

Zanvyl Krieger School of Arts and Sciences
Whiting School of Engineering

Undergraduate and Graduate Programs 2007–2009



Calendar 2007–2008

Fall 2007

August 31–September 4	Orientation for all new undergraduates
September 4–5	Registration for graduate students
September 6	First day of classes
October 15	Fall break day—no classes
November 12–21	Undergraduate registration for spring term
November 22–25	Thanksgiving vacation
December 10	Last day of classes
December 11–12	Reading period
December 13–20	Final examination period
December 21–January 6	Midyear vacation

Spring 2008

January 7–25	Intersession
January 21	Martin Luther King Day—no classes
January 24–25	Registration for graduate students
January 28	First day of classes
March 17–23	Spring vacation
April 14–25	Undergraduate registration for fall term
May 2	Last day of classes
May 5–7	Reading period
May 8–15	Final examination period
May 22	Commencement

Summer 2008

May 27–June 27	Summer Session, Term I
June 30–August 1	Summer Session, Term II

Organic Chemistry

June 2–June 27	Summer Session, Term I
July 30–July 25	Summer Session, Term II

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.

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For the most up-to-date 2007–2008 academic calendar, visit
www.jhu.edu/registrar/calendar.html

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 have been designed to share the university's unique intellectual life and educational philosophy with you. 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 must 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.

The low student-faculty ratio on the Homewood campus is a direct consequence of this educational philosophy, which 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, as Gilman put it, can "go forward rapidly or go forward slowly according to the fleetness of his foot and his freedom from impediment." 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 are 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.

The main number for the Johns Hopkins University Homewood campus is 410-516-8000.

The Johns Hopkins University Web site is www.jhu.edu.

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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 4,112 undergraduates, 1,439 graduate students, and 155 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 advisers. 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 dean of undergraduate education, who oversees four major components within the area. The dean's position provides a single point of accountability for all programs relating to the quality of the undergraduate experience for students in both the Krieger and the Whiting schools. The areas under the dean's purview include Academic Programs and Advising for Arts and Sciences students, Enrollment and Academic Services, Student Life, and Business Operations and Administrative Services. (Information on Academic Advising and its areas can be found beginning on page 41.)

The dean and the areas reporting to the dean 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 123 Garland 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 102 Levering Hall. 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 five 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 adviser who serves as a first friend and source of information.

Departmental and faculty adviser 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 acquaint 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 Web site listing information specific to graduate students, www.jhu.edu/gro.

Student Activities and Involvement

Once they are accustomed to the academic schedule, students 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 Department of Student Development and Programming, 410-516-

4873 (Mattin Center, Ross Jones Building), www.jhu.edu/studentprograms/OSI/home.html.

Baltimore

As an urban center, Baltimore has undergone tremendous revitalization in recent years. The city showplace is the Inner Harbor, which has boutiques 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 Student Affairs Baltimore Film Forum, 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.

The Baltimore Museum of Art, which adjoins the campus, is known for its collections of primitive and modern art. 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 nine 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 fraternity and sorority activities. The Baltimore Collegetown Network connects college students to numerous resources like restaurants, nightlife, shopping, attractions, arts, and sports. In addition, Collegetown sponsors a shuttle to places like the Inner Harbor, other colleges, and some area malls. The Collegetown Web site can be accessed at www.collegetown.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 Levering Lounge are the sites of a variety of social activities. Levering Union also has a comfortable, newly renovated lobby area with a coffee/sandwich shop, a small theater, meeting rooms, and a food court area.

The Mattin Center is the location for the Student Development and Programming staff office suite 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, 10 individual music practice rooms, two group rehearsal rooms, three meeting rooms, and a dance studio. A café in the theater lobby offers light fare 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, 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 250 student organizations cater to interests including cultural, religious, recreation, performing arts, politics, and academics. Over half of the recognized organizations belong to the Student Activities Commission (SAC), a branch of Student Council. The Student Council is the elected body that meets weekly to serve as the recognized undergraduate voice to the university's faculty and administration. Graduate students and organizations are represented by the Graduate Representative Organization (GRO). The GRO sponsors an annual academic symposium 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 15 publications including the *News-Letter*, a weekly student newspaper; *Hullabaloo*, the yearbook; the *Black and Blue Jay*, a humor magazine; *Film Society*, a publication which discusses film and cinema; or *Zeniada*, a student-run literary magazine.

