of materials, nonoindentation testing, stresses in thin films, novel electrochemical deposition methods, computer simulations.

Shiyi Chen, Research Professor: statistical theory and computation of fluid turbulence, mesoscopic physics and Lattice Boltzmann computational methods, molecular dynamics and granular flows, computational fluid dynamics and numerical analysis, micro- and nano-fluidics, flow through porous media and environmental sciences, nonlinear dynamics and applied mathematics, large scale computing and parallel algorithm, multiscale phenomena and computational methods.

Andrew F. Conn, Industrial Liaison (Conn Consulting, Inc.): mechanical engineering design.

Thomas Dragone, Adjunct Associate Professor: aerospace structures and materials, airframe structure design and development, materials science.

Ryan Eustice, Adjunct Assistant Professor (Department of Naval Architecture and Marine Engineering, University of Michigan).

Gregory L. Eyink, Professor (Department of Applied Mathematics and Statistics): mathematical physics, fluid mechanics, turbulence, dynamical systems, partial differential equations, nonequilibrium statistical physics, geophysics and climate.

Gabor Fichtinger, Adjunct Associate Professor, Computer Science and Radiology: Director of Computer Integrated Surgical Systems and Technology (CISST).

Lori Graham-Brady, Associate Professor, Civil Engineering: stochastic finite element methods, probabilistic mechanics, stochastic simulation of material properties, micromechanics.

Tihomir Hristov, Associate Research Scientist.

Iulian Iordachita, Associate Research Scientist: robotics, medical robotics and instrumentation, mechanisms and mechanical transmissions for robots, advance electro-mechanical design, biologically-inspired mechanisms.

Hyung-Suk Kang, Associate Research Scientist.

James Lee, Adjunct Professor.

Edwin Malkiel, Adjunct Associate Research Scientist.

Steven Marra, Senior Lecturer.

Daniel Naiman, Professor, Applied Mathematics and Statistics: statistics, computational probability, bioinformatics.

Mark Robbins, Professor (Physics and Astronomy): Connecting and contrasting atomistic and macroscopic descriptions of non-equilibrium processes including friction, adhesion, large-strain mechanical deformation, fracture, heat flow, fluid flow, and boundary conditions at interfaces between different materials. Techniques include molecular simulations, continuum calculations and multiscale modeling approaches that bridge the two.

Jack C. Roberts, Research Professor (Applied Physics Laboratory): advanced composite materials.

Jian Sheng, Adjunct Assistant Professor (University of Minnesota).

Alexander Spector, Research Professor, Biomedical Engineering: biosolid mechanics, cell mechanics and biophysics, molecular motors, mathematical and computational modeling.

Daniel Stoianovici, Associate Professor (Brady Urological Institute): medical robotics.

Lester Su, Associate Research Professor: experimental fluid mechanics, turbulent mixing and combustion, combustion systems, laser diagnostics, interaction of experiments and simulations, spray and droplet dynamics.

Pazhayannur Swaminathan, Research Professor (Applied Physics Laboratory).

Russell H. Taylor, Professor (Computer Science): medical robotics, computer-assisted surgery.

Nitish V. Thakor, Professor (Biomedical Engineering): medical instrumentation and medical micro and nanotechnologies, neurological instrumentation, signal processing, computer applications.

Eric Tytell, Assistant Research Scientist.

David Van Wie, Research Professor (Applied Physics Laboratory).

Rene Vidal, Associate Professor (Biomedical Engineering): biomedical image analysis, computer vision, machine learning, dynamical systems, signal processing.

Liming Voo, Associate Research Professor (Applied Physics Laboratory).

Timothy Weihs, Associate Professor (Materials Science and Engineering), Director of the Center for Leadership Education: self-propagating exothermic reaction and joining with reactive multilayer foils, processing and characterization of thin films, layered materials, and thin film reactions, mechanical testing of metals and biological materials.

Thomas Wright, Adjunct Research Professor: theoretical solid mechanics, wave propagation, dynamic failure, adiabatic shear localization, instabilities.

Facilities

Most teaching and research facilities of the department, as well as the departmental office, are located in Latrobe, Krieger, Wyman, Maryland and Hackerman Halls. The undergraduate laboratories are equipped with sophisticated data acquisition and analysis systems. A V-6 automobile engine with dynamometer and a computer-controlled milling machine are examples of facilities used for undergraduate instruction. The mechatronics laboratory allows students to design and build their own robots for a class competition. A separate laboratory is used by the seniors to construct and test their prototypes in the yearlong design project course. Computer facilities are readily available to undergraduates throughout the department and the Whiting School.

Research facilities include laboratories in several disciplines. The Laboratory for Impact Dynamics and Rheology includes facilities for the study of failure, instabilities, impact and dynamic phenomena. The Laboratory for Active Materials and Biomimetics contains facilities for the characterization of tissues, active materials and biomaterials. These, coupled with electron microscopy facilities, enable innovative research on the mechanical properties of materials.

The Microspecimen Testing Laboratory has special tensile test machines for specimens as thin as 60 nanometers. The Computational Solid Mechanics Laboratory uses state-of-the-art finite-element techniques to study the physics of impact, wear, and more generally, the behavior of materials under high deformation and high-deformation rates. The calculations are conducted at length scales ranging from the nanoscale up to the macroscale.

A large hydrodynamics laboratory is the home of laser-based flow simulation and analysis research, and the Corrsin wind tunnel is equipped with modern instrumentation for turbulence research. The heat transfer laboratory is equipped for research using holographic interferometry to study heat transfer in complex geometries with single- and two-phase flows.

The Laboratory for Computational Sensing and Robotics consists of numerous laboratories and collaborating research centers covering multiple domains. The robotics and mechatronics laboratory is fully equipped for the construction and testing of prototypes of novel robotic systems. The Dynamical Systems and Control laboratory is equipped for design, fabrication, and testing of advanced robotic arms and underwater robots. Experimental equipment includes a test-bed remotely operated underwater vehicle. The Locomotion in Mechanical and Biological Systems (LIMBS) laboratory is equipped with an industrial six-axis manipulator, and as well as the facilities for the development of mobile and medical robots.

Financial Aid

Scholarships and other forms of financial assistance for undergraduates are described under Admissions and Finances (see page 23). In addition, selected undergraduates may be employed as laboratory assistants on research projects. Assistance in various forms is available for graduate students, including tuition fellowships, fellowships with stipend, research assistantships, and competitively-awarded hourly teaching assistant positions. Applications for graduate study must be received by January 5 for consideration.

Research assistantships support graduate students who work with professors on their research contracts and grants.

Undergraduate Programs

The Department of Mechanical Engineering offers two undergraduate programs: the bachelor of science in mechanical engineering and the bachelor of science in engineering mechanics. Both programs are accredited by ABET, the Accreditation Board for Engineering and Technology. The department offers concentrations in biomechanical engineering and aerospace engineering. For additional information regarding both the mechanical engineering and engineering mechanics academic programs, please consult the undergraduate advising manuals which are available on the departmental website at **http://www.me.jhu.edu/advise.html**. For details and an explanation of ABET requirements, visit **www.abet.org**.

Requirements for the Bachelor's Degree

See also General Requirements for Departmental Majors, page 48; Writing Requirement, page 44; and the department's undergraduate advising manuals.

The Mechanical Engineering Program

The mission of the B.S. in mechanical engineering degree program is to provide a rigorous educational experience that prepares a select group of students for leadership positions in the profession and a lifetime of learning. The faculty is committed to maintaining a modern and flexible curriculum which, building on a foundation of basic sciences and mathematics, develops a solid education in the mechanical engineering sciences. The aim of the Mechanical Engineering program is to build com-

petence in the design and development of thermal, fluid, and mechanical systems, to promote a broad knowledge of the contemporary social and economic context, and to develop the communication skills necessary to excel.

The program provides a basic background in thermal and mechanical systems. Laboratory instruction, as well as the senior design project, gives the student hands-on experience. Each student's program of study is planned in consultation with his or her faculty advisor. Students are encouraged to develop depth in one or two areas of concentration within mechanical engineering chosen from fluid mechanics, mechanics of solids and design, heat transfer and energy, robotics, and biomechanics. The choice of concentration is decided in the junior year after consultation with the student's faculty advisor.

The objectives for the B.S. in mechanical engineering degree program are designed to provide a high-quality educational experience that is tailored to the needs and interests of the student. The program will educate a select group of engineers who, after graduation, will be successful and on track to become leaders among their peers as (1) engineers in industry, government laboratories and other organizations, or (2) advanced students in the best graduate programs.

Students graduating from the B.S. in mechanical engineering will have demonstrated the ability to

- understand and apply the fundamentals of mathematics (through linear algebra and multivariate calculus), numerical methods, statistical analysis, and physical sciences (physics and chemistry) necessary to attain competence in the mechanical engineering disciplines.

- design, conduct, evaluate, and report experiments including analysis and statistical interpretation of data.

- identify, formulate, and solve engineering problems in the areas of thermo-fluid and mechanical systems.

- use basic concepts from the mechanical engineering sciences, modern engineering tools (machine-tools, laboratory instrumentation, and computer hardware and software), and related subjects to design mechanical engineering components and processes, taking into account constraints such as manufacturability, cost, safety, environmental, and socio-political impacts.

- enter professional practice and/or graduate school, with the recognition of the need for life-long learning and the ability to pursue it.

- use effective communication, multidisciplinary teamwork, and possess awareness of professional and ethical responsibilities, and an appreciation of the societal, economic, and environmental impacts of engineering.

The Mechanical Engineering curriculum is structured as follows:

Mathematics (19 credits; grades of D, D+, D- or F not accepted)

110.108 Calculus I

110.109 Calculus II

110.202 Calculus III (or 110.211 Honors Multivariable Calculus

550.291 Linear Algebra/Differential Equations (or 110.212 Honors Multivariable Calculus or 110.201 Linear Algebra, plus 110.302 Differential Equations)

Statistics Elective at the 300-level or above (e.g. 560.435 Probability and Statistics in Civil Engineering or 550.310 Probability and Statistics)

Science (12 credits; grades of D, D+, D- or F not accepted)

530.103-104 Introduction to Mechanics I/II

171.102 Physics II

173.112 Physics Lab II

510.101 Introduction to Materials Chemistry or 030.101 Chemistry I

Humanities (18 credits)

Six humanities and/or social science electives (designated H or S in this catalog); of which one must specifically teach writing (either 060.113 or 060.114 Expository Writing, 220.105 Introduction to Fiction and Poetry Writing, or another course as approved by the student's advisor). To obtain coherence and depth in these humanities and social science electives, at least six credits must be at the 300-level or higher. While a course grade of C- or higher is preferred, up to 10 credits with a D or D+ grade will be accepted. For examples of areas of concentration and more details, see the academic advising manual at **http://www.me.jhu.edu/advising.html**.

Required Engineering Courses (51 credits; grades of D, D+, D- or F not accepted)

530.101/102 Freshman Experiences in Mechanical Engineering I/II

530.105/106 Mechanical Engineering Freshman Laboratory I/II

530.201 Statics and Mechanics of Materials

530.202 Dynamics

530.215 Mechanics-Based Design

530.231 Mechanical Engineering Thermodynamics

530.241 Electronics and Instrumentation [or 520.213 Circuits followed by 520.345 Electrical and Computer Engineering Laboratory or 525.134 Electrical Engineering Laboratory II.]

530.327 Introduction to Fluid Mechanics

530.334 Heat Transfer

530.343 Design and Analysis of Dynamical Systems

530.352 Materials Selection

530.414 Computer Aided Design

530.454 Manufacturing Engineering

660.461 Engineering Business and Management [or 660.105 Introduction to Business and 660.341 Business Process and Quality Management.]

Capstone Design (8 credits; grades of D, D+, D- or F not accepted)

530.403/404 Engineering Design Project I/II

Mechanical Engineering Electives (9 credits; grades of D, D+, D- or F not accepted)

Three courses (300-level or higher) in mechanical engineering

Technical Electives (9 credits; grades of D, D+, D- or F not accepted)

Three (E), (Q), or (N) courses at or above the 300-level, chosen from any combination of courses in engineering, basic sciences, or mathematics selected in consultation with the student's advisor. These courses are intended to complement the mechanical engineering electives. One of the three technical electives may be a computer language course taken at any level.

A program of not less than 126 credits must be completed to be eligible for the bachelor's degree. All undergraduate students must follow a program approved by a faculty member in the department who is selected as the student's advisor.

Aerospace Engineering Concentration

A student may specialize in aerospace engineering once a solid background in the fundamentals of mechanical engineering has been developed through the basic Mechanical Engineering courses. This concentration requires knowledge and background in several fields including advanced dynamics, flight mechanics, propulsion, aerospace materials and structures, signal processing, control systems, astrophysics and space systems. Students pursuing the Aerospace Engineering Concentra-

tion are required to take at least five of the following courses (which can be counted toward the Mechanical Engineering elective and Technical Elective requirements in the general Mechanical Engineering program):

530.328 Fluid Mechanics II

530.418 Aerospace Structures and Materials

530.424 Dynamics of Robots and Spacecraft

530.425 Mechanics of Flight

530.432 Jet and Rocket Propulsion

530.467 Thermal Design Issues for Aerospace Systems

530.470 Space Vehicle Dynamics and Control

535.442 Control Systems for ME Applications

615.444 Space Systems I

615.445 Space Systems II

Any five of the courses listed above are required. A sixth course amongst this list, though not required is highly recommended.

Other courses relevant to the concentration which don't count toward the requirements include:

171.118 Stars and the Universe

520.214 Signals and Systems

520.401 Basic Communications

525.445 Modern Navigation Systems

Biomechanics Concentration

A student may specialize in Biomechanics once a solid background in the fundamentals of mechanical engineering has been developed through the core Mechanical Engineering or Engineering Mechanics courses. The essence of mechanics is the interplay between forces and motion. In biology, mechanics is important at the macroscopic, cellular, and subcellular levels.

At the macroscopic length scale biomechanics of both soft and hard tissues plays an important role in computer-integrated surgical systems and technologies, e.g., medical robotics. At the cellular level, issues such as cell motility and chemotaxis can be modeled as mechanical phenomena. At the subcellular level, conformational transitions in biological macromolecules can be modeled using molecular dynamics simulation, which is nothing more than computational Newtonian mechanics; statistical mechanics, or using coarse-grained techniques that rely on principles from the mechanics of materials.

In addition, much of structural biology can be viewed from the perspective of Kinematics, e.g., finding spatial relationships in data from the Protein Data Bank.

Each student who pursues the Biomechanics concentration will, in consultation with his or her academic advisor, choose the set of technical and mechanical engineering course electives that best matches the student's interests. Upon completion of the concentration, notification of this achievement is placed on the student's academic record and transcript.

A student may specialize in biomechanics once a solid background in the fundamentals of mechanical engineering has been developed through the basic courses. Students pursuing the biomechanics concentration within mechanical engineering are required to take at least four of the following courses. Two among the four should be chosen from the biomechanics-oriented courses, indicated by an asterisk (*).

530.410 Biomechanics of the Cell*
530.426 Biofluid Mechanics*
530.440 Computational Biomechanics of
    Biological Macromolecules*
540.440 MicroNanotechnology (Chemical and
    Biomolecular Engineering)*
530.445 Introduction to Biomechanics*
580.455 Introduction to Orthopaedic
    Biomechanics (Biomedical Engineering)*
530.448 Biosolid Mechanics*
530.672 Biosensing and BioMEMS*
580.221 Molecules and Cells (Prerequisite:
    030.101 Introductory Chemistry)
580.421 through 580.423 Systems
    Bioengineering I with lab: Cells and
    Membranes, Cardiovascular Systems
    (Prerequisite: 580.221 Molecules and Cells)
510.431 Biocompatibility of Materials
510.435 Mechanical Properties of Biomaterials
580.440 Cellular and Tissue Engineering
530/580.452 Cellular and Tissue Engineering
    Laboratory
530.495 Microfabrication Lab

Note: Some courses on this list may require 030.205 Organic Chemistry as a prerequisite. This course will count as a technical elective when taken to allow enrollment in the appropriate biomechanics concentration courses. Note that 030.205 has several prerequisites: 030.101-102 Intro to Chemistry and 030.105-106 Chemistry labs.

Students may not use the satisfactory/unsatisfactory option for required courses, including (H) and (S). Exceptions can be considered and approved by their faculty advisors. Further, the Department of Mechanical Engineering requires that grades of C- or better be obtained in all required engineering, mathematics, and science courses (i.e. grades of D, D+ or D- will not be accepted). The department will accept D, D+ or D- grades only up to a maximum of 10 credit hours for Humanities (H) and Social Sciences (S) courses.

Sample Program:

• Year 1

Fall

110.108 Calculus I	4
510.101 Intro to Materials Chemistry	3
530.101 Freshman Experiences in Mechanical Engineering I	2
530.103 Intro to Mechanics I	2
530.105 Mechanical Engineering Freshman Lab I	1
H/S Elective	3
Subtotal	15

Spring

110.109 Calculus II	4
530.102 Freshman Experiences in Mechanical Engineering II	2
530.104 Intro to Mechanics II	2
530.106 Mechanical Engineering Freshman Lab II	1
H/S Elective: Writing	3
H/S Elective	3
Subtotal	15

• Year 2

Fall

110.202 Calculus III	4
530.201 Statics and Mechanics	3+1
530.231 Mechanical Engineering Thermodynamics	3+1
171.102 General Physics II	4
173.112 General Physics II Lab	1
Subtotal	17

Spring

550.291 Linear Algebra/Differential Equations	4
530.202 Dynamics	3+1
530.215 Mechanics Based Design	3+1
530.241 Electronics and Instrumentation	3+1
Subtotal	16

• Year 3

Fall

530.327 Intro to Fluid Mechanics	3+1
530.352 Materials Selection	3+1
530.414 Computer Aided Design	3
H/S Elective	3
Statistics Elective	3
Subtotal	17

Spring

530.334 Heat Transfer	3+1
530.343 Design and Analysis of Dynamic Systems	3+1
Mechanical Engineering Elective	3
Technical Elective	3
Subtotal	14

• Year 4

Fall

530.403 Engineering Design Project I	4
530.454 Manufacturing Engineering	3
660.461 Engineering Business and Management	3
Technical Elective	3
H/S Elective	3
Subtotal	16

Spring

530.404 Engineering Design Project II	4
Mechanical Engineering Elective	3
Mechanical Engineering Elective	3
Technical Elective	3
H/S Elective	3
Subtotal	16
Total	**126**

The Engineering Mechanics Program

The mission of the B.S. in engineering mechanics degree program is to provide a rigorous educational experience that prepares a select group of students for leadership positions in the profession and a lifetime of learning. The faculty is committed to maintaining a modern and flexible curriculum which, building on a foundation of basic sciences and mathematics, develops a solid education in the mechanical engineering sciences. The aim of the Engineering Mechanics program is to build competence in the analysis, design, and modeling of fluid and solid systems, to promote a broad knowledge of the contemporary social and economic context, and to develop the communication skills necessary to excel.

The educational objectives for the B.S. in engineering mechanics degree are designed to educate a select group of science-oriented engineers who, after graduation, will be successful and on track to become leaders among their peers as (1) advanced students in the best graduate programs in engineering, science, medical schools, or law schools, or (2) as engineers in industry, government laboratories and other organizations.

Students graduating from the B.S. in Engineering Mechanics programs will have demonstrated the ability to

- understand and apply the fundamentals of mathematics (through linear algebra and multivariate calculus), numerical methods, statistical analysis, and physical sciences (physics and chemistry) necessary to attain competence in the mechanics or related disciplines such as applied physics, bioengineering, or other scientific/engineering disciplines.

- understand the interplay between engineering science and the design, evaluation, and reporting of experiments including analysis and statistical interpretation of data.

- identify, formulate, and solve engineering problems in the mechanical sciences.

- use basic concepts from the mechanical sciences, mathematics, the basic sciences, and related subjects, as well as modern engineering tools, to design mechanical engineering components and processes, taking into account constraints such as manufacturability, cost, safety, environmental, and socio-political impacts.

- enter graduate school and/or professional practice with the tools needed for life-long learning and the recognition of its importance.

- use effective communication, multidisciplinary teamwork, and possess awareness of professional and ethical responsibilities, and an appreciation of the societal, economic, and environmental impacts of engineering.

The curriculum is intended to enable graduates to explore fundamental questions in many fields of engineering. Emphasis is placed on the basic sciences (mathematics, physics, and chemistry) and on the analysis, modeling, and design aspects of solid and fluid engineering systems. Although specific core courses are required, the student is encouraged and guided by his or her advisor to select an individual program of study, within ABET guidelines, according to the student's particular goals. This program of study may range from a general study of mechanics or engineering science to more specialized programs in a variety of areas, such as robotics, fluid dynamics, environmental engineering, mechanics of solids, experimental mechanics, dynamical systems, mechanics of materials, or biomechanics.

This flexibility makes the program ideal for double-majors and for those wishing to tailor a strong foundation for graduate work in a wide range of disciplines. All mathematics elective and technical elective courses must be at the 300-level or higher, unless approved by their faculty advisor.

Either Mathematics with a focus on applications (23 credits; grades of D, D+, D- or F not accepted)

110.108 Calculus I
110.109 Calculus II
Either 110.202 Calculus III, or 110.211 Honors Multivariable Calculus, or 110.201 Linear Algebra [semester one]
Either 550.291 Linear Algebra/Differential Equations, or 110.212 Honors Multivariable Calculus, or 110.302 Differential Equations [semester two]
Another Mathematics Elective
Statistics Elective at the 300 level or above (e.g. 560.435 Probability and Statistics in Civil Engineering or 550.310 Probability and Statistics)

…or Mathematics with a focus on fundamentals (23 credits; grades of D, D+, D- or F not accepted)

110.108 Calculus I
110.109 Calculus II
110.211 Honors Multivariable Calculus I
110.212 Honors Multivariable Calculus II
110.302 Differential Equations
Statistics Elective at the 300 level or above (e.g. 560.435 Probability and Statistics in Civil Engineering or 550.310 Probability and Statistics)

Basic Science (16-17 credits; grades of D, D+, D- or F not accepted)

530.103-104 Introduction to Mechanics I/II *or* 171.101 Physics I and 171.111 Physics Lab I
171.102 Physics II and 171.112 Physics Lab II
510.101 Introduction to Materials Chemistry (or 030.101 Chemistry I)
Another basic science elective

Humanities (18 credits)

Six humanities and/or social science electives (designated H or S in this catalog) of which one must specifically teach writing (either 060.113 or 060.114 Expository Writing, 220.105 Introduction to Fiction and Poetry Writing, or another course as approved by the student's advisor). To obtain coherence and depth in these humanities and social science electives, at least six credits must be at the 300-level or higher.

Required Engineering Courses (minimum of 26 credits; grades of D, D+, D- or F not accepted)

Introductory Engineering and Computing

530.101-102 Freshman Experiences in Mechanical Engineering I and II and 530.105-106 Mechanical Engineering Freshman Laboratory I and II provide the necessary engineering and computing instruction for freshmen and are strongly recommended.

Alternate introductory courses are available. If 530.101-102 and 530.105-106 are not taken, students must take one course from each of the engineering and computing course lists below:

Introductory Engineering:
500.101 What is Engineering? (recommended)
520.137 Introduction to Electrical and Computer Engineering
570.108 Introduction to Environmental Engineering

Computing:
500.200 Computing for Engineers
560.220 Civil Engineering Analysis
600.107 Introduction to Java
Any other computing course approved by the faculty advisor

Other Required Engineering Courses:
530.201 Statics and Mechanics of Materials
560.202 Dynamics
530.231 Mechanical Engineering Thermodynamics
530.405 Mechanics of Solids and Structures or 530.215 Mechanics Based Design
530.327 Introduction to Fluid Mechanics

Capstone Design (8 credits; grades of D, D+, D- or F not accepted):

530.403-404 Engineering Design Project I/II

Engineering Science Electives (12 credits; grades of D, D+, D- or F not accepted):

One course in the mechanics of solids
One course in the mechanics of fluids
One additional course in the mechanics of either solids or fluids
One course in either materials or dynamics

Engineering Mechanics Electives (6 credits; grades of D, D+, D- or F not accepted)

Two additional elective courses in the same area of engineering mechanics (solid mechanics, fluid mechanics, or dynamics).

Technical Electives (minimum of 18 credits; grades of D, D+, D- or F not accepted)

A minimum of four (E), (Q), or (N) courses at or above the 300-level, chosen in consultation with the student's advisor from any combination of courses in engineering, basic sciences, or mathematics.

Appropriate choices from the social sciences and philosophy may be also used to fulfill this requirement (for example, 180.305 Game Theory, 150.420 Logic), if approved by the student's advisor. Because of the importance of computer languages in modern technical society, students may take computer language courses at any level.

Fluid mechanics courses may be chosen from courses such as:

530.328 Fluid Mechanics II
530.425 Mechanics of Flight
530.426 Biofluid Mechanics
530.444 Computer Aided Fluid Mechanics and Heat Transfer
570.301 Environmental Engineering I: Fundamentals

Dynamics courses may be chosen from courses such as:

530.343 Design and Analysis of Dynamic Systems
530.424 Dynamics of Robots and Spacecraft
530.420 Robot Sensors and Actuators
171.204 Classical Mechanics
550.391 Dynamical Systems

Solid mechanics courses may be chosen from courses such as:

530.215 Mechanics Based Design
530.405 Mechanics of Solids and Structures, if not used to satisfy the required engineering courses
530.414 Computer-Aided Design
530.448 Biosolid Mechanics
530.730 Finite Element Methods
560.206 Solid Mechanics and Theory of Structures
560.445 Advanced Structural Analysis

A program of 127-128 credits, based on the requirements above must be completed to be eligible for the bachelor's degree.

Students may not use the satisfactory/unsatisfactory option for required courses, including (H) and (S), unless approved by their faculty advisor. The department will accept D or D+ grades only up to a maximum of 10 credit hours except where indicated. All undergraduate students must follow a program approved by a faculty member in the department who is selected as the student's advisor.

Biomechanics Concentration

Engineering Mechanics (EM) is a highly flexible program offered by the Department of Mechanical Engineering, which is ideal for students who want to specialize in any area of mechanics, including biomechanics. The essence of mechanics is the interplay between forces and motion.

In biology, mechanics is important at the macroscopic, cellular, and subcellular levels. At the macroscopic length scale biomechanics of both soft and hard tissues plays an important role in computer-integrated surgical systems and technologies (e.g., medical robotics). At the cellular level, issues such as cell motility and chemotaxis can be modeled as mechanical phenomena. At the subcellular level, conformational transitions in biological macromolecules can be modeled using molecular dynamics simulation (which is nothing more than computational Newtonian mechanics), statistical mechanics, or using coarse-grained techniques that rely on principles from the mechanics of materials. In addition, much of structural biology can be viewed from the perspective of Kinematics (e.g., finding spatial relationships in data from the Protein Data Bank).

Each student who pursues the biomechanics concentration within the EM major will, in consultation with his or her EM advisor, choose the set of technical and EM electives that best matches the student's interests. Many electives from other departments are acceptable. The electives for the EM major are structured as follows:

Engineering Science Electives (12 credits)

One course in solid mechanics
One course in fluid mechanics
One additional course in mechanics of either solids or fluids
One course in either materials or dynamics

Engineering Mechanics Electives (6 credits)

Two additional courses in the same area of mechanics (i.e., fluids, solids, or dynamics)

Technical Electives (18 credits)

Chosen from 300-level courses in engineering and the sciences in consultation with the student's faculty advisor. Examples of bio-oriented courses which can be applied to the above three categories include (but are not limited to):

250.353 Computational Biology
530.426 Biofluid Mechanics
530.440 Computational Mechanics of Biological Macromolecules
530.445 Introductory Biomechanics
530.446 Experimental Biomechanics
530.448 Biosolid Mechanics

530.495 Microfabrication Laboratory

540.409 Modeling Dynamics and Control for Chemical and Biological Systems

580.455 Introduction to Orthopaedic Biomechanics

550.471 Combinational Analysis

This is not a complete list of possible courses that can be taken, and not all of these courses must be taken. Rather, students who wish to pursue the biomechanics concentration will take at least five courses such as those listed above. These five should be concentrated either at the cellular/subcellular length scale or in macroscopic biomechanics. Note that given the flexibility of the EM program, it would be possible for students to satisfy both of these kinds of concentrations simultaneously if they apply all 12 of their elective courses toward this end.

Sample Program:

• Year 1

Fall

110.108 Calculus I	4
510.101 Intro to Materials Chemistry	3
Intro to Engineering Elective and Lab I	3
H/S Elective (1)	3
Basic Science Elective	3
Subtotal	16

Spring

110.109 Calculus II	4
Intro to Computing Elective *or*	
Intro to Engineering Elective and Lab II	3
H/S Elective (2)	3
H/S Elective (3) (writing)	3
Subtotal	13

• Year 2

Fall

110.202 Calculus III	4
530.201 Statics and Mechanics	3+1
530.231 Mechanical Engineering Thermodynamics	3+1
171.102 General Physics II	4
173.112 General Physics II Lab	1
Subtotal	17

Spring

550.291 Linear Algebra/Differential Equations	4
530.202 Dynamics	3+1
530.215 Mechanics-Based Design	3+1
Technical Elective (1)	4
Subtotal	16

• Year 3

Fall

530.327 Intro Fluid Mechanics	3+1
Engineering Mechanics elective (solids)	3+1
Technical Elective (2)	4
Statistics Elective	3
Subtotal	15

Spring

Engineering Mechanics elective (fluids)	3+1
Engineering Mechanics elective (solids/fluids)	3+1
Technical Elective	3
Mathematics Elective	3
H/S Elective (4)	3
Subtotal	17

• Year 4

Fall

530.403 Engineering Design Project I	4
Engineering Mechanics elective	3
Engineering Mechanics elective	3
Engineering Mechanics elective (materials/dynamics)	3
H/S Elective (5)	3
Subtotal	16

Spring

530.404 Engineering Design Project II	4
Technical Elective (4)	4
Technical Elective (5)	4
H/S Elective (6)	3
Subtotal	15
Total	**127**

The Concurrent Five-Year Bachelor's / Master's Program

The Mechanical Engineering Department offers a concurrent five-year bachelor's/master's program for mechanical engineering and engineering mechanics majors. Applications to the BS/MSE program should be submitted by January 5 for consideration of Spring admission and June 15 for possible Fall admission, during applicant's junior (3rd) year.

To apply for admission, the student must submit an application. In addition, the student will need to present a statement of purpose, college transcripts, and three letters of recommendation; two of which should be from Mechanical Engineering faculty.

Upon acceptance into the program, students will be asked to develop an outline of their proposed academic program with their advisor.

Graduate Programs

Admission and Advising

To be admitted to graduate study in the Department of Mechanical Engineering, applicants must submit credentials sufficient to convince the faculty that they thrive in a program of advanced course work and/or research. No academic degree is required, but the applicant should have at least two years of relevant undergraduate training, or the equivalent, and should have achieved very high marks or have given other evidence of outstanding ability. Graduate Record Examination scores must be submitted.

Upon arrival, each graduate student is assigned to a faculty advisor to help map a tentative program for the first year and enter the intellectual life of the department. The student is expected to remain in regular communication with the advisor. The advisor may use a variety of methods to assess the student's progress, sometimes including special oral or written examinations. It is not necessary that a student have the same advisor in successive years. After serious research for a dissertation has begun, the research supervisor will automatically function as advisor. All graduate students attend the weekly Mechanical Engineering Graduate Seminars.

Requirements for the M.S.E. Degree

Essay Option: For the master of science in engineering degree at least eight one-semester courses are required. At least half of them must be selected among those listed as graduate courses in this catalog. The remaining courses can be chosen from 300 and 400-level courses in this catalog, with the advisor's approval. A completed piece of research conducted under the guidance of a full-time faculty member of the department and reported as a master's essay is required. All students must follow a course of study approved by their individual advisor.

Non-Essay Option: A non-essay master of science in engineering degree is also offered. The student must successfully complete a coordinated sequence of ten courses, which typically requires one year of full-time resident graduate study. At least six of the ten courses must be selected amongst the graduate courses of this catalog. The intent of this program is to provide the student with an intensive exposure to fundamental and advanced topics within mechanical engineering and engineering mechanics. All students must follow a course of study approved by their individual advisor.

Requirements for the Ph.D. Degree

As soon as the student is prepared to do so, he/she should fulfill the requirements for candidacy. In addition to general university requirements, the student must pass two exams. The first is an oral Departmental Qualifying Exam based on core courses. This exam is usually taken after the third semester of enrollment. The second is a preliminary oral examination satisfying the Graduate Board requirements. This is a comprehensive examination in which students must demonstrate proficiency at the graduate level in their field of specialization; it is taken after the Departmental Qualifying Exam.

Although there are no formal course requirements, students are presumed to be prepared by studies equal to six 600-level courses in their field of specialization and six courses in related fields. All candidates for the doctorate must complete two semesters as a teaching assistant as part of their training. All students are required to follow a course of study approved by their individual advisor.

The final and principal requirement for the doctorate is a piece of original research worthy of publication. Candidates must write a dissertation describing their work in detail and successfully defend it in a final oral presentation and examination.

Undergraduate Courses

530.101-102 (E) Freshman Experiences in Mechanical Engineering I and II
An overview of the field of mechanical engineering along with topics that will be important throughout the mechanical engineering program. This one-year course includes applications of mechanics, elementary numerical analysis, programming in Matlab, use of computer in data acquisition, analysis, design, and visualization, technical drawing, the design process and creativity, report preparation, teamwork, and engineering ethics. Corequisites are 530.103-104 and 530.105-106, and 110.109 (for spring).
Staff   2 credits each semester/offered yearly

530.103-104 (E) Introduction to Mechanics I and II
A one-year course offering in-depth study of elements of mechanics, including linear statics and dynamics, rotational statics and dynamics, thermodynamics, fluids, continuum mechanics, transport, oscillations, and waves. This is an alternative to 171.101, designed specifically for Mechanical Engineers and Engineering Mechanics students taking 530.101-102 concurrently. Corequisites are 530.101-102 and 530.105-106 (laboratory).
Staff   2 credits each semester/offered yearly

530.105-106 (E) Mechanical Engineering Freshman Laboratory I and II
Hands-on laboratory complementing 530.101-102 including experiments, mechanical dissections, and design experiences distributed throughout the year. Experiments are designed to give students background in experimental techniques as well as to reinforce physical principles. Mechanical dissections connect physical principles to practical engineering applications. Design projects allow students to synthesize working systems by combining mechanics knowledge and practical engineering skills. Corequisites are 530.101-102.
Staff   1 credit each semester/offered yearly

530.110 Chair's Dialogue on Grand Engineering Challenges
The purpose of this course is to allow the Mechanical Engineering Department Chair and students to engage in a meaningful dialogue about grand engineering challenges facing the world today. Based on the premise that these challenges constitute the opportunity of a lifetime disguised as a series of unsolvable problems, the course will explore the technical, scientific, political, and societal facets of these challenges and the opportunities for engineers to engage in topics such as energy, the environment, medical health, and national security.
Hemker   1 credit   fall

530.201 (E) Statics and Mechanics of Materials
Equilibrium of rigid bodies, free-body diagrams, design of trusses. One-dimensional stress and strain, Hooke's law. Properties of areas. Stress, strain, and deflection of components subjected to uniaxial tension, simple torsion, and bending. Prerequisite: 171.101 or 530.103 and 530.104; or permission of instructor.
Graham-Brady   4 credits
(3 hours lecture, 1 hour lab)   fall

530.202 (E) Dynamics
Basic principles of classical mechanics applied to the motion of particles, system of particles and rigid bodies. Kinematics, analytical description of motion; rectilinear and curvilinear motions of particles; rigid body motion. Kinetics: force, mass, and acceleration; energy and momentum principles. Introduction to vibration. Includes laboratory experience. Prerequisite: 530.201 or 560.201.
Nakata   4 credits
(3 hours lecture, 1 hour lab)   spring

530.215 (E) Mechanics-Based Design
Stresses and strains in three dimensions, transformations. Combined loading of components, failure theories. Buckling of columns. Stress concentrations. Introduction to the finite element method. Design of fasteners, springs, gears, bearings, and other components. Prerequisite: 530.201 or 560.201.
Ramesh, Wang   4 credits
(3 hours lecture, 1 hour lab)   spring

530.231 (E) Mechanical Engineering Thermodynamics
Properties of pure substances, phase equilibrium, equations of state. First law, control volumes, conservation of energy. Second law, entropy, efficiency, reversibility. Carnot and Rankine cycles. Internal combustion engines, gas turbines. Ideal gas mixtures, air-vapor mixtures. Introduction to combustion. Corequisite: 171.102; Prerequisite: 110.109.
Meneveau, Katz   4 credits (3 hours lecture, 1 hour lab)   fall

530.241 (E) Electronics and Instrumentation Laboratory
Introduction to basic analog electronics and instrumentation with emphasis on basic electronic devices and techniques relevant to mechanical engineering. Topics include basic circuit analysis, laboratory instruments, discrete components, transistors, filters, op-amps, amplifiers, differential amplifiers, power amplification, power regulators, AC and DC power conversion, system design considerations (noise, precision, accuracy, power, efficiency), and applications to engineering instrumentation. Prerequisites: Physics I or Intro to Mechanics I and II, plus Physics II. Corequisites: one of three Linear Algebra and Differential Equations course options: 1) 550.291, 2) both 110.201 and 110.302, or 3) both 110.201 and 110.306.
Cowan, Whitcomb   3 credits   fall

530.327 (E) Introduction to Fluid Mechanics
Physical properties of fluids. Fluid statics. Control volumes and surfaces, kinematics of fluids, conservation of mass. Linear momentum in integral form. Bernoulli's equation and applications. Dimensional analysis. The Navier-Stokes equations. Laminar and turbulent viscous flows. External flows, lift and drag. Prerequisites: 110.302 or 550.291, plus 530.202.
Mittal   4 credits (3 hours lecture, 1 hour lab)   fall

530.328 (E) Fluid Mechanics II
Linear and angular momentum in integral form, applications to turbomachines. The Navier-Stokes equations. Inviscid flow. Laminar viscous flow. Boundary layers. Turbulence. Compressible flows. Projects using computational tools, design of pipe network.
Meneveau   3 credits   spring

530.334 (E) Heat Transfer
Steady and unsteady conduction in one, two, and three dimensions. Elementary computational modeling of conduction heat transfer. External and internal forced convection. Performance and design of heat exchangers. Boiling and condensation. Black-body and gray-body radiation, Stefan-Boltzmann law view factors and some applications. Prerequisites: 530.231, 530.327.
Herman, Prosperetti   4 credits (3 hours lecture, 1 hour lab)   spring

530.343 (E) Design and Analysis of Dynamic Systems
Modeling and analysis of damped and undamped, forced and free vibrations in single and multiple degree-of-freedom linear dynamical systems. Introduction to stability and control of linear dynamical systems. Prerequisites:

110.108, 110.109, 110.202, and 550.291, plus for Mechanical Engineering majors 530.241.