Performing Arts

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 sex, 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, 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 Organizations

More than 50 cultural and religious groups representing a wide diversity of Homewood students sponsor programs, films, concerts, and lectures. Cultural groups include the Chinese Student Association, Black Student Union, Caribbean Cultural Society, South Asian Society of Hopkins, and Organizacion Latina Estudiantil. Religious groups include Agape Campus Ministry, Buddhist Student Association, Catholic Community, Hindu Student Council, Hopkins Hillel, Jain Students Association, Muslim Student Association, and Hopkins Christian Fellowship.

Special Interest Clubs

There is a wide range of special interest groups on campus. These groups include Model UN, College Bowl, Diverse Sexuality and Gender Alliance (DSAGA), and the Debate Council. If you have an interest in sports or recreation, we have 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 student who believes that a new organization is needed can register to start a new group.

Honor Societies

Along with various cocurricular 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. 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 awarded *Baltimore*

magazine’s 2006 “Best Concert Series,” Shriver Hall Concert Series for 41 years has been presenting to Maryland music enthusiasts world-class chamber music concerts and solo recitals by the world’s most famous artists. ALL Series events are FREE to ALL Homewood and Peabody 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 “Violence in America,” “Who Am I? The Changing Role of Sexuality in America, The Great American Experiment: A Juxtaposition of Capitalism and Democracy,” “Rebuilding America: Peace and Prosperity at What Price?,” “America in Decline: Crisis or Illusion?,” “The Imprisonment of Ideas: The First Amendment in Crisis,” “A Nation United: Politics and Power in the 21st Century,” and “Changing Times: Who Are We?” 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 totally 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 36th 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 73) and at www.jhu.edu/artwork.

Athletics and Recreation

The Department of Athletics and Recreation is responsible for intercollegiate athletics, sport clubs, and the campus recreational programs for students, staff, and faculty. The facilities of the New-

ton 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' 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 sport club program offers competition and instruction in the following groups: badminton, 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, ski and snow boarding, men's and women's soccer, women's softball, soo bahk do, taekwondo, table tennis, tennis, men's and women's ultimate, men's and women's volleyball. 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 14 varsity intercollegiate teams for men (lacrosse, football, soccer, cross country, basketball, wrestling, swimming, water polo, fencing, baseball, indoor and outdoor track, tennis, and rowing) and 12 varsity intercollegiate teams for women (tennis, fencing, swimming, basketball, lacrosse, field hockey, cross-country, indoor and outdoor track, soccer, rowing, 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 or in university-approved Greek housing (second-year students).

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 advisers 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 leases 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 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 leases 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 modern 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 Web site at www.jhu.edu/~hds/offcampus.

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., Balti-

more, 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

After several years of planning, virtually every aspect of campus dining has been transformed this year, all as a means of improving the quality of campus life for students, faculty, and staff.

Development of the plan for campus dining, or “dining vision” as it has come to be known, began in earnest after reviewing the findings and recommendations of the university’s Committee on Undergraduate Education (CUE) report. The commission included diverse members from across the Hopkins community charged with identifying the core values that should characterize a Hopkins undergraduate experience and to develop recommendations for specific actions that would improve the quality of undergraduate education, both inside and outside the classroom.

Exponential improvement of the campus dining experience was a key recommendation of the CUE that reverberated clearly with university administration, and drove the development of the dining vision and its implementation.

Key components of the campus dining transformation include:

- Complete renovation of the former Terrace Court Café, renamed *Fresh Food Café*;
- Renovation of the Levering *Food Court and Coffee Shop*—including five new retail venues;
- Development of *Nolan’s* at Charles Commons, a terrific dining, student recreation and “university living room” facility;
- Complete renovation of the former Wolman Station resident dining hall and Depot convenience store into the new *Charles Street Market and Einstein Bros. Bagels*; and
- Appointment of Aramark Campus Services as the new campus dining contractor.

Although already quite extensive, the transformation to campus dining is an ongoing process. Campus Dining Services is committed to continual improvement and welcomes comments and suggestions. Email Dave Furhman at dfurhman@hd.jhu.edu.

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), \$.

Dining Options

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

Freshman Options

Considered a fundamental element of the freshman experience, communal dining at the Fresh Food Café provides freshmen with a wide variety of dining choices all under one roof in a comfortable, congenial environment. Freshmen will utilize their required 19 or 14 (or 14 or 11 per week kosher) meals per week plan at the Fresh Food Café. In addition, the Meals in a Minute program provides meals to go when class-schedule conflicts preempt regular meals at the Fresh Food Café.

In addition to all-you-care-to-eat meals at the Fresh Food Café, students may use their dining dollars at any JHU Dining outlet on campus. When combined with regular meals, Dining Dollars provide freshmen with terrific dining flexibility.

The Fresh Food Café

Fresh, seasonal, and locally sourced ingredients are the foundation of every meal served at the Fresh Food Café.

Renovated from top to bottom in the summer of 2006, the Fresh Food Café serves more than 3,000 meals of impeccable quality each day to the university community. The Café utilizes display cooking, where dishes are prepared right in front of the customer allowing for both customization as well as the freshest product possible.

Stations include:

- A made-to-order deli featuring Boar’s Head brand meats, house-made premium sandwiches and salads, a selection of premium cheeses, and an unparalleled variety of artisanal breads;
- A made-to-order char grill offering boneless, skinless chicken breast, 6 oz. hand-formed 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 including (as seasons permit): yellow grape tomatoes, purple cauliflower, fresh strawberries, raspberries, and blackberries; gorgonzola and feta cheeses; house-made croutons and dressings; and an enormous array of fresh seasonal artisanal breads, rolls, and baked goods. In addition,

a dedicated char grill at the salad station provides guests with an ever-changing daily variety of protein toppers including salmon filet, Ahi tuna, turkey tenders, and shrimp to name a few;

- A homestyle station providing hot, homestyle entrees including a carving station, made-from-scratch soups, and side dishes of farm-fresh vegetables;
- A hearth station baking pizzas, strombolis, calzone, and pasta casseroles;
- A separate vegan and vegetarian station offering made-to-order stir fry, baked casseroles, and soup;
- Sweet endings are always possible at our dessert island offering fresh fruits and berries, warm cobblers and outrageous cakes, cookies, and pies; another station serves customers made-to-order combinations of ice cream or frozen yogurt with fresh-baked, warm cookies, hand-dipped cones, sundaes, and a dizzying array of hot and cold toppings and mix-ins.
- Quench your thirst with a dazzling variety of beverages both cold and hot. We have everything including soy milk, cappuccino, no-sugar-added juices, sodas, teas, and of course, pure filtered water.
- Taam Tov, the university's kosher servery, provides a wide array of tempting, wholesome 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 pastel color scheme.

As part of their meal plan, freshmen are provided Dining Dollars, which may be used at any campus dining facility operated by Aramark, including:

Nolan's at Charles Commons: The New Campus Livingroom

A product of more than five years of planning, Nolan's at Charles Commons began operation in September of 2006. As students moved into the 618-bed residence hall for the very first time, Nolan's took its rightful place as the jewel in Johns Hopkins University's dining crown.

Named in honor of the contribution made to the university by the David Nolan Family, the new facility is located on the third level of the university's new Charles Commons complex and has quickly become a favorite dining, meeting, and recreation facility for students, faculty, and staff.

The dining area and menu options 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 ingredients each season has to offer. Under the supervision of Aramark Campus Services executive chef Michael Gueiss, the Nolan's menu focuses on classic favorites utilizing only premium ingredients.

Those premium ingredients result in unparalleled quality and variety with stations that include **CRISP**, a premium tossed-to-order salad station side by side with a premium made-to-order deli exclusively featuring Boar's Head brand meats; **THE HEARTH**, baking a wide variety of pizzas, calzones, strombolis, and pasta specialties; **THE GRILLE** offering USDA choice steak, burgers, and fish; **PASSPORT** providing customers with a daily rotating menu of international favorites including sushi and rice bowls, as well as regional American fare; and **FINALES** proudly scooping flavorful and rich gelato, baked desserts, and fruit smoothies.

In addition to retail dining, Nolan's includes ample soft seating, a two-sided glass and stone fireplace, a private dining room accommodating groups up to 40, a performance stage, two pool tables, and a balcony for al fresco dining.

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

Open for lunch Monday-Friday, the Levering Food Court provides a variety of dining options right in the middle of campus. Options include:

Levering Leaves—a tossed-to-order salad station;

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

Mas Mex—burritos, quesadillas, and nachos;

Savory Deli—Boar's Head brand meats and cheeses and artisanal breads;

Grab and Go—sandwiches and snacks that are ready to go;

Meals in a Minute—for students on a traditional (Freshman) meal plan who can't get back to the Fresh Food Café for lunch;

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 fresh mangoes to asiago bagels, the Charles Street Market at Johns Hopkins University has everything—or just about everything.

Developed, designed, and built to serve a diverse university population, the Charles Street Market provides the JHU campus community with a seem-

ingly unending variety of fresh produce, grocery items, frozen foods, and health and beauty aids. In addition, a special “Hot & Not” section offers both hot, ready-to-enjoy meals and an extensive chilled salad bar.