Sun, Cowan   4 credits (3 hours lecture,
1 hour lab)   spring

530.344 (E) Dynamic Systems Laboratory
This is an alternate laboratory course for the lab component in 530.343 (Design and Analysis of Dynamic Systems). This lab course is required for students who have taken the course abroad or outside JHU.

Okamura   1 credit   spring

530.352 (E) Materials Selection
An introduction to the properties and applications of a wide variety of materials: metals, polymers, ceramics, and composites. Considerations include availability and cost, formability, rigidity, strength, and toughness. This course is designed to facilitate sensible materials choices so as to avoid catastrophic failures leading to the loss of life and property. Prerequisite: 530.215 or permission of instructor.

Hemker   4 credits (3 hours lecture, 1 hour lab)   fall

530.403-404 (E) Engineering Design Project
This senior year "capstone design" course is intended to give some practice and experience in the art of engineering design. Students working in teams of two to four will select a small-scale, industry-suggested design problem in the area of small production equipment, light machinery products, or manufacturing systems and methods. A solution to the problem is devised and constructed by the student group within limited time and cost boundaries. Preliminary oral reports of the proposed solution are presented at the end of the first semester or sooner. A final device, product, system, or method is presented orally and in writing at the end of the second semester. Facilities of the Engineering Design Laboratory (including machine shop time) and a specified amount of money are allocated to each student design team for purchases of parts, supplies, and machine shop time where needed. Prerequisites: For mechanical engineering majors: 530.215, 530.327. For engineering mechanics majors and biomedical engineering majors: 530.215 or 530.405, and 530.327. To receive credit for this course, both semesters must be completed.

Hemker   8 credits   academic year

530.405 (E) Mechanics of Solids and Structures
This course provides an introduction to the mathematical and theoretical foundations of the mechanics of solids and structures. We will begin with the mathematical preliminaries used in continuum mechanics: vector and tensor calculus, then introduce kinematics and strain measures, descriptions of stress in a body, frame indifference, conservation laws: mass, momentum, energy balance, and entropy. These concepts will be applied to develop the constitutive equations for solids and fluids, methods for solving boundary values problems that occur in engineering structures, energy methods, and foundations of the finite element method. Prerequisites: 110.201, Linear Algebra and Differential Equations, and 530.215 or permission of the instructor.

Ramesh   3 credits   spring

530.410 (E, N) Biomechanics of the Cell and Organisms
Mechanical aspects of the cell are introduced using the concepts in continuum mechanics. Discussion of the role of proteins, membranes and cytoskeleton in cellular function and how to describe them using simple mathematical models. Prerequisite: Introductory physics, a year of calculus, and preferably, linear algebra.

Sun   3 credits   spring

530.414 (E) Computer-Aided Design
The course outlines a modern design platform for 3D modeling, analysis, simulation, and manufacturing of mechanical systems using the "Pro/E" package by PTC. The package includes the following components:

- **Pro/ENGINEER:** is the kernel of the design process, spanning the entire product development, from creative concept through detailed product definition to serviceability.
- **Pro/MECHANICA:** is the main analysis and simulation component for kinematic, dynamic, structural, thermal and durability performance.
- **Pro/NC:** is a numeric-control manufacturing package. This component provides NC programming capabilities and tool libraries. It creates programs for a large variety of CNC machine tools.

Stoianovici   3 credits   each semester

530.415 (E, N) Energy Engineering: Fundamentals and Future
This course examines the science and engineering of contemporary and cutting-edge energy technologies. Materials Science and Mechanical Engineering fundamentals in this area will be complemented by case studies that include fuel cells, solar cells, lighting, thermoelectrics, wind turbines, engines, nuclear power, biofuels, and catalysis. Students will consider various alternative energy systems, and also to research and engineering of traditional energy technologies aimed at increased efficiency, conservation, and sustainability. Prerequisite: undergraduate course in thermodynamics. Co-listed with 500.405.

Erlebacher, Katz, Hemker   3 credits

530.418 (E) Aerospace Structures and Materials
An introduction to the design of aircraft and spacecraft structures and components. This course will build on skills learned in 530.215 Mechanics-Based Design and 530.352 Materials Selection. Prerequisites: 530.215, 530.352 or consent of instructor.

Hemker   3 credits

530.420 (E) Robot Actuators and Sensors
Introduction to modeling and use of actuators and sensors in mechatronic design. Topics include electric motors, solenoids, micro-actuators, position sensors, and proximity sensors. Laboratory. Prerequisites: 171.101 or 530.103 and 530.104, plus 171.102, 110.108, 110.109, 110.202, 550.291, and either 530.241 or 520.345.

Whitcomb   3 credits   fall

530.421 (E) Mechatronics
Students from various engineering disciplines are divided into groups of two to three students. These groups each

develop a microprocessor-controlled electromechanical device, such as a mobile robot. The devices compete against each other in a final design competition. Topics for competition vary from year to year. Class instruction includes fundamentals of mechanism kinematics, creativity in the design process, an overview of motors and sensors, and interfacing and programming microprocessors. Prerequisite: 530.420 or permission of instructor.

Chirikjian   3 credits   spring

530.424 (E) Dynamics of Robots and Spacecraft
An introduction to Lagrangian mechanics with application to robot and spacecraft dynamics and control. Topics include rigid body kinematics, efficient formulation of equations of motion, stability theory, and Hamilton's principle. Prerequisite: 560.202 or 530.202.

Chirikjian   3 credits   spring/even years

530.425 (E) Mechanics of Flight
Elements of flight dynamics: aerodynamics forces, gliding, cruising, turning, ascending, descending, stability, etc. Review of the pertinent fluid mechanic principles. Application to two-dimensional airfoils and theory of lift. Three-dimensional airfoils. Boundary layers. Effects of compressibility. Subsonic and supersonic flight. Prerequisites: 530.231, 530.327, 530.328 (may be taken concurrently), or permission of the instructor.

Prosperetti, Herman   3 credits   spring/odd years

530.426 (E) Biofluid Mechanics
Course will cover selected topics from physiological fluid dynamics, including respiratory flow patterns, blood flow and pulse propagation, aerodynamics of phonation and speech, rheology of blood flow in the microcirculation, aquatic animal propulsion, and animal flight.

Mittal   3 credits   fall

530.432 (E) Jet and Rocket Propulsion
The course covers several topics associated with power generation and conversion. Gas turbines, such as turbo-jet, turbo-fan, and turbo-prop engines, as well as their components, are discussed. Included are the characteristics of compressors, turbines, combustion chambers, diffusers, and nozzles. A brief introduction to rocket propulsion with liquid and solid fuels is also given. The second part of the course deals with internal combustion engines, including two- and four-stroke engines as well as diesel engines. Prerequisites: 530.231, 530.327.

Katz   3 credits   spring/alternating years

530.435 (E) Refrigeration and Heating, Ventilating, and Air Conditioning
This course deals with processes and equipment used for refrigeration and heating, ventilating, and air conditioning. Topics include thermodynamic refrigeration cycles, refrigerants, air conditioning systems, indoor air quality, heat load, cooling load. Prerequisite: 530.334.

Herman   3 credits   fall/even years

530.440 (E) Computational Mechanics of Biological Macromolecules
Biological macromolecules such as proteins and nucleic acids consist of thousands of atoms. Whereas crystallographic data of these molecules provides baseline information on their three-dimensional structure, their biological function can depend to a great extent on mechanical characteristics such as conformational flexibility. In this course, we will examine numerical methods for modeling shape fluctuations in large biomolecules using coarse-grained elastic network models. The course will consist of lectures, reading papers, and performing computer projects. No prior knowledge of biochemistry or molecular biology is required. Prerequisite: Knowledge of linear algebra and differential equations.

Chirikjian   3 credits

530.444 (E) Computer-Aided Fluid Mechanics and Heat Transfer
Computer simulation has become an essential part of science and engineering and this course introduces the student to the use of computer simulation in the disciplines of heat transfer and fluid mechanics. The commercial software COMSOL is used on a wide variety of problems, ranging from simple models for which analytical solutions are available, to complex, unsteady, multiphysics real-life problems. Problems will be solved by identifying proper governing equations and boundary conditions first, and then implementing these in the COMSOL environment. Applications will include heat conduction, convection and radiation, internal and external flows, with applications ranging from mechanical to biomedical and aerospace engineering.

Herman   3 credits   spring/odd years

530.445 (E, N) Introduction to Biomechanics
An introduction to the mechanics of biological materials and systems. Both soft tissue such as muscle and hard tissue such as bone will be studied as will the way they interact in physiological functions. Special emphasis will be given to orthopedic biomechanics. Prerequisite 530.215.
Belkoff   3 credits   fall

530.446 (E, N) Experimental Biomechanics
An introduction to experimental methods used in biomedical research. Standard experimental techniques will be applied to biological tissues, where applicable and novel techniques will be introduced. Topics include strain gauges, extensometers, load transducers, optical kinematic tracking, digital image correlation, proper experimental design, calibration and error analysis. Of particular emphasis will be maintaining native tissue temperature and hydration. Laboratory will include "hands-on" testing.
Belkoff   3 credits

530.448 (E) Biosolid Mechanics
This class will introduce fundamental concepts of statics and solid mechanics and apply them to study the mechanical behavior bones, blood vessels, and connective tissues such as tendon and skin. Topics to be covered include concepts of small and large deformation, stress, constitu-

tive relationships that relate the two, including elasticity, anisotropy, and viscoelasticity, and experimental methods. Prerequisites: Linear Algebra and Differential Equations. A prior class in statics and mechanics (e.g. 530.201) will be helpful.

Nguyen   3 credits

530.449 (E) Compressible Flow

One-dimensional flow: acoustic, expansion and shock waves. Rankine-Hugoniot relations. Quasi-one-dimensional flow: variable area duct, de Laval nozzle, choking. Unsteady waves. Shock tube. Two-dimensional flow; expansion fans, oblique shocks, characteristics. Linearized flow. Transonic and supersonic flight.

Prosperetti   3 credits

530.451 (E) Cell and Tissue Engineering Laboratory

This laboratory course will consist of three experiments that will provide students with valuable hands-on experience in cell and tissue engineering. Experiments include the basics of cell culture techniques, gene transfection and metabolic engineering, basics of cell-substrate interactions I, cell-substrate interactions II, and cell encapsulation and gel contraction.

Wang   2 credits

530.454 (E) Manufacturing Engineering

An introduction to the various manufacturing processes used to produce metal and nonmetal components. Topics include casting, forming and shaping, and the various processes for material removal including computer-controlled machining. Simple joining processes and surface preparation are discussed. Economic and production aspects are considered throughout. Prerequisites: 530.215 and 530.352 or permission of instructor.

Staff   3 credits   fall

530.457 (E, N) Introduction to Acoustics

This course is an introduction to the science of sound and its applications to music, speech communication, science, and engineering. Topics include hearing, speech, wave propagation, microphones and loudspeakers, noise control, underwater sound, and room acoustics. Recommended prerequisite: 530.327.

Prosperetti   3 credits

530.467 (E) Thermal Design Issues for Aerospace Systems

This course deals with processes, systems, instruments and equipment for aerospace systems. Issues of energy conversion and thermal design are emphasized. Topics include thermodynamic concepts and heat transfer processes for aerospace systems (with emphasis on radiation), the space environment, influence of gravity on heat transfer, power generation for space systems (energy sources, solar cell arrays, energy storage), thermal control (analysis techniques, design procedures, active versus passive design, heating and refrigeration), environmental effects.

Herman   3 credits

530.470 (E) Space Vehicle Dynamics and Control

In this course we study applied spacecraft orbital and attitude dynamics and their impact on other subsystems. In the orbital dynamics part of the course, we discuss some the issues associated with orbital insertion, control and station keeping. Focus is on the two-body problem regime where conic solutions are valid. Orbit perturbations are also considered. For attitude dynamics, different attitude representations such as of direction cosines, quaternions, and angles are introduced. Then we look at the forces and moments acting on space vehicles. Attitude stability and control considerations are introduced.

Staff   3 credits   spring

530.491-492 Special Topics

Selected topics for third- and fourth-year students in mechanical engineering and other engineering departments. Offered by arrangement with faculty advisor and instructor in charge.

Staff   1-3 credits

530.495 (E, N) Microfabrication Laboratory

This laboratory course is an introduction to the principles of microfabrication for microelectronics, sensors, MEMS, and other synthetic microsystems that have applications in medicine and biology. Course comprised of laboratory work and accompanying lectures that cover silicon oxidation, aluminum evaporation, photoresist deposition, photolithography, plating, etching, packaging, design and analysis CAD tools, and foundry services. Co-listed as 520/580.495.

Andreou, Wang   4 credits   fall

530.496 (E) Micro/Nanoscience and Biotechnology

An introduction to the physical and chemical principles important to MEMS, BioMEMS, and bionanotechnology. Topics include scaling laws, colloids and surfaces, micro and nanofluidics, thermal forces and diffusion, chemical forces, electrokinetics, electric aspects of surface chemistry, capillary forces and surface tension, and top-down and bottom-up nanofabrication.

Wang   3 credits   fall/even years

530.525-526 Independent Research

Students pursue research problems individually or in pairs. Although the research is under the direct supervision of a faculty member, students are encouraged to pursue the research as independently as possible.

Staff   1-3 credits

530.527 Independent Study

Staff   1-3 credits

Graduate Courses

530.600 Master's Graduate Research
Staff

530.605 Mechanics of Solids and Materials I
This course provides an introduction to the mathematical and theoretical foundations of the mechanics of solids and materials. We will begin with the mathematical pre-liminaries of continuum mechanics: vectors and tensors calculus, then introduce the kinematics of deformation and descriptions of stress in a continuum: Eulerian and Lagrangian descriptions, followed by conservation laws: mass, momentum, and energy balance, and entropy. These concepts will be applied to develop the concepts of constitutive relations: frame invariance, material sym-metry, and dissipation. The second half of the class will be devoted to elasticity, both classical and finite elasticity, and solution methods for boundary value problems.
Ramesh, Nguyen   3 hours   fall

530.606 Mechanics of Solids and Materials II
An overview of the area of the mechanics of solids and materials, with the intent of providing the foundation for graduate students interested in research that involves these disciplines. The course is based on the principles of continuum mechanics, and covers the fundamental concepts of elasticity, plasticity, and fracture as applied to materials. One objective is to get graduate students to the point that they can understand significant fractions of research seminars and papers in this area. This mathemat-ically rigorous course emphasizes the setup and solution of boundary value problems in mechanics, and attempts to integrate the primary behaviors with deformation and failure mechanisms in materials. Special topics covered may include (depending on the interests of the student body) wave propagation, viscoelasticity, geomechanics or biomechanics.
Ramesh, El-Awady   3 hours   spring

530.610 Statistical Mechanics in Biological Systems
Application of equilibrium and nonequilibrium concepts in statistical mechanics to biology is presented in some detail. Topics include many-body dynamics and equilib-rium ensembles, thermodynamics and phase transitions, free energy functionals, computer simulations of biologi-cal systems, nonequilibrium model such as the Langevin equation and the Fokker-Planck equation, kinetic models of biochemical networks, Markov models of stochastic sys-tems and pattern formation in nonequilibrium systems. Emphasis will be on quantitative understanding of bio-logical problems.
Sun   3 hours   fall

530.612 Computational Solid Mechanics
This course teaches in-depth and hands-on understand-ing of numerical methods for solid mechanics problems. The course begins with a review of the fundamental con-cepts of the finite element method for linear boundary value problems (BVP) and initial boundary value prob-lems (IBVP) in solid mechanics. Then more advance methods for nonlinear BVPs are presented and applied to problems of material inelasticity and finite elasticity. Topics covered include the strong and weak statements of the BVP, weighted residual methods, time integration, Newton-type methods for nonlinear problems, and error estimation and convergence.
Nguyen   3 hours   spring/even years

530.620 Robot Sensors and Actuators (graduate level)
Introduction to modeling and use of actuators and sensors in mechatronic design. Topics include electric motors, solenoids, micro-actuators, position sensors, and proximity sensors. Laboratory.
Whitcomb   3 hours   fall

530.621-622 Fluid Dynamics I, II
Kinematics. Stress. Conservation of mass, momentum, and energy. Newtonian fluids. The Navier- Stokes equations. Inviscid flows. Laminar viscous flows. Vorticity. Instability. Turbulence. Boundary layers. External flows. Compress-ible flows. Introduction to non-Newtonian fluids.
Meneveau, Knio, Katz   3 hours   fall/spring

530.624 Dynamics of Robots and Spacecraft (graduate level)
An introduction to Lagrangian mechanics with applica-tion to robot and spacecraft dynamics and control. Top-ics include rigid body kinematics, efficient formulation of equations of motion, stability theory, and Hamilton's principle.
Chirikjian   3 hours   spring/even years

530.625 Turbulence
Fundamental equations of fluid mechanics, Reynolds averaging, and the closure problem. Scaling and self-preservation in boundary-free and wall-bounded shear flows. Isotropic turbulence and spectral theories. Vorticity dynamics, intermittency, and cascade models. Turbulence modeling: one- and two-equation models, Reynolds stress modeling, and large-eddy simulations.
Meneveau   3 hours   fall/even years

530.631 Conduction and Radiation
In the first part of the course, the focus is on steady and transient two- and three-dimensional heat conduction. Energy balances and the energy equation are reviewed, and mathematical methods for solving partial differen-tial equations are discussed. Heat transfer with a phase change, and contemporary conduction problems are dis-cussed. In the second part of the course radiative proper-ties and thermal radiation exchange are reviewed. The equation of transfer for participating media is developed, and simplification is discussed.
Herman   3 hours   fall/odd years

530.632 Convection
This course begins with a review of the phenomenologi-cal basis of the constitutive models for energy and mass flux. Then, using the transport theorem, general conser-vation and balance laws are developed for mass, species, energy, and entropy. Scaling analysis is used to determine when simplifications are justified, and simplified cases are solved analytically. Experimental results and correlations

are given for more complex situations. Free, mixed, and forced internal and external convection are studied, and convection with a phase change is also explored.
Prosperetti   3 hours

530.637 Energy and the Environment
The course focuses on advanced topics related to energy and thermodynamics. The objective of this course is to provide a thorough understanding of the environmental impacts related to energy conversion systems. The use of the second law of thermodynamics is introduced to quantify the performance of energy conversion systems. Topics such as global warming, alternative energy sources (solar, wind power, geothermal, tides, etc.) and new technologies (fuel cells and hydrogen economy) and resources and sustainable development are addressed. A section of the course is devoted to current trends in nuclear energy generation and environmental issues associated with it.
Prerequisite: Thermodynamics
Herman   3 hours   fall

530.642 Plasticity
The theory of the inelastic behavior of metallic materials. Experimental background and fundamental postulates for the plastic stress-strain relations. Mechanisms of plastic flow; single-crystal and polycrystalline plasticity. Boundary value problems. Variational principles, uniqueness and the upper and lower bound theorems of limit analysis. Slip line theory. Dynamic plasticity and wave phenomena. Finite strain plasticity and instability.
Ramesh   3 hours

530.646 Introduction to Robotics
Graduate-level introduction to robotics with emphasis on the mathematical tools for kinematics and dynamics. Topics include forward and inverse kinematics, trajectory generation, position sensing and actuation, and manipulator control.
Cowan   3 hours   fall

530.647 Adaptive Systems
Graduate-level introduction to adaptive identification and control. Emphasis on applications to mechanical systems possessing unknown parameters (e.g., mass, inertia, friction). Topics include stability of linear and nonlinear dynamical systems, Lyapunov stability, input-output stability, adaptive identification, and direct and indirect adaptive control.
Whitcomb   3 hours   spring/even years

530.653 Advanced Systems Modeling
This course covers the following topics at an advanced level: Newton's laws and kinematics of systems of particles and rigid bodies; Lagrange's equations for single- and multi-degree-of-freedom systems composed of point masses; normal mode analysis and forced linear systems with damping, the matrix exponential and stability theory for linear systems; nonlinear equations of motion: structure, passivity, PD control, noise models and stochastic equations of motion; manipulator dynamics: Newton-Euler formulation, Langrange, Kane's formulation of dynamics, computing torques with O(n) recursive manipulator

dynamics: Luh-Walker-Paul, Hollerbach, O(n) dynamic simulation: Rodrigues-Jain-Kreutz, Saha, Fixman. There is also an individual course project that each student must do which related the topics of this course to his or her research.
Chirikjian   3 hours

530.656 Mechanisms of Deformation and Fracture
An advanced course on the microscopic mechanisms that control the mechanical behavior of materials. Methods and techniques for measuring, understanding, and modeling: plasticity, creep, shear banding, and fracture will be addressed. Subjects to be covered include dislocation theory and strengthening mechanisms, high temperature diffusion and grain boundary sliding, shear localization, void formation, ductile rupture, and brittle fracture.
Hemker   3 hours

530.657 Physical Acoustics
This course provides a foundation for modern acoustics including derivation of wave equation and its solution in various media, sound radiation, sound propagation, instrumentation, and sound/structure interaction. Specific applications of focus will be determined by the research interests of the students of the class.
Prosperetti   3 hours

530.671 Statistical Mechanics in Biological Systems
Principles of statistical physics are discussed in the context of biological problems. After an introduction, topics covered will include equilibrium theory of liquids and polymers, theory of chemical reactions in complex environments, stochastic models, dynamics of membranes and channels, theory of biological motors, and computer simulations of liquids and proteins.
Sun   3 hours   fall

530.672 Biosensing and BioMEMS
The course discusses the principles of biosensing and introduces micro- and nano-scale devices for fluidic control and molecular/cellular manipulation, measurements of biological phenomena, and clinical applications. Co-listed as 580.672.
Wang   3 hours   spring

530.675 Observer Theory and Application
This course addresses in state estimation for finite dimensional linear and nonlinear dynamical systems. Topics include classical observer theory for linear dynamical systems and Kalman filters as well as more recent developments in state estimation techniques for nonlinear dynamical systems. Applications to state estimation of physical systems. Prerequisites: state-space linear control theory, probability and stochastic processes, linear algebra, and differential equations.
Whitcomb   3 hours

530.676 Locomotion in Mechanical and Biological Systems
Advanced graduate course on the mechanics of locomotion in animals and machines, and neural control of locomotion. Terrestrial, aquatic, and aerial locomotion modes

are considered. Topics include dynamical systems theory, linear and nonlinear differential equations, Poincaré and Floquet theory, and system identification techniques. Prerequisite: graduate course in robotics, controls, or dynamical systems theory, and a basic understanding of probability theory; or permission of instructor.
Cowan   3 hours   spring/even years

530.701 Uncertainty Analysis and Downscaling

This course will describe several approaches used to infer small-scale information from large-scale observations (downscaling). Downscaling is especially useful for multi-scale phenomena characterized with power-law spectra or fractal geometry. Topics: self-consistency conditions across length-scales to determine model parameters in coarse-grained simulations. Tools for characterizing scale-invariant (fractal) processes. Sample applications of downscaling as practiced today: of inferring small-scale information from large scale-observations is most often inherently uncertain. The second part of this course will explore uncertainty models in the analytical context of scaling. Topics: assimilation of data and models (Kalman filtering and related methods for nonlinear models and very large data sets), statistical analysis of spatial-temporal data (independent components analysis, kernel methods). Application to downscaling in atmospheric data. Co-listed with 560.701.
Igusa, Meneveau   3 hours   fall

530.710 Optical Measurement Techniques

Optic-based techniques are being utilized as measurement and data transmission tools in a growing number of applications. The objective of this course is to introduce graduate students with limited background in optics (but with background in graduate-level mathematics) to the fundamentals of optics and their implementation. Topics covered include reflection, refraction, fluorescence, phosphorescence and diffraction of light; review of geometric optics, lenses, lens systems (microscope, telescope), mirrors, prisms; aberrations, astigmatism, coma, and methods to correct them; light as an electromagnetic wave; Fourier optics; spectral analysis of optical systems; coherent and incoherent imaging, holography, interferometry, diffraction grating; lasers, polarization, light detectors; elements of nonliner optics, birefringence; optical fibers, data transmission, and networking.
Katz   3 hours

530.730 Finite Element Methods

The basic concepts of the FEM are presented for one-, two-, and three-dimensional boundary value problems (BVPs). Problems from heat conduction and solid mechanics are addressed. The key topics include relationships between strong, weak, and variational statements of BVPs, weighted residual methods with an emphasis on the Galerkin method, specialization of Galerkin approximations of weak statements and Ritz approximations of variational statements to obtain finite element formulations, specific element formulations, convergence properties, solutions of linear systems of equations, and time-dependent problems.
Staff   3 hours fall

530.732 Fracture of Materials

An advanced examination of fracture mechanisms in ductile and brittle materials. Both the mechanics and the materials aspects are covered with importance placed on the synthesis of the two approaches. Topics include linear elastic fracture mechanics, ductile fracture, the J-integral, atomistic aspects of fracture in polycrystalline materials, fracture in ceramics and polymers, influence of the material microstructure on fracture toughness and ductility in FCC and BCC materials.
Ramesh   3 hours

530.748 Stress Waves, Impact, and Shocks

Elastic waves in unbounded media. Elastic waveguides. Waves in elastic-plastic and nonlinear elastic materials. Analysis of impact on materials and structures. Impact on various scales, from planetary to microscopic. Shock waves. Impact signatures in materials (time permitting).
Ramesh   3 hours

530.757 Nanomechanics

A research-level course examining the mechanics of nanoscale assemblies and microscale structures used for investigating nanoscale phenomena. Applications in scanning probe systems, materials, and biology will be of interest. Each student will be expected to complete a paper on a research topic chosen together with the instructor.
Ramesh   3 hours   fall

530.759 Research Seminar in Plasticity and Failure

A weekly research seminar featuring ongoing research as well as reviews of new papers of interest in the general areas of plasticity and failure. The course will have an emphasis on dynamic phenomena, but will consider both engineering materials and biological systems. Students will be expected to make two presentations during the semester.
Ramesh   2 hours

530.762 Advanced Mathematical Methods of Engineering

A problem-oriented, unified view of the classical methods of applied mathematics based on the theory of Hilbert spaces: Fourier and Fourier-Bessel series, spherical harmonics, Green's functions, theory of distributions.
Prosperetti   3 hours   spring

530.763 Topics in Complex Systems: Chaos, Fractals and Self-Organization

Chaos in low-dimensional dynamical systems: maps and ordinary differential equations. Lagrangian chaos and mixing in two-dimensional laminar flows. Fractal geometry, Julia sets, collage theorem, multifractals. Applications to growth processes, turbulence, and Brownian motion. Self-organized criticality.
Meneveau   3 hours   fall/odd years

530.766 Numerical Methods

Elementary introduction to numerical methods for the solution of fundamental problems in engineering. Computer assignments requiring programming.
Knio, Mittal   3 hours   fall

530.767 Computational Fluid Dynamics
Advanced introduction to major approaches in the simulation of the incompressible flow: finite-difference, finite-element, finite-volume, boundary-element, spectral, and Lagrangian discretizations. Computer project requiring programming.
Knio   3 hours   spring

530.773 Topics in Applied Mathematics for Engineering
The material covered in this course depends on the class's and instructor's interests. Topics include multiple-scale methods applied to nonlinear oscillations and wave propogation, homogenization, singular perturbations, nonlinear waves, complex variables and conformal mapping, calculus of variations, and others.
Prosperetti   3 hours

530.777 Multi-Phase Flow
An introduction to basic contemporary ideas concerning gas, liquid, and solid-fluid two-phase flows.
Prosperetti   3 hours

530.800 Independent Study
Staff   1-3 hours

530.801-802 Graduate Research
Staff   1-3 hours

530.803-804 Mechanical Engineering Graduate Seminar
Staff   1 hour

530.807-808 Graduate Seminar in Fluid Mechanics
Meneveau 1 hour

530.809-810 Mechanics and Materials Graduate Seminar
Hemker   1 hour

Cross-listed

270.621 Transmission Electron Microscopy: Practice and Applications
fall/even years

270.622 Transmission Electron Microscopy: Theory and Understanding
spring/odd years

500.405 Energy Engineering: Fundamentals and Future

500.602 Seminars in Environmental and Applied Fluid Mechanics

500.745 Seminar in Computational Sensing and Robotics

500.809 Mechanics of Materials and Structures Graduate Seminar

520.353 Control Systems

520/580.672 Biosensing and BioMEMS

560.201 Statics and Mechanics of Materials

560.202 Dynamics

560.701 Uncertainty Analysis and Downscaling

560.730 Finite Element Methods

580.448 Biomechanics of the Cell and Organisms

Robotics		
Mechanical Engineering	530.343	Design and Analysis of Dynamic Systems
	530.420	Robot Actuators and Sensors
	530.421	Mechatronics
	530.424	Dynamics of Robots and Spacecraft
	530.620	Robot Actuators and Sensors (graduate)
	530.624	Dynamics of Robots and Spacecraft (graduate)
	530.646	Introduction to Robotics
	530.676	Locomotion in Mechanical and Biological Systems
Computer Science	600.435	Artificial Intelligence
	600.446	Computer-Integrated Surgery I and II
	600.452	Computer-Integrated Surgery Seminar
	600.461	Computer Vision
	600.646	Advanced Computer-Integrated Surgery II
Electrical/Computer Engineering	520.214	Signals and Systems
	520.353	Control Systems
	520.454	Control Systems Design

Institute for NanoBioTechnology

The Institute for NanoBioTechnology (INBT) is a Johns Hopkins University center for integrated nanobiotechnology research, education, and outreach. Launched in May 2006 with funding from NASA, the National Science Foundation, and the Howard Hughes Medical Institute, INBT aims to revolutionize health care by bringing together internationally renowned faculty expertise, students, and world-class research facilities in medicine, engineering, the sciences, and public health to create groundbreaking technologies. Supportive funding also has been provided by the Johns Hopkins School of Medicine, Whiting School of Engineering, Krieger School of Arts and Sciences, and Bloomberg School of Public Health. INBT collaborates with industry through its Corporate Partnership Program, which is open to companies involved in aspects of nanobiotechnology such as drug and gene delivery, biomedical imaging, medical diagnostics, medical instrumentation, cell sorting and separations, biosensors, and materials and chemicals.

INBT headquarters are located in the newly renovated New Engineering Building in Suite 100, on the Homewood campus. Laboratory facilities and faculty are located at several other Johns Hopkins locations. INBT research is organized into three core areas.

- Diagnostics and Therapeutics: development of devices to diagnose and treat disease.

- Cellular and Molecular Dynamics: manipulating cells to investigate biological functions and disease progression.

- Health and the Environment: studying the effects of nanotechnology on the environment and public health and examining potential nanobiotechnology solutions, including environmental remediation.

Education programs at INBT are designed to foster the next wave of nanobiotechnology innovation. Goals include training a new generation of scientists and engineers who are better able to work between physical sciences/engineering fields and life sciences/medical fields and creating an entrepreneurial environment for students. INBT facilitates graduate programs in nanobiotechnology funded by the National Institutes of Health (NIH), and National Science Foundation (NSF). Three postdoctoral training programs in Nanotechnology for Cancer Medicine are funded by NIH. Additional nanobiotechnology research opportunities exist through INBT's summer Research Experience for Undergraduates (REU) and International Research Experience for Students (IRES), both funded by NSF. Students from any major may learn the techniques of science writing or animation for nanotechnology and medicine through independent study.

For more information, visit INBT's website at http://inbt.jhu.edu/.

Undergraduate Course

500.495 (E,N) Animation in Nanotechnology
This course involves the use of animation to visualize scientific processes in nanotechnology and medicine. Animation is becoming an increasingly important tool in both research and education, especially in fields such as nanobiotechnology that involve complex processes and occur at multiple length scales. Understanding of the subject matter is gained through interaction with faculty and graduate students in research groups in the Institute for NanoBioTechnology. The course follows the basic animation pipeline from concept to post production. Same as 500.695.
Searson   3 credits

Graduate Courses

EN.500.617 Cancer Nanotechnology Training Center (CNTC) Tutorial
This course is to allow CNTC fellows the opportunity each week to review and present on cancer research topics. The papers and discussions covered will be on areas of human cancers and nanotechnology and include the latest developments from studies of model organisms.

EN.500.620 Fundamental Laboratory Principles of Nanobiotechnology
This laboratory course introduces students to fundamental concepts of materials science and cell engineering required for research in biological nanoscience. Topics covered include cell culture, quantitative light microscopy, and synthesis of nanoparticles. This laboratory course is a prerequisite for NanoBio Laboratory (500.621). Permission of instructor is required.

500.621 NanoBio Laboratory

This course introduces students to concepts and laboratory techniques in nanobiotechnology. The focus of the laboratory is on nanoparticle carriers for drug delivery and markers for imaging. The laboratory involves the synthesis of nanoparticles using solution phase techniques and characterization by optical techniques such as dynamic light scattering and absorbance spectroscopy. Strategies for functionalization of nanoparticles are covered with focus on methods for attaching biomolecules. The basic aspects of cell culture and optical microscopy techniques will be covered. Nanoparticles functionalized with a drug or gene will be used to perform transfection experiments and compared to standard techniques.

500.695 Animation in Nanotechnology

This course involves the use of animation to visualize scientific processes in nanotechnology and medicine. Animation is becoming an increasingly important tool in both research and education, especially in fields such as nanobiotechnology that involve complex processes and occur at multiple length scales. Understanding of the subject matter is gained through interaction with faculty and graduate students in research groups in the Institute for NanoBioTechnology. The course follows the basic animation pipeline from concept to post production. Same as 500.495.

Searson

Professional Communication Program

Effective management and successful leadership requires effective communication. Toward those ends, the PCP program emphasizes a collaborative approach that helps students learn to communicate—both in person and in writing—in academic settings and "the real world." To help students understand the impact of their work in a global and economic context, PCP courses use case- and project-based methods focused on contemporary issues. Classes emphasize individual and team assignments designed to help students learn how to skillfully interact with each other, with disciplinary peers, and with broader, non-specialist audiences.

The Faculty

Julie Reiser, Senior Lecturer: professional communication, oral presentations, social media and marketing, blogging, dissertation writing, 20th-Century American literature and theory.

Eric Rice, Associate Director and Senior Lecturer: organizational behavior, social entrepreneurship, management, negotiation and conflict management, leadership, public speaking, professional communication.

Pamela Sheff, Senior Lecturer: professional communication, marketing, public relations, science and scientific writing, oral presentations, higher education in prisons and community-based learning.

Part-time Faculty

Kevin Dungey, Senior Lecturer: oral presentations.

Nora Frenkiel, Lecturer: professional communication.

Jason Heiserman, Lecturer: oral presentations.

Andrew Kulanko, Senior Lecturer: oral presentations.

Don McNeilly, Lecturer: professional communication, oral presentations, research writing.

Emily Manus, Lecturer: professional communication.

Charlotte O'Donnell, Lecturer: professional communication, oral presentations, creative writing.

Eric Vohr, Lecturer: professional communication, journalism.

Undergraduate Courses

661.110 (W) Professional Communication for Science, Business, and Industry

(formerly as both Technical Communication and Business Communication)

This course teaches students to communicate effectively with a wide variety of specialized and non-specialized audiences. Projects include production of resumes, cover letters, proposals, instructions, reports, and other relevant documents. Class emphasizes writing clearly and persuasively, creating appropriate visuals, developing oral presentation skills, working in collaborative groups, giving and receiving feedback, and simulating the real world environment in which most communication occurs. Not open to students who have taken 661.110 as Technical Communication or 661.120 Business Communication.

Manus, O'Donnell, McNeilly, Frenkiel, Reiser, Rice, Sheff, Vohr   3 credits   fall, spring, and summer

661.111 (W) Professional Communication for ESOL Students

This course teaches ESOL students to communicate effectively with a wide variety of specialized and non-specialized audiences. It also provides ESOL-specific help with grammar, pronunciation, and idiomatic expression in these different contexts. Projects include production of resumes, cover letters, proposals, instructions, reports, and other relevant documents. Class emphasizes writing clearly and persuasively, creating appropriate visuals, developing oral presentation skills, working in collaborative groups, giving and receiving feedback, and simulating the real world environment in which most communication occurs. Not open to students who have taken 661.110 as Technical Communication or Professional Communication for Science, Business, and Industry or 661.120 Business Communication. Co-listed with 661.611. No audits.

Manus, O'Donnell, McNeilly, Frenkiel, Reiser, Rice, Sheff, Vohr   3 credits   fall and spring

661.150 (W) Oral Presentations

This course is designed to help students push through any anxieties about public speaking by immersing them in a practice-intensive environment. Students learn how to speak with confidence in a variety of formats and venues—including extemporaneous speaking, job interviewing, leading a discussion, presenting a technical speech, and other relevant scenarios. They learn how to develop effective slides that capture the main point with ease and clarity, hone their message, improve their delivery skills, and write thought-provoking, well-organized speeches that hold an audience's attention.

Dungey, Heiserman, Kulanko, O'Donnell, Reiser, Sheff 3 credits   fall, spring and summer

661.310 (W) Writing about Science and Engineering

Conventional wisdom says that scientific writing is dull and arcane. The truth is that good scientific writing is

interesting and easy to read. Scientists who have the broadest audiences know how to tell a good story and know how to engage and persuade their readers. Students work closely with the professor and each other in a seminar/workshop setting. The goal is to weld critical thinking to compelling writing.

Reiser, Rice, Sheff   3 credits   fall and spring

661.315 The Culture of the Engineering Profession

This course focuses on building understanding of the culture of engineering while preparing students to communicate effectively with the various audiences with whom engineers interact. Working from a base of contemporary science writing (monographs, non-fiction, popular literature and fiction), students engage in discussion, argument, case study, and project work to investigate the engineering culture and challenges to that culture, the impacts of engineering solutions on society, the ethical guidelines for the profession, and the ways engineering information is conveyed to the range of audiences for whom the information is critical. Additionally, students will master many of the techniques critical to successful communication within the engineering culture through a series of short papers and presentations associated with analysis of the writings and cases.

Reiser, Rice, Sheff   3 credits   spring

661.390 (W) Online Journalism: Jay Street: A Journal of Entrepreneurship and Technology at JHU

Online journalism, especially at the intersection of science, technology and marketing, is a rapidly growing field. This interactive course, open to students in all academic disciplines, produces JayStreet, an online journal, focusing on science and business with a JHU connection. Using a combination of guest speakers, investigative reporting, cases and selected readings, we will explore current issues in technology commercialization and related business problems. Participating entrepreneurs will work directly with students, sharing insights into their business ventures. Serving as writers, editors and designers, students will choose a theme and design the journal, develop cases, articles and interviews, blogs and videos, providing themselves a key credential for the future. Prerequisite: At least one writing intensive course and/or permission of the instructor.

Sheff   3 credits   spring

661.410 Research Writing

Research writing—whether in the sciences, social sciences, medicine, or humanities—is a critical component for success as an academic. Yet, for many, the process of writing becomes less a labor of love than a source of dread, performance anxiety, and procrastination. This course is designed to be user-friendly "kick in the pants" that helps students succeed in planning, developing, editing, and finishing a 20-30 page writing project specific to their disciplines. Projects can include a research report, journal article, literature review, dissertation chapter, grant proposal, or other relevant document. The course is run as a workshop and tailored to meet the specific needs of each group. Course focuses on

refining content, organizing ideas, deploying appropriate citation practices, formatting correctly, working with writer's block, and setting workable goals to facilitate the writing process. Class meets together and individually with instructor. Open only to seniors and only by special permission of instructor.

Reiser, Rice, Sheff, McNeilly   3 credits

661.425 Ethics of Biomedical Innovation

Engineers confront problems and make decisions that hold long term social consequences for individuals, organizations, communities, and the profession. For biomedical engineers, these decisions may relate to inventions such as medical devices and pharmaceuticals, neural prosthetics and synthetic biological organisms, responsible and sustainable design, and availability of biotechnology in the developing world. Using a combination of cases, fieldwork, and readings, we examine the ethical issues, standards, theory, and consequences of recent emerging engineering interventions as a way to understand the profession and to form a basis for future decisions. In addition students will learn and practice multiple forms of communication, including oral, visual, and written rhetoric. A particular focus will be communication targeted to different stakeholders including other professionals and the public. Students will apply good communication principle to the discussion of biomedical engineering ethics, develop their own ethical case studies and participate in group projects to aid ethical decision making, and to improve communication of biomedical ethical issues to others. Co-listed with 580.425.

Rice   3 credits   fall

661.453 Social Media and Marketing

Students design and manage their own "guerilla" marketing and communications firm that works with a local, non-profit client. The student-run firm develops the client's online presence and marketing campaign using a variety of social media resources including website development, blogging, Google Analytics, FB, Tumblr, Twitter, or other tool they determine to be critical to the project. The course is welcome to all students who have had either one writing course—in professional communications, oral presentations, expository writing, or writing seminars—or one marketing course. The course also welcomes students with graphic design, start-up, or other relevant business or management experience. Co-listed with 661.653. Recommended prerequisite: one writing course in professional communication strongly recommended and/or 660.250 Principles of Marketing. No audits.

Reiser, Rice, Sheff, Kendrick   3 credits

661.454 Blogging, Editing, and Copywriting

This course will teach students how to develop, write, and manage content for social media. Students will gain significant experience in both freelance and managerial-level contexts. In this highly experiential course, students will create and market their own blog, solicit and do copywriting for clients, and manage the content creation process for a collaborative class project. The course will emphasize best practices for search engine optimization

(SEO), intuitive design, social media metrics, freelance project management skills (querying/soliciting for new work, invoicing, and client retention), and content management strategies appropriate for publishing, marketing, and other relevant environments. Prerequisite: one writing course in any discipline (professional communication, expository writing, or writing seminars). Cap: 20 (undergraduate); 5 (graduate)
Reiser   3 credits   fall

661.487 Advanced Communications Skills for Science, Business, and Industry
This course helps students build advanced communication skills that are critical for leveraging their academic experience in the "real world." Course emphasizes reporting information, polishing CVs and resumes, presenting conference papers, participating in poster sessions, tailoring information to both specialist and non-specialist audiences, and writing grant proposals for funding. Undergraduates are required to be conducting research with a faculty member or by special permission of instructor. Co-listed with 661.687 and 662.687.
Reiser, Rice, Sheff   3 credits   spring

661.488 Communicating Decisions in a Crisis
This course focuses on using communication to defuse and manage crisis situations. Students work in teams to consider issues including organizational culture, defining strategy, leadership styles, project management, negotiation and conflict management, stakeholder needs, defending positions, disagreeing agreeably, managing large and small groups, ethics, and social responsibility. Open to advanced undergraduates who have taken 661.110 or 661.150. Co-listed with 661.688.
Rice, Sheff   3 credits

Graduate Courses

661.610 Research Writing
Research writing—whether in the sciences, social sciences, medicine, or humanities—is a critical component for success as an academic. Yet, for many, the process of writing becomes less a labor of love than a source of dread, performance anxiety, and procrastination. This course is designed to be user-friendly "kick in the pants" that helps students succeed in planning, developing, editing, and finishing a 20-30 page writing project specific to their disciplines. Projects can include a research report, journal article, literature review, dissertation chapter, grant proposal, or other relevant document. The course is run as a workshop and tailored to meet the specific needs of each group. Course focuses on refining content, organizing ideas, deploying appropriate citation practices, formatting correctly, working with writer's block, and setting workable goals to facilitate the writing process. Class meets together and individually with instructor. Co-listed with 661.410.
Reiser, Rice, Sheff, McNeilly

661.651 Marketing Communications and Strategy
This course is designed to introduce students to key marketing, communications, and strategic issues surrounding the process of bringing new products to the marketplace. Through cases, readings, discussion and hands-on team projects, students develop a flexible approach to thinking about marketing problems, maximizing resources and creating strategic solutions. Written and oral work focuses on communicating effectively with target audiences using integrated media and developing interpersonal skills essential for managers, including presenting to a hostile audience, running meetings, listening, and contributing to group decision making.
Sheff   fall

661.653 Social Media and Marketing
Students design and manage their own "guerrilla" marketing and communications firm that works with a local, non-profit client. The student-run firm develops the client's online presence and marketing campaign using a variety of social media resources including website development, blogging, Google Analytics, FB, Tumblr, Twitter, or other tool that they determine to be critical to the project. The course is welcome to all students who have had either one writing course—in professional communications, oral presentations, expository writing, or writing seminars—or one marketing course. The course also welcomes students with graphic design, start-up, or other relevant business or management experience. Co-listed with 661.653. Recommended prerequisite: one writing course in professional communication strongly recommended and/or 660.250 Principles of Marketing. No audits.
Reiser, Rice, Sheff, Kendrick

661.654 Blogging, Editing, and Copywriting
This course will teach students how to develop, write, and manage content for social media. Students will gain significant experience in both freelance and managerial-level contexts. In this highly experiential course, students will create and market their own blog, solicit and do copywriting for clients, and manage the content creation process for a collaborative class project. The course will emphasize best practices for search engine optimization (SEO), intuitive design, social media metrics, freelance project management skills (querying/soliciting for new work, invoicing, and client retention), and content management strategies appropriate for publishing, marketing, and other relevant environments. Prerequisite: one writing course in any discipline (professional communication, expository writing, or writing seminars). Cap: 20 (undergraduate); 5 (graduate)
Reiser   3 credits   fall

661.687 Advanced Communications Skills for Science, Business, and Industry
This course helps students build advanced communication skills that are critical for leveraging their academic experience in the "real world." Course emphasizes reporting information, polishing CVs and resumes, presenting conference papers, participating in poster sessions, tailoring information to both specialist and non-specialist audi-

ences, and writing grant proposals for funding. Co-listed with 661.487.

Reiser, Rice, Sheff   spring

661.688 Communicating Decisions in a Crisis
This course focuses on using communication to defuse and manage crisis situations. Students work in teams to consider issues including organizational culture, defining strategy, leadership styles, project management, negotiation and conflict management, stakeholder needs, defending positions, disagreeing agreeably, managing large and small groups, ethics, and social responsibility. Co-listed with 661.488.

Rice, Sheff

661.710 Dissertation Writing Workshop
This course focuses on helping doctoral students complete work on their dissertations. Course materials and activities emphasize goal setting, project planning, building and defending claims, documenting research, learning citation practices, building a daily writing practice, dealing with the isolation/depression common to dissertation writers, and, in general, supporting the overall dissertation writing process. Course may also include relevant visits from the CBO Office in the MSE, the graduate board, and current professors from a variety of fields.

Reiser, Rice, Sheff, McNeilly

Research, Information, and Academic Centers

Biocalorimetry Center

The Biocalorimetry Center is dedicated to the development and application of new technologies aimed at measuring the energetics associated with protein interactions and the development of thermodynamic-based algorithms for drug design. The algorithms developed at the Center are widely acknowledged to be at the forefront of the available technologies for drug development.

During the last decade, extraordinary advances have been made in technologies for the structure determination of biological macromolecules. The structures of thousands of protein molecules have been determined at atomic resolution, opening the doors to new developments in our understanding of biological systems. Since all biochemical reactions, including the binding of pharmaceutical drugs to their targets, are controlled by their energetics, knowledge and manipulation of the energetics at the atomic level provides the researcher with an unprecedented degree of control over biological binding reactions. Having access to the overall and atomic-level partitioning of the binding energetics effectively accelerates the design of new and more effective drugs toward specific targets.

The research work at the Biocalorimetry Center involves the application of state-of-the-art microcalorimetric instrumentation to biological systems, the development of new computational algorithms for thermodynamic analysis, the development of molecular computation models aimed at dissecting the binding energetics of drug/protein interactions, and the development of thermodynamic based strategies for drug design and optimization. The Biocalorimetry Center collaborates with academic and pharmaceutical laboratories around the world.

Center for Astrophysical Sciences

The Center for Astrophysical Sciences (CAS) is an organization created at the Johns Hopkins University in 1985 to promote and coordinate the development of research in astrophysics and closely related sciences on the campus, with the goal of establishing the university as a world leader in the field. Its current Director is Professor Timothy Heckman. Complementing the activities of the Space Telescope Science Institute, also on the university's Homewood campus, CAS fosters a broad range of scientific activities in theoretical, experimental, and observational astrophysics and planetary space science.

Members of the center come primarily from the faculty and research staff of the university's department of Physics and Astronomy. At present, the center has about a hundred members, engaged in a wide variety of research projects ranging from laboratory studies and spectroscopy of the Earth's upper atmosphere to observational and theoretical investigations of the origin and destiny of the universe.

Hopkins is one of a small number of universities that builds and flies space instrumentation. Hopkins astronomers helped build the Faint Object Spectrograph for the Hubble Space Telescope (HST) and one of the two instruments (COSTAR) that corrected the spherical aberration in the HST's primary mirror. They then used the corrected HST instruments to demonstrate the presence of a 2 billion solar mass black hole in the center of M87.

The Hopkins Ultraviolet Telescope (HUT) flew twice aboard the space shuttle, obtaining spectra of active galaxies, hot stars, supernova remnants, and planets. The most significant result obtained was the first measurement of the amount of ionized helium in the intergalactic medium. Ionized helium is an important tracer of the evolution of structure in the universe, and this measurement is the first hard constraint for current cosmological models.

From 1999 through 2007, CAS operated the Far Ultraviolet Spectroscopic Explorer (FUSE), a satellite for high-resolution spectroscopy. FUSE observed with much higher sensitivity and spectral resolution than HUT. Its primary scientific accomplishments were to measure the deuterium abundance in different environments throughout the galaxy, a key parameter in models of Big Bang cosmology, and to determine the distribution of hot gas in the interstellar medium of our own galaxy.

CAS led the development of the Advanced Camera for Surveys (ACS), which was launched aboard the space shuttle Columbia on March 1, 2002. A CAS team of scientists used ACS to study the evolution of galaxies and clusters of galaxies at high redshift, investigate Jupiter and Io, and discover planets and protoplanetary disks around nearby stars. ACS increased the discovery efficiency of the HST by a factor of 10 or more in the blue and the near infrared. ACS has been a major contributor in our expansion of knowledge about the universe.

The Wilkinson Microwave Anisotropy Probe (WMAP) was a major NASA mission led by CAS. WMAP's observations of the subtle structures present in the cosmic microwave background

(the universe at an age only 300,000 years after the Big Bang) have resoundingly substantiated the Big Bang model and confirmed the existence of Dark Energy WMAP ushered in the era of "precision cosmology".

CAS is a major partner in the Galaxy Evolution Explorer (GALEX) satellite. GALEX is surveying the entire sky for stars, galaxies, and quasars that are bright in the ultraviolet. GALEX is determining the history of star formation in galaxies at redshifts from 0 to 2, and will ultimately identify one million quasars. The GALEX data archive is being developed and managed by JHU astronomers and computer scientists.

CAS's NASA-supported sounding rocket program is one of only a small number of such programs nationwide. They offer students the opportunity to gain hands-on experience building payloads for sub-orbital rocket flights at White Sands, New Mexico.

CAS is involved in a number of ways with the JHU Applied Physics Lab (APL) in areas of space science and technology. Examples include the "New Horizons" mission to Pluto which is scheduled to arrive at Pluto in July 2015, and a project to develop the next generation of CMOS detectors that have application to both optical and X-ray astronomy.

CAS is also heavily engaged in major programs in ground-based astronomy, particularly those that involve large surveys. This involvement includes both the scientific exploitation of these surveys but also the development of the advanced data-mining tools that allow scientists to use these vast databases to make discoveries.

CAS plays a leading role in the National Virtual Observatory (NVO), which is uniting the astronomical databases of many earthbound and orbital observatories. This project is taking advantage of the latest computer technology, data storage, and analysis techniques to build the framework for the Virtual Observatory, a facility that will organize all available astronomy data and literature into a coherent whole, regardless of differences in data formats. The NVO will be accessible by anyone, from anywhere on the Internet. The National Science Foundation, which has started this project with a five-year, $10 million Information Technology Research grant titled "Building the Framework of the National Virtual Observatory," announces that this will "put the universe online." The system will provide an efficient synthesis of data over a wide range of wavelengths and time intervals, from many different observatories and instruments. It will open up new areas of research that are cur-

rently impractical or impossible. The Virtual Observatory will provide a unique and powerful base for teaching astronomy, for demonstrating the process of scientific discovery to students and the public, and for sharing the benefits of new developments in information technology.

CAS is an active partner in the Sloan Digital Sky Survey (SDSS). CAS members served as the CEO and Program Manager of the SDSS project during its construction phase, built the two spectrographs for the 2.5-m SDSS telescope, and designed the data structure and software for the SDSS data archive. SDSS has surveyed one-quarter of the sky in five colors, providing the raw data from which a catalog of 100 million objects, associated photometric parameters, and postage stamp images has been produced; spectra have also been taken of 1 million galaxies and 100,000 quasars. These data have been to measure the structure of the universe and the formation and evolution of galaxies and black holes. The SDSS is currently undertaking a new survey of our Milky Way Galaxy, is also measuring the properties of Dark Energy, and is searching for planets orbiting other stars.

CAS is also a member of the Pan-STARRS1 project which built on the heritage of the SDSS by conducting a series of multicolor imaging surveys of the sky using the world's most advanced astronomical "gigapixel" camera and a widefield 1.8-m telescope in Hawaii. Pan-STARRS1 has opened the time domain to a wide range of scientific areas, including everything from the detection of near-Earth asteroids to the detection of extra-solar planets, to the determination of the cosmic evolution of Dark Energy. CAS members are playing leading roles in several of the science-driven key projects and are playing a key role in the development of the massive Pan-STARRS data archive.

CAS is a member of the Large Synoptic Survey Telescope, recently endorsed as the highest-priority new large project in ground-based astronomy by the National Academy of Sciences decadal survey "New Worlds, New Horizons in Astronomy & Astrophysics". CAS members served on both the main decadal survey panel and its program prioritization panel for Electromagnetic Observations from Space.

CAS is home to a major effort in experimental cosmology, focused primarily on observations of the cosmic microwave background (CMB). They have lead roles in the NSF-funded Cosmology Large Angular Scale Surveyor project, Atacama Cosmology Telescope, and the Atacama B-mode Search project.

Members of CAS also undertake a vibrant and wide-ranging program in theoretical and computational astrophysics with topics ranging from the formation and dynamics of planetary systems, to the properties of super-massive black holes, to the nature of dark energy.

Graduate students at JHU participate in all aspects of research within the center. Students at JHU, in calibrating optics and detectors for space instruments and then using data from these instruments for their thesis, are working at the forefront of observational astrophysics.

Center for Cardiovascular Bioinformatics and Modeling

The Center for Cardiovascular Bioinformatics and Modeling (CCBM) was established in 2003. The mission of the CCBM is to develop new methods for the representation, storage, analysis, and modeling of biological data and to apply these methods to better understand cardiovascular function in both health and disease. Specific research areas include: a) statistical modeling and analysis, of properties of gene and protein networks; b) development of ontologies, databases, and grid services supporting biological data mining; c) dynamical modeling of signal transduction, mitochondrial energetics, ion channel function, and intracellular calcium dynamics in cardiac myocytes; d) magnetic resonance imaging and modeling of cardiac ventricular anatomic structure; e) measurement and modeling of electrical conduction in heart; and e) parallel and distributed computing applications in cardiovascular modeling.

Center for Imaging Science (CIS)

The CIS was established in 1998 as a research center at The Johns Hopkins University, Whiting School of Engineering. The CIS brings together a diverse group of scientists whose work is highly interdisciplinary, revolves around the symbolic interpretation of high-dimensional data, and rests on theoretical advances in mathematics and statistics, traditional signal and systems processing, and information theory.

The director of CIS is Dr. Michael I. Miller. CIS faculty have their principal appointments across a wide range of academic units, including Computer Science (Greg Hager), Applied Mathematics and Statistics (Donald Geman, Carey Priebe, Laurent Younes), Electrical and Computer Engineering (John Goutsias, Jerry Prince, Trac Tran), and Biomedical Engineering (Patrick Barta, Michael Miller, Tilak Ratnanather, Rene Vidal). More

information about participating faculty and their research can be found at **http://cis.jhu.edu**.

Research: Researchers at CIS conduct foundational and multidisciplinary research in modern imaging science, which is viewed in very broad terms. The focus is on the development of the mathematical and algorithmic foundations of imaging science, including image formation, analysis, representation, synthesis, and compression and especially image understanding including specific applications, for instance to neuropsychiatry and machine vision.

Education: The educational program at the CIS is embedded within the newly-created Institute for Computational Medicine, which offers a multi-year plan for a coherent, cross-departmental program of study in imaging science, accounting for necessary preparation in mathematics, computer science and classical signal and image processing.

Technology Transfer: The CIS faculty is also involved in student consulting, patent protection, software licensing and industrial collaboration. In addition, the CIS sponsors weekly seminars presented by researchers who are leaders in imaging.

Visit the Center for Imaging Science website for more information at **http://cis.jhu.edu** or contact Kilheffer@jhu.edu.

Center for Language and Speech Processing

The Center for Language and Speech Processing (CLSP), housed in Hackerman Hall, was established in the Whiting School of Engineering in 1992. CLSP receives substantial support from the federal government to promote education and research in the science and technology of language and speech. Multidisciplinary in nature, the center has close ties to faculty in the Whiting School of Engineering, the Krieger School of Arts and Sciences, and the School of Medicine. CLSP also maintains relations with industrial, academic, and governmental organizations all over the world.

CLSP maintains a comprehensive research and education program leading to a Ph.D. degree. Research is conducted by faculty, and graduate students affiliated with five associated academic departments: Biomedical Engineering, Cognitive Science, Computer Science, Electrical and Computer Engineering, and Applied Mathematics and Statistics. The research involves work in all aspects of language and speech science and technology, with fundamental studies under way in areas such as language modeling, pronunciation modeling, natural language processing, machine translation, neural auditory processing, acoustic processing,

optimality theory, and language acquisition. Graduate students interested in conducting research at the center must first be admitted to a graduate program in one of the departments associated with CLSP.

The center coordinates a full complement of courses dealing with language or speech science and technology, taking advantage of the latest biological, physiological, biomedical, psychological, cognitive, linguistic, mathematical, and engineering resources available. CLSP regularly updates the subject material and augments the course offerings to reflect the changing technology. As part of its educational mission, the center offers a wide range of lectures from prominent speakers throughout the academic year and organizes an annual summer research workshop. Selected for their current achievements, expository ability, and lecture subjects, internationally known speakers present the seminars. The workshop is an intensive six-week research effort by CLSP affiliates and participants from other universities, industry, and the federal government.

CLSP serves as a centerpiece for world-class research at Johns Hopkins in speech and language processing. Visit the CLSP website for more information at **www.clsp.jhu.edu**.

Center for Social Organization of Schools

The Center for Social Organization of Schools (CSOS) is an educational research center funded largely through federal grants from the Department of Education, National Institutes of Health and other agencies. The center has two primary objectives: (1) to develop scientific knowledge about how schools affect their students and (2) to use this knowledge to develop better school practices and organization.

The center focuses on K-12 programs in high-poverty, low-achieving schools throughout the country, especially the comprehensive Talent Development secondary reform model. The common objectives of the center's programs are to apply scientific designs, measures, and methods to provide clear tests of the true impact of new educational approaches and to provide empirical evidence on how to improve the education of students in high-poverty schools.

CSOS also includes the Center on School, Family, and Community Partnerships. The mission of this center is to conduct and disseminate research, development, and policy analyses that produce new and useful knowledge and practices that help families, educators, and members of communities to work together to improve schools, strengthen families, and increase student success. Major proj-

ects include the National Network of Partnership Schools, which includes schools, districts, and state educational agencies that are working to develop partnerships.

Work at the center maintains a balance among basic research, studies of specific problems in schools, and development of useful products and information for school use. The Talent Development secondary implementation center works with more than 90 middle and high schools across the country, providing professional development, curriculum materials, and school organization assistance, as well as the broader services of school transformation plans.

In partnership with the Baltimore City Public Schools, CSOS opened the Baltimore Talent Development High School in September 2004 with approximately 150 ninth-graders. The school graduated its first class in 2008 with a graduation rate of more than 80 percent. The center is also the operator for Baltimore Civitas School, which opened in 2008 for grades 6-12. In July 2010, Talent Development became the turnaround partner for William C. March Middle School in Baltimore.

Curriculum developers continue to develop science, social studies and language/literature materials for both middle and high school courses used by many schools across the country. A new social and study skills course, Mastering Middle Grades, is under development, as is College Know-How, a 12th-grade course designed to prepare students for the challenges of college. The teaching guides developed for the social studies series, *A History of US,* are published by Oxford Press; science materials are published by the Smithsonian Institution Press.

The center's research serves a variety of audiences: scientists in the sociology of education and the social psychology of the learning process, education policymakers, and state and local education personnel all the way into the classroom.

CSOS also houses The Baltimore Education Research Consortium (BERC), a partnership of Johns Hopkins, Morgan State University and Baltimore City Public Schools (www.baltimore-berc.org) and the Everyone Graduates Center (www.every1graduates.org). BERC's purpose is to coordinate and disseminate long- and short-term data analysis and research to help Baltimore students and their families. The Everyone Graduates Center brings together the research and best practices of all programs at CSOS, in an attempt to identify and eliminate the hurdles that keep students from graduating from high school ready for college, career training and a productive civic life.

CSOS is also home to Diplomas Now (www.diplomasnow.org) a new collaboration that helps the toughest middle and high schools in America's largest cities ensure that every student graduates ready for college or career. Diplomas Now is a partnership among Talent Development, City Year and Communities In Schools; it is the first fully integrated approach to improving a school's curriculum and instruction, while providing the right students with the right support at the right time.

In 2010, Diplomas Now won a federal Investing in Innovation grant to expand this program to 60 more schools in the next four years. In 2010–11, Diplomas Now worked in 20 schools in 10 cities.

Center for Talented Youth

The Johns Hopkins University Center for Talented Youth is a premier supplemental educational program for highly gifted K-12 students. CTY focuses on identifying, developing, and understanding academic talent in bright young people.

In 1972, Dr. Julian Stanley, then professor of psychology at Hopkins, began work with a handful of very bright seventh-graders. This work crystallized in 1979 with the official founding of CTY and an annual talent search to identify bright young people. Over 60,000 students annually enroll in the Talent Search, which since 1979 has served over 1,700,000 students.

CTY offers summer courses that enroll 10,000 students annually and have become international models of academic excellence. A large array of online offerings, including AP courses, enrolls 10,000 students each year. Rounding out CTY's services are a magazine for gifted students, advanced diagnostic testing, and counseling and mentorships through the Study of Exceptional Talent (SET).

In summary, CTY offers gifted students, their families, and their teachers a wide range of programs and services to nurture their intellectual abilities, enhance personal development, and foster better understanding of the needs of talented youth. CTY makes intensive efforts to find and develop talents from all neighborhoods and walks of life, and has added an international office to coordinate numerous overseas activities.

The institute has a main office located in Baltimore and a regional office in Los Angeles.

Chemical Propulsion Information Analysis Center

The Chemical Propulsion Information Analysis Center (CPIAC), continuously operated by The Johns Hopkins University since 1946, is a full-service Department of Defense (DoD) information analysis center in the fields of missile, space, and gun propulsion technologies. The mission of the CPIAC is to serve as the U.S. national clearinghouse for worldwide information, data, and analysis on chemical, electrical, and nuclear propulsion for missile, space, and gun propulsion systems. The CPIAC library contains over 115,000 documents dating from the 1930s.

The technical scope involves collection, analysis, synthesis, and dissemination of scientific and technical information to support research, development, technology, engineering, acquisition, logistics, and maintenance activities carried out by the DoD and their contractors, and appropriate international organizations.

The products and services provided by the CPIAC are thorough, unbiased, and referenced propulsion information and data for the propulsion community in the form of literature and data compilations, technical inquiry responses, technology assessments, publications, propulsion manuals, computer codes, web-based databases, and technical and administrative support of the Joint Army-Navy-NASA-Air Force (JANNAF) Interagency Propulsion Committee and its 11 subcommittees.

A third function of the CPIAC is to perform technical area tasks (TATs) relevant to our core mission. TATs are analytical and technical in nature and are separately sponsored and funded.

Institute for Biophysical Research

The Institute for Biophysical Research was established in 1988. Situated in Jenkins Hall, the institute—which spans two campuses and includes researchers from four schools—is focused on collaborative efforts and training in integrative biophysics.

Since its inception, the institute has been interdisciplinary and includes an affiliated NIH predoctoral program (Program in Molecular Biophysics). Associated activities include an annual retreat where groups present their latest work and a well-attended monthly seminar series.

The Institute for Computational Medicine

The mission of the ICM, launched in 2005, is to develop quantitative approaches for understanding the mechanisms, diagnosis, and treatment of human disease through applications of mathematics and computational science. The Institute is based in the Computational Sciences and Engineering Building, and consists of two affiliated centers—The Center for Imaging Science and the Center for Cardiovascular Bioinformatics and Modeling. Research is focused in three broad areas. Research in Biological Systems Modeling is directed at understanding the

molecular basis of human disease through development and application of experimentally based dynamical systems models. A major focus is heart disease. ICM researchers now have the capability to model heart disease at levels spanning from the molecule to electromechanical function of the heart. These models are being used to investigate how disease-induced changes at the molecular level can lead to generation of arrhythmias in the heart. A long-term goal is to use In Silico models of heart function to design new treatments for heart disease. Research in the area of Computational Anatomy is directed at mathematical and computational analysis of anatomic structure/function and its variation in health and disease. These methods are being used to identify structural changes in the brain that are early anatomic biomarkers of disease. They are also being used to study changes in heart shape and motion that are early indicators of developing heart disease. Research in Mathematical Bioinformatics is directed at developing new computational approaches for inferring the structure of molecular networks, and for identifying molecular biomarkers indicating disease type, stage, and treatment. Current applications include cancer and heart disease.

Institute for Policy Studies

The Johns Hopkins Institute for Policy Studies (IPS) is the focal point for public policy research and graduate education at JHU. It seeks to sharpen thinking about public problems and their resolution, improve policy decisions and their implementation, and raise the level of debate about important policy choices. Much of its work focuses on the problems of urban areas.

Through its research programs, IPS develops new knowledge on the scope and causes of social and economic problems and identifies actions that can be taken by government, private business, and the nonprofit sector to alleviate these problems. IPS research focuses principally on such fields as human resource development policy, housing and urban policy, criminal justice, economic development, the nonprofit sector, and program evaluation.

IPS seeks to bring its own research and that of others to the attention of public and private decision makers and the general public and to stimulate discussion and action. Its public education activities include the Johns Hopkins Social Policy Seminar Series (run jointly with the departments of Economics and of Health Policy and Management), the Press and Public Policy Seminar series, monthly brownbag seminars, special lectures on timely topics each year, seminars for city and state

officials, the publication of research reports, and an occasional paper series.

IPS offers a master's degree in public policy, which responds to the need to improve the way society approaches complex public problems. Its Intro to Urban Policy course combines a seminar with structured internships with local and state government agencies and nonprofit organizations. Its International Fellows Program in Urban Studies brings urban scholars and practitioners to IPS to conduct advanced comparative urban policy research on public policy problems in their home cities that are also relevant to the challenges faced by Baltimore. An International Fellows in Philanthropy Program brings scholars and managers of private, nonprofit, or philanthropic organizations abroad to the institute for orientation to the U.S. nonprofit sector. IPS also houses the Center for Civil Society Studies, which examines the nonprofit sector in the U.S. and abroad, the Center on Housing, Neighborhoods and Communities, which studies the roles of the residential environment in the lives of children and families and of public policies that promote beneficial effects, and the Sar Levitan Center for Social Policy Studies, which develops and promotes workforce development for out-of-school youth.

IPS is guided by a director, and an associate director for research. It is also advised by a National Advisory Board of prominent corporate and civic leaders. IPS faculty are drawn from the fields of economics, political science, public policy, sociology, and urban planning. Most hold part-time appointments in the university's academic departments. In addition, several faculty members from departments throughout JHU have joint appointments in the master's program, teaching courses and participating in its seminars and research projects.

The Integrated Imaging Center

The Integrated Imaging Center (*IIC, http://www. jhu.edu/iic*), established in 1998, is a Homewood campus microscopy and imaging resource serving the diverse research needs of the Whiting School of Engineering and the Krieger School of Arts & Sciences. It is variously located in Dunning, Jenkins, and Olin Halls on the Johns Hopkins University Homewood campus; and it is a close partner with the *Institute for NanoBioTechnology*. Additionally, it also houses the imaging core for the recently established Engineering in Oncology Center; the Homewood X-ray Macromolecular Crystallography Center; the Homewood Flow-Cytometry Resource; and the High-Resolution Analytical Electron Microbeam Facility.

As rapid advances have been made in the development of new techniques for cellular, environmental, and materials imaging, the visualization of molecules and proteins at the light and electron microscopic level has become an essential component of any comprehensive study of the natural and engineering sciences. This is because cutting-edge microscopy can provide detailed information on the relative distribution/relationship of molecules within cells and materials that cannot be obtained by any other method. Accordingly, microscopy not only complements but greatly extends the results obtained by other approaches such as biochemical, immunochemical, and analytical methods. Such state-of-the-art tools and methodologies employed regularly by the *IIC* include laser scanning confocal microscopy; scanning and transmission electron microscopy, fluorescence correlation spectroscopy, X-ray crystallography, phosphorimaging, energy dispersive and electron energy loss spectroscopy, and cryo-TEM.

The Center has become an essential partner in numerous research projects with investigators at Hopkins, as well as with other researchers at institutions nationally and internationally. Moreover, the IIC offers both undergraduate and graduate courses in microscopy (as well as regular workshops) as a means of providing to the JHU community training and exposure to the latest, most advanced microscopy techniques, emphasizing the cooperative integration of these techniques with other biological/engineering research tools.

Maryland Space Grant Consortium

Established in 1989, the National Space Grant College and Fellowship Program now consists of 52 partnerships (one in every state, plus the District of Columbia and Puerto Rico) funded by NASA to encourage cooperative university, government, and industry interdisciplinary research, training, and public service aerospace programs; to promote science, mathematics, and technology education; and to recruit and train women and minorities for aerospace careers. One of the partnerships is Maryland Space Grant Consortium. Its membership of ten institutions includes The Johns Hopkins University (Lead Institution) and the JHU Applied Physics Laboratory.

Maryland Space Grant Consortium offers a constantly changing variety of programs. The Earth/Space Science teacher certificate Program for Elementary and Secondary Mathematics and Science Teachers offers training consisting of graduate courses in Earth and space science. The Outreach Programs include a Balloon Payload Program, where students launch payloads to near space on weather balloons.

Undergraduate scholarships and graduate fellowships are provided from NASA and consortium funds for selected students pursuing studies in the space-related subjects. Small amounts of funding for research activities are also available in cases where the proposed research involves students, females, and/or underrepresented minorities, and more than one member institution. To find out more, visit **http://md.spacegrant.org**.

Materials Research Science and Engineering Center (MRSEC)

Nanostructured materials with nanometer-scale entities have created a new area of materials research and made possible device applications that depend on the physical dimensions and intricate structures of these materials. In recent years, magnetic nanostructures have provided some of the most exciting areas for the exploration of new physical phenomena and new technologically important devices such as spin-valve giant magneto-resistance read heads, and magnetic random access memory (MRAM).

The Materials Research Science and Engineering Center (MRSEC) at the Johns Hopkins University (JHU), one of 26 MRSECs funded by the National Science Foundation, is composed of scientists at JHU, Brown University, Carnegie Mellon University, and the National Institute of Standards and Technology (NIST). Research in the center focuses on the science and engineering of magnetoelectronics. Research areas include:

- Perpendicular spin transport in magnetic tunnel junctions.
- Magnetic nanorings and other novel device architectures.
- Materials with perpendicular magnetic anisotropy
- Spin transfer torque effects
- Organic magnetoelectronic materials.
- Explorations of magnetoelectronic effects in lateral structures.

The research effort encompasses synthesis and processing, characterization of nanostructures, measurements of properties, theoretical modeling, and prototype device fabrication and applications. These five tightly linked components form the research basis of this MRSEC.

The JHU MRSEC also has extensive Education Outreach programs and extensive collaborations with other academic institutions, national labs, and industrial concerns.

Scholarships, Fellowships, Awards, and Prizes
Provided through Gifts from Alumni and Friends of The Johns Hopkins University

Undergraduate Scholarships

Need-Based Scholarships and Loans

Recipients are chosen from those students who have applied for and received grant assistance from the Office of Student Financial Services.

Abrams Family Endowed Scholarship. Established in 1988 by Paul '56 and Natalie Abrams for undergraduate support for Arts and Sciences students from Prince Georges County, Maryland.

Abrams Scholarship. Established in 2007 by Paul '56 and Natalie Abrams to provide support to undergraduate students participating in a dual degree program between the Zanvyl Krieger School of Arts and Sciences and the Peabody Institute.

Arthur and Catherine B. Adel Scholarship. Established in 2002 for the benefit of Arts and Sciences undergraduate students majoring in physics and/or astronomy.

Associated Italian American Charities J. Jay and Hazel Pecora Memorial Scholarship. Established in 1984 to provide scholarship support for a student of Italian descent at the Whiting School of Engineering, based on need and academic excellence. Provided by the Associated Italian American Charities of Maryland, honoring Mr. and Mrs. J. Jay Pecora '38.