Occupying more than 3,500 square feet in the university’s Wolman residence hall, the Charles Street Market provides customers with unprecedented convenience, variety, and quality on campus. With operating hours from early morning to late night, the JHU campus community now has a retail store befitting the Johns Hopkins name.

In addition to the dizzying array of items offered, the Charles Street Market is home to Einstein Bros. Bagels (www.einsteinbros.com)—the first such national brand on the Homewood campus. Offering a wide selection of freshly baked bagels, pastries, sandwiches, and salads, Einstein Bros. Bagels was welcomed by the campus with outstretched arms.

The Fine Print

Once a student enrolls in a meal plan you are committed for the entire academic year unless your student status changes.

- Students will be allowed to *change* meal plans during well-publicized specified change periods twice each academic year. No other changes will be permitted.
- Points can only be used in Sodexo dining facilities and are *non-taxable*.
- Additional blocks can be purchased in 25-block increments for \$200. Points can be purchased in 50-point increments.
- Points cannot be purchased unless you are a meal plan participant.
- Any changes made to a meal plan will be subject to a \$15 administrative fee. Cancellations will be assessed a \$25 fee.

Questions?

Contact Housing & Dining Services, 410-516-7961 or www.jhu.edu/hds.

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 Web site 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 characteristic in any student program or activity administered by the university, or with regard to admission or employment. Defense Department discrimination in ROTC programs on the basis of sexual orientation conflicts with this university policy. The university continues its ROTC program, but encourages a change in the Defense Department Policy. 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. For persons with disabilities it is important to provide to the university a comprehensive evaluation of a specific disability from an appropriate qualified diagnostician that identifies the type of disability, describes the current level of functioning in an academic or employment setting, and lists recommended accommodations. It is important to make an appointment at least two weeks prior to the start of the semester to ensure that accommodations are provided in a timely manner. For questions and concerns regarding physical and programmatic access, specific campus accommodations, resolution of complaints and problems, and identification of other support services, please contact:

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

Dr. Richard Sanders, Director of

Academic Advising
sanders@jhu.edu
410-516-8216

Morris Hunt, Fellowship Program Coordinator,
Graduate Programs
Mhunt1@jhu.edu
410-516-6487

Student Health and Wellness Center

The JHU Homewood Student Health and Wellness Center (SHWC), located in the AMR II dorms, provides comprehensive, confidential health services to students enrolled in the schools of Arts and Sciences, Engineering, and Nursing. Staffed by physicians credentialed through the Johns Hopkins Hospital and by nationally certified nurse practitioners and a nurse midwife, 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 diseases), health education, and international travel consultations (including immunizations). Allergy shots are offered by appointment. Services rendered within the Health Center are free of charge.

Students are also referred to an extensive network of community-based and Johns Hopkins subspecialists. A limited pharmacy service is available to students who receive their health care directly from SHWC staff. During the academic year (September to May), the center is open Monday through Friday from 8:30 a.m. to 5:00 p.m. and on Saturday mornings from 9 to noon. Visits to the center are by appointment (410-516-8270); students almost always can be seen the same day for acute illnesses. The after-hours emergency service (in operation at all times when the center is closed) can be reached through the University Security Office (410-516-7777). The center maintains a Web site (www.jhu.edu/~shcenter) with up-to-date information on a wide variety of health topics. An informative self-care manual designed specifically for students can also be accessed through the Web site. 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. Our 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 alcohol and other drugs, stress management, sexual health, nutrition, and physical activity 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), Colleges Against Cancer, 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 AMR II Room 0223, or on the Web at www.jhu.edu/health.

Counseling Center

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 School of Nursing, and the Peabody Institute. The counseling services and the outreach programs are designed to enhance the personal and interpersonal development of students and to maximize students’ potential to benefit from the academic environment and experience. We further strive to foster a healthy, caring university community, which is as beneficial to the intellectual, emotional, and physical development of students as possible.

Counseling Services

The Counseling Center offers individual, couples, and group counseling 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
- Difficulty in making a career choice

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 and couples 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.

In the event that psychotropic medication may be indicated, a consulting psychiatrist at the Counseling Center will evaluate the student and prescribe and monitor medication as needed.

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.

Career Decision Making

The center's staff can help students begin the process of developing career goals. Individual career assessment and counseling are offered, as well as workshops and programming related to making decisions about majors and careers. State-of-the-art computerized software is also available to assist students with tasks such as seeking information about specific careers or identifying options which capitalize on individual strengths