Associated Italian American Charities Peter and Mary Torrieri Memorial Scholarship. Established in 1982 to provide scholarship support for a student of Italian descent at the Whiting School of Engineering, based on need and academic excellence. Provided by the Associated Italian American Charities of Maryland in honor of Peter and Mary Torrieri.

Nathan Albstein and Charles McKenna Memorial Scholarship. Established by Carolyn and Andrew '78 Albstein in 2001 in memory of their late fathers. This need-based scholarship is awarded annually to an academically talented student at the Zanvyl Krieger School of Arts and Sciences.

Phyllis F. Albstein and Lorraine McKenna Scholarship. Established in 2003 by Carolyn and Andrew '78 Albstein to honor both of their mothers. It is their hope that this scholarship will encourage undergraduates to participate in campus activities and contribute to enhancing the quality of student life.

American Council on Italian Matters of Maryland Scholarship. Established in 1993 by the American Council on Italian Matters of Maryland, this need-based scholarship is awarded to a young woman of American-Italian heritage, preferably from Maryland, who is an undergraduate at the Whiting School of Engineering.

Avery Scholarship. Established in 2006 by Dennis S. Avery and his wife, Sally Wong-Avery, to support undergraduate scholarships at the Zanvyl Krieger School of Arts and Sciences.

Michael S. Applestein Scholarship. Established in 1967 through a bequest from Lena Applestein, Michael Applestein's sister, who became the beneficiary of a trust fund upon his death. A member of the Class of 1908, Michael Applestein was an inspector for the U.S. Customs House in Washington, D.C. This scholarship is awarded to students in the Zanvyl Krieger School of Arts and Sciences and is based on academic merit and financial need.

Margareta E. Augustine Scholarship. Established in 1998 by Mr. and Mrs. Norman Augustine to provide scholarships for biomedical engineering undergraduates at the Whiting School of Engineering. Mr. Augustine is a university trustee emeritus.

Susan J. Baisley Scholarship. Established in 2001 by Susan J. Baisley '80 to support academically talented Zanvyl Krieger School of Arts and Sciences undergraduates who are interested in a career in communications. Students majoring in the Writing Seminars, English, or Film and Media will be eligible for the scholarship.

Henry Scott Baker Memorial Scholarship. Established in 1984 by Frances R. Baker, '24, in memory of her husband, Henry Scott Baker, Sr., an engineering graduate from the Class of 1917. This scholarship is awarded to an engineering student based on financial need and academic merit.

Christopher and Kristy Baker Family Scholarship. Established in 2008 by Christopher J. '85 and Kristy Z. '85 Baker to benefit students at the Zanvyl Krieger School of Arts and Sciences.

Dr. Janet Bassett Baker and Dr. Lawrence H. Baker Memorial Scholarship. Established for need-based scholarship assistance to deserving students at the Zanvyl Krieger School of Arts and Sciences, preferably a resident of Baltimore.

Theodore F. Baker Scholarship. Established in 2010 by members of the Baker family in honor of Theodore Baker's 72nd birthday. Mr. Baker is a member of the Whiting School of Engineering Class of 1961. He is the leader in a legacy of Hopkins graduates; his three sons, Chris, Ben and Theodore, Jr., all followed in their father's footsteps and attended Johns Hopkins University. The scholarship

supports undergraduate students on the Homewood Campus.

Kimberly and Jeffrey Barber Family Scholarship. Established in 2008 for Zanvyl Krieger School of Arts and Sciences undergraduates by Jeffrey S. Barber and Kimberly A. Hsu-Barber, both members of the Class of 1995. Baltimore Orioles Scholarship. Established in 1978 by the Baltimore Orioles Foundation for students who intend to pursue teaching and/or coaching careers and who demonstrate financial need.

William Sherman Bansemer Scholarship. Established in 1945 through the estate of Caroline Bansemer to support undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

Mark C. Bauer Scholarship. Established in 2002 to support undergraduate students with financial need and outstanding academic ability. Preference is given to Arts and Sciences students majoring in natural sciences who have demonstrated a keen intellect and extraordinary potential.

William Brown Baxley Memorial Scholarship. Established in 1959 to aid needy and deserving engineering students from Maryland at the Whiting School of Engineering. The fund was established by C. Herbert Baxley, a 1919 engineering graduate, in memory of his brother, W. Brown Baxley. William Brown Baxley graduated in 1917 from the School of Engineering and lost his life in France in World War I while serving as an officer in the American Expeditionary Forces.

Becker Family Scholarship. Established in 1995 by Dr. George L. Becker Jr., BA '50 to support Arts and Sciences undergraduate students majoring in neuroscience.

Gail and Gwen Becker Scholarship for Men's and Women's Lacrosse. Established by Dr. Larry Becker '60, on the anniversary of his 40th reunion in memory of Gail and Gwen Becker. Larry Becker was a varsity athlete on the lacrosse and basketball teams at Johns Hopkins. Gail and Gwen were successful athletes in their own right, Gwen a professional ballerina, and Gail a professional tennis player. The scholarship supports undergraduate members of the men's and women's lacrosse team, alternating each year between the two programs.

Harris J. and Elaine Belman Scholarship. Established in 2005 by Mrs. Elaine Schneider Belman in memory of her husband, Harris J. Belman '64. This scholarship provides financial aid to undergraduate students at the Whiting School of Engineering with preference going to students who are conducting research which could impact the treatment or cure of double myeloma or other forms of cancer.

Berman/Weinstein Family Scholarship. Established in 1998 to support freshman at the Zanvyl Krieger School of Arts and Sciences. First preference will be given to a freshman undergraduate with a diagnosed learning disability (also referred to as a learning style difference).

David and Patricia Bernstein Scholarship. Established in 2002 by David, '57 and Patricia Bernstein. While attending Hopkins, Mr. Bernstein played on both the freshman lacrosse and soccer teams. The scholarship supports undergraduate students in the Zanvyl Krieger School of Arts and Sciences.

Beta Theta Pi Scholarship. Established in 1989 by various members of Alpha Chi for students who demonstrate financial need or are members of Beta Theta Pi or progeny of Alpha Chi and Beta Theta Pi. Preference is given to students participating in university-sponsored athletics or students with need who have shown initiative in financing their education.

Arthur Barneveld Bibbins Scholarship. This fund was made possible by a bequest and is used to assist worthy engineering students in the purchase of books and other necessities. The scholarship is awarded based on need.

Carl and Rachel Berg Scholarship. Established in 2005 by Rachel K. and Carl D. Berg to provide support for undergraduate students at the Zanvyl Krieger School of Arts and Sciences, with preference given to a students studying philosophy.

W. B. Fund Scholarship. Established in 1982 by Warren Bishop '61 to honor Homewood undergraduate student athletes who demonstrate financial need.

Scott M. Black Scholarship. Established in 2004 by Mr. Black, who graduated from the School of Arts and Sciences in 1968 with a degree in applied mathematics and economics. He went on to receive his master's of business administration in finance from Harvard Business School and is the founder and president of Delphi Management, Inc. The scholarship supports undergraduate students in the Zanvyl Krieger School of Arts and Sciences.

Frederick Edgar Blaser Scholarship. Established in 1951 by Elizabeth Blaser Robertson as a memorial to her father. The scholarship supports students at the Zanvyl Krieger School of Arts and Sciences.

Arnold S. and Donna R. Blaustein Scholarship. Established in 2006 by Arnold Blaustein '62 and his wife, Donna to support undergraduate students at the Zanvyl Krieger School of Arts and Sciences who have demonstrated financial need and academic achievement.

Lewis W. Bluemle Jr., M.D. Endowed Scholarship. Established in 2002 by the Connelly Foundation to honor Lewis W. Bluemle Jr., M.D., '43, '46, to provide financial aid to Homewood undergraduates at the Krieger School of Arts and Sciences and the Whiting School of Engineering, with primary preference given to highly meritorious students from the Commonwealth of Pennsylvania.

Stanley E. Blumberg Memorial Scholarship. Established in 1992 by Norma Blumberg in memory of her husband, Stanley '35. Mr. Blumberg was director of the alumni relations office from 1970 to 1983. A librarian with the Enoch Pratt Libraries, Mrs. Blumberg died in 2003. The schol-

arship supports undergraduate students in the Zanvyl Krieger School of Arts and Sciences.

Blum-Kovler Foundation Scholarship. Established in 1987 by the Blum-Kovler Foundation and Mr. H. Jonathon Kovler to support undergraduate students at the Zanvyl Krieger School of Arts and Sciences. The Blum-Kovler Foundation Scholarship. Established in 1953 and supports arts, healthcare, hospital, human services, Jewish federated giving programs, medical research, and public policy.

Milton Blumenfeld Scholarship. Established in 1991 through the estate of Mr. Blumenfeld, a member of the Class of 1930, to support students at the Zanvyl Krieger School of Arts and Sciences.

Robert A. and Irene M. Boenning Endowed Scholarship. Established in 2001 by Irene M. and Robert A. Boenning '62 to provide need-based scholarships to students in the Department of Electrical and Computer Engineering at the Whiting School of Engineering.

Charles F. Bonilla Scholarship. Established in 1992 by various donors for undergraduates in the Department of Chemical and Biomolecular Engineering. The scholarship memorializes Dr. Bonilla, a former Johns Hopkins faculty member.

J. Richard Boylan Scholarship in the Humanities. Established in 1987 by the family and friends of the late J. Richard Boylan, this scholarship provides undergraduate support for students studying the humanities. Awards are based on academic merit and financial need.

Andrew J. and Dolores M. Bozzelli Undergraduate Scholarship. Established in 2007 by Dolores Bozzelli and the estate of her husband, Andrew J. Bozzelli '53, a university trustee emeritus. The scholarship provides support to students majoring in biomedical engineering.

Robert J. Brauer Memorial Scholarship. Established in 1981 by the family and friends of Robert J. Brauer, Class of 1967, to be awarded annually to deserving and needy undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

Charles Harmon Bronner Scholarship. Established in 2007 through the estate of Charles Harmon Bronner '25. This scholarship supports students at the Whiting School of Engineering.

Kenneth L. Brown Scholarship. Established in 2005 by Heather Hay Murren '88 to honor her late grandfather. It supports economics majors at the Zanvyl Krieger School of Arts and Sciences who are from Maryland or Pennsylvania.

Helen K. Browne Scholarship. Established in 1994 by Stephen J. Browne in honor of his mother. Mr. Browne received his bachelor's degree in political economy in 1968. He was a member of the band and Tau Epsilon Phi. This scholarship offers support to Zanvyl Krieger School of Arts and Sciences undergraduates majoring in economics.

Winston T. and Mamie N. Brundige Scholarship. Established in 1996 by Winston '42 and Mamie Brundige to provide financial support to students at the Zanvyl Krieger School of Arts and Sciences.

Morgan M. Buchner, Jr. Scholarship. Established in 1996 by Morgan M. Buchner Jr. '61, '65, this endowment provides financial assistance to undergraduate students at the Whiting School of Engineering. The recipient is selected based on merit.

Annegerd and George Bunting Scholarship. Established in 2005 by George L. Bunting, Jr. to recognize outstanding students at the Zanvyl Krieger School of Arts and Sciences. Mr. Bunting is a university trustee and a committed friend of Johns Hopkins. His creation of this scholarship reflects the importance friends of the university place on a Johns Hopkins education.

Alpha Holliman Bush Memorial Scholarship. Established in 1999 by Janice Bush '76 and her husband, Eric L. Hagestad, in memory of Janice's grandmother. This scholarship assists pre-medical Zanvyl Krieger School of Arts and Sciences students who demonstrates an interest and talent in music.

Caples Family Endowed Scholarship. Established in 2008 by Rob Caples '78 to support undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

Edwin S. Carr Memorial Scholarship. Established by James G. Rickards '73, '74 and fellow Beta Theta Pi fraternity brothers of Edwin S. Carr in Mr. Carr's memory in 2001. The fund provides an annual need-based scholarship to a Zanvyl Krieger School of Arts and Sciences undergraduate who, like Mr. Carr, is a BA/MA international studies student focusing on Russian or Eastern European Studies. It is the hope of Mr. Rickards and the other donors that through this scholarship, students will come to remember Mr. Carr as someone known for his high intelligence and quick wit which helped to build character and endeared him unforgettably to his friends.

Richard Wolfe Casner Memorial Scholarship. Established in 1970 in memory of Mr. Casner '65, this scholarship gives preference to junior or senior Arts and Sciences students majoring in history, with students in Far Eastern studies given first preference.

Centennial Scholarship. Established in 1976 from donations made during the University's Centennial Ball. Scholarships are awarded to engineering students who demonstrate financial need.

Rex T. Chao Memorial Scholarship. Established in 1997 in memory of Rex T. Chao. This scholarship supports an incoming freshman for four years of study and is based on need and interests in the study and performance of classical music, with first preference given to a student with an intention to pursue a major in political science.

Sidney Checket Endowed Scholarship. Established in 1984 by Sidney Checket and the Checket Family Foundation to assist undergraduate students at the Zanvyl

Krieger School of Arts and Sciences. Awards are based on academic merit and financial need.

Karen A. Cheng Scholarship. Established in 2003 to provide support for an international relations major with demonstrated extracurricular interest in the visual or performing arts.

Carrie K. and Walter H. Church Scholarship. To support deserving and needy undergraduate students on the Homewood Campus.

Henry A. Ciccarone Scholarship. Established in 1989 in memory of Henry Ciccarone to provide scholarships for lacrosse players.

Class of 1916 Scholarship. Established by the class to provide scholarships for Homewood undergraduates who demonstrate need.

Class of 1925 Scholarship. Established by the class in 1978 to provide scholarships to Homewood undergraduates demonstrating financial need.

Class of 1929 Scholarship. Established by the class on the occasion of their 50th reunion to support Homewood undergraduates.

Class of 1930 Scholarship. Established by the class on the occasion of their 50th reunion to support Homewood undergraduates who demonstrate academic excellence.

Class of 1934 Scholarship. Established by the class to provide scholarships for Homewood undergraduate students.

Class of 1935 Scholarship. Established in 1991 by the class to provide need-based undergraduate support to Homewood students.

Class of 1940 Scholarship. Established by the class in 1987, to provide need-based undergraduate support to Homewood students.

Class of 1941 Scholarship. Established in 1991 by the class to provide need-based undergraduate support to Homewood students.

Class of 1942 Scholarship. Established by the class in 1992 to provide scholarships to Homewood undergraduates who demonstrate need.

Class of 1943 Scholarship. Established by the class in 1993 to provide scholarships to Homewood undergraduates who demonstrate need.

Class of 1949 Scholarship. Established by the class in 1996 to provide scholarships to worthy Homewood undergraduates who demonstrate need.

Class of 1950 Scholarship. Established by the class in 1990 to provide scholarships to Homewood undergraduates who demonstrate need.

Class of 1951 Scholarship. Established in 1991 by the class to provide need-based undergraduate support to Homewood students.

Class of 1952 Scholarship. Established by the class in 1992 to provide scholarships to Homewood undergraduates who demonstrate need.

Class of 1953 Scholarship. Established by the class in 1993 to provide annual scholarships to Homewood undergraduate students demonstrating financial need.

Class of 1954 Scholarship. Established by the class in 1986 to provide scholarships for worthy Homewood students based on academic achievement.

Class of 1956 Scholarship. Established by the class in 1990 to provide scholarships for Homewood undergraduates who demonstrate need.

Class of 1957 Scholarship. Established by the class in 1992 to provide scholarship support to Homewood undergraduate students.

Class of 1958 Scholarship. Established by the class in 1993 to provide annual scholarships to Homewood undergraduate students demonstrating financial need.

Class of 1959 Scholarship. Established by the class to provide financial aid to need-based Homewood undergraduate students.

Class of 1963 Scholarship. Established by the class in 1993 to provide annual scholarships to Homewood undergraduate students demonstrating financial need.

Class of 1968 Scholarship. Established by the class in 1993 to provide need-based scholarships for Homewood undergraduate students.

Class of 1971 Scholarship. Established in 1991 to provide need-based undergraduate scholarships to Homewood students.

Class of 1977 Scholarship. Established by the class to provide annual scholarships to Homewood undergraduate students demonstrating financial need.

Class of 1987 Scholarship. Established in 2007 by the class to support Homewood undergraduate students.

Edward W. and Madelyn S. Clautice Scholarship. Established in 1999 by Edward W. Clautice '38 in memory of his wife, Madelyn Clautice, to whom he was married for 53 years. The scholarship supports undergraduate engineering students.

William C. Clouspy Memorial Scholarship. Established in 1995, in memory of William C. Clouspy '60, to provide scholarships to undergraduate students in the Zanvyl Krieger School of Arts and Sciences.

Jerome Cohen Scholarship. This scholarship was established in 2006, at the request of the late Jerome Cohen, for the Zanvyl Krieger School of Arts and Sciences.

Cordish Endowment for Men's Lacrosse. Established in 2005 by David S. Cordish to provide scholarship support to members of the men's varsity lacrosse team.

Cowan Family Endowment for Men's Lacrosse. Established in 2004 by Mr. Joseph W. Cowan '69. As an undergraduate, Mr. Cowan was a member of the lacrosse team, playing on three consecutive championship teams from 1967–1969. In 1986, Mr. Cowan was inducted into the Lacrosse Hall of Fame and into the Maryland Athletic Hall of Fame in 1990. He created this scholarship to support students on the men's lacrosse team.

Andrew Paul Cox Scholarship. Established in 1990 by the late A. Paul Cox Jr., '59, '70, and his wife Trudy A. Cox, in honor of his father. This fund provides scholarships for electrical engineering students based upon merit and financial need.

Crane-Huntington Endowed Scholarship. Established in 2001 by Sharon Crane '84, '90 and her husband R. Danny Huntington to provide support for biology or chemistry rising sophomores who do not aspire to a medical career. The purpose of this scholarship is to encourage students to explore careers where their interests and abilities in science can be utilized other than in medicine.

Neil R. Cronquist Scholarship. Established in 2008 by Neil R. Cronquist to support undergraduate students at the Whiting School of Engineering.

William H. H. Cullimore III Memorial Scholarship. Established in 1988 by the late Emily Rodney Cullimore in memory of Mr. William Cullimore '22, to provide undergraduate scholarships to students at the Whiting School of Engineering who graduated from Baltimore Polytechnic Institute.

Roger Dalsheimer Scholarship in the Humanities. Established in 1996 to provide undergraduate support to students majoring in the humanities at the Zanvyl Krieger School of Arts and Sciences.

Jack Davis Memorial Scholarship. Established in 1989, in memory of Mr. Davis, to provide scholarships to undergraduates at the Zanvyl Krieger School of Arts and Sciences.

Day Family Scholarship. Established in 1997 by Mrs. Betty P. Day to provide scholarships to Homewood undergraduates from the state of Colorado.

Daniel and Conor Denhihan Scholarship. Established in 2002 to support undergraduate scholarships for members of the men's varsity lacrosse team.

LeRoy and Nola Dickson Endowed Scholarship. Established in 1999 by LeRoy Dickson '60, '62, '68 and his wife, Nola Dickson, to provide scholarships to undergraduate students who are undergraduates at the Whiting School of Engineering.

Charles C. Diggs Scholarship. Established by Mr. Diggs '40 in 1996 to provide need-based scholarships to undergraduates at the Whiting School of Engineering.

Nancy G. and B. Boro Djordjevic Scholarship. Established in 1998 by B. Boro Djordjevic '78, '80 and his wife, Nancy G. Djordjevic to provide scholarships for under-

graduate students at the Whiting School of Engineering in the areas of nondestructive evaluation, materials engineering, or mechanical engineering.

Dorsey Scholarship. Established in 1999 by Herbert Dorsey '62 in honor of his mother, to provide scholarship support for engineering undergraduate students who reside in the Washington, D.C. metropolitan area.

Cyrus L. Doub Memorial Scholarship. Established in 1977 in memory of Cyrus L. Doub '19, by his sister, Mrs. Frances Doub North, and his son, Richard M. Doub. The fund provides scholarships for students who are majoring in electrical engineering and qualify for financial aid.

Eleanor Chamberlain Drake and James Frederick Drake Scholarship. Established in 2007 by Michael A. Cormack and Jennifer Drake Cormack to provide support for an undergraduate student studying the humanities at the Zanvyl Krieger School of Arts and Sciences.

Ina and Howard Drew Scholarship. Established in 2001 by Ina and Howard Drew, both BA '78. This need-based scholarship, supporting undergraduates at the Zanvyl Krieger School of Arts and Sciences, is in recognition of the benefits the Drews received from their Hopkins education and their commitment to assist talented students in coming to Hopkins. Furthermore, it is through this lasting legacy at Hopkins that Howard and Ina hope to encourage Drew Scholars to become active future members of the Hopkins alumni community.

Hugh L. Dryden Memorial Scholarship. Established in 1973 by Mrs. Dryden to honor her husband, a graduate of The Johns Hopkins University. The fund is used for scholarship aid at the Zanvyl Krieger School of Arts and Sciences.

Edwin C. Duncan Scholarship. Established in 2000 by Robert R. Duncan '71, in honor of his father, a lifelong sportsman and longtime supporter of Hopkins lacrosse. Robert Duncan is a former Hopkins varsity lacrosse player who played on two national championship teams coached by Bob Scott. This scholarship supports members of the men's varsity lacrosse team who have demonstrated academic and athletic integrity.

Dymowski Endowed Scholarship. Established in 1994 to assist deserving Zanvyl Krieger School of Arts and Sciences undergraduate students who demonstrate financial need. Preference is given to graduates of Calvert Hall College High School, Towson, Maryland.

John Howard Eager Scholarship. Established by John Howard Eager in 1957 to provide need-based scholarships to Homewood undergraduates.

Earl Family Scholarship. Established in 2002 by Matthew A. Earl '94 to provide support to a junior or senior at the Krieger School, who but for the financial assistance provided by this scholarship, would otherwise be unable to attend Johns Hopkins University. The recipient will have declared a major in the natural sciences.

William Eichengreen Scholarship. This scholarship was established in 2005 at the request of the late William Eichengreen '37. This scholarship is for undergraduate students in the Zanvyl Krieger School of Arts and Sciences.

Otto and Hilda Einolf Family Scholarship. Established by the late Charles W. Einolf '56 and his wife, Dorothy Einolf, to support full-time or part-time students at the Whiting School of Engineering. This need-based scholarship memorializes Mr. Einolf's parents.

Helen Eakin Eisenhower Scholarship. Established in 1983 in memory of Helen Eakin Eisenhower, wife of Milton S. Eisenhower, eighth president of The Johns Hopkins University, to provide scholarships for engineering undergraduates.

Dr. Milton S. Eisenhower Scholarship. To provide financial aid to need-based undergraduates at the Zanvyl Krieger School of Arts and Sciences.

John Engalitcheff, Jr. Scholarship. Established in 1989 by associates of the late Mr. Engalitcheff '30 and the Baltimore AirCoil Company to provide scholarships for full-time or part-time students at the Whiting School of Engineering.

Engineering Emeriti Professors' Student Aid Scholarship. Established in 1958 by Johns Hopkins engineers to honor professors of engineering who have reached the age of retirement. Its purpose is to provide need-based scholarships to deserving students pursuing studies in engineering.

Jeffrey M. Epstein and Ronit Adler Scholarship. Established in 2003 by Jeffrey Epstein '73 and his wife, Ronit Adler, this scholarship supports an undergraduate student in the Zanvyl Krieger School of Arts and Sciences who has demonstrated an interest in the history of the Jewish people, contemporary Jewish life, and Judaism through participation in Judaic studies and Jewish community organizations.

Harry W. Ewald, Class of 1918 Scholarship. Established in 2004 by Edith Ewald, to honor her husband, Harry '18. The scholarship supports undergraduate students in the Zanvyl Krieger School of Arts and Sciences.

Edgar F. Felder, Jr. Memorial Scholarship. Established in 2006 by Mark H. Felder and Beth Ann Felder '85 to support undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

Fenzel Family Scholarship. Established in 2006 by John Fenzel, Jr. to provide support for undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

Dale Fike Memorial Scholarship. Established in 2006 by various alumni from the classes of 1982, 1983, and 1984 in memory of Dale Fike, a 1983 alumnus of the School of Arts and Sciences. This scholarship supports undergraduates at the Zanvyl Krieger School of Arts and Sciences.

Finston/Robertson Scholarship. Established in 2000, this scholarship is awarded to financially needy undergraduate students in the Zanvyl Krieger School of Arts and Sciences with a diagnosed learning disability (also referred to as a learning style difference).

First Generational Scholarship. Established anonymously in 2000 by an alumnus to provide need-based support to Zanvyl Krieger School of Arts and Sciences undergraduates who are the first in his/her family to attend college, or who otherwise demonstrate financial need.

Frances Howard Flatau Scholarship. Established in 2001 by William H. B. Howard, M.D. '59, in honor of his sister, Mrs. Frances Howard Flatau. The scholarship award is based on academic achievement and financial need and given to junior or senior undergraduate students majoring in an engineering discipline at the Whiting School of Engineering. Preference is given to biomedical engineering students.

William Fox, Jr. Scholarship. Established in 2005 by the William Fox, Jr. Foundation to provide financial aid to undergraduate students at the Whiting School of Engineering.

Fox/Jeffrey Scholarship. Established in 2000 to support undergraduate students at the Zanvyl Krieger School of Arts and Sciences. Preference for this need-based scholarship will be given to students focusing their academic interests in the social sciences and/or the humanities.

Myer A. L. Frank Scholarship. Established in 1989 through the will of the late Mrs. Martha Frank Lauer in memory of her brother. The Myer A. L. Frank Scholarship is awarded by the university to a graduate of the Baltimore City College.

Miriam D. Frankl Scholarship. Established in 2010 upon the untimely death of Miriam Frankl, member of the Class of 2011. At Hopkins, Frankl was following in her aunt and grandmother's footsteps as she pursued a degree in the sciences. She was a leader in her sorority, Alpha Phi, and was described as inquisitive and adventurous. The scholarship was established in Miriam's memory by friends and family to support undergraduates at the Zanvyl Krieger School of Arts and Sciences.

Charles Carroll Fulton Memorial. This fund was established in 1927 by Dollie Glovins Fulton in memory of her father, Charles Carroll Fulton, for scholarship assistance to needy Homewood undergraduate students.

Christina Funke Scholarship. Established in 1964 through a bequest gift from Walter A. O. Funke to support talented students at the Zanvyl Krieger School of Arts and Sciences who demonstrate financial need.

Lillian Gavurin Memorial Scholarship. Established in 2003 to support Zanvyl Krieger School of Arts and Sciences undergraduate students with financial need who have demonstrated social responsibility and tolerance of diversity through ongoing involvement in nonreligious community service. The scholarship will be awarded to

a student in his or her freshman or sophomore year and granted to the same student year to year, up to four years or achievement of degree.

Elisabeth Gilman Memorial Scholarship. Established by Robert Nelson in memory of Miss Elisabeth Gilman, whose father was the first president of The Johns Hopkins University. The fund has since been augmented by the friends and family of the late S. Page Nelson, former treasurer of the University. Awards are based on academic merit and financial need.

Christopher H. Lee and Susan D. Ginkel Baltimore Scholarship. Established in 2008 by Christopher H. Lee '74 and his wife, Susan D. Ginkel, to support tuition and related expenses for undergraduates who have demonstrated financial need and are admitted to the Johns Hopkins University as part of the Baltimore Scholars Program or subsequent programs that provide support for Baltimore City public high school graduates.

Bernard Glatt Memorial Scholarship. Established by Jeanne L. Fink and Henry J. Fink in 1978 in memory of Bernard Glatt, an educator and former student of Johns Hopkins University. Awards are given to Arts and Sciences undergraduates based on academic merit and financial need.

Dr. Herman K. Goldberg Scholarship. Established in 2007 by Nathan Z. Goldberg to support undergraduate scholarships for two students who, but for the assistance provided by the scholarship, would otherwise be unable to attend Johns Hopkins University, and who, while receiving this scholarship, have declared a major in the premedical program.

Aurora G. Granofsky Scholarship. Established in 2001 to provide scholarship support for deserving Arts and Sciences students to the extent consistent with applicable laws and regulations. Any deserving student of Mexican citizenship or immediate descent to be given first consideration. Financial hardship is to be of first consideration.

Greenberg Family Scholarship. Established in 2003 by William S. Greenberg '64 to aid needy undergraduates from New Jersey with preference to either graduates of Columbia High School, The Lawrenceville School, and Princeton Day School, or undergraduates from Scandinavia in recognition of the righteousness of the Scandinavian people toward the Jewish people during World War II.

William S. and Betty K. W. Greenberg-Bologna Scholarship. Established in 2007 by William S. Greenberg '64 to support Arts and Sciences undergraduate students participating in the Bologna study abroad program.

Mr. and Mrs. Stanley D. Greenblatt and Mr. and Mrs. Alan L. Greenblatt Scholarship. Established in 1977, this scholarship is based on academic excellence and is awarded to undergraduate students on the Homewood campus at the Schools of Arts and Sciences or Engineering.

Grey Lady Scholarship. Established in 1996 by an alumnus on the occasion of his 40th reunion. The scholarship is to be used for a student at the Zanvyl Krieger School of Arts and Sciences who demonstrates financial need. Preference is given to a qualified student who resides in Nantucket.

Charles G. Groh Scholarship. Established in 2000 by Charles G. Groh '53. The recipient of the Groh Scholarship will either be in a double degree program with The Peabody Institute which results in two degrees—BA from KSAS and bachelor of music from Peabody—or be a music minor at the Zanvyl Krieger School of Arts and Sciences. The scholarship is awarded based upon financial need.

I. Cyrus Gutman Scholarship. Established in 1986, this endowed scholarship supports financially needy students at the Zanvyl Krieger School of Arts and Sciences.

Hackerman Scholarships. Established in the fall of 1985 by Lillian and Willard Hackerman '38 and Mrs. G.W.C. Whiting for students majoring in engineering. Students must have demonstrated need and must be a graduate of the Baltimore Polytechnic High School.

A. Z. Hartman Memorial Scholarship. Established in 1917 by Mrs. Susan M. Hartman to honor her husband, Professor A. Z. Hartman of Baltimore City College, to provide undergraduate scholarship assistance to students at the Zanvyl Krieger School of Arts and Sciences. Awards are based on academic merit and financial need.

William H. Hazlehurst Scholarship. Established in 1999 by William Hazlehurst '49 for the benefit of undergraduate students at the Zanvyl Krieger School of Arts and Sciences with financial need.

Jeremy W. Head Scholarship. Established in 1992 by Alice Head of Houston, Texas, in memory of her husband, Jeremy Head '62, who was an executive at Exxon Corporation. The scholarship supports students at the Zanvyl Krieger School of Arts and Sciences who have demonstrated financial need.

William Randolph Hearst Fund of the Baltimore Scholars Program. Established by Hearst Foundation, Inc. in 2010 to provide scholarships for the Baltimore Scholars Program with preference given to students who intend to permanently reside in the United States after completion of their studies.

Isaac and Catharine S. Hecht Scholarship. Established in 2010 to support tuition and related expenses for Arts and Sciences students who have demonstrated financial need. Preference will be given to students involved in community service for non-profit organizations in Baltimore City or County.

Michael Heinl Scholarship. Established in 2003 by Michael Heinl '72, this scholarship supports an undergraduate student at the Zanvyl Krieger School of Arts and Sciences who supports the Diverse Sexuality and Gender Alliance (DSAGA) student organization at Johns Hopkins.

Samuel and Elsie Helfrich Scholarship. Established in 1988 through the estate of Samuel Helfrich to support deserving students at the Zanvyl Krieger School of Arts and Sciences.

Carroll D. Hennick Memorial Scholarship. Established in 2002 to provide financial aid to non-medical undergraduate and graduate students in science and engineering.

Robert E. Hess Memorial Scholarship. In 1984, the estate of Alice R. Hess provided for the establishment of this scholarship in memory of her son. Awards are given to Homewood undergraduates based on financial need and academic merit.

Sylvia Mattin Heusch Scholarship. Established in 2000 to support undergraduate students studying the humanities at the Zanvyl Krieger School of Arts and Sciences with first preference given to history of art students.

Richard and Carol Hochman Scholarship. Established in 1987, this fund provides support to middle-income liberal arts students from public schools in the New York metropolitan area. Awards are given to Homewood undergraduates based on academic merit and financial need.

Hollander Memorial Scholarship. Established in 1991 in honor of the late Dr. Jacob Hollander to provide scholarships to Homewood undergraduates in the field of political economy.

Heather Murphy Holmes Memorial Scholarship. Established in 1996 by J. Scott and Suzanne Murphy Holmes in loving memory of their daughter, Heather. The scholarship is awarded to a Homewood undergraduate who has demonstrated a strong commitment to enhancing the lives of children living in the Baltimore community.

Homewood Campus Music Scholarship. Established in 1996 by Dr. Sung Oh to support undergraduate students at the Zanvyl Krieger School of Arts and Sciences who have a music minor.

Richard and Joan Howell Scholarship. Established in 2004 by Richard '55 and Joan Howell to provide financial aid to undergraduate students at the Whiting School of Engineering. Primary preference is given to recent graduates of Dundalk High School. Secondary preference is given to recently graduated students of Catonsville High School.

George J. Hudgins, Jr. Scholarship. Established by Mr. Hudgins '58 in 1994 to provide scholarships at the Whiting School of Engineering with first preference given to deserving graduates of the Baltimore Polytechnic Institute.

Huston Family Scholarship in Memory of Allan S. and Elsie C. Huston. Established in 2006 by Allan S. Huston Jr. '66 and his wife, Jane M. Huston, in memory of his parents. Scholarships are to be awarded to well-rounded Whiting School students who demonstrate appropriate financial need with preference given to students who have an interest in athletics.

Albert D. Hutzler, Jr. Memorial. Established in 1986 to support Arts and Sciences undergraduate students who demonstrate financial need.

Stanley Gene Jacobson Memorial Scholarship. Established in 1986 to assist financially needy students at the Zanvyl Krieger School of Arts and Sciences.

K. Michael Jeffrey Scholarship. Established in 2005 by Deborah J. Jeffrey, Esq. '82 to support undergraduate students studying the humanities or social sciences. Ms. Jeffrey is a former member of the Zanvyl Krieger School of Arts and Sciences advisory board. She created this scholarship in memory of her father.

Jochebed Scholarship. Established in 2000 by Heather Hay Murren '88 to support Krieger School undergraduates. Preference is given to a junior or senior who has demonstrated an interest through community service, or career aspiration, in improving the health, education, or well-being of low-income mothers and their children.

Johns Hopkins University Alumni Association Scholarship. Established to provide undergraduate need-based scholarships to students at the Homewood Schools.

Christian A. Johnson Scholarship. Established by the Christian A. Johnson Endeavor Foundation in 1984 to support deserving Arts and Sciences undergraduate students who demonstrate financial need.

Paul J. and Susan D. Kadri Family Scholarship. Established in 2006 by Paul J. Kadri '87 and his wife, Susan Kadri. The scholarship supports undergraduate students from the Krieger School of Arts and Sciences or the Whiting School of Engineering with preference given to students who have graduated from high schools in which Mr. Kadri has served as an administrator.

Herbert E. Kahler Scholarship. Established in 2008 by Herbert F. Kahler '58 to benefit undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

Leonidas P. Kaouris Memorial Scholarship. Established by Jon Savitz '87, Josh Givelber '88, Mark Goodman '87, and other classmates of Leo Kaouris, to honor their close friend, who in 1996 lost his life after a brave battle with cancer. The scholarship is awarded to undergraduate students at the Zanvyl Krieger School of Arts and Sciences, who demonstrate academic promise and financial need.

Geraldine Karetsky Jersey Girl Endowed Scholarship. Established by Andy Karetsky '88 and his wife Pam, to honor his mother's "special" birthday. The fund provides a yearly scholarship to an academically talented graduate of the Bergen County, New Jersey public school system. In establishing the scholarship in her name, Andy and Pam Karetsky honor Geraldine Karetsky's commitment to higher education and her charitable spirit.

Z. Morton Katz Memorial Scholarship. Established in 1919 by friends of Z. Morton Katz of Baltimore, a former Johns Hopkins University student who lost his life in the Battle of Montfaucon in France. The scholarship is awarded annually to an Arts and Sciences student who is

a graduate of Baltimore City College. Recipients are chosen on the basis of superior character and scholarship.

Stan and Stephanie Katz Scholarship. Established in 2006 by Dr. Stanley M. Katz to support a Krieger School undergraduate student majoring in economics, with a preference given to students who pursue course work in the Center for Financial Economics. The scholarship will be awarded in the student's sophomore year and will continue for all three years provided need is indicated.

Edgar Kemler Memorial Scholarship. Established in 1966 by Mrs. Rebecca M. Kemler in honor of her son, Edgar Kemler. This fund provides aid to an undergraduate student in the social sciences or the humanities at the Zanvyl Krieger School of Arts and Sciences. Awards are based on academic merit and financial need.

Marci and Larry Kenney Scholarship. Established by Marci Kenney '78, '79 and her husband, Larry Kenney Jr. '78, to support Homewood undergraduate students. Preference for this need-based scholarship is given to academically talented students.

William L. Kepper Memorial Endowed Scholarship. Established in 2001 by his children Kimberlee '78, '79, Eileen, Will, and Heidi Kepper. The need-based scholarship, awarded to a Zanvyl Krieger School of Arts and Sciences undergraduate who has demonstrated an interest in acting or film and media, recognizes Mr. Kepper's accomplishments as an actor and producer. It is the hope of his children that his memory will be carried on by those William L. Kepper Scholars who share his passion for acting and film and media.

Jeong H. Kim Scholarship. Established in 1999 by Jeong Kim '82, '89 to provide undergraduate need-based scholarships at the Whiting School of Engineering.

Benjamin and Fortuna Iseman Klotz Memorial Scholarship. Established through the estate of Fortuna Iseman Klotz in 1985, this endowed scholarship fund is used to assist financially needy Homewood undergraduate students.

Carl A. Knierim Scholarship. Established in 1981 by Dora Will Knierim in memory of her husband, Carl Adam Knierim '24, to provide financial assistance for Arts and Sciences undergraduate students majoring in chemistry. Awards are based on academic merit and financial need.

Arthur R. and Rena A. Knipp Scholarship. Established in 1972 by Mrs. Margaret K. Charny in honor of her parents. Her father graduated from Johns Hopkins and throughout his life maintained a keen interest in the university. The fund provides financial assistance for financially needy Arts and Sciences undergraduate students, preferably in the fields of physics or mathematics.

Bertram Koslin Scholarship. Established in 2001 by Elizabeth A. Koslin to support an undergraduate at the Whiting School of Engineering, with preference given to students in the field of computer science.

Milton W. Kronsberg Memorial Scholarship. Established in 1998 by Frederica Kronsberg in memory of her husband, Milton W. Kronsberg '32, to aid financially needy undergraduate students at the Zanvyl Krieger School of Arts and Sciences who have demonstrated an interest in the history of the Jewish people, contemporary Jewish life, and Judaism through participation in Judaic studies and Jewish community organizations.

Kurz Family Scholarship. Established in 2005 by Donald A. Kurz '77 to support undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

KSAS 9/11 Alumni Memorial Scholarship. Established in 2001 in honor of the sudden loss of five alumni of the Zanvyl Krieger School of Arts and Sciences in the September 11 attacks. This scholarship is to be awarded to a current undergraduate student of the school.

Kumin Family Scholarship. Established in 2007 by Solomon Kumin '99 to support members of the varsity lacrosse team.

Eli M. Lamb Memorial Scholarship. Established in 1916 by the Alumni Association of the Friends School of Baltimore to assist financially needy students at the School of Arts and Sciences, with preferences given to Friends alumni.

Land Scholarship. Established in 1991 by Dr. W. Everett Land '28, '33 and Mrs. Land, these scholarships provide support for undergraduate or graduate students in the Departments of Chemistry or Chemical and Biomolecular Engineering.

Al and Jerrie LaPointe Scholarship. Established in 2010 through the estate of Jerrie LaPointe to support undergraduate students on the Homewood Campus.

Albert G. Laverty Scholarship. Established in memory of Albert G. Laverty '53 by his daughter, Lynn L. Elsenhans, his wife, Martha A. Laverty, and numerous family and friends who contributed to his memorial fund. This scholarship provides support to students in the Department of Chemical and Biomolecular Engineering at the Whiting School of Engineering, with preference given to students who indicate a professional desire to work in the energy industry or do research that is related to promoting safe, secure, or affordable sources of energy.

W. Jeffrey Lawrence Scholarship. Established in 2000 by W. Jeffrey Lawrence '77, '78. This endowed scholarship will support Krieger School undergraduate students in the BA/MA program with SAIS.

Nevin O. Lawyer Scholarship. Established to provide need-based scholarships to Homewood undergraduates whose permanent residence prior to entering college was the state of Maryland.

Sidney Stanford Leichter Scholarship. Established in 2009 by Anthony P. Leichter '59 to support undergraduate students at the Zanvyl Krieger School of Arts and Sciences who are interested in the areas of history of art, archeology and classics.

Lenrow Family Scholarship. Established in 2006 by Ruth and Jay '76 Lenrow to support undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

Elliot and Marjory Levi Scholarship. Established in 1999 by Alan Levi '71 in honor of his parents, the scholarship is awarded to an Arts and Sciences undergraduate based on academic merit and financial need. J. Elliot Levi graduated from the School of Arts and Sciences in 1934 and from the School of Medicine in 1938.

Robert H. Levi Scholarship. Established in 1990 by his children to provide scholarships for undergraduates at the Zanvyl Krieger School of Arts and Sciences.

David and Marcia Levy Scholarship. Established to provide assistance to undergraduate students at the Zanvyl Krieger School of Arts and Sciences who demonstrate financial need. Preference given to writing seminars majors.

Robert Forster and Vernon L. Lidtke Scholar. Established in 2007 by Richard L. Posen '72, William H. Linder '72, and other various donors to provide support for one student each year (juniors and seniors) with a well developed major or concentration in the social sciences. Preferences given to those students interested in History.

Sweetser Linthicum Esquire Scholarship. Established in 1997 to provide scholarships to deserving Arts and Sciences students majoring in the fields of history or political science.

Donald Ho Yu Liu, M.D. and Emilie Chua Liu, M.D. Scholarship. Established in 2005 by Diana C. Liu to provide support to a Krieger School undergraduate student with financial need who is pursuing a career in medicine.

William D. Loring Scholarship. Established in 2008 by Reverend William Loring '58 and his wife, Diane, to support undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

Vernon Lynch Scholarship. Established in 1925 by Mr. Edmund Lynch of New York in memory of his brother, Vernon Lynch, who died while engaged in service during World War I. The fund supports graduates of the Baltimore City College who are accepted for undergraduate admission on the Homewood Campus.

Edward MacNichol Scholarship. Established to provide scholarships to undergraduates at the Zanvyl Krieger School of Arts and Sciences.

Helen and Sam Mandel and Anita and Julian Mandel Educational Scholarship. Established by Howard Mandel '77 and his wife, Susan, in honor of Howie's parents and grandparents' commitment to education. The fund supports undergraduate students at the Zanvyl Krieger School of Arts and Sciences. Preference for the need-based scholarship is given to incoming freshmen from Brooklyn, New York; Queens, New York, Stuyvesant High School in New York; or Los Angeles.

Jerome and Helen Margulies Scholarship. Established by Frederic Margulies '69 in memory of his parents. The scholarship is need-based and is awarded to an undergraduate student at the Zanvyl Krieger School of Arts and Sciences who has demonstrated an interest in the history of the Jewish people, contemporary Jewish life, and Judaism through participation in Judaic studies and Jewish community organizations.

Maryland Section of the American Society of Civil Engineers Scholarship. This scholarship was established in 2006 by the Maryland Section of the American Society of Civil Engineers to support civil engineering students. Recipients are selected on academic merit and financial need, must be members of the ASCE student chapter, and shall be undergraduate students who have junior or senior standing. The scholarship may be renewable for any selected student who maintains good academic standing.

Maryland Society of Professional Engineers J. Jay Pecora Memorial Scholarship. Established in 1990 to provide scholarships to Whiting School of Engineering students who are residents of the state of Maryland, demonstrate financial need, and are entering their senior year.

Maryland Society of Professional Engineers Wallace S. North P.E. Memorial Scholarship. Established in 2008 to provide scholarships to Whiting School of Engineering students who are residents of the state of Maryland, demonstrate financial need, and are entering their senior year.

James E. McClaine Scholarship. Established in 1999 by James E. McClaine '63 and his wife, Kay E. McClaine '64 to support undergraduate students in an engineering discipline.

Gail J. McGovern Endowed Scholarship. Established in 1999 by Gail J. McGovern '74 and a trustee of the university. This scholarship provides need-based assistance for students studying mathematics or science at the Zanvyl Krieger School of Arts and Sciences. First preference is given to female students who attended an urban public high school prior to attending the university.

Charles O. McKenzie Jr. Scholarship. Established in 2007 by Charles O. McKenzie Jr. '49, to support undergraduate students at the Whiting School of Engineering.

William E. and Elda M. Meiers Scholarship. Established in 1999 by William E. Meiers '52 and his wife, Elda M. Meiers, to support deserving undergraduate students majoring in an engineering discipline. Mr. Meiers is retired from the Exxon Corporation, and hopes that this scholarship will attract undergraduates to the field of engineering.

The Melissaratos Family Scholarship. Established in 1999 by Mr. Aristides Melissaratos '66, to provide scholarship support to deserving undergraduate students majoring in an engineering discipline. Preference is given to engineering students who are from the city of Baltimore, Maryland.

Jay Menon, M.D. Memorial Scholarship. Established in 2000 by his wife, Shama, and daughter, Seema. The scholarship supports freshmen and sophomores who have recognizable accomplishments illustrating their desire to pursue a career in medicine and who maintain at least a 3.0 GPA. The scholarship recognizes Dr. Menon's accomplishments as a renowned orthopedic and hand surgeon who trained at Johns Hopkins Hospital and Sinai Hospital from 1973–1977. The Jay Menon Memorial Scholarship is a loving tribute to the memory of an extraordinary physician and caring individual.

Messner Family Baltimore Scholarship. Established in 2008 by Michael G. and Jenny Messner to support tuition and related expenses for undergraduates who have demonstrated financial need and are admitted to the Johns Hopkins University as part of the Baltimore Scholars Program or subsequent programs that provide support for Baltimore City public high school graduates.

Joseph Meyerhoff Scholarship. Established in 1979 by Joseph Meyerhoff who had attended the University in 1918. The scholarship provides support to deserving students at the Whiting School of Engineering who major in civil engineering.

Miller Scholarships. Established in 1993 by Charles D. Miller '49 to provide scholarships to Zanvyl Krieger School of Arts and Sciences undergraduates who previously participated in the CTY program.

Raymond D. Miller, Jr. Scholarship. Established by the estate of Raymond D. Miller, Jr. to provide scholarships to undergraduate students at the Whiting School of Engineering.

Jan M. Minkowski Scholarship. Established in 2002 in memory of Jan M. Minkowski '63, a Whiting School electrical and computer engineering professor emeritus. This scholarship supports deserving undergraduate students majoring in electrical and computer engineering, computer science, or mathematical sciences and serves to attract undergraduates to these fields.

John G. Monteabaro Foundation Endowed Scholarship. Established in 2005 by the John G. Monteabaro Foundation, Inc. to provide support for an undergraduate student, with preference given to a student who is a resident of Howard County, MD, majoring in mathematics within the Zanvyl Krieger School of Arts and Sciences.

Patricia Biggs Morrison Scholarship. Established in 1998 by William F. Morrison '49, in honor of his wife to provide financial assistance for undergraduates in the Zanvyl Krieger School of Arts and Sciences.

Tobia H. and Morton M. Mower Scholarship. Established in 1996 to provide scholarships for undergraduate students at the Zanvyl Krieger School of Arts and Sciences who demonstrate financial need.

James J. Murren Scholarship. Established in 2004 by Heather Hay Murren '88 to support a needy Krieger School undergraduate student studying art history or another area within the humanities with an interest in athletics.

Sylvia Friedberg Nachlas Scholarship. Established in 1988 by Sylvia F. Nachlas to support needy and deserving students at the Zanvyl Krieger School of Arts and Sciences.

Ruth Nagle Watkins Scholarship. Established in 2006 through a bequest from the late Ruth Nagle Watkins to provide scholarships for Arts and Sciences students majoring in art history.

Sol and Irene Nathan Baltimore Scholarship. Established by Irvin Nathan '64 to support Homewood undergraduate students who are admitted to Johns Hopkins University as part of the Baltimore Scholars Program or subsequent programs that provide support for Baltimore City public high school graduates.

James H. Nelson Scholarship. Established in 1998 by James Nelson '75, an attorney from Boulder, Colorado. This scholarship is to be awarded to a financially needy Homewood freshman who demonstrates substantial academic achievement and significant non-academic promise. Geographic preferences given first to students from Boulder and Longmont, Colorado; Kauai County, Hawaii; Jackson County, Illinois.

Nguyen Family Endowed Scholarship. Established in 2006 by Chris and Elizabeth Nguyen to provide support for an undergraduate student who is a rising junior or senior at the Zanvyl Krieger School of Arts and Sciences, with preference given to a student whose focus is premedical education with an interest in children's health.

Ronald M. Nordmann and Jodi E. Nordmann Undergraduate Scholarship. Established in 1999 by Mr. Nordmann '63 to support undergraduate students at the Zanvyl Krieger School of Arts and Sciences with demonstrated financial need. Mr. Nordmann and his daughter, Dr. Jodi Nordmann Harap '93, wanted to help students who might otherwise be unable to attend Johns Hopkins.

Dr. W. Luther Norem Scholarship. Established in 1994 to provide financial aid for deserving students at the Zanvyl Krieger School of Arts and Sciences.

Ralph S. O'Connor Scholarship. Established in 1993 to provide scholarships to undergraduates at the Zanvyl Krieger School of Arts and Sciences. Preference given to students from Texas or Montana.

Willie J. Oliver, Jr. Scholarship Fund. Established in 2002 by George Skegas '77. This scholarship provides financial support for undergraduate scholar-athletes at the Zanvyl Krieger School of Arts and Sciences.

Alan T. Ossermann, Sr. Scholarship. Established in 1982 by J. Julian Osserman to provide scholarship assistance to students of engineering science. Awards are based on academic merit and financial need.

Paleologos Family Scholarship. Established in 2000 to provide undergraduate scholarships for members of the men's lacrosse team.

Mr. and Mrs. Samuel F. Palmisano Scholarship. Established in 2002 by Mr. and Mrs. Samuel J. Palmisano '73, in honor of his parents, to provide support for well-rounded undergraduates at the Whiting School of Engineering who are studying computer science.

Kumud Arvind Patel and Arvind Vithaldas Patel Scholarship. Established by Rajul Patel '94 in honor of his parents to award scholarships to Homewood undergraduate students based on financial need or adversity.

Joseph B. and Frances T. Payne Scholarship. Established in 1999 to support deserving and needy Homewood undergraduate students at the Johns Hopkins University.

Pansini Pearls Scholarship. Established in 2006 by Michael O. Pansini, Esq. '82 to support Zanvyl Krieger School of Arts and Sciences undergraduate students, with preference given to those from Philadelphia.

George A. Petrossian, M.D., Scholarship. Established in 2005 by George A. Petrossian, M.D., for undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

Phi Ep Buddy Scholarship. Established by various members of the Phi Epsilon Pi fraternity to provide undergraduate support for students at the Zanvyl Krieger School of Arts and Sciences.

Neal R. Pilzer Scholarship. Established in 2000 by Neal R. Pilzer '78 to benefit one or more undergraduate students at the Zanvyl Krieger School of Arts and Sciences, with preference given to film and media studies majors.

Abraham Pikoos Memorial Scholarship. Established in 1989 by Mindelle Weinberg in memory of her late father, Abraham Pikoos '21, to assist students majoring in mathematics, physics, or engineering.

James F. Pitts Scholarship. Established in 2004 by James F. Pitts '73, '78 and his wife, F. Kay Pitts. The scholarship provides financial aid to undergraduate engineering students at the Whiting School of Engineering.

Lynn and Gray Poole Humanities Scholarship. Established in 1969 by friends and colleagues of Lynn D. Poole, director of public relations at The Johns Hopkins University from 1946 to 1966. This scholarship was created to honor his memory and to support financially needy and scholarly undergraduate students studying the humanities at the Zanvyl Krieger School of Arts and Sciences.

Timothy J. Popko Memorial Scholarship. Established by Ethan Leder '84 and other classmates of Timothy J. Popko, to honor their close friend who tragically lost his life between his freshman and sophomore years at Hopkins. The scholarship, based on need, will be awarded to a Homewood undergraduate student who demonstrates not only academic promise, but also talent and interests in extracurricular areas.

Helen C. Potter Scholarship. Established in 1988 to support worthy and needy Arts and Sciences undergraduates in the field of political economy.

Guy Railey Lacrosse Scholarship. Established in 2004 by Beverly Railey to honor her husband, Guy Railey '58. Mr. Railey was a teacher and coach at Johns Hopkins, as well as an alumnus of the Krieger School. Mr. Railey passed away in December 2003. This scholarship supports students on the men's lacrosse team.

Dr. and Mrs. William F. Railing Scholarship. Established by the Railings on the occasion of Dr. Railing's 50th reunion to provide assistance to a third- or fourth-year undergraduate student at the Zanvyl Krieger School of Arts and Sciences, who is majoring in economics, who maintains a 3.0 grade point average and who has completed half the course work for a degree in economics. In addition, the student should have made positive contributions to the university community. The Railing Scholarship Fund is awarded based on financial need and preference is given to students who are graduates of Baltimore City College.

Anna Rappa Memorial Scholarship. Established in 1984 by the family and friends of Mrs. Rappa to assist undergraduates at the Zanvyl Krieger School of Arts and Sciences who graduated from Baltimore city or county high schools. Awards are based on academic merit and financial need.

Howard J. Read Scholarship. Established in 2000 by Howard J. Read '66, to support undergraduates at the Zanvyl Krieger School of Arts and Sciences.

Charles Charretton Reeder Scholarship. Established in 1992, in memory of Mr. Reeder '30, to provide scholarship support for undergraduate students at the Whiting School of Engineering.

Dr. Edward F. Reese Memorial Scholarship. Established in 1991 by Ralph H. Reese in memory of his father, this scholarship is designated to support Arts and Sciences undergraduates from the Monongahela Valley, with preference given to graduates of Steel Valley High School.

Riemann Family Scholarship. Established in 2006 by Christopher D. Riemann, M.D. '89, this scholarship provides support to undergraduate students at the Whiting School of Engineering who demonstrate financial need and who plan to attend medical school.

George L. Rogosa Undergraduate Scholarship. Established in 2000, the scholarship is awarded annually to undergraduates at the Zanvyl Krieger School of Arts and Sciences with financial need and strong academic promise.

Martha O. Roseman Scholarship. Established in 2000, this scholarship is awarded annually to a need-based undergraduate at the Zanvyl Krieger School of Arts and Sciences. First preference will be given to an undergraduate with a diagnosed learning disability.

Richard P. Rosenberg Baltimore Scholarship. Established in 2008 by Gail J. McGovern '74 to benefit one or more Homewood undergraduate students with demonstrated financial need who qualify for tuition relief through the Baltimore Scholars Program.

Roger and Bobbi Rosenberger Scholarship. Established in 1999 by Roger Rosenberger '65 and his wife, Bobbi Rosenberger, to provide undergraduate scholarships for students at the Whiting School of Engineering.

Ben and Esther Rosenbloom Scholarship. Established in 1990 to provide scholarships for undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

John W. and Mary Lou Ross Scholarship. Established in 2000 by the late John W. Ross, who was a research associate in the Department of Materials Science and Engineering, and his late wife, Mary Lou Ross. This scholarship supports deserving undergraduate students at the Whiting School of Engineering who are citizens or permanent residents of the United States, academically eligible, and deserving of financial assistance. Preference is given to engineering students majoring in materials science and engineering.

Rob Roy Scholarship. Established in 2002 by Thomas L. Wheeler, Engr '53 and his wife Carolyn C. Wheeler, in honor of the late Robert H. Roy, a former Johns Hopkins Engineering dean, to provide scholarship support to undergraduate students at the Whiting School of Engineering. Awards are based on academic success and financial need.

Arthur C. Rubenstein Scholarship. Established in 1964 to support Homewood students from the District of Columbia or the area immediately adjacent, with preference to students who show promise of proficiency in basketball.

John F. Ruffle Endowed Scholarship. Established in 2001 by John F. Ruffle '58. This scholarship supports undergraduates at the Zanvyl Krieger School of Arts and Sciences who, but for the financial assistance provided by this scholarship, would otherwise be unable to attend the Johns Hopkins University.

Marshal and Janet Salant Homewood Scholarship. Established in 2006 by Marshal L. Salant '80, this scholarship supports Homewood undergraduate students. Preference is given to students who major in either economics or applied mathematics and statistics.

Salant Student Investment Scholarship. The Salant Student Investment Program is a non-credit project established in 1999 by Marshal L. Salant '80 to allow students to participate in real-life investment strategies. Five percent of the profit made by the students is used to fund this scholarship. The award is given to a student interested in financial mathematics.

Sardella Scholarship for Men's Lacrosse. Established in 2007 by Louis M. Sardella '69. While at Hopkins, Lou played varsity soccer, but has since become an avid lacrosse fan. He established this scholarship to honor all those who have worn the Johns Hopkins uniform and represented his alma mater.

Sardella Endowed Scholarship for Engineering Undergraduates. Established in 1999 by Louis M. Sardella '69 to support undergraduates at the Whiting School of Engineering with preference given to students from the greater Baltimore area.

Philip Schaefer Scholarship. Established in 1930 by Mrs. Johanna Raegner of New York to honor Philip Schaefer by providing financial assistance to a deserving Arts and Sciences student from the city of Baltimore who demonstrates financial need.

Robert C. Scharf Engineering Scholarship. Established in 2001 by colleagues and friends of Robert C. Scharf '59 who was an alumnus of Johns Hopkins University's part-time engineering program. This fund provides scholarship support to civil engineering students with preference given to students from Anne Arundel County whose needs resemble those of Robert C. Scharf some 45 years ago.

Dylan Schlott Scholarship. Established in 2000, this undergraduate scholarship supports a member of the men's lacrosse team.

Richard S. Schlotterbeck Memorial Scholarship. Established in 2002 in memory of Richard S. Schlotterbeck '37 to provide scholarship support to students majoring in an engineering discipline at the Whiting School of Engineering. Preference is given to first generation students.

Hermann O. Schmidt Memorial Scholarship. Established in 2000 by a bequest from Clara McMahon Schmidt '42 in memory of her husband, Hermann Schmidt '26, '40. Clara Schmidt had a long relationship with Hopkins, serving as an associate professor emeritus of Business and Education at the time of her death. The scholarship supports undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

Jerome D. Schnydman Scholarship. Established in 2005 by friends and family to honor Mr. Schnydman's legacy. Jerry Schnydman '67 played varsity lacrosse at Hopkins from 1964–1967. A three-time All-American midfielder, he was the captain of the 1967 national championship team. Jerry continued to support the lacrosse program as a long-time assistant coach after graduation. In 1998, Jerry was inducted into the Johns Hopkins Athletic Hall of Fame, and in 2003, into the National Lacrosse Hall of Fame. This scholarship supports members of the men's lacrosse team.

Schrodel Endowed Scholarship. Established by Charles S. Schrodel Jr. '57 through a planned gift announced in 2001, to benefit undergraduates at the Whiting School of Engineering.

Robert H. Scott Endowed Scholarship. Established in 2008 by the Class of 1958 reunion committee to recognize the impact their coach, teacher and motivator, Bob Scott, had on so many members of the class. Mr. Scott was

head coach for the Blue Jays men's lacrosse team for 20 years and led seven national championship teams. After retiring from coaching, he served as athletic director at Hopkins for 22 years. He was inducted into the National Lacrosse Hall of Fame in 1994 and retired from Hopkins in 1995 after 41 years of dedicated service.

Ruth and Herschel Seder Scholarship. Established in 1974 by Milwaukee Valve Company, Inc. to assist students from middle-income families with preference given to students who are preparing for careers in engineering. Mr. Seder '39 a university trustee emeritus, is president of Milwaukee Valve Company.

Edward Henry Sehrt and Helen Ludwig Sehrt Scholarship. Established in 2008 by the Helen Sehrt Trust, Trustee Nancy Hamrick to establish and award annual scholarships for undergraduate students majoring in German literature, language, or philosophy who maintain at least the equivalent of a B average in their Germanic studies.

Seidman Family Scholarship. Established in 2007 by Neil H. Seidman '89 to support a Krieger School undergraduate student with an interest (in order of preference) in: i. History of Science and Technology, or ii. Jewish Studies. If there is no such qualified candidate, the scholarship with be awarded to a Krieger School undergraduate student with demonstrated financial need.

Ida and Jack Sekulow Scholarship Fund. Established in 1987 by Eugene Sekulow '53, '60, and Erwin Sekulow '59, in memory of their parents. Provides scholarship aid to needy undergraduates at the Zanvyl Krieger School of Arts and Sciences.

Barbara and M. Sigmund Shapiro Family Scholarship. Established in 1980 by M. Sigmund Shapiro '48 and his wife, Barbara, to provide financial support to undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

Kenneth Edwin Shaw Scholarship. Established by the estate of Francine S. Shaw in 2009 in memory of her late husband, Kenneth Edwin Shaw '67, '68, to support undergraduate students at the Whiting School of Engineering.

LeRoy and Helen Sheats Scholarship. Established in 1995 by Helen Sheats in memory of her husband. LeRoy Sheats was a member of the Class of 1928. The scholarship supports undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

Klara Shorey Memorial Scholarship. Established in 1997 to provide support for undergraduate students at the Zanvyl Krieger School of Arts and Sciences majoring in Russian and literature.

Leonie Shorey Scholarship. Established in 1997 to provide support for undergraduate students at the Zanvyl Krieger School of Arts and Sciences majoring in French and literature.

Michael Shorey Memorial Scholarship. Established in 1997 to provide scholarships for undergraduate students at the Zanvyl Krieger School of Arts and Sciences majoring in chemistry.

Rajendra and Neera Singh Scholarship in the G.W.C. Whiting School of Engineering. Established in 2004 by Dr. and Mrs. Singh to provide need-based scholarship support to strong and deserving undergraduate students at the Whiting School of Engineering.

Albert and Elaine Slechter Scholarship for Engineering Undergraduates. Established in 1999 by Mr. Albert J. Slechter '62 and his wife, Elaine, to support engineering undergraduate students with preference given to Maryland residents with financial need. Mr. Slechter is a founding member of the Society of Engineering Alumni (SEA).

Smilow Family Scholarship. Established in 1999 by Michael Smilow '60 and his son David '84 to provide scholarships to undergraduate students at the Zanvyl Krieger School of Arts and Sciences who are in need of financial assistance. The dean of the Krieger School will award the Smilow Family Scholarships to qualified students on the basis of evidence of the candidate's character, interpersonal skills, and unrealized potential.

Philip S. W. Smith Scholarship. Established in 2009 by Mr. Smith '89, to support humanities majors at the Zanvyl Krieger School of Arts and Sciences, with preference given to students from Canada.

Garrett J. Solomon Scholarship. Established in 2003 to provide need based scholarships to undergraduate students enrolled at the Zanvyl Krieger School of Arts and Sciences. Preference is given to students from New England with Massachusetts as first preference who have declared a major in Humanities and will have demonstrated a commitment to extracurricular activities. In the event a student is unavailable to be named from New England, the donor wishes that a student from the Mid-Atlantic States be selected.

Scott and Margaret Starks Scholarship. Established in 1999 by Scott Starks '74 and his wife, Margaret Starks. This scholarship is to support an undergraduate member or members of the women's lacrosse team.

Dr. Karl J. Steinmueller Scholarship. Established to provide assistance to Homewood students who are without sufficient funds to complete their undergraduate education.

Osmar Steinwald Memorial Scholarship. Established in 1995 to provide scholarships to undergraduates at the Zanvyl Krieger School of Arts and Sciences.

S. David Sternberg, M.D. Undergraduate Scholarship. Established in 2000 through a bequest by S. David Sternberg, M.D. '42. This scholarship is for a Zanvyl Krieger School of Arts and Sciences undergraduate with substantial financial need.

Ernest and Doris St. Peter Scholarship. Established in 1999 by Gary R. St. Peter '72, in honor of his parents. To be awarded annually to an Arts and Sciences undergraduate student who, but for financial assistance provided by this scholarship, would otherwise be unable to attend Johns Hopkins University, and who, while receiving this scholarship, actively demonstrates an ongoing commitment to community service and a commitment to helping another person by his or her volunteer participation in a local tutoring or mentoring program.

Matt "Stoff" Stoffel Scholarship. Established in 2008 by various donors to support one or more male undergraduate students affiliated with the men's lacrosse program.

Summerfield Scholarship. Established in 1990 by the Solon E. Summerfield Foundation, Inc. This scholarship, which provides support to outstanding engineering undergraduate students, is dedicated in memory of Solon E. Summerfield.

Louise and Earl Sweeney Scholarship. Established in 2000 by William E. Sweeney, Jr., Ph.D. on the anniversary of his 40th reunion in honor of his parents. The fund will provide scholarships for undergraduate students at Homewood who are academically talented and who have demonstrated involvement in campus activities.

Melvin and Jeannette Tabler Endowed Scholarship Fund for Undergraduate Engineering Students. Established in 2002 to attract undergraduates to the field of engineering and to honor Melvin Tabler '34 and his wife, Jeannette Tabler. The scholarship provides support to undergraduate students majoring in an engineering discipline at the Whiting School of Engineering.

Morris and Charlotte Tanenbaum Scholarship. Established in 1996 by Dr. and Mrs. Tanenbaum of Short Hills, New Jersey. Dr. Tanenbaum '49 is a university trustee emeritus. The scholarship supports undergraduate students at the Zanvyl Krieger School of Arts and Sciences.

John J. Tatum Memorial Scholarship. Established in 1994 by the estate of Beulah Benton Tatum '43, in honor of John J. Tatum '93, to provide scholarships for students at the Homewood Schools.

Honorable Edward O. Thomas Scholarship. Established in 2000 by the Judge Thomas and his wife, Katherine. Judge Thomas graduated from Johns Hopkins in 1940 with a degree in Political Science. He is a retired judge with the Maryland State Government. This scholarship supports undergraduate students at the Zanvyl Krieger School of Arts and Sciences who demonstrate financial need.

J. Trueman Thompson Student Aid Scholarship. Established in 1972 by professor emeritus J. Trueman Thompson to provide scholarship support to students who major in the fields of science or engineering.

Lauren Renee Thompson Scholarship. Established in in celebration of Lauren's life in 2003 by classmates to support deserving Homewood students at the Johns Hopkins University.

William S. Todman, Sr. Scholarship. Established in 1977 by William S. Todman Sr. '38 for Arts and Sciences undergraduate students who demonstrate academic excellence and financial need.

T. Rowe Price Scholarship. Established by the T. Rowe Price Foundation, this scholarship is awarded to an engineering student interested in finance or mathematics.

Triumph Scholarship. Established in 1999 by Kenneth K. Yagura '63 and his wife, Terry Yagura, this scholarship provides support to deserving Homewood undergraduate students from the Los Angeles area public school system, with preference given to students from urban public schools. The scholarship is awarded to students based on financial need.

Isabel S. F. and Hadley K. Turner Scholarship. Established in 1973 by Mr. and Mrs. Turner in memory of their son, Julius Turner. The fund provides scholarship assistance in political science annually on the basis of character, diligence in the pursuit of learning, scholastic standing consistent with a student's capabilities, and financial need.

USX Scholarship Fund. The purpose of this fund is to provide scholarships to students in business-related majors in the Krieger School of Arts and Sciences and the Whiting School of Engineering with preference to USX employees and children.

Venbrux Family Scholarship. Established in 2003 by Anthony Venbrux, this scholarship supports a Krieger School undergraduate from Washington, Alaska, Idaho, or Montana.

Dr. William R. Van Dersal and Dr. Eva P. Gaines Van Dersal Scholarship. Established in 2007 by the Estate of Eva Peyton Gaines Van Dersal for undergraduate students at the Zanvyl Krieger School of Arts and Sciences with a preference for students majoring in Public Health Studies.

Michael and Jacqueline Vassallo Scholarship. Established to award scholarships to students at the Zanvyl Krieger School of Arts and Sciences on the basis of true merit and nondiscrimination.

Glen Wall and Matthew O'Mahony Memorial Scholarship. Established in 2002 by alumni, family, and friends in memory of Glen Wall '84 and Matt O'Mahony '84, who lost their lives on September 11, 2001, at the World Trade Center. This scholarship will be awarded to a Krieger School undergraduate who demonstrates an interest in athletics and is well-rounded.

Severn Teackle Wallis Memorial. The Wallis Memorial Association established in 1906 a fund for scholarships to assist financially needy students.

Arthur and Clara Ward Scholarship. Established in loving memory of Arthur and Clara Ward by Dorothy Mears Ward and their son Arthur T. Ward Jr. '33, '39. Awards are given to Arts and Sciences undergraduates based on academic merit and financial need.

Frederick C. Warring Memorial Scholarship. Established to provide scholarships to Arts and Sciences students who demonstrate need.

Earl Wasserman Memorial Scholarship. This scholarship was established by Stephen Weissman '57 in honor of Dr. Earl Wasserman, professor of English from 1949 to 1973, to assist an academically talented and financially needy undergraduate English major.

Walter J. Webb Sr. Memorial Scholarship. Established in 1991 by Mr. and Mrs. William Clouspy '59 to provide financial aid for Arts and Sciences undergraduates who demonstrate need.

Louis Weinberg Scholarship. Established in 1988 to provide undergraduate scholarships for students at the Whiting School of Engineering.

Westwind Scholarship. Established in 2004 to provide scholarship support to undergraduate students at the Whiting School of Engineering.

Captain Newton White, Jr. Scholarship. Established in 1958 by Captain Newton White, Jr., a naval officer who commanded the aircraft career USS Enterprise before the Second World War. White became interested in Johns Hopkins after reading a chemistry textbook by Ira Remsen. Having been educated in a one-room schoolhouse in Tennessee, White instituted the Captain Newton White, Jr. scholarships in 1958, to provide an opportunity for students from Tennessee or Maryland to attend the University.

Jack and Frank Wilen Scholarship. Established in 1973 by Ruth Wilen Cooper in honor of her husband and brother-in-law. The fund is used to provide scholarship assistance to a needy and deserving Arts and Sciences undergraduate student who could not otherwise afford an education at Johns Hopkins.

Joseph S. Wimbrough and Robert W. Gelinas Memorial Scholarship. Established in 1976 by Mr. and Mrs. Joseph N. Wimbrough in memory of their sons, Joseph S. Wimbrough and Robert W. Gelinas. Preference is given to engineering students who demonstrate financial need.

Women's Lacrosse Scholarship. Established anonymously in 2002 to support members of the women's lacrosse team at Johns Hopkins.

William E. Woodyear Scholarship. Established in 1894 by Mrs. R. Blanche Woodyear as a memorial to her husband. Awards are based on academic merit and financial need.

Wye Scholarship. Established by Donald W. Curtis '38 in 1996 for undergraduate scholarships at the Whiting School of Engineering.

James Yewell Scholarship. Established in 2006 at the request of the late James M. Yewell. This fund is to be used for general scholarship aid.

Yaffe Family Scholarship. Established in 2000 by David Yaffe '74 and his wife, Deborah, to support an undergraduate scholarship for a Zanvyl Krieger School of Arts and Sciences sophomore who did not receive need-based

grant funding in his/her freshman year. The scholarship is awarded to academically talented students who achieve a minimum 3.0 GPA.

Yaffe Family Scholarship II. Established in 2004 by David Yaffe '74 and his wife, Deborah, to provide support for a first generation, non-pre-medical, Krieger School undergraduate with financial need.

Zitzmann Family Scholarship. Established in 1998 to support need-based undergraduates at the Zanvyl Krieger School of Arts and Sciences. Preference given to history, English, or political science majors.

Merit-Based Scholarships

Recipients are chosen from those students who have been determined eligible for merit-based funding.

Louis Azrael Fellowship in Communications. This fellowship honors the memory of Louis Azrael, a distinguished Baltimore newspaperman. It is awarded annually to a sophomore or junior student who is interested in pursuing a career in journalism, writing, radio, television, or another aspect of the communications industry.

Walter S. Baird Trust Fund. Established in 1980 by the late Dr. Walter S. Baird, a university trustee emeritus, for Whiting School students interested in physics. The award is based on academic merit.

The France-Merrick Foundations. Established to provide Homewood undergraduate scholarships for students engaging in community activities.

Conrad Gebelein Memorial Scholarships. Established in 1982 by alumni and friends of Conrad Gebelein, a talented musician and composer who was the Hopkins bandleader and director from 1924 to 1980. This scholarship is awarded annually to one or more junior or senior students who are currently members of the Johns Hopkins University Band and who exemplify such personal character traits as sensitivity, seriousness for musical excellence, and active participation in concert and sports events that endeared Conrad Gebelein to all who knew him.

Hodson-Gilliam Success Endowment. This endowment was established in 2005 by the Hodson Trust to provide partial tuition support for minority undergraduate students.

Hodson Humanities Merit Award. Established to provide undergraduate merit scholarships to Zanvyl Krieger School of Arts and Sciences students in the humanities.

Hodson Success Award. Established in 1993 by the Hodson Trust. The New Jersey trust was created by Thomas S. Hodson, father of Colonel Clarence S. Hodson who founded Beneficial Finance. These need-based awards assist underrepresented minority students from the mid-Atlantic region who are exceptionally talented. The scholarships guarantee that the students will be loan-free during their four years at Hopkins and have no work-study assignments during their first two years.

Hodson Scholarship Fund. Thomas S. Hodson, father of Colonel Clarence S. Hodson, founder of the Beneficial Finance System, created the Hodson Trust, which established the Hodson Fund. Income from this fund supports Hodson Scholarships (merit) and Hodson Success Awards (need-based) for exceptionally talented undergraduate students. Awards are made to incoming freshmen based on high school counselor nomination.

U.S. Army ROTC Scholarships. Army ROTC scholarships pay up to $20,000 per year and are awarded on the basis of merit rather than need. Four-year scholarships are available to high school seniors; three- and two-year scholarships are available to freshmen and sophomores, respectively. Further details may be obtained from the Director, Military Science Program, The Johns Hopkins University.

Charles Roger Westgate Scholarship in Engineering. Established in 1998 by Kwok-leung Li '79 and his wife Felice V. Li, '80 in honor of Charles Roger Westgate, the William B. Kouwenhoven Professor of Engineering. These scholarships are awarded based on merit and provide full tuition and partial support for room and board for four years of undergraduate study in engineering.

Not all of the scholarships listed here are available or will be awarded every year.

Graduate Fellowships

Graduate fellowships are determined by the academic departments. For complete information on graduate financial aid, see page 27.

Paul G. Agnew Fund. Established by the bequest of Mrs. Ethna M. Agnew in 1968, this fund provides graduate fellowships in the Department of Physics.

Mary D. Ainsworth Fund. Created in memory of Dr. Ainsworth, former faculty member at the Zanvyl Krieger School of Arts and Sciences, to support women graduate studies.

APL Fellowship in Science and Engineering. The Applied Physics Laboratory has established predoctoral fellowships for resident graduate students whose research interests are related to research at the APL. Students in the science and engineering departments are eligible. Interested students should contact the chair of the appropriate department. Applicants must be approved by the University Fellowship Committee and by the Applied Physics Laboratory.

ARCS Foundation Fellowships. The Washington Chapter of the ARCS Foundation, Inc., established annual Achievement Rewards for College Scientists at The Johns Hopkins University. Fellowships are generally awarded to graduate students in the areas of engineering, life sciences, mathematics, medicine, or physical sciences.

Susan J. Baisley '80 Graduate Fellowship. Created in 2007 by Susan Baisley '80, to endow a fellowship in the humanities.

Christina L. Balk Fellowship Fund. This fund was established to assist graduate student research in the Department of Earth and Planetary Sciences.

Robert Balk Fellowship Fund. This fund was established in 1964 by Dr. Christina L. Balk as a memorial to her late husband. Dr. Balk received her Ph.D. in geology from Johns Hopkins in 1933. In accordance with her wishes, awards are made to assist students in financing field work in geology.

Leon Gilbert Barnhart Memorial Fund. Established in 1984 by Gilbert and Laal Barnhart in memory of their son who was a member of the Class of 1967, this fund provides a one-term dissertation fellowship in the Philosophy Department.

August John Bauernschmidt Jr. Memorial Scholarship Fund. The estate of August J. Bauernschmidt Jr. provided an endowment fund which assists deserving and financially needy students in the Department of Earth and Planetary Sciences.

Isidor S. L. Bermann Memorial Fellowship. A bequest received in 1937 under the will of Mrs. Lillian Hunt Bermann established a fellowship as a memorial to her husband. The fellowship is awarded to a graduate student in the Department of Philosophy.

Bodmer Fellowship in Electrical and Computer Engineering. Established in 2009 by Max G. Bodmer '50, this fellowship supports a top student in the Department of Electrical and Computer Engineering.

Dr. Nathaniel Boggs Jr. Memorial Fellowship. This fellowship, established by Paula Boggs '81 in memory of her father, will support graduate students in the sciences who have done undergraduate work at historically black colleges or universities.

Gordon L. and Beatrice C. Bowles Fellowship. Established in 1999 by William R. Bowles '60, in memory of his parents, to provide financial aid to graduate students at the Whiting School of Engineering.

S. James and Marion D'Alessandro Fellowship. Established in 1995 by Dolores and Andrew Bozzelli '53 in honor of her parents, S. James and Marion D'Alessandro, to support outstanding master's degree candidates during the first semester of study in the Department of Biomedical Engineering.

Phillips and Camille Bradford Fellowship. Established in 2004 by Phillips Bradford '62 and his wife, Camille Bradford, to support deserving graduate students at the Whiting School of Engineering. Dr. Bradford wished to establish this fund to assist students, who like himself, want to obtain advanced degrees in engineering.

R. W. Bromery Fund. Established in 1995 in honor of Dr. Bromery to support graduate students in the Department of Earth and Planetary Sciences.

Louis M. Brown Engineering Fellowship. Established in 2004 by Louis M. Brown, Jr. '65 to support graduate students at the Whiting School of Engineering.

Adam T. Bruce Biology Fellowship. This endowed fellowship was established in 1887 in memory of Adam T. Bruce, Ph.D., former faculty member, by his mother. In 1925, Mr. Frederick Bruce, brother of Dr. Bruce, added to the fund for the purpose of awarding fellowships in biology.

Andrew and Elvira Bozzelli Fellowship. Established in 1995 by Dolores and Andrew Bozzelli '53 in honor of his parents, Andrew and Elvira Bozzelli, to support outstanding master's degree candidates during their first semester of study in the Department of Biomedical Engineering.

Emmett and Elsie Buhle Endowed Fund in Chemistry. This fellowship was established by Dr. and Mrs. Emmett Buhle, along with matching funds from American Home Products, to help support deserving graduate students in the Department of Chemistry.

Francis D. "Spike" Carlson Fellowship Fund. Established in 2000 by a grateful alumnus in memory of Francis D. Carlson '42 who was a distinguished faculty member and chair of the Department of Biophysics at the Krieger School of Arts and Sciences. This fellowship provides stipends or research grants to outstanding graduate students in the Jenkins Department of Biophysics.

Arthur Douglas and Ivan Fleming Chambers Fellowship in Chemistry. Established by Mrs. Grace Baker Chambers of Charlotte, North Carolina, to honor the memory of her husband, Ivan Fleming Chambers (Ph.D., Chemistry, University of Geneva, 1925) and his father, Arthur Douglas Chambers (Ph.D., Chemistry, The Johns Hopkins University, 1896). The fellowship supports exceptionally promising graduate students in the Department of Chemistry.

Chemical Foundation Fellowships. The Chemical Foundation, Inc., provided a gift to create this fellowship in the Department of Chemistry.

Howard and Jacqueline Chertkof Endowed Fellowship for Engineering Graduate Students. Established in 1999 by Howard L. Chertkof '57 and his wife, Jacqueline Chertkof, this fellowship supports graduate engineering students with preference given to students studying in the fields of emerging technologies.

Carl Christ Fellowship. This fund was established to support outstanding graduate students who are at the dissertation stage of their research in the Department of Economics.

Walter L. Clark Fellowship. Established by bequest, this fund supports graduate students with first preference given to students enrolled in the J.D./Ph.D. program in the Department of Psychological and Brain Sciences.

Ernst Cloos Memorial Fellowship. Established in 2007 by Miner B. Long '53, to support a graduate fellowship in the Department of Earth and Planetary Sciences.

Bernard M. Cohen Scholarship. A bequest by Dr. Cohen of Arlington, Virginia, established this fund to aid needy students in the sciences and humanities.

Harriet H. Cohen Engineering Fellowship. Established in 2004 by Neil L. Cohen '83 and his wife, Sherry Z. Cohen, in memory of Mr. Cohen's mother to provide support for graduate students at the Whiting School of Engineering.

The Charles and Catherine Counselman Endowed Fellowship. Established in 2000 by Charles C. '38 and his wife, Catherine Counselman, to provide financial aid to graduate students in the Department of Applied Mathematics and Statistics at the Whiting School of Engineering.

Creel Family Engineering Fellowship. Established in 2004 by George C. Creel '55 to support graduate students at the Whiting School of Engineering.

Gordon Croft Endowed Fellowship. Established in 1987 by L. Gordon Croft '56. This is awarded to students at the Whiting School of Engineering who reside in Charles County, Maryland, and who are U.S. citizens.

Allan C. and Dorothy H. Davis Fellowship. This fund provides graduate fellowship support to the Department of Physics and Astronomy for students in the field of astrophysics.

William and Lois Diamond Fellowship. This fellowship provides support to a graduate student in the Department of History and is awarded on the basis of academic merit.

H.A.B. Dunning Fellowship for Chemical Research. Dr. H.A.B. Dunning established this fellowship for chemical research in 1932.

Charles Albert Earp Fellowship. Established in 2005 to support graduate or prospective graduate students in the Department of History who are concentrating their studies in the areas relating to the American Civil War.

Dr. J. Brian Eby Fellowship in Geology. Established in 1976 by Dr. Eby, who received his undergraduate and graduate training at the university, this fellowship is awarded to a graduate student in the Department of Earth and Planetary Sciences.

Emma J. Edelstein Memorial Fellowship. This fellowship was created by the will of Dr. Ludwig Edelstein, former professor, in memory of Mrs. Edelstein. It is awarded annually to a graduate student in the Department of Classics.

Dwight D. Eisenhower Fellowship. In commemoration of General Eisenhower's birthday in 1963, a substantial number of members of the Capitol Hill Club of Washington, D.C., subscribed to the Dwight D. Eisenhower Scholarship Fund to be given to an institution selected by him. He selected The Johns Hopkins University, and a fellowship was established to support students studying American history.

A. Marshall Elliott Romance Scholarship. A bequest by Dr. A. Marshall Elliott established this scholarship for graduate students in the Department of Romance Languages.

David W. Elliott Memorial Fund. This fund was established to assist graduate students engaged in independent field work and to enhance in other ways geological field studies by students.

Endowed Fellowship in the Zanvyl Krieger School of Arts and Sciences. This fellowship was created with the express purpose of attracting the most outstanding students to the Zanvyl Krieger School of Arts and Sciences.

Doris Roberts Entwisle Teaching Fellowship. Supports an advanced graduate student in the Department of Sociology teaching an undergraduate course in the area of his or her dissertation research.

G. Heberton Evans, Jr. Graduate Fellowship. This fellowship was endowed by students, colleagues, and friends in memory of G. Heberton Evans Jr., A.B., Ph.D., professor and chair of Political Economy, and dean of the Faculty of Philosophy.

Gloria Flaherty Fellowship. Established in 1998 to provide graduate fellowships to worthy students specializing in eighteenth century literature in the Department of English.

F. Millard Foard Fellowship. This fellowship is in memory of F. Millard Foard, a graduate of Johns Hopkins University, Class of 1920, and is to be awarded to a graduate student studying the languages.

Georg Wilhelm Gail Fellowship Fund. This fellowship was established by the will of Georg Philip Landmann Gail in memory of his father, Georg Wilhelm Gail. The fellowship is used as the university may direct to aid deserving graduate students in the German Department.

William Gardner, Ph.D. Fellowship. Created by William Bentley Gardner, Ph.D. 1968, to support graduate students in the Department of Physics and Astronomy.

General Electric Foundation Fellowship. Established in 1982 by the foundation to encourage outstanding scholars in engineering and computer science to pursue academic careers. The fellowship is awarded to a graduating senior to assist with the first year of graduate work in a doctoral program in physics, chemistry, engineering, or computer science.

Basil L. Gildersleeve Fellowship. In 1925, alumni and friends created this fund to honor Dr. Basil Lanneau Gildersleeve, former professor of Greek. In her will, Professor Gildersleeve's widow added to the fund. The resulting annual fellowship is reserved for a student of Greek.

Jack Greene Endowed Fellowship. Supports research and travel for graduate students in the Department of History.

Gregory Fellowship in Engineering. Established in 2005 by the estate of Richard Sears Gregory '42 to support graduate students at the Whiting School of Engineering.

Harriet K. Greif Fellowship. This fund supports students participating in the master's of liberal arts program.

Eugene W. Gudger Fellowship. The endowment fund, established as a gift from Dr. Eugene W. Gudger in 1946, provides a fellowship for a graduate student in biology.

Clarence M. Guggenheimer Fund. This fund was established in 1976 by Mrs. Irma H. Guggenheimer in memory of her late husband. Awards are made to graduate students in the field of political economy.

Lee and Albert H. Halff Doctoral Student Award. Established in 2005 by Dr. Albert H. Halff '50 to provide support to a doctoral student with exceptional work in the Department of Geography and Environmental Engineering at the Whiting School of Engineering.

Ferdinand Hamburger, Jr. Fellowship in Electrical Engineering. Established in 1994 by the estate of Dr. Hamburger '24, '31 and his wife, Opal L. Hamburger '39. This fellowship is named for professor emeritus and former chair of the Electrical Engineering Department, Ferdinand Hamburger Jr., this fund provides fellowships for graduate students in electrical engineering.

Cornelia G. Harcum Fellowship. As the result of a bequest of Miss Cornelia G. Harcum, former student in the Department of Archaeology, the university has established a fellowship open to women students in classical archaeology.

Ralph Harper Endowment. Supports students participating in the master's of liberal arts program.

James Hart Fellowship in Political Science. By a bequest of Jane Lewis Hart, this fellowship in political science was established in 1972.

The Carl E. Heath Fellowship. Established by Dr. Carl E. Heath Jr. '52. The fund provides support for female graduate students at the Whiting School of Engineering.

Richard C. Henry Fund. Established in 1993 in honor of Dr. Henry to support graduate students who display academic interest in contributing a project to the Space Grant Consortium or in the department of Physics and Astronomy.

Ada Sinz Hill Fellowship. This fellowship is to be awarded to a woman graduate student in the Department of Chemistry.

Hodson Fellowship Fund in the Humanities. The Hodson Trust was created by Thomas S. Hodson, brother of Colonel Clarence S. Hodson, who was the founder of the Beneficial Hodson Finance System. The Hodson Trust established the Hodson Fellowship Fund in the Humanities. Income of the fund will support outstanding graduates who intend to pursue careers in college teaching.

Laurence B. Holland Graduate Fellowship in American Literature. The Holland Fellowship provides dissertation year support for a doctoral candidate pursuing research in American literature in the Department of English.

Alfred, Meta E., Ella, Charles and Maggie Horstmeier Memorial Fund. This fellowship was established by the bequest of Ella M. S. Horstmeier in 1947. The fund is used to provide tuition for a student or students of advanced German and German prose composition.

William H. Huggins Fellowship in Electrical and Computer Engineering. Established in 2001 by William H. Huggins, this fund provides support for students and faculty who demonstrate excellence in teaching, academic achievement, and research and to advance electrical and computer engineering at the Whiting School of Engineering.

Warren B. Hunting Scholarship. In 1925, Mrs. Alice E. Hunting endowed a fellowship fund to honor her son, Warren Belknap Hunting. The scholarship is open to graduate students in the field of political science.

Rufus P. Isaacs Graduate Fellowship. This fund, established in 1982 by the Department of Mathematical Sciences in memory of Rufus Isaacs, engineering professor emeritus, provides a first-year fellowship for a student in mathematical sciences at the Whiting School of Engineering.

Joel Stewart Ish Fellowship. Established to honor the memory of Joel Stewart Ish '69, '71, '75 by his family and friends, this fund annually provides one or more graduate fellowships in the Department of Political Science.

Samuel Iwry Fund. Founded with the generous help of Mr. Alvin Blum, Class of 1930, to honor Professor Samuel Iwry, this fund provides assistance to graduate students of biblical and Hebraic studies in the Department of Near Eastern Studies.

George and Sylvia Kagan Graduate Fellowship. Established in 2005 through the estate of George M. Kagan to support doctoral candidates in the Department of History.

Martha and Rebecca Katz Graduate Loan Fund. This fund provides loans for graduate students at the School of Arts and Sciences.

Adolf Katzenellenbogen Memorial Fund. Established by the Maryland Vassar Club in 1966 through contributions from friends and students, this memorial fund honors Professor Adolf Katzenellenbogen, who came to Johns Hopkins from Vassar to become chair of the Department of History of Art. Awards are made to outstanding students in this department.

Cornelia Hohenberg Kaye Memorial Research Grant in German-Austrian Culture. This endowment will provide travel and research money to a graduate student planning a dissertation on some aspect of modern (late- 19th- and 20th-century) culture in Germany and/or Austria.

Donald E. Kerr Sr. and Barbara Kerr Stanley Fellowship in the Department of Physics and Astronomy. Established in 1999 by Mrs. Stanley in memory of her first husband, who taught in the department from 1949 to 1975. The fellowship will be awarded to a graduate student of exceptional promise who exemplifies Dr. Kerr's dedication to the field of physics.

Martin and Mary Kilpatrick Fellowship. The estate of Martin and Mary Kilpatrick established this fellowship to provide support for students of exceptional ability and promise in the Department of Chemistry.

Alexander Kossiakoff Fellowship. This fellowship was established in 1997 to provide an annual award to a graduate student in the Department of Chemistry.

Samuel H. Kress Foundation Fellowship. In 1964, the Kress Foundation Fellowship in the History of Art was established.

History of Art Department Internship Program at the Walters Art Museum. Established in 1999 by Zanvyl Krieger '28, as a gift to, and matched by, The Walters Art Museum. The fellowship funds doctoral students at the dissertation stage in the history of art to conduct curatorial work at the Walters and, after being awarded the Ph.D., to serve there as postdoctoral fellows. The School of Arts and Sciences was named for Mr. Krieger in 1995.

Carrie M. Kurrelmeyer Fund Endowment. Created in 1992 by a planned gift from Dr. Carrie M. Zintl, the funds are to be used for fellowships and library acquisitions for the Department of History of Art.

Professor William Kurrelmeyer Fund. A bequest by Dr. Carrie M. Kurrelmeyer Zintl, the fund supports fellowships for needy and deserving graduate students in the Department of German, especially those who are engaged as instructors in said department.

Malcolm Lauchheimer Fellowship. This fund was established to support graduate fellowships in history or political science.

Leon Lauer Fellowship. This fund was established in 1941 by the gift of Mrs. Martha Frank Lauer, to provide a fellowship for a student at the Schools of Arts and Sciences or Engineering.

Hassie Roseman Lichtenstein and Reuben Roseman Fellowship. Established by Dr. Ephraim Roseman '33, in memory of his sister Hassie R. Lichtenstein and his brother Reuben '29, '33, the fellowship will support a graduate student in the Department of Chemistry.

Richard A. Macksey Fellowship in the Humanities. Established in 2000 by an alumnus of the class of 1981 to honor Professor Richard Macksey and his dedication to the humanities and to undergraduate and graduate education. This fellowship will be awarded to the graduate student assigned to coordinate the Honors Program in the Humanities Center, which the donor cites as "one of the great highlights of a Hopkins education."

Leon Madansky Postdoctoral Fellowship in the Henry A. Rowland Department of Physics and Astronomy. Established in 2000 by Rena Madansky in memory of her husband who was a professor in the Department of Physics and Astronomy from 1948 until his death in 2000. This fellowship will support a postdoctoral graduate in theoretical high energy (particle) physics who demonstrates intellectual independence and exceptional creativity.

Ernest M. Marks Graduate Fellowship. This fellowship provides support for an outstanding graduate student in the Department of Chemistry.

William H. McClain Dissertation Fund. Established by friends and alumni of the Department of German in honor of Professor William McClain, this fund provides dissertation support for a doctoral candidate in the German Department.

Johns Hopkins Medtronic Fellows Program. Funded by The Medtronic Foundation, this fellowship awards graduate students in the field of biomedical engineering design and research with preference given to women, underrepresented minorities, or economically disadvantaged students who many not have been able to attend graduate school for financial reasons.

Joseph Meyerhoff Fellowship. Established in 1979 by Joseph Meyerhoff who had attended the University in 1918. The fellowship provides support to deserving students at the Whiting School of Engineering who are studying civil engineering at the graduate level.

Mellon Endowment for Doctoral Students in the Humanities. Created by the Andrew W. Mellon Foundation In 1983 to support doctoral students in the humanities.

Hortense G. Moses Scholarship. This scholarship, funded by the Federation of Jewish Women's Organizations, was established for the encouragement of education in Hebrew at the university and is to be awarded annually to a student for outstanding work in elementary Hebrew.

James M. Motley Fellowship. The income of this fund is to be awarded each year by the university to a student doing advanced work in the humanities.

Nancy Norris Fellowship. Supports students participating in the master's of liberal arts program.

Leonard Obert Graduate Fellowship Fund. Awards from this fund, which was set up through the generosity of Dr. Leonard Obert '38, are made to graduate students at the Krieger School of Arts and Sciences based upon academic accomplishment and financial need.

George Owen Fellowship. This fund was established in 1992 by Dr. Deha Owen in memory of her late husband. The fund supports graduate fellowships at the Krieger School of Arts and Sciences.

Charles Lathrop Pack Fellowship in Memory of John Grier Hibben. This fellowship is available to a graduate student in the Department of Political Science for study in international relations.

Charles Lathrop Pack Fellowship in Memory of Walter Hines Page. This fellowship is available to a graduate student at the Krieger School of Arts and Sciences who is interested in international relations.

Payback Fellowship. Established in 2004 by an anonymous donor to support graduate students at the Whiting School of Engineering. The fund was established to "pay back" the state of Maryland for Senatorial Scholarships the donor received while attending Johns Hopkins.

George Peabody Scholarship Fund. Established in 1912 to support graduate or undergraduate students in the Department of Sociology whose focus is in the field of education.

Francis J. Pettijohn Scholarship in Geology in the Department of Earth and Planetary Sciences. This scholarship will support a graduate student in the Department of Earth and Planetary Sciences and be awarded based on merit and financial need.

Bridgette Phillips Memorial Fund. This fund supports a fellowship in Byzantine and medieval studies in the Department of History.

Robert B. Pond, Sr. Fellowship. This fund was established by an anonymous donor in 2004 to support deserving graduate students at the Whiting School of Engineering.

T. Rowe Price Memorial Fellowships. Established in 1984 to honor the memory of Mr. T. Rowe Price by the T. Rowe Price Associates Foundation, this fund makes available two fellowships each year for the most outstanding doctoral candidates in the Department of Economics: one to a first-year and the other to a continuing student. Preference is given to students interested in international economics.

Walter Cottrell Quincy Fund. This fund was endowed by bequest of Mrs. Martha R. Quincy and provides four annual awards for deserving students in the Department of Physics.

William S. Rayner Fellowship. This fellowship was endowed by Mrs. Bertha Rayner Frank and Mr. Albert W. Rayner in memory of their father. Candidates are selected from those doing advanced work in Semitic languages.

William A. Reinsch Fellowship. This fellowship is meant to augment stipends and provide research support for promising young scholars in the Department of Political Science whose work relates to one of the following areas of interest: the emergence of China, globalization, or international trade and security.

Hoomes Rich Graduate Fellowship. Established through an estate gift, this fund provides first-year fellowship support for graduate students in the Department of Civil Engineering at the Whiting School of Engineering.

Walter L. Robb Fellowship. Established in 2003 by Walter L. Robb to support deserving graduate students at the Whiting School of Engineering.

Donald S. Rodbell Memorial Fellowship. Established by Adele Rodbell in memory of her husband, Donald S. Rodbell '49, '53 to support second-year Ph.D. candidates in the Department of Materials Science and Engineering who best exemplify the interests and determination of Dr. Rodbell, an engineer, physicist, and materials scientist.

Edmund Law Rogers Fellowship. Endowed by Mrs. Edmund Law Rogers and her daughter, Mrs. Kirby Flower Smith, this fellowship is awarded annually in the Classics Department.

George Henry Rogers and Mary Rogers Memorial Fellowship. In 1950, by a bequest of Mrs. Keziah Rogers, an endowed fellowship was established for research in the Departments of Chemistry and Physics.

Ben and Esther Rosenbloom Foundation Fellowship. This fund was established to provide fellowships for graduate students at the Krieger School of Arts and Sciences.

John W. and Mary Lou Ross Fellowship in the Department of Materials Science and Engineering. This fund was established through an estate gift to provide graduate support for students at the Whiting School of Engineering who are academically eligible and deserving of financial need. Preference is given to students majoring in materials science and engineering.

The Sadie and Louis Roth Fellowship. The Sadie and Louis Roth Fellowship was established by Anthony Paul Leichter to provide assistance for graduate students studying art history.

Dean Robert H. Roy Fellowship. Established in 1990 by various alumni and friends in recognition of Rob Roy '28, former dean of the School of Engineering. This fund supports interdepartmental fellowships for graduate education at the Whiting School of Engineering.

David Sachs Graduate Fellowships in Philosophy. Established in 1999 by the estate of David Sachs, professor emeritus of philosophy. A member of the faculty from 1969 to 1992, he was noted for his scholarship in the areas of ancient philosophy, philosophy of the mind, and ethics. The fellowship assists academically meritorious graduate students in philosophy.

Jay D. Samstag Engineering Fellowship. Established in 2004 by Jay D. Samstag '60 in honor of his parents, Phil and Helen Samstag, to provide support for graduate students at the Whiting School of Engineering.

Dr. Benjamin T. Sankey Fellowship. Established to assist graduate students in the writing seminars department of the Zanvyl Krieger School of Arts and Sciences.

William H. Schwarz Instructorship. Established in 2000 by alumni from the Class of 1953 to honor William H. Schwarz, '51, '55, '57 and his commitment to making the Undergraduate Chemical Engineering Laboratory a defining moment of undergraduate education. The fellowship supports graduate students who are teaching in the laboratory.

John Adams Scott Fellowship. In 1928, John C. Schaffer endowed this fellowship for a student in Greek, honoring Professor Scott of Northwestern University, who received the degree of doctor of philosophy from Johns Hopkins in 1897.

Siebel Scholars Program. Funded by The Siebel Scholars Foundation, this fellowship is awarded to students entering the final year of their master's or doctoral program in a biomedical engineering discipline. The fellows are selected based on merit.

Charles S. Singleton Estate. This bequest supports graduate fellowships for the study of Italian literature and provides travel funds to and from Italy for that purpose.

Ella E. Slack Scholarship. Endowed by the bequest of Mrs. Ella E. Slack of Baltimore, Maryland, to provide a fellowship in the graduate school.

John W. Snow Fellowship. Supports students participating in the master of liberal arts program.

Rudolph Sonneborn Fellowship. Established by Dr. and Mrs. Henry Sonneborn III and Mr. Rudolf G. Sonneborn, this award provides a fellowship in the Department of Chemistry.

Villa Spelman Travel Fellowship. Established in 1994 to enable graduate students to travel to Italy for the study of works of art.

Joseph Evans Sperry Fellowship. By the bequest of Mrs. Lee Wilson Sperry, a fellowship was established for a student whose doctoral dissertation will be concerned with the history of architecture.

Leonard and Helen R. Stulman Fellowship in the Humanities. Established by Leonard Stulman '25 and Helen Stulman to support humanities graduate students in the Krieger School of Arts and Sciences.

Nicole Suveges Fellowship. Created in 2008 in memory of Nicole Suveges, a Hopkins graduate student in the Department of Political Science who was killed in Iraq. The fund supports field research among graduate students in comparative politics or international relations.

Doris S. Sweet Fellowship. Supports students participating in the master's of liberal arts program.

Gaston I. Sweitzer Fellowship Fund. As a result of a bequest of Ida Lockwood Sweitzer, this fund was established to aid minority students at the Krieger School of Arts and Sciences.

Richard A. and Rachel M. Swirnow Fellowship. Established in 2007 by Richard A. Swirnow '55 and his wife, Rachel M. Swirnow, through The Swirnow Charitable Foundation, Inc. This graduate fellowship is awarded to biomedical engineering students with preference given to students majoring in biomedical engineering design.

Ellen E. Swomley, Ph.D. '46, Endowed Fellowship Fund in Physics and Astronomy. The purpose of this fund is to provide fellowship aid for qualified graduate students in the Department of Physics and Astronomy.

Roszel C. Thomsen Scholarship. Supports students participating in the master's of liberal arts program.

Frederick Jackson Turner Society Fellowship. This fund supports graduate students in the Department of History.

United States Steel Foundation Loan Fund. This fund provides loans for graduate students at the Schools of Arts and Sciences and Engineering.

University Fellowships and Teaching Assistantships. A number of fellowships and teaching assistantships are provided by the university to all departments in the School of Arts and Sciences and School of Engineering on an annual basis. Fellowships may provide stipends and tuition support.

Robert S. Waldrop and Dorothy L. Waldrop Fellowship. Established in 2007 to provide fellowship support for promising graduate students in the Department of Psychological and Brain Sciences.

Arnold E. Waters, Jr. and Elizabeth Stewart Waters Fund. Income from this fund is used to support students in the Department of Earth and Planetary Sciences.

Herman A. Weinstein MLA Fellowship. Supports students participating in the master's of liberal arts program.

Marshall K. Wiley Fellowship. Supports students participating in the master's of liberal arts program.

Lois V. Williams Fellowship. Established in 2003 through the estate of Lois V. Williams '46 to support graduate students at the Zanvyl Krieger School of Arts and Sciences.

Abel Wolman Fellowship. Established in 1986 by the Whiting School of Engineering in honor of longtime faculty member Abel Wolman '15 to attract the strongest doctoral applicants. Wolman Fellowships are given on a competitive basis to outstanding first-year doctoral students.

Harry Woolf Fellowship. Established in 1990 to support graduate fellows in the Department of History of Science and Technology.

Jun Wu and Yan Zhang Endowed Graduate Student Fellowship. Established in 2006 by Jun Wu '98, '03 and his wife, Yan Zhang, for graduate fellowships in the Department of Computer Science at the Whiting School of Engineering.

Virginia and Edward Wysocki, Sr. Memorial Fellowship in Electrical and Computer Engineering. Established in 2004 by Edward M. Wysocki Jr. '72, '77 in memory of his parents. This fund provides financial aid to graduate students in the Department of Electrical and Computer Engineering at the Whiting School of Engineering.

Dr. Eugene W. Zeltmann and Susan C. Zeltmann Fellowship in Chemistry. This fellowship was established in 1999 by Eugene Zeltmann, Ph.D., who received his doctorate in chemistry from Johns Hopkins in 1967, and his wife, Susan. The fellowship will provide support to graduate students in the Department of Chemistry at the Zanvyl Krieger School of Arts and Sciences.

Awards and Prizes

Awards and prizes are determined by the academic department or by selected committees.

William H. and Martha P. Amend Award. This award is given to a student participating in ROTC who demonstrates outstanding leadership ability and academic accomplishment.

American Institute of Chemical Engineers Award for Scholastic Achievement. Presented to the chemical and biomolecular engineering student with the highest scholastic standing after the sophomore year.

Applied Mathematics and Statistics Achievement Award. This award recognizes outstanding achievement by an applied math and statistics undergraduate across a broad spectrum of departmental activities including academic performance, research, pedagogy, and leadership.

Applied Mathematics and Statistics Award for Excellence in Teaching. This award is presented to a student, serving as a teaching assistant or teaching fellow in the Department of Applied Math and Statistics, deemed the most able instructor by students and faculty.

Applied Mathematics and Statistics Mathematical Modeling Competition Prize. This prize is given to the team submitting the best solution in the Consortium for Mathematics and its Applications Annual International Mathematical Modeling Competition.

Alexander K. Barton Cup. The Alexander K. Barton Cup is awarded each year to that member of the senior class of any undergraduate department of the university who has most faithfully served the interests and ideals of the university and who, by his character and influence throughout his collegiate course, has best exemplified the qualities which earned and held for Alexander K. Barton, of the Class of 1914 of The Johns Hopkins University, the respect and affection of his fellows, both during his course and his life outside.

James F. Bell Award. Established in honor of James F. Bell, professor emeritus in the Department of Mechanical Engineering, this award recognizes outstanding research and scholarly achievement in mechanical engineering.

Biomedical Engineering Distinguished Service Award. This award is presented to biomedical engineering students who have demonstrated outstanding service to the academic community through their work with the Biomedical Engineering Society (BMES) or the Biomedical Engineering Honor Society (BMEHS).

H. L. Brown Family Travel Award. Awarded to an undergraduate majoring in international studies to assist with travel expenses related to their major.

Lucien Brush Award for Excellence in Environmental Engineering. Established in memory of Lucien M. Brush Jr., who was a faculty member in the Department of Geography and Environmental Engineering for 25 years. This

award is presented annually to the graduating senior with outstanding achievement in environmental engineering.

Alexander R. and Avis M. Butler Prize. This prize is awarded annually in the Department of History for the best research paper written by a student in the first year of graduate study. The prize was established in 1957 by Professor Butler, who received his doctoral degree from the Department of History.

Center for Leadership Education Course Assistant Excellence Award. Established in 2003 to honor the commitment and dedication of outstanding course assistants who have served the Center for Leadership throughout the year. Selection is based on student, faculty, and staff evaluations.

Chemical and Biomolecular Engineering Undergraduate Research Award. Awarded to an undergraduate student who demonstrates contributions to research in Chemical and Biomolecular Engineering.

Chemical and Biomolecular Engineering Special Service Award. Awarded to a non-major student who has made outstanding contributions to the Department of Chemical and Biomolecular Engineering.

Civil Engineering Award. This award is given for outstanding achievement by a graduating senior for academic excellence, leadership, and service in the Department of Civil Engineering.

James S. Coleman Award. This award was established by the Department of Sociology in 1994 in honor of Dr. James S. Coleman, first chair of the department. The award is for outstanding academic achievement by a senior majoring in sociology and is presented at graduation.

Computer Science Outstanding Senior Award. Presented annually to a senior computer science major for academic excellence, leadership, and service in computer science.

Computer Science Outstanding Teaching Award. Presented annually to a student who has demonstrated outstanding effort and skill in assisting with the teaching of computer science courses.

Computer Science Special Service Award. Presented annually to a student who has performed outstanding work to benefit the Department of Computer Science, Johns Hopkins University and the community.

Charles A. Conklin Award. This award honors Charles A. Conklin III '27. This award is presented to outstanding electrical and computer engineering seniors to recognize their academic achievements.

Paul A. C. Cook Award. This award was established by Mrs. Ellie Cook in memory of her husband Paul A. C. Cook, an alumnus of the School of Engineering. The award, which is to be presented annually to an outstanding chemical and biomolecular engineering student who is a sophomore or junior.

Creel Family Teaching Assistant Award. Established in 2004 by George C. Creel '55 to honor the effort, enthusiasm, and contribution of teaching assistants in the Department of Mechanical Engineering.

The Evangelia Davos Prize. Established in 2007 by Peter Davos '00 in memory of his aunt, this prize is awarded annually to the Classics major or minor whose work in Greek studies has been outstanding.

Professor Joel Dean Undergraduate Teaching Awards. Established by Whiting and Krieger School parent Joel Dean to honor his father and funded by the Joel Dean Foundation, this award honors graduate student teaching assistants in the Department of Applied Mathematics and Statistics who demonstrate an intense devotion to teaching and a talent for making mathematics more understandable.

Department of Geography and Environmental Engineering Faculty Award. This award is given to a senior for outstanding service and academic achievement in the Department of Geography and Environmental Engineering.

The Christopher B. Elser Award. Established in 2004 by friends and family of the late Christopher Elser. In his time at Hopkins, Chris dedicated himself to his friends, soccer, his studies, and the community around him. Awarded annually to a bright and talented upperclassman who shares Chris's passion for athletics and dedication to the community, it is the family's hope that this award will keep Chris's spirit alive on the Homewood campus and beyond.

Francis J. and Mary T. Fisher Research Award. Established by the Fisher family to honor Francis J. Fisher '63, a committed supporter of the Whiting and Krieger Schools. This award is given annually to an undergraduate student who is excelling academically and is engaged in basic or applied cancer research.

William J. Friday Award. Established in 1997 through the estate of William J. Friday. It is given annually to students in the graduating class who have been designated by the faculty as deserving students.

Genentech Process Research and Development Outstanding Student Award. Established in 2008, Genentech recognizes an outstanding chemical and biomolecular engineering student in disciplines related to the needs of the biotechnology industry.

Robert George Gerstmyer Award. Established in memory of Mr. Gerstmyer '43 by his two sons and awarded for outstanding undergraduate achievement in mechanical engineering.

Father George S. Glanzman Award. Established in memory of Father George S. Glanzman, a former faculty member of the Department of Near Eastern Studies, this prize is awarded annually for the outstanding paper by an undergraduate or graduate student in Near Eastern Studies.

Louis E. Goodman, M.D. Award. Established by the late Dr. Goodman, a member of the Class of 1934, and his family, to encourage the cultural interests of premedical students at Johns Hopkins and to foster their sensitivity to ideas and matters beyond the realm of medicine. Awarded to a student in his or her junior year to carry out an independent project in the arts or humanities.

Belle and Herman Hammerman Award. This award was established by Belle and Herman Hammerman in honor of their son, Judge Robert I.H. '50. It is presented to a senior who is entering law school and has combined academic excellence with outstanding qualities of leadership. The award, which includes an inscribed gold medal, is presented at Commencement.

Max Hochschild Fund. This prize fund was established in 1954 by Mrs. Charles R. Austrian and Mrs. Albert D. Hutzler to honor their father, Max Hochschild, on his 100th birthday. The prize is awarded annually to the undergraduate student in economics who has shown the greatest promise and proficiency in this field. The recipient of the prize is determined by the Department of Economics and receives the award at Commencement.

Jacob H. Hollander Prize Fund. For a number of years Professor Jacob H. Hollander, former chair of the Department of Political Economy, awarded a prize for the best contribution to a college student journal. He bequeathed a sum to the university, the income from which is now awarded annually to an outstanding undergraduate enrolled in the Writing Seminars as selected by the faculty of that department.

William H. Huggins Awards. Established in 1985, these awards are presented to a senior and a junior in the Department of Electrical and Computer Engineering for outstanding scholarship and service to the department and to his or her fellow students.

Howard Hughes Summer Research Program. The goal of the Howard Hughes Undergraduate Summer Research Fellowship Program is to encourage undergraduates in the Schools of Arts and Sciences and Engineering to pursue a career in biomedical and/or basic research. Fellows receive a stipend of $3,000 and work in the lab of their choice for nine weeks during the summer. Their research results are presented at the end of the program at a poster session. This program, which is open to freshmen, sophomores, and juniors, not only offers an invaluable learning experience but also helps develop important skills in proposal writing, obtaining research funding, carrying out a project, and reporting the results. The Johns Hopkins University gratefully acknowledges the Howard Hughes Medical Institute, which provides the funding for this program.

Richard J. Johns Award. This award was established in honor of Richard J. Johns, M.D., the first director of the Department of Biomedical Engineering. It is presented to students who have achieved a high level of academic success.

Joseph L. Katz Award. Established in 2008, this award is given to chemical and biomolecular engineering seniors for academic excellence in the engineering senior lab course and for service to the department and fellow students.

Professor Donald E. Kerr Memorial Physics Award. Established by Mr. Albert Nerken in memory of Professor Kerr of the Department of Physics, this award and a medal are awarded annually to the outstanding undergraduate student majoring in physics.

Arthur M. Kouguell Prize. This award was established by the parents and friends of the late Arthur M. Kouguell, Class of 1973. The prize is given annually by the Department of History to the graduating senior whose overall academic performance as a history major best represents Arthur Kouguell's commitment to scholarly and humane values.

Martin C. Larrabee Award in Biophysics. This award was established by the colleagues, former students, and other friends of Martin C. Larrabee, faculty member in the Department of Biophysics, on the occasion of his 70th birthday. It is awarded annually to a senior for meritorious research in biophysics.

Ernest M. Marks Award. This award is made to graduate teaching assistants in the Department of Chemistry in recognition of excellence in instruction.

Irini J. Maroulis Award. Established in 2010 by Maria Maroulis '96, '01 in honor of her mother, Irini J. Maroulis, this award recognizes an undergraduate engineering student who best exemplifies her dedication to community service and outreach.

Materials Science and Engineering Achievement Award. Awarded for outstanding achievement by a graduating senior in Materials Science and Engineering.

Senior Design Engineering Award. Recognizes an undergraduate with outstanding contributions to the design and conduct of an independent research project in the Department of Materials Science and Engineering.

Paul A. McCoy Prize. In 1958, a fund was established by Mr. and Mrs. Neal McCoy in memory of their son, a former graduate student in political science at the university. An annual gift for the most distinguished master's essay in political science is awarded to a student selected by a professional committee of that department.

Maryland Section of the American Society of Civil Engineers Scholarship Award. This award was established by the Maryland Section of the American Society of Civil Engineers. It is presented to civil engineering students who have achieved a high level of academic success.

Charles A. Miller Award. Named for Charles A. Miller Jr. '40, this award recognizes outstanding academic achievement by a mechanical engineering undergraduate.

William Miller Essay Prize. The William Miller Essay Prize is awarded annually for a self-contained essay of outstanding quality in any field of philosophy. The $1000 award

is open to students in philosophy at the pre-dissertation stage of their graduate work.

William Kelso Morrill Award. The William Kelso Morrill Award for excellence in the teaching of mathematics is awarded every spring to the graduate student who best exemplifies the traits of Kelso Morrill: a love of mathematics, a love of teaching, and a concern for students.

Michael J. Muuss Research Award. Established by Dr. Rolf Muuss in honor of his son, Michael J. Muuss '79. The award is given each year to a Department of Computer Science undergraduate for the best application of research to practice.

The Naddor Prize. Established in honor of the late Professor Eliezer Naddor, the first recipient of a Ph.D. in operations research in the United States and a long-time faculty member in the department. This prize is awarded to a non-senior applied mathematics and statistics student for distinguished academic or extracurricular activities.

David Olton Memorial Endowment Fund. This memorial was established in 1994 in memory of David S. Olton, a former professor in the Department of Psychological and Brain Sciences at The Johns Hopkins University. This fund provides an annual award to a graduating senior for undergraduate excellence in psychology. It also sponsors a yearly speaker in the area of behavioral neuroscience in honor of Dr. Olton's important contributions in that field.

Christopher J. Pinto Memorial Award. Established by alumni of the Tau Epsilon Phi Fraternity, members of the Class of 1984, and friends of the Pinto family, this award is presented to a senior reflecting the academic and leadership abilities and strong moral character of Chris Pinto, a member of the Class of 1984 who died in his senior year.

Joseph C. Pistritto Research Award. This undergraduate research award in computer science was established in 2000 by Joseph C. Pistritto '79, '80 a Department of Electrical and Computer Engineering alumnus, and is designed to support and foster excellence in undergraduate research.

Robert B. Pond Sr. Achievement Award. This award was established by the colleagues, former students, and other friends of Professor Robert B. Pond Sr., in recognition of his devotion to undergraduate education and his extraordinary ability to motivate and evoke sincere interest from students and colleagues alike. This award is given annually by the Department of Materials Science and Engineering to the graduating senior who best exemplifies Robert Pond's commitment to scholarly and humane values.

The Provost's Undergraduate Research Awards. The Provost's Undergraduate Research Awards program is an effort to encourage undergraduates to engage in research activity. This program was founded on the belief that involvement in research not only enhances a student's learning experience, but helps develop important skills in proposal writing, obtaining research funding, carrying out a project, and reporting the results. When students work with faculty sponsors, these skills are nurtured and fine-tuned. The research is performed in either the summer or fall, and any freshman, sophomore, or junior is eligible to apply. Each year, students receive awards in amounts up to $2,500, with the option of conducting their research for academic credit. The Johns Hopkins University gratefully acknowledges the Hodson Trust which has donated the funding for this program.

Sarah and Adolph Roseman Achievement Award. This award in chemistry was established in 1966 by Dr. Ephraim Roseman in memory of his parents. The annual gift is awarded in recognition of outstanding accomplishment in chemistry. The chair of the department determines the student recipient or recipients, and presentation is made at Commencement.

Robert Bruce Roulston Prize. Contributions were received beginning in 1944 from former students, colleagues, and friends of Professor Roulston of the Department of German to establish this fund to honor him on the occasion of his retirement from the University. Income from the fund is used for the annual Robert Bruce Roulston Prize for German, which is awarded to the best student in German.

Royal Society of Arts Silver Medal. This prize is awarded for distinguished achievement by an undergraduate in the application of art or science in the field of commerce or industry, and for significant participation in student activities.

Dr. Diane O'Connor Salazar Award. This award was established in memory of Diane O'Connor Salazar '89 by her family. This is an annual award in the Department of Chemistry, with first preference given to a female graduate student.

David G. Sandberg Award for Campus Leadership. This award, established in 1991 in honor of David G. Sandberg, a member of the Class of 1972, is presented annually to an outstanding junior who has demonstrated dedication to a variety of co-curricular organizations and activities.

Gerard H. Schlimm Award. The Schlimm Award is presented annually to an undergraduate student for exceptional accomplishments in the field of civil engineering.

William N. Sharpe Jr. Award for Student Involvement. This award honors Professor William N. Sharpe, Jr., founding chair of the Department of Mechanical Engineering, and recognizes significant leadership or achievement by a mechanical engineering student in extracurricular activities.

Shriver-Howard Scholar Athlete Award. Established by Dr. William H. B. Howard '63 in honor of George Van Bibber Shriver, John Schultz Shriver, William Hand Browne Howard, and Harriet Shriver Rogers, this award is made to the graduating senior who has demonstrated outstanding achievement both academically and athletically while at Johns Hopkins.

The Smile Train Award. The Smile Train is a nonprofit organization that is dedicated to helping children born with cleft lips and cleft palates. Working internationally, the Smile Train's goal is to eradicate the problem of clefts through a comprehensive approach to training doctors, making surgeries available to children and supporting research to find a cure. Additional information on the Smile Train can be found at www.smiletrain.org. Internship awards are being offered to undergraduates who may work in various areas as they apply to cleft lips and palates. Project scope may include but is not limited to clinical studies, genetic research, computer profiling, virtual surgery, speech pathology, psycho/social aspects, health care coverage, and internships with craniofacial teams. These are paid internships and include a trip to New York City where the Smile Train scholars will provide a written report on their project and participate in a symposium.

George M. L. Sommerman Engineering Graduate Teaching Assistant Award. This annual award recognizes one or more Whiting School of Engineering graduate teaching assistants who have demonstrated excellence and talent in their instruction of undergraduate students.

Julian C. Stanley Award. Established to provide an annual award to an undergraduate student in the Department of Psychological and Brain Sciences who most closely approximates Dr. Stanley's personal and professional standards of excellence.

Louis Sudler Prize in the Arts. The Louis Sudler Prize in the Arts is awarded at Commencement to a graduating senior from the Krieger School of Arts and Sciences or the Whiting School of Engineering or a fourth-year student at the School of Medicine who, in the opinion of the faculty, has demonstrated excellence or the highest proficiency in performance, execution, or composition in one of the following general areas: music, theater, writing, painting, sculpture, or visual media such as film, photography or videotape. The prize is made possible through the generosity of Mr. Louis Sudler, chairman of Sudler and Company, Chicago, who has had a lifelong commitment to the arts and particularly to music.

Tau Beta Pi Appreciation Awards. To recognize the most active senior members of the Johns Hopkins chapter of Tau Beta Pi.

Linda Trinh Memorial Award. Established in memory of Linda Trinh, Class of 2005, and awarded to a biomedical engineering design team that embodies her spirit, qualities and accomplishments.

Robert Tucker Prize in International Studies. The Tucker Prize is awarded for the best undergraduate senior thesis in international studies.

Julius Turner Memorial Prize. Parents, friends, and relatives of the late Julius Turner, former student and teacher of political science, have contributed funds to make available an annual prize every spring for the best senior essay in the Department of Political Science. A committee consisting of faculty and alumni makes the presentation annually. All majors in the Department of Political Science are eligible to compete.

Severn Teackle Wallis Memorial Prize. Received from the Wallis Memorial Association in 1906, this fund provides a prize for an outstanding essay in Spanish literature or history.

The Florence "Meg" Long Walsh/Second Decade Society Leadership Award. This award was established in memory of Meg Walsh '84 by her family, The Second Decade Society, classmates, and friends to honor Meg's leadership in the global community and to develop the next generation of Hopkins leadership. The award provides a graduating senior of the Krieger School with a stipend for a year of travel and independent study abroad. It is the largest award of its kind at Hopkins. The Second Decade Society is the leadership development organization for the Krieger School of Arts and Sciences. Society members, elected 10 to 20 years after graduation, are leaders in their professions and communities.

John Boswell Whitehead Award. Established in 1980 by the faculty in the Department of Electrical and Computer Engineering, this award is presented annually for outstanding achievements in electrical and computer engineering by an undergraduate student.

Loy Wilkinson Award. Named for Loy Wilkinson '54, this award is presented for a demonstrated record of academic excellence, leadership, and service in chemical and biomolecular engineering by graduating seniors.

Wolman Award. Established in memory of M. Gordon "Reds" Wolman, a faculty member in the Department who contributed to the academic growth of the university through service as a department chair and interim provost and through strong advocacy of interdisciplinary studies. This award is given annually to a graduating senior who exhibits both promise and spirit in regards to interdisciplinary work.

Woodrow Wilson Undergraduate Research Fellowship Program. Established in 1999 through the endowment of the James B. Knapp Sr. Deanship, this program provides support for undergraduate research in the humanities, natural sciences, and social sciences. Awards are based on academic merit.

Additional Grants and Funds

Bander Family Fund for Undergraduate Independent Study in Arts and Sciences. Believing that creative minds often seek learning experiences outside the conventional classroom, Neil Bander '69 established the Bander Family Fund to support undergraduate independent study at the Krieger School of Arts and Sciences. Income from the fund will provide an annual award, on a competitive basis, to one or more qualified sophomores, juniors, or seniors who submit a proposal to pursue independent study. All work must be supervised by a faculty sponsor with a preference (but not a requirement) that it be for academic credit.

Morton K. Blaustein Memorial Fund. Established in 1991 to provide funds for innovative research by students and young faculty members.

John and Diane Cooke History of Art Graduate Travel Fund. Created to provide travel stipends for graduate students to see the objects of their study.

Wm. Hooper Grafflin Fund. Established in 1915 to support and promote original research in the line of industrial chemistry.

William S. Greenberg, Class of 1964, Athletic Education Fund. In celebration of his 35th reunion, Mr. Greenberg created this fund to recognize the value and importance of the educational experience provided by the men's varsity fencing program at Johns Hopkins. As a tribute to past, current, and future members of the team, the fund supports the operation and training, including foreign travel, of the men's varsity fencing program.

J. Brien Key Graduate Student Assistance Fund. This fund is used to provide graduate students at the Krieger School of Arts and Sciences with funds to be used for miscellaneous expenses that they might encounter while pursuing their degrees. This money could be used for books and other fees or other expenses associated with attending the school which may arise, i.e., travel to conduct research or attend scholarly meetings, and any other extemporaneous expenses needed while attending graduate school.

Richard P. Longaker Endowment. Established in 1989 by Dr. Longaker to support research and travel for graduate students whose work focuses on Eastern European studies, especially but not exclusively related to Italy, and on the humanities.

Lita Osmundsen Fund for Summer Field Research. Established in 1993 to support summer field work and research for first-year graduate students in the Department of Anthropology.

Richard B. and Ruth D. Palmer Field Work Fund. Established by graduate alumnus Richard Palmer and his wife, Ruth, the fund encourages students of Earth science to spend time in the field by supporting field work integral to their graduate research in the Department of Earth and Planetary Sciences.

Trustees and Administration

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Vice President for Communications and Public Affairs

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*Vice Provost for Information Technology
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International Studies*

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Dean of the Krieger School of Arts and Sciences

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Interim Dean of the Carey Business School

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Dean of the School of Education

Nicholas P. Jones
Dean of the Whiting School of Engineering

Edward D. Miller
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Martha Hill
Dean of the School of Nursing

Jeffrey Sharkey
Director of the Peabody Institute

Michael J. Klag
Dean of the Bloomberg School of Public Health

Winston Tabb
*Dean of University Libraries and Museums,
Vice Provost for the Arts*

Ralph Semmel
Director of the Applied Physics Laboratory

Arts and Sciences, Engineering, and Homewood Student Affairs

Deans

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*James B. Knapp Dean
Krieger School of Arts and Sciences*

Richard E. McCarty
Dean Emeritus, Krieger School of Arts and Sciences

Gregory F. Ball
*Vice Dean for Science and Research Infrastructure
Krieger School of Arts and Sciences*

Kellee Tsai
*Vice Dean for Humanities and Social Sciences
Krieger School of Arts and Sciences*

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*Vice Dean for Undergraduate Education
Krieger School of Arts and Sciences*

Ben Vinson
*Vice Dean for Centers & Interdepartmental Programs and
Graduate Programs
Krieger School of Arts and Sciences*

Judith A. Babbitts
*Vice Dean for Graduate and Professional Programs
Krieger School of Arts and Sciences*

John Latting
Dean, Undergraduate Admissions

Wendy Spivak
*Interim Senior Associate Dean for Finance and
Administration
Krieger School of Arts and Sciences*

Sylvia Eggleston Wehr
*Associate Dean of External Affairs
Krieger School of Arts and Sciences*

Faculty, Zanvyl Krieger School of Arts and Sciences

In listing the members of the teaching staff of the School of Arts and Sciences, the date in parentheses indicates the year of original appointment. Joint appointments or directorships are listed last.

Emeritus Faculty

Professors Emeriti

John Baldwin, Ph.D.
Charles Homer Haskins Professor Emeritus
History

Charles Albro Barker, Ph.D.
American History

Stephen Barker, Ph.D.
Philosophy

John Barth, M.A.
The Writing Seminars

Michael Beer, Ph.D.
Biophysics

Maurice Bessman, Ph.D.
Biology

John Boardman, Ph.D.
Mathematics

Luigi Burzio, Ph.D.
Cognitive Science

Carl F. Christ, Ph.D**.**
Economics

Jerrold Cooper, Ph.D.
W.W. Spence Professor Emeritus of Semitic Languages
Near Eastern Studies

Matthew Crenson, Ph.D.
Political Science

Charles Dempsey, Ph.D.
History of Art

Marcel Detienne, Ph.D.
Classics

Gabor Domokos, Ph.D.
Physics and Astronomy

Doris Entwisle, Ph.D.
Sociology

Douglas Fambrough, Ph.D.
Biology

Gordon Feldman, Ph.D.
Physics and Astronomy

George Fisher, Ph.D.
Earth and Planetary Sciences

Richard Flathman, Ph.D.
Political Science

Robert Forster, Ph.D.
History

Thomas Fulton, Ph.D.
Physics and Astronomy

Hans Goedicke, Ph.D.
Near Eastern Studies

Richard Goldthwaite, Ph.D.
History

Bert Green, Ph.D.
Psychological and Brain Sciences

Jack Greene, Ph.D.
History

Allen Grossman, Ph.D.
English

John W. Gryder, Ph.D.
Chemistry

Bruce Hamilton, Ph.D.
Economics

Neil Hertz, M.A.
Humanities Center; English

John Holland, Ph.D.
Social Relations

J. Woodford Howard, Ph.D.
Thomas P. Stran Professor Emeritus
Political Science

Jun-ichi Igusa, Ph.D.
Mathematics

Brian R. Judd, Ph.D.
Gerhard H. Dieke Professor Emeritus
Physics and Astronomy

Chung Kim, Ph.D.
Physics and Astronomy

Susan Kovesi-Domokos, Ph.D.
Physics and Astronomy

Georg Krotkoff, Ph.D.
Near Eastern Studies

Lieselotte E. Kurth, Ph.D.
German

Yung K. Lee, Ph.D.
Physics and Astronomy

Vernon Lidtke, Ph.D.
History

Warner Love, Ph.D.
Biophysics

Georg Luck, Ph.D.
Classics

Richard Macksey, Ph.D.
Humanities Center

Henry Maguire, Ph.D.
History of Art

Richard E. McCarty, Ph.D.
William D. Gill Professor Emeritus of Biology
James B. Knapp Dean Emeritus
Zanvyl Krieger School of Arts and Sciences

Edward L. McDill, Ph.D.
Sociology

Jean-Pierre Meyer, Ph.D.
Mathematics

Sidney Mintz, Ph.D.
William L. Strauss Professor Emeritus
Anthropology

Brown L. Murr, Ph.D.
Chemistry

Stephen Nichols, Ph.D.
James M. Beall Professor Emeritus
German and Romance Languages and Literatures

Alex Nickon, Ph.D.
Chemistry

Paul R. Olson, Ph.D.
Hispanic and Italian Studies

Ronald Paulson, Ph.D.
English

Aihud Pevsner, Ph.D.
Jacob L. Hain Professor Emeritus
Physics and Astronomy

Owen M. Phillips, Ph.D.
Decker Professor Emeritus
Earth and Planetary Sciences

John G. A. Pocock, Ph.D.
Harry C. Black Professor Emeritus
History

Orest Ranum, Ph.D.
History

Pamela Reynolds, Ph.D.
Anthropology

Dean W. Robinson, Ph.D.
Chemistry

Willie Lee Rose, Ph.D.
History

Dorothy Ross, Ph.D.
Arthur O. Lovejoy Professor Emerita of History

Jerome Schneewind, Ph.D.
Philosophy

Howard Seliger, Ph.D.
Biology

Joseph Shalika, Ph.D.
Mathematics

Allen Shearn, Ph.D.
Biology

Nancy Struever, Ph.D.
Humanities Center and History

James C. Walker, Ph.D.
Physics and Astronomy

Mack Walker, Ph.D.
History

H. Peyton Young, Ph.D.
Scott and Barbara Black Professor Emeritus
Economics

Larzer Ziff, Ph.D.
Caroline Donovan Professor of English
Literature Emeritus
English

Professors

Peter Achinstein (1962)
Professor, Philosophy
A.B. 1956, Harvard, M.A. 1958, Ph.D. 1961

Rina Agarwala (2006)
Assistant Professor, Sociology
B.A. 1995, Cornell University; M.A. 1999,
Harvard University
Ph.D. 2006, Princeton University

Karl Alexander (1974)
Professor and Chair, Sociology
John Dewey Professor of Sociology
B.A. 1968, Temple; M.A. 1970, University of
North Carolina, Ph.D. 1972

Ronald Allen (1991)
Adjunct Professor, Physics and Astronomy

Nadia Altschul (2010)
Visiting Assistant Professor, German and Romance
Languages and Literatures

David Altschuler (1987)
Adjunct Associate Professor, Sociology

Amanda Anderson (1999)
Professor, English
Caroline Donovan Professor of English Literature
B.A. 1981, Dartmouth; M.A. 1988, Cornell,
Ph.D. 1989

Wilda C. Anderson (1978)
Professor, German and Romance Languages and
Literatures
B.A. 1972, Cornell, M.A. 1976, Ph.D. 1979

Joel Andreas (2003)

Associate Professor, Sociology

B.A. 1995, University of Illinois at Chicago;
M.A. 1998, University of California, Los Angeles;
Ph.D. 2003

N. Peter Armitage (2005)

Assistant Professor, Physics and Astronomy

B.Sc. 1994, Rutgers University
Ph.D. 2002, Stanford University

John Astin (2001)

*Visiting Professor, The Writing Seminars—Program in
Theater Arts and Studies*

Paul Attewell (2010)

Visiting Professor, Sociology

Jonathan Bagger (1989)

Professor, Physics and Astronomy; Mathematics
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B.A. 2002; M.A. 2007, Johns Hopkins University
Ph.D. 2010, University of California, Irvine

Dimitrios Yatromanolakis (2003)
Associate Professor, Classics; Anthropology; Humanities Center
B.A. 1992, University of Athens
M.St. 1993, D.Phil. 1998, University of Oxford

H. Peyton Young (2009)
Research Professor, Economics

Yuan Yuan (2010)
J. J. Sylvester Assistant Professor, Mathematics

Benjamin Zaitchik (2008)
Assistant Professor, Earth and Planetary Sciences
A.B. 1998, Harvard University
M.S. 2001, Cornell University
Ph.D. 2006, Yale University

Nadia Zakamska (2010)
Assistant Professor, Physics and Astronomy
B.Sc. 1999; M.Sc. 2001, Moscow Institute of Physics and Technology
Ph.D. 2005, Princeton University

Alessandro Zannirato (2005)
Associate Teaching Professor, German and Romance Languages and Literatures

David Zappulla (2008)
Assistant Professor, Biology
B.A. 1995, Middlebury College
Ph.D. 2002, Stony Brook University

Melinda Zeder (2001)
Adjunct Professor, Near Eastern Studies

Haiqing Zhao (2002)
Associate Professor, Biology
B.S. 1985, Beijing University, M.S. 1988;
Ph.D. 1997, Yale University

Yixian Zheng (1999)
Adjunct Professor, Biology

Larzer Ziff (1/2000)
Research Professor, English

Steven Zucker (1984)
Professor, Mathematics
Sc.B. 1970, Brown; Ph.D. 1974, Princeton

Other Faculty Appointments

Lecturers

Fadel Abdallah, M.S.
Center for Language Education—Arabic 2007

Muhammed Alan, Ph.D.
Mathematics 2009

Bruce Anderson Alan, Ph.D.
German and Romance Languages and Literatures 2010

Emily Anderson, Ph.D.
Classics 2010

Catherin R. Arthur, M.A.
History 2008

Flavia Azeredo
German and Romance Languages and Literatures 2010

Romie Banerjee, Ph.D.
Mathematics 2010

Mary M. Bensabat-Ott, Ph.D.
Senior Lecturer
German and Romance Languages and Literatures 9/1991

Glenn Blake, M.A.
Senior Lecturer
The Writing Seminars 2006; 2008

Vivian Braun, M.A.
Center for Language Education 2010

Richard Brown, Ph.D.
Senior Lecturer
Mathematics 2009

Lucy Bucknell, M.A.
Senior Lecturer
The Writing Seminars 2000; 2008

Beatrice Caplan, Ph.D.
German and Romance Languages and Literatures 2006

Aiguo Chen, M.A.
Center for Language Education—Chinese 2008

Clay Cogswell, M.F.A.
The Writing Seminars 2010

Kristin Cook-Gailloud
German and Romance Languages and Literatures 2009

Caitlin Cross-Barnet, Ph.D.
Sociology 2010

Tristan Davies, M.A.
Senior Lecturer
The Writing Seminars 1987; 1997

Dariush Dehghan, Ph.D.
Center for Language Education—Persian 2006

Maria del Rosario Ramos, Ph.D.
German and Romance Languages and Literatures 2008

Linda DeLibero, M.A.
Senior Lecturer, Writing Seminars 2001

Margaret Denithorne
The Writing Seminars (Program in Theater Arts and Studies) 2007

Barbara DiPietro, Ph.D.
Institute for Policy Studies—Public Policy Program 2010

Jessica Dunn, M.A.
Psychological and Brain Sciences 2008

Ryan Edel, B.A.
The Writing Seminars 2010

William Evans, M.F.A., M.A.
Senior Lecturer, English 2005

Emily Fisher, Ph.D.
Biology 2008

Patrick Fleming, Ph.D.
Senior Lecturer
Biophysics 2004; 2007

Heather Roberts Fox, Ph.D.
Psychological and Brain Sciences 2011

Paula Gefaell-Borras
German and Romance Languages and Literatures 2008

Michael Giandrea, Ph.D.
Institute for Policy Studies—Public Policy Program 2010

James Glossman
The Writing Seminars (Program in Theater Arts and Studies) 2004

Nancy Gooding, M.A.
Center for Language Education—ESL 2010

James D. Goodyear, Ph.D.
Senior Lecturer
Associate Director, Public Health Studies Program 2000

Linda Gottlieb, M.F.A.
The Writing Seminars 2010

Jane Greco, Ph.D.
Senior Lecturer, Chemistry 2006

Claude Guillemard, D.E.A.
Senior Lecturer
German and Romance Languages and Literatures 1991

Nancy Hall
Institute for Policy Studies—Public Policy Program 2010

Ye Han, Ph.D.
Center for Language Education—Chinese 2010

Stephen Harris, J.D.
Sociology 1/1993 (part-time)

Susan Harrison, M.A.
Institute for Policy Studies—Public Policy Program 2010

Floyd Hayes, Ph.D.
Senior Lecturer
Political Science 2004
Coordinator, Programs in Africana Studies

Rena Hoisington, Ph.D.
History of Art 2011

Robert Horner, Ph.D.
Senior Lecturer
Biology 1989

Audrey Huang, Ph.D.
Biology 2005

Aranzazu M. Hubbard, M.A.
German and Romance Languages and Literatures 2010

Ann Jarema, M.S.
Psychological and Brain Sciences 2007

Veronika Jicinska, Ph.D.
German and Romance Languages and Literatures 2010

Jane Kamau, B.S.
Center for Language Education—Kiswahili 1/2008

Gregory Kane
Lecturer
The Writing Seminars 2008 (part-time)

Choonwon Kang, Ph.D.
Center for Language Education—Korean 1990

Satoko Katagiri, M.A.
Center for Language Education—Japanese 2003

Pamela Kirkpatrick, M.F.A.
The Writing Seminars 2010

David Klein, Ph.D.
Senior Lecturer, Chemistry 1999

Robert Knisely, J.D.
Institute for Policy Studies—Public Policy Program 2010

Jian Kong, Ph.D.
Senior Lecturer
Mathematics 2004

Chris Kraft, Ph.D.
Psychological and Brain Sciences 2002

Joel Kramer, Ph.D.
Mathematics 2009

Stephen Lackaye, M.F.A.
The Writing Seminars 2010

Lu Li, M.A.
Center for Language Education—Chinese 2010

Bavo Lievens, M.A.
History 2001

Liman Lievens, B.A.
Center for Language Education—Chinese 1996

Sarah Manekin, B.A.
English 2008

John Mann, Ed.D.
Senior Lecturer
The Writing Seminars 2004; 2008

Molly Marra
Junior Lecturer
Institute for Policy Studies—Public Policy Program 2010

Joseph H. Martin, Ph.D.
The Writing Seminars (Program in Theater Arts and Studies) 2007

Elena Marx, M.A.
English 2008

Laura Mason, Ph.D.
Senior Lecturer
History 2011

Michele Mazzocco, Ph.D.
Psychological and Brain Sciences 2006

David McNeal, M.A.
Center for Language Education—Chinese 2011

Robert Mintz, Ph.D.
History of Art 2010

Rachel Monroe, B.A.
The Writing Seminars 2009

Barbara Morgan, Ph.D.
Senior Lecturer
Economics 2006

Anne-Elizabeth Murdy Brodsky, Ph.D.
English 2007

Carlos Munoz, M.A.
German and Romance Languages and Literatures 2011

Makiko Nakao, M.A.
Center for Language Education—Japanese 1994

Desislava Nikolova, M.A.
German and Romance Languages and Literatures 2008

Jennifer Neemann, Ph.D.
Senior Lecturer
Psychological and Brain Sciences 2010

Carolyn Norris, Ph.D.
Senior Lecturer
Biology 2000

Marie Theresa O'Connor, Ph.D.
English 2010

Sakiko Olsen, Ph.D.
Senior Lecturer
Earth and Planetary Sciences 1996

George Oppel, Ph.D.
English 2010

Larry Orr, Ph.D.
Institute for Policy Studies—Public Policy Program 2010

Patricia Palmer, M.A.
Lecturer and Coordinator, ESL
Center for Language Education—2004 (part-time)

Cindy Parker, M.D., M.P.H.
Earth and Planetary Sciences 2008

Louis Pasternack, Ph.D.
Senior Lecturer
Chemistry 2001

Rebecca Pearlman, Ph.D.
Senior Lecturer
Biology 2001

Martin Perschler , Ph.D.
History of Art 2009

Brian Plow
The Writing Seminars 2009

Daniel Pontious, A.B.
Junior Lecturer
Institute for Policy Studies—Public Policy Program 2010

Matthew Porterfield
The Writing Seminars (Film and Media Studies) 2008

Ellen Robbins, Ph.D.
Near Eastern Studies 1992

William Roche
The Writing Seminars (Program in Theater Arts and Studies) 2004

Elizabeth Rodini, Ph.D.
Senior Lecturer
History of Art 2004

Mark Rom, Ph.D.
Political Science 2010

Suzanne Roos, Ph.D.
Senior Lecturer
German and Romance Languages and Literatures 1993

Uma Saini, M.A.
Senior Lecturer
Center for Language Education—Hindi 2000

Steve Scafidi, M.F.A.
The Writing Seminars 2008

Richard Shingles, Ph.D.
Biology, 2005

Joanne Simpson
The Writing Seminars 1999

Khalil Tahrawi, Ph.D.
Center for Language Education —Arabic 2004

Michelle Tracy, M.A.
German and Romance Languages and Literatures 2007

Tina Trapane, Ph.D.
Senior Lecturer
Chemistry 1999

Jason Tyler, B.A.
The Writing Seminars (Film and Media Studies) 2011

Magda von der Heydt, Ph.D.
Senior Lecturer
Sociology 2006

Kathryn Wagner, Ph.D.
Senior Lecturer
Political Science 2010
Program Coordinator Aitchison Program

Meredith Ward, M.A.
The Writing Seminars (Film and Media Studies) 2008

Sue Waterman
German and Romance Languages and Literatures 2003

Barry Weingarten, Ph.D.
Senior Lecturer
German and Romance Languages and Literatures 1999

Heidi Wheeler, M.A.
German and Romance Languages and Literatures 1999

Greg Williamson, M.A.
Senior Lecturer
The Writing Seminars 1989

April Wuensch, Ph.D.
German and Romance Languages and Literatures 2004
Coordinator, French Elements

Lu Zhang, Ph.D.
Sociology 2010

Military Science

Stephen Pomper
Lieutenant Colonel
Director and Professor of Military Science

Jeremy Bushyager
Major
Assistant Professor of Military Science/Enrollment Officer

Tara Larkin
Captain
Executive Officer

Rolando Rodriguez
Captain

Garth Ambersley
Master Sergeant
Senior Army Instructor

Charles Thompson
Sergeant First Class
Army Instructor

Michael Bishop
Staff Sergeant
Army Instructor/MD National Guard Liaison

Joint Appointments

Emily Agree, Ph.D.
Associate Professor (Public Health)
Sociology 1/1996

Marilyn Albert, Ph.D.
Professor (Medicine)
Psychological and Brain Sciences 2005

Mariam Alexander, M.D., M.P.H.
Assistant Professor (Public Health)
Public Health Studies Program 2010

Richard Allen, Ph.D.
Assistant Professor (Medicine)
Psychological and Brain Sciences 1997

Nan Marie Astone, Ph.D.
Associate Professor (Public Health)
Sociology 1989

Stanley Becker, Ph.D.
Professor (Public Health)
Public Health Studies Program 2008

David Bishai, Ph.D.
Associate Professor (Public Health)
Economics 2006

Amanda Blackford, Sc.M.
Biostatistician (Medicine)
Public Health Studies Program 2010

Dana F. Boatman
Associate Professor (Medicine)
Cognitive Science 5/1993

Jef Boeke, Ph.D., D.Sc.
Professor (Medicine)
Adjunct Professor, Biology, 2007

Lee Bone, M.P.H., R.N.
Associate Professor (Public Health)
Public Health Studies Program 2010

Lynda Burton, Sc.D.
Adjunct Associate Professor (Public Health)
Public Health Studies Program 2010

Shiyi Chen, Ph.D.
Professor (Engineering)
Physics and Astronomy 4/2006

Lawrence Cheskin, M.D.
Associate Professor (Public Health)
Public Health Studies Program 2011

Nathaniel Comfort, Ph.D.
Associate Professor (Medicine)
History of Science and Technology 2004

Charles Edward Connor, Ph.D.
Associate Professor (Medicine)
Director, Krieger Mind/Brain Institute
Psychological and Brain Sciences 2006

Leslie Cope, Ph.D., M.S.E.
Assistant Professor (Medicine)
Public Health Studies Program 2010

Robert Dalrymple, Ph.D.
Professor (Engineering)
Earth and Planetary Sciences 1/2002

John Desmond, Ph.D.
Associate Professor (Medicine)
Cognitive Science 2007

William Eaton, Ph.D.
Professor (Public Health)
Sociology 1989

David Edwin, Ph.D.
Associate Professor (Medicine)
Psychological and Brain Sciences 1990; 1999

Jason Eisner, Ph.D.
Assistant Professor (Engineering)
Cognitive Science 2002

Margaret Ensminger, Ph.D.
Professor (Public Health)
Sociology 1992

Joshua Epstein, Ph.D.
Professor (Medicine)
Economics 2010

Greg Eyink, Ph.D.
Professor (Engineering)
Mathematics 2004
Physics and Astronomy 4/2006

Ruth Faden, Ph.D.
Professor (Public Health)
Policy Studies Program, Institute for Policy Studies
Arts and Sciences 9/1992

Michael Falk, Ph.D.
Professor (Engineering)
Physics and Astronomy 2009

Mary Fissell, Ph.D.
Professor (Medicine)
History 1/2007
History of Science and Technology 1/1992

Carolyn Furr-Holden, Ph.D.
Assistant Professor (Public Health)
Public Health Studies Program 2011

Kelly Gebo, M.D., M.P.H.
Associate Professor (Medicine)
Sociology 2008
Director, Public Health Studies Program, KSAS

Barry Gordon, M.D.
Professor (Medicine)
Cognitive Science 1992

David Gracias, Ph.D.
Associate Professor (Engineering)
Chemistry 2004

Steve Hanke, Ph.D.
Professor (Engineering)
Economics 1971

Marta Hanson, Ph.D.
Assistant Professor (Medicine)
History of Science and Technology 2005

Kevin Hemker, Ph.D.
Professor (Engineering)
Earth and Planetary Sciences 1/1998

Stewart Hendry, Ph.D.
Professor (Medicine)
Krieger Mind/Brain Institute
Psychological and Brain Sciences 1/2002

Argye Hillis-Trupe, Ph.D.
Professor (Medicine)
Cognitive Science 1999

Steven Hsiao, Ph.D.
Associate Professor (Medicine)
Krieger Mind/Brain Institute
Psychological and Brain Sciences 1/2002

Pien-Chien Huang, Ph.D.
Professor (Public Health)
Biophysics 2004

Howard Katz, Ph.D.
Professor (Engineering)
Chemistry 2004

Scott Kahan, M.D., M.P.H.
Instructor (Public Health)
Public Health Studies Program 2010

Alfredo Kirkwood, Ph.D.
Assistant Professor (Medicine)
Krieger Mind/Brain Institute
Psychological and Brain Sciences 1/2002

Pravin Krishna, Ph.D.
Professor (SAIS)
Economics 2004

Thomas LaVeist, Ph.D.
Professor (Public Health)
Sociology 1992

Philip Leaf, Ph.D.
Professor (Public Health)
Public Health Studies Program 2010

Harry Marks, Ph.D.
Associate Professor (Medicine)
Anthropology 2005
History 1/2007
History of Science and Technology 5/1989

Guy McKhann, M.D.
Professor (Medicine)
Krieger Mind/Brain Institute
Cognitive Science
Psychological and Brain Sciences 1/2002

Graham Mooney, Ph.D.
Assistant Professor (Medicine)
History of Science and Technology 2004

Vicente Navarro, Ph.D.
Professor (Public Health)
Sociology 1989
Policy Studies Program, Institute for Policy Studies
Arts and Sciences 9/1992

Sandra Newman, Ph.D.
Professor (Institute for Policy Studies, Director)
Sociology 2000

Ernst Niebur, Ph.D.
Associate Professor (Medicine)
Krieger Mind/Brain Institute
Psychological and Brain Sciences 1/2002

Mitsukuni Nishida, Ph.D.
Assistant Professor (Business)
Economics 2010

Randall Packard, Ph.D.
Professor (Medicine)
History 2003
History of Science and Technology 1/2002

Cindy Parker, M.D., M.P.H.
Assistant Professor (Public Health)
Earth and Planetary Sciences 2010

Darcy Phelan, Ph.D.
Assistant Scientist (Public Health)
Public Health Studies Program 2011

Paula Pitha-Rowe, Ph.D.
Professor (Medicine)
Biology 2007

Gianna Pomata, Ph.D.
Professor (Medicine)
History of Science and Technology 2008

Erica J. Schoenberger, Ph.D.
Professor (Engineering)
Anthropology 1989

Peter Searson, Ph.D.
Professor (Engineering)
Physics and Astronomy 2006

Robert Siliciano, M.D., Ph.D.
Professor (Medicine)
Biology 2007

Katherine Smith, Ph.D.
Associate Professor (Public Health)
Sociology 2005

Donald Steinwachs, Ph.D.
Professor (Public Health)
Public Health Studies Program 2010

James Tielsch, Ph.D.
Professor (Public Health)
Public Health Studies Program 2010

Daniel Todes, Ph.D.
Professor (Medicine)
History of Science and Technology 1984

Michael Trush, M.P.H.
Professor (Public Health)
Public Health Studies Program 2010

Amy Ong Tsui, Ph.D.
Professor (Public Health)
Sociology 2002

Rudiger von der Heydt, Ph.D.
Professor (Medicine)
Krieger Mind/Brain Institute
Psychological and Brain Sciences 1/2002

Susan Weiss, Ph.D.
Chair/Faculty (Peabody)
German and Romance Languages and Literatures 2002

Michael Yu, Ph.D.
Associate Professor (Engineering)
Chemistry 2001

Barry Zirkin, M.P.H.
Professor (Public Health)
Public Health Studies Program 2010

Faculty, Whiting School of Engineering

In listing the members of the teaching staff of the School of Engineering, the date in parentheses indicates the year of original appointment. Any joint appointments or directorships are listed last.

Professors Emeriti

John Boland, Ph.D.
Geography and Environmental Engineering

Moise H. Goldstein Jr., D.Sc.
Electrical and Computer Engineering

Willis Gore
Electrical and Computer Engineering

Robert Green, Ph.D.
Materials Science and Engineering

Richard I. Joseph, Ph.D.
Electrical and Computer Engineering

Joseph L. Katz, Ph.D.
Chemical and Biomolecular Engineering

Jerome Kruger, Ph.D.
Materials Science and Engineering

C. Harvey Palmer Jr., Ph.D.
Electrical and Computer Engineering

Wilson J. Rugh, Ph.D.
Electrical and Computer Engineering

Eugene D. Shchukin, Ph.D.; Dr.Sc.
Research Professor Emeritus, Geography and Environmental Engineering

Charles (Roger) Westgate, Ph.D.
Electrical and Computer Engineering

Professors

Soumyadipta Acharya (2010)
Assistant Research Professor, Biomedical Engineering

Yanif Amad (2010)
Assistant Professor, Computer Science
B.E. 2001, Imperial College of Science, Technology and Medicine
M.S., 2004, Brown University, Ph.D. 2009

Robert Allen (2004)
Associate Research Professor, Biomedical Engineering

Yair Amir (1995)
Professor, Computer Science
B.S. 1985, Technion, Haifa, M.S. 1990;
Ph.D. 1995, Hebrew University of Jerusalem

Annalingam Anandarajah (1984)
Professor, Civil Engineering
B.S. 1977, University of Sri Lanka;
M.S. 1980, UC Davis, Ph.D. 1982

Andreas Andreou (1987)
Professor, Electrical and Computer Engineering;
B.S. 1978, Higher Technical Institute, Cyprus;
M.S. 1982, Johns Hopkins University, Ph.D. 1986

Gregory Aranovich (2002)
Research Professor, Chemical and Biomolecular Engineering

Dilipkumar Asthagiri (2006)
Assistant Professor, Chemical and Biomolecular Engineering
B.S. 1992, Indian Institute of Technology;
M.S. 1994, University of Michigan;
Ph.D. 1999, University of Delaware

Giuseppe Ateniese (1999)
Associate Professor, Computer Science
B.S. 1995, University of Salerno;
Ph.D. 2000, DISI, University of Genoa

Baruch Awerbuch (1994)
Professor, Computer Science
B.S. 1978, Technion, Haifa; M.S. 1982, Ph.D. 1984

Joel Bader (2003)
Associate Professor, Biomedical Engineering;
Computer Science
B.S. 1986, Lehigh University;
Ph.D. 1989, UC Berkeley

William P. Ball (1992)
Professor, Geography and Environmental Engineering;
Civil Engineering
B.S. 1976, University of Virginia;
M.S. 1977, Stanford, Ph.D. 1990

Michael J. Betenbaugh (1988)
Professor, Chemical and Biomolecular Engineering
B.S. 1981, University of Virginia;
Ph.D. 1988, University of Delaware

Michael Bevan (2008)
Associate Professor, Chemical and Biomolecular Engineering
B.S. 1994, Lehigh University
Ph.D. 1999, Carnegie Mellon University

Edward J. Bouwer (1985)
Abel Wolman Professor and Chair, Geography and Environmental Engineering; Civil Engineering
B.S. 1977, Arizona State University;
M.S. 1978, Stanford, Ph.D. 1982

Grace S. Brush (1978)
Professor, Geography and Environmental Engineering
B.S. 1949, St. Francis Xavier University;
M.S. 1951, University of Illinois;
Ph.D. 1956, Harvard

Randal Burns (2001)

Associate Professor, Computer Science
B.S. 1993, Stanford;
M.S. 1997, UC Santa Cruz, Ph.D. 2000

Ilene J. Busch-Vishniac (2004)

Research Professor, Mechanical Engineering
B.S./B.A. 1976, University of Rochester;
M.Sc. 1978, M.I.T., Ph.D. 1981

Chris Callison-Burch (2007)

Assistant Research Professor, Computer Science

Robert C. Cammarata (1987)

Professor, Materials Science and Engineering;
Mechanical Engineering
B.S. 1979, M.I.T.; M.S. 1980, Harvard, Ph.D. 1985

Kai Loon Chen (2008)

Assistant Professor, Geography and Environmental
Engineering
B.E. 2001, University of Singapore; M. E. 2003,
National University of Singapore;
M.S. 2004, Yale University;
Ph.D. 2008, Yale University.

Shiyi Chen (1999)

Research Professor, Mechanical Engineering; Applied
Mathematics and Statistics
B.S. 1982, Zhejiang University; M.S. 1984, Peking
University, Ph.D. 1987

Gregory S. Chirikjian (1992)

Professor, Mechanical Engineering; Computer Science;
Electrical and Computer Engineering; Applied
Mathematics and Statistics
B.S. 1988, Johns Hopkins University; M.S. 1988;
Ph.D. 1992, California Institute of Technology

A. Brinton Cooper (2001)

Associate Research Professor, Electrical and
Computer Engineering

Noah Cowan (2003)

Associate Professor, Mechanical Engineering;
Computer Science
B.S. 1995, Ohio State, M.S., 1997;
Ph.D. 2001 University of Michigan

Honggang Cui (2010)

Assistant Professor, Chemical & Biomolecular Engineering
B.S, 1999 Beijing University of Chemical Technology
M.S. 2002, Tsinghua University
Ph.D. 2007, University of Delaware

Robert A. Dalrymple (2002)

The Willard & Lillian Hackerman Professor,
Civil Engineering; Earth and Planetary Sciences in
Arts and Sciences
A.B. 1967, Dartmouth; M.S. 1968, University of
Hawaii; Ph.D. 1973, University of Florida

Frederic M. Davidson (1970)

Professor, Electrical and Computer Engineering
B.S. 1964, Cornell;
Ph.D. 1969, University of Rochester

Marc D. Donohue (1979)

Professor, Chemical and Biomolecular Engineering
Vice Dean for Research, Whiting School of Engineering
(2007); Director, Advanced Technology Lab
B.S. 1973, Clarkson College of Technology;
Ph.D. 1977, UC Berkeley

Andrew S. Douglas (1983)

Professor, Mechanical Engineering; Biomedical Engineering
Vice Dean for Faculty, Whiting School of Engineering
(2007)
B.S. 1975, University of Cape Town, M.S. 1977;
Ph.D. 1982, Brown University

German Drazer (2005)

Assistant Professor, Chemical and Biomolecular Engineering
B.S. 1991, University of Buenos Aires
M.S. 1994, University de Cuyo & Instituto Balseiro
Ph.D. 1999

Jason Eisner (2000)

Associate Professor, Computer Science
B.S. 1990, Harvard; M.S. 1993, Cambridge
University; Ph.D. 2001, University of Pennsylvania

Jafaar El-Awady (2010)

Assistant Professor, Mechanical Engineering
B.S. 2001 Cairo University M.S. 2003
Ph.D. 2008, University of California, Los Angeles

Mounya Elhilali (2008)

Assistant Professor, Electrical and Computer Engineering
B.S. 1998, Al Akhawayn University; M.S. 2003,
University of Maryland; Ph.D. 2004

J. Hugh Ellis (1984)

Professor, Geography and Environmental Engineering;
Chair, Civil Engineering
B.S. 1979, University of Waterloo, M.S. 1981,
Ph.D. 1984

Jonah Erlebacher (2000)

Professor, Materials Science and Engineering;
Chemical and Biomolecular Engineering
B.S. 1991, Yale; Ph.D. 1999, Harvard

Ralph R. Etienne-Cummings (1998)

Professor, Electrical and Computer Engineering; Associate
Director of Education and Outreach Programs in the
Engineering Research Center for Computer-Integrated
Surgical Systems and Technology.
B.S. 1988, Lincoln University;
Ph.D. 1995, University of Pennsylvania

Gregory Eyink (2002)

Professor, Applied Mathematics and Statistics; Mechanical
Engineering; Mathematics (A&S)
B.S. 1981, Ohio State, Ph.D. 1987

Michael Falk (2008)

Associate Professor, Materials Science and Engineering
B.A. 1990, Johns Hopkins University; M.S.E. 1991;
Ph.D. 1998, University of California

James A. Fill (1988)
Professor, Applied Mathematics and Statistics;
Computer Science
B.S. 1976, University of Illinois; M.S. 1979,
University of Chicago, Ph.D. 1980

Donniell Fishkind (2001)
Associate Research Professor, Applied Mathematics
and Statistics

Amy Foster (2010)
Assistant Professor, Electrical and Computer Engineering
B.S.2003, State University of New York at Buffalo
M.S. 2007, Cornell University, Ph.D. 2009

Mark Foster (2010)
Assistant Professor, Electrical and Computer Engineering
B.S, 2003, Cornell University M.S. 2007, Ph.D. 2008

Joëlle Fréchette (2006)
Assistant Professor, Chemical and Biomolecular Engineering
B.E. 1998, École Polytechnique de Montréal;
M.A. 2000, Princeton University, Ph.D. 2003

Donald Geman (2001)
Professor, Applied Mathematics and Statistics; Electrical
and Computer Engineering
B.S. 1965, University of Illinois;
Ph.D. 1970, Northwestern

Sharon Gerecht (2007)
Assistant Professor, Chemical and Biomolecular
Engineering
B.A. 1994, Technion – Israel Institute of Technology;
M.Sc. 1999, Tel Aviv University; Ph.D. 2004,
Technion – Israel Institute of Technology

Somnath Ghosh (2010)
Research Professor, Civil Engineering

John I. Goutsias (1986)
Professor, Electrical and Computer Engineering; Applied
Mathematics and Statistics
B.S. 1981, National Technical University of Athens;
M.S. 1982, University of Southern California,
Ph.D. 1986

David Gracias (2003)
Associate Professor, Chemical and Biomolecular
Engineering
M.S. 1986, Indian Institute of Technology
Ph.D. 1999, UC Berkeley

Lori Graham-Brady (2000)
Associate Professor, Civil Engineering
B.S. 1990, Dartmouth; M.S. 1994, Princeton,
Ph.D. 1996

Jeffrey Gray (2002)
Associate Professor, Chemical and Biomolecular
Engineering
B.S.E. 1994, University of Michigan;
Ph.D. 2000, University of Texas

Joseph Greenstein (2005)
Assistant Research Professor. Biomedical Engineering

John L. Griffin (2008)
Assistant Research Professor, Computer Science

James K. Guest (2005)
Assistant Professor, Civil Engineering
B.S.E. 1998, University of Pennsylvania
M.S.E. 2001; M.A. 2003 Princeton University
Ph.D. 2005, Princeton University

Seth Guikema (2008)
Assistant Professor, Geography and Environmental
Engineering
B.S. 1997, Cornell University; M.E. 1999, University
of Canterbury; M.S. 1999, Stanford University;
Ph.D. 2003

Gregory D. Hager (1999)
Professor and Chair, Computer Science; Electrical and
Computer Engineering
B.S. 1983, Luther College;
M.S. 1985, University of Pennsylvania, Ph.D. 1988

Steve H. Hanke (1969)
Professor, Geography and Environmental Engineering;
Economics
B.A. 1964, University of Colorado, Ph.D. 1969
B.A. 1984, Cornell; M.S. 1987, UC Santa Barbara,
Ph.D. 1990

Kevin J. Hemker (1993)
Professor and Chair, Mechanical Engineering; Materials
Science and Engineering; Earth and Planetary Sciences
B.S. 1985, University of Cincinnati;
M.S. 1987, Stanford, Ph.D. 1990

Cila Herman (1992)
Professor, Mechanical Engineering
B.S. 1982, University of Novi Sad, Yugoslavia,
M.S. 1988; Ph.D. 1992, University of Hanover,
Germany

Hynek Hermansky (2008)
Professor, Electrical and Computer Engineering
M.S. 1972, Technical University Brno;
D. Eng. 1983, University of Tokyo

Margarita Herrera-Alonso (2007)
Assistant Professor, Materials Science & Engineering
B.S. 1997, Facultad de Quimica, M.S. 1999
M.S. 2004, University of Massachusetts, Ph.D. 2004

Markus Hilpert (2002)
Associate Professor, Geography and Environmental
Engineering
B.S. 1993, University of Karlsruhe, Germany;
D.Eng. 1997

Benjamin F. Hobbs (1996)
Theodore M. & Kay W. Schad Professor, Geography and
Environmental Engineering; Applied Mathematics
and Statistics
B.S. 1976, South Dakota State University;
M.S. 1978, SUNY, Syracuse; Ph.D. 1983, Cornell

Susan Hohenberger-Waters (2007)
Assistant Professor, Computer Science
B.S. 2000, Ohio State University
M.S. 2003, MIT; Ph.D. 2006, MIT

Kalina Hristova (2001)

Associate Professor, Materials Science and Engineering
B.S. 1987, University of Sofia, M.S. 1988;
Ph.D. 1994, Duke

Todd Hufnagel (1996)

Professor, Materials Science and Engineering
B.S. 1989, Michigan Technological University;
M.S. 1991, Stanford, Ph.D. 1995

Youngmi Hur (2008)

Assistant Professor, Applied Mathematics and Statistics
B.S. 1993, Korea Advanced Institute of Science
and Technology;
M.S. 1997; Ph.D. 2006, University of Wisconsin

Pablo Iglesias (1991)

*Professor, Electrical and Computer Engineering; Applied
Mathematics and Statistics; Biomedical Engineering*
B.S. 1987, University of Toronto;
Ph.D. 1991, Cambridge University

Takeru Igusa (1999)

*Professor, Civil Engineering; Applied Mathematics
and Statistics*
B.S. 1977, Harvard; M.S. 1979, UC Berkeley, Ph.D.
1983

Iulian Iorachita (2010)

Assistant Research Professor, Mechanical Engineering

Bruno Jedynak (2003)

*Associate Research Professor, Applied Mathematics
and Statistics*

Nicholas P. Jones (2004)

*Benjamin T. Rome Dean, Whiting School of Engineering;
Professor of Civil Engineering*
B.E. 1980, The University of Auckland;
M.S. 1981, California Institute of Technology,
Pasadena, Ph.D. 1986

Jin Ung Kang (1999)

Professor and Chair, Electrical and Computer Engineering
B.S. 1992, Western Washington University;
M.S. 1993, University of Central Florida, Ph.D. 1996

Alexander E. Kaplan (1986)

Professor, Electrical and Computer Engineering
M.S. 1961, Moscow Institute for Physics and
Technology; Ph.D. 1967, USSR Academy of Sciences

Damianos Karakos (2007)

*Assistant Research Professor, Electrical and Computer
Engineering*

Rachel Karchin (2006)

Assistant Professor, Biomedical Engineering
B.S. 1998, University of California, Santa Cruz
M.S. 2000, University of California, Santa Cruz
Ph.D. 2003, University of California, Santa Cruz

Michael J. Karweit (1979)

*Research Professor, Center for Education and Outreach;
Chemical and Biomolecular Engineering*

Howard Katz (2004)

Professor and Chair, Materials Science and Engineering
B.S. 1978, Massachusetts Institute of Technology
Ph.D. 1982, University of California, Los Angeles

Joseph Katz (1987)

*William F. Ward Distinguished Professor, Mechanical
Engineering; Geography and Environmental Engineering*
B.S. 1977, Tel Aviv University; M.S. 1978,
California Institute of Technology, Ph.D. 1982

Peter Kazanzides (2003)

Associate Research Professor, Computer Science

Michael Kazhdan (2004)

Assistant Professor, Computer Science
B.A. 1997, Harvard
M.A., 2001, Princeton, Ph.D. 2004

Sanjeev Khudanpur (2001)

*Associate Professor, Electrical and Computer Engineering;
Computer Science*
B.S. 1988, Indian Institute of Technology;
Ph.D. 1997, University of Maryland

Jacob Khurgin (1988)

Professor, Electrical and Computer Engineering
M.S. 1979, Leningrad Institute of Optics;
Ph.D. 1987, Polytechnic University of New York

Deok-Ho Kim

Assistant Research Professor, Biomedical Engineering

Omar Knio (1991)

Professor, Mechanical Engineering
B.S. 1984, American University of Beirut;
M.S. 1986, M.I.T., Ph.D. 1990

Konstantinos Konstantopoulos (1997)

*Professor and Chair, Chemical and Biomolecular
Engineering; Biomedical Engineering*
B.S. 1989, National Technology University of Athens;
Ph.D. 1995, Rice University

S. Rao Kosaraju (1970)

*Edward J. Schaefer Professor, Computer Science;
Applied Mathematics and Statistics*
B.S. 1964, Andhra University;
M.S. 1966, Indian Institute of Technology;
Ph.D. 1969, University of Pennsylvania

Frederick Krambeck (2002)

Research Professor, Chemical and Biomolecular Engineering

Rajesh Kumar (2007)

Assistant Research Professor, Computer Science

Michael Lavine

Assistant Research Professor, Computer Science

Juhghoon Lee

*Assistant Research Professor, Electrical and Computer
Engineering*

Nam Lee (2008)

*Assistant Research Professor, Applied Mathematics and
Statistics*

Siu Tang (Tim) Leung (2008)
Assistant Professor, Applied Mathematics and Statistics
B.S. 2003, Cornell University; Ph.D. 2008, Princeton University

Andre Levchenko (2001)
Associate Professor, Biomedical Engineering
B.S. 1992, Moscow Institute of Physics and Technology; M.S. 1995, Columbia University, Ph.D. 1998

En (Evan) Ma (1998)
Professor, Materials Science and Engineering
B.S. 1982, Tsinghua University, China, M.S. 1985; Ph.D. 1989, California Institute of Technology

Feilim Mac Gabhann (2009)
Assistant Professor, Biomedical Engineering; Institute for Computational Medicine
B.E. 1997, University College, Dublin; Ph.D. 2006, Johns Hopkins University

Hai-Quan Mao (2002)
Associate Professor, Materials Science and Engineering
B.S. 1988, Wuhan University, Ph.D. 1993

Mark Martin (2004)
Assistant Research Professor, Electrical and Computer Engineering

Gerald M. Masson (1981)
Professor, Computer Science; Director, Johns Hopkins University Information Security Institute
B.S. 1966, Illinois Institute of Technology; M.S. 1968, Northwestern, Ph.D. 1971

James Mayfield (2004)
Associate Research Professor, Computer Science

Patricia McGuiggan (2006)
Associate Research Professor, Materials Science and Engineering

Charles V. Meneveau (1990)
Louis M. Sardella Professor, Mechanical Engineering; Geography and Environment Engineering
B.S. 1985, University Federico Santa Maria, Chile; M.S. 1987, Yale, Ph.D. 1989

Gerard G. L. Meyer (1973)
Professor, Electrical and Computer Engineering
M.S. 1967, UC Berkeley, Ph.D. 1970

Michael I. Miller (1998)
Herschel and Ruth Seder Professor, Biomedical Engineering; Director, Center for Imaging Science; Electrical and Computer Engineering; Applied Mathematics and Statistics; Computer Science
B.S. 1976, SUNY; M.S. 1978, Johns Hopkins University, Ph.D. 1983

Amitabh Mishra (2008)
Assistant Research Professor, Computer Science

Judith Mitrani-Reiser (2010)
Assistant Professor, Civil Engineering
B.S. 2000, University of Florida; M.S. 2001, University of California, Berkely; Ph.D. 2007, California Institute of Technology

Rajat Mittal (2009)
Professor, Mechanical Engineering
B.E. 1989, Indian Institute of Technology; M.S. 1991, University of Florida; Ph.D. 1995, University of Illinois at U.C.

Daniel Q. Naiman (1982)
Professor and Chair, Applied Mathematics and Statistics
B.S. 1977, Cornell; M.S. 1979, University of Illinois, Ph.D. 1982

Narutoshi Nakata (2007)
Assistant Professor, Civil Engineering
B.S. 1999, Kyoto University; M.S. 2001; Ph.D. 2007, University of Illinois at U.C.

Thao (Vicky) Nguyen (2007)
Assistant Professor, Mechanical Engineering
B.S., 1998 Massachusetts Institute of Technology
M.S., 2000 Stanford University, Ph.D. 2004

Catherine S. Norman (2005)
Assistant Professor, Geography and Environmental Engineering
B.A. 1997, Drew University: M.A. 2001, University of California at Santa Barbara, Ph.D. 2005

Allison Okamura (2000)
Professor, Mechanical Engineering; Computer Science
B.S. 1994, UC Berkeley; M.S. 1996, Stanford, Ph.D. 2000

Marc Ostermeier (2000)
Associate Professor, Chemical and Biomolecular Engineering
B.S. 1990, University of Wisconsin; Ph.D. 1996, University of Texas, Austin

Christine Piatko (2004)
Assistant Research Professor, Computer Science

Theodore O. Poehler (1973)
Research Professor, Electrical and Computer Engineering; Materials Science and Engineering

Carey S. Priebe (1994)
Professor, Applied Mathematics and Statistics; Computer Science
B.S. 1984, Purdue; M.S. 1988, San Diego State University; Ph.D. 1993, George Mason University

Jerry L. Prince (1989)
William B. Kouwenhoven Professor and Associate Director for Research in Engineering Research Center for Computer-Integrated Surgical Systems and Technology, Electrical and Computer Engineering; Computer Science; Applied Mathematics and Statistics
B.S. 1979, University of Connecticut; M.S. 1982, M.I.T., Ph.D. 1988

Andrea Prosperetti (1985)
Charles A. Miller Jr. Distinguished Professor in Mechanical Engineering; Geography and Environmental Engineering
B.S. 1968, Università di Milano; M.S. 1972, California Institute of Technology, Ph.D. 1974

Kaliat T. Ramesh (1988)
Professor, Mechanical Engineering;
Materials Science and Engineering
B.S. 1982, Bangalore University, India;
M.S. 1987, Brown, Ph.D. 1987

Tilak (John) Ratnanather (1998)
Assistant Research Professor, Biomedical Engineering,
Center for Imaging Science

A. Lynn Roberts (1993)
Professor, Geography and Environmental Engineering
B.S. 1977, Pomona College; M.S. 1984, University of
Waterloo; Ph.D. 1993, M.I.T.

Lucy Robinson
Assistant Research Professor, Applied Mathematics and
Statistics

Aviel Rubin (2003)
Professor, Computer Science
B.S. 1989 University of Michigan, M.S. 1991,
Ph.D. 1974

Sridevi Sarma (2009)
Assistant Professor, Biomedical Engineering;
Institute for Computational Medicine
B.S. 1994, Cornell University;
S.M. 1997, M.I.T; Ph.D. 2006

Benjamin Schafer (2000)
Professor and Chair, Civil Engineering
B.S. 1993, University of Iowa; M.S. 1995, Cornell,
Ph.D. 1997

Edward R. Scheinerman (1984)
Vice Dean for Education, Whiting School of Engineering
(2008); Assoc. Dean for Education (2007); Professor,
Applied Mathematics and Statistics; Computer Science
B.S. 1980, Brown; M.S. 1981, Princeton,
Ph.D. 1984

Erica J. Schoenberger (1984)
Professor, Geography and Environmental Engineering
B.S. 1974, Stanford; M.S. 1979, UC Berkeley,
Ph.D. 1984

Peter C. Searson (1990)
Joseph R. Reynolds Professor, Materials Science and
Engineering; Chemical and Biomolecular Engineering
B.S. 1978, University of Manchester, M.S. 1980,
Ph.D. 1982

Lian Shen (2004)
Assistant Research Professor, Civil Engineering
B.S. 1997, University of Science and Technology
of China; Ph.D. 2000, M.I.T.

Scott F. Smith (1988)
Professor, Computer Science
B.S. 1983, Purdue University;
Ph.D. 1989, Cornell University

James Spall (2004)
Research Professor, Applied Mathematics and Statistics

Alexander A. Spector (1998)
Research Professor, Biomedical Engineering

James B. Spicer (1993)
Professor, Materials Science and Engineering
B.S. 1985, Southern Methodist University;
Ph.D. 1991, Johns Hopkins University

Alan Stone (1983)
Professor, Geography and Environmental Engineering;
Civil Engineering
B.S. 1978, University of Maryland;
M.S. 1981, California Institute of Technology,
Ph.D. 1983

Kim Strohbehn (2004)
Assistant Research Professor, Electrical and Computer
Engineering

Lester K. Su (2002)
Associate Research Professor, Mechanical Engineering

Sean Sun (2003)
Associate Professor, Mechanical Engineering
B.S. 1994, Pennsylvania State University
Ph.D. 1998, UC Berkeley

Danielle Tarraf (2008)
Assistant Professor, Electrical and Computer Engineering
B.E. 1996, American University of Beirut;
M.S. 1998, Massachusetts Institute of Technology;
Ph.D. 2006

Russell H. Taylor (1995)
Professor, Computer Science; Mechanical Engineering;
Director, Center for Computer Integrated Surgical Systems
and Technology
B.S. 1970, Johns Hopkins University;
Ph.D. 1976, Stanford University

Andreas Terzis (2003)
Associate Professor, Computer Science
B.S. 1995, University of Patras, 1995, M.S. 1997;
Ph.D. 2000, University of California

Trac Duy Tran (1998)
Associate Professor, Electrical and Computer Engineering
B.S. 1994, M.I.T., M.S. 1994;
Ph.D. 1998, University of Wisconsin

Natalia Trayanova (2006)
Professor, Biomedical Engineering, Institute for
Computational Medicine
M.S. 1982, Sofia University, Bulgaria
Ph.D. 1986, Bulgarian Academy of Sciences

Jonathan Trostle (2007)
Assistant Research Professor, Computer Science

David Van Wie (2004)
Research Professor, Mechanical Engineering

Fijoy Vadakkumpadan
Assistant Research Professor, Institute for Computational
Medicine

Rene Vidal (2004)
Associate Professor, Biomedical Engineering;
Computer Science; Mechanical Engineering
B.A. 1995, Catholic University
M.S. 2000, UC Berkeley, Ph.D. 2003

Tza-Huei (Jeff) Wang (2002)
Associate Professor, Mechanical Engineering
B.S. 1995, University of Patras; M.S. 1997, UCLA

Timothy P. Weihs (1995)
Professor, Materials Science and Engineering;
Mechanical Engineering
B.S. 1983, Dartmouth; M.S. 1985;
Ph.D. 1990, Stanford University

Howard L. Weinert (1974)
Professor, Electrical and Computer Engineering
B.S. 1967, Rice; M.S. 1968, Stanford, Ph.D. 1972

James West (2003)
Research Professor, Electrical and Computer Engineering

Louis L. Whitcomb (1994)
Professor, Mechanical Engineering; Computer Science
B.S. 1984, Yale University; M.S. 1988, Ph.D. 1992

John C. Wierman (1981)
Professor, Applied Mathematics and Statistics;
Director, Center for Leadership Education
B.S. 1971, University of Washington, Ph.D. 1976

Peter R. Wilcock (1987)
Professor, Geography and Environmental Engineering;
Civil Engineering
B.S. 1978, University of Illinois; M.S. 1981, McGill;
Ph.D. 1987, M.I.T.

Justin Williams (2002)
Associate Research Professor, Geography and
Environmental Engineering

Denis Wirtz (1994)
Theophilus Halley Smoot Professor, Chemical and
Biomolecular Engineering; Materials Science and
Engineering
B.S. 1998, University of Belgium; M.S. 1990,
Stanford, Ph.D. 1993

Kevin Yarema (2001)
Associate Professor, Biomedical Engineering
B.S. 1988, Walla Walla College; Ph.D. 1994, M.I.T.

David Yarowsky (1996)
Professor, Computer Science
B.S. 1987, Harvard University;
M.S. 1993, University of Pennsylvania, Ph.D. 1996

Laurent Younes (2003)
Professor, Applied Mathematics and Statistics
M.S. 1985, University Paris Sud, Ph.D. 1988

Michael Yu (2001)
Associate Professor, Materials Science and Engineering;
Chemical and Biomolecular Engineering; Chemistry
B.S. 1990, Korea University, M.S. 1993;
Ph.D. 1998, University of Massachusetts

Other Faculty Appointments

Lecturers

Hedy Alavi, Ph.D.
Senior Lecturer and Assistant Dean for International
Programs
Geography and Environmental Engineering 1997

Lawrence Aronhime, M.B.A.
Senior Lecturer, W.P. Carey Program in Entrepreneurship
and Management 2001

David Audley, Ph.D.
Senior Lecturer, Applied Mathematics and Statistics 1997

David Berstein
Lecturer, Information Systems Institute, 2010

Eoghan Casey, Ph.D.
Lecturer, Information Systems Institute, 2008

Beryl Castello, Ph.D.
Senior Lecturer, Applied Mathematics and Statistics 2004

Andrew F. Conn, Ph.D.
Senior Lecturer, Mechanical Engineering 1989

Lise Dahuron, Ph.D.
Lecturer, Chemical and Biomolecular Engineering 2007

Kevin Dungey, Ph.D.
Senior Lecturer, Professional Communication Program 1998

David Fisher, J.D.
Senior Lecturer, W.P. Carey Program in Entrepreneurship and
Management 2001

Mark Franceschini
Senior Lecturer, W.P. Carey Program in Entrepreneurship
and Management 2000

Nora Frenkiel, J.D.
Lecturer, W.P. Carey Program in Entrepreneurship and
Management, 2009

Peter Fröhlich, Ph.D.
Senior Lecturer, Computer Science 2005

Robert E. Glaser, Ph.D.
Lecturer, Electrical and Computer Engineering 1987

An Goffin, Ph.D.
Lecturer, Chemical and Biomolecular Engineering 2008

Eileen Haase, Ph.D.
Lecturer, Biomedical Engineering 2003

Kathleen Havey, MBA
Lecturer, W.P. Carey Program in Entrepreneurship and
Management, 2009

Jason Heiserman
Lecturer, Center for Leadership Education 2009

Joanne F. Houlahan, Ph.D.
Senior Lecturer, Computer Science 1996

Illysa Izenberg, MBA
Lecturer, W.P. Carey Program in Entrepreneurship and
Management, 2010

Michael Jacobs
Lecturer, Computer Science 1999

Robert E. Jenkins, M.S.
Senior Lecturer, Electrical and Computer Engineering 1988

Pamela Jones, J.D.
Lecturer, Center for Leadership Education 2009

George Kalb
Lecturer, Computer Science 2000

Leslie Kendrick, M.B.A.
Senior Lecturer, W.P. Carey Program in Entrepreneurship and Management 2000

Sheela Kosaraju, J.D.
Lecturer, Computer Science 2008

Andrew F. Kulanko, M.S.
Senior Lecturer, Professional Communication Program 2001

Darren Lacey, J.D.
Lecturer, Information Security Institute 2004

Aida Lebbos, J.D.
Lecturer, W.P. Carey Program in Entrepreneurship and Management, 2009

Harold Lehmann, M.D., Ph.D.
Lecturer, Computer Science 1993

Annette Leps, M.B.A.
Senior Lecturer, W.P. Carey Program in Entrepreneurship and Management, 2006

Thomas Llanso
Lecturer, Information Security Institute, 2005

Emily Manus.
Lecturer, Center for Leadership Education 2008

John Matteo, M.S.E.
Lecturer, Civil Engineering 2008

Timothy McGee, Ph.D.
Lecturer, Mechanical Engineering, 2011

Donald McNeilly, Ph.D.
Lecturer, W.P. Carey Program in Entrepreneurship and Management, 2009

Rachel Moran, M.B.A.
Lecturer, W .P. Carey Program in Entrepreneurship and Management, 2010

Robert Niewoehner, Ph.D.
Lecturer, W.P. Carey Program in Entrepreneurship and Management, 2010

Charlotte O'Donnell, M.F.A.
Lecturer, W.P. Carey Program in Entrepreneurship and Management, 2009

Martin Ozimek, Ph.D.
Lecturer, Mechanical Engineering, 2011

Peter Porosky, M.F.A.
Lecturer, Professional Communication Program 2000

Jack L. Powell Jr., C.F.A., C.M.A.
Senior Lecturer, W.P. Carey Program in Entrepreneurship and Management 1997

Sai S. Prakash, Ph.D.
Lecturer, Chemical and Biomolecular Engineering, 2009

Julie Reiser, M.A.
Senior Lecturer, Center for Leadership Education 2007

Joshua Reiter, Ed.D.
Lecturer, W.P. Carey Program in Entrepreneurship and Management 2000

Eric Rice, Ph.D.
Senior Lecturer, W.P. Carey Program in Entrepreneurship and Management, 2006

Yury Ronzhes, Ph.D.
Lecturer, Mechanical Engineering 2008

Charles Russo, M.S.; P.E.
Lecturer, Civil Engineering 2003

Douglas S. Sandhaus, J.D.
Senior Lecturer, W.P. Carey Program in Entrepreneurship and Management 2002

Rachel Sangree, Ph.D.
Lecturer, Civil Engineering, 2009

Pamela Sheff, Ph.D.
W.P. Carey Program in Entrepreneurship and Management, 2006

Andrew Siegel, Ph.D.
Lecturer, Information Security Institute, 2010

William Smedick, Ed.D.
Lecturer, W.P. Carey Program in Entrepreneurship and Management, 2007

Judy Smylie, J.D.
Lecturer, W.P. Carey Program in Entrepreneurship and Management, 2006

John Thomas, Ph.D.
Lecturer, Mechanical Engineering, 2011

Fred Torcaso, Ph.D.
Senior Lecturer, Applied Mathematics and Statistics 2002

James Tzitzouris, Ph.D.
Lecturer, Applied Mathematics and Statistics, 2003

Niklas Vigener, M.S.; P.E.
Lecturer, Civil Engineering 2003

Eric Vohr, M.A.
Lecturer, Center for Leadership Education 2007

Francie Weeks, M.A.
Lecturer, Center for Leadership Education,2009

Orla Wilson, Ph.D.
Lecturer, Materials Science and Engineering 2008

Joint Appointments

Stephen Belkoff, Ph.D.
Associate Professor, Orthopedic Surgery (Medicine)
Mechanical Engineering 2001

Emad Boctor, Ph.D.
Assistant Professor, Radiology and Radiological Sciences
(Medicine)
Computer Science, 2009

Paul Bottomly, Ph.D.
Professor, Radiology (Medicine)
Electrical and Computer Engineering 2000

Patrick Breysse, Ph.D.
Professor, Environmental Health (Public Health)
Chemical and Biomolecular Engineering

Michael Edidin, Ph.D.
Professor, Biology (Arts and Sciences)
Materials Science and Engineering, 2005

Eric Frey, Ph.D.
Professor, Radiology (Medicine)
Electrical and Computer Engineering, 2010

John Isaacs, Ph.D.
Professor, Chemical Therapeutics (Medicine)
Chemical and Biomolecular Engineering

Stuart W. Leslie, Ph.D.
Professor, History of Science and Technology (Arts and Sciences)
Geography and Environmental Engineering 1997

Elliot McVeigh, Ph.D.
Professor, Biomedical Engineering (Medicine)
Electrical and Computer Engineering

Aleksander S. Popel, Ph.D.
Professor, Biomedical Engineering (Medicine)
Mechanical Engineering 1986
Chemical and Biomolecular Engineering

Arman Rahmim, Ph.D.
Assistant Professor, Radiology (Medicine)
Electrical and Computer Science 2010

Mark Robbins, Ph.D.
Professor, Physics and Astronomy (Arts and Sciences)
Mechanical Engineering 2001

Douglas Robinson, Ph.D.
Professor, Physics and Astronomy (Arts and Sciences)
Mechanical Engineering 2007

Dan Stoianovici, Ph.D.
Associate Professor, Urology (Medicine)
Mechanical Engineering, 2005

Alexander Szalay, Ph.D.
Professor, Physics and Astronomy (Arts and Sciences)
Computer Science 2001

Benjamin Tsui, Ph.D.
Professor, Radiology (Medicine)
Electrical and Computer Engineering 2006

Raimond L. Winslow, Ph.D.
Professor, Biomedical Engineering (Medicine);
Director, Center for Cardiovascular Bioinformatics and
Modeling, Computer Science 1991

Jin Zhang, Ph.D.
Associate Professor, Pharmacology & Molecular Sciences
(Medicine)
Chemical and Biomolecular Engineering

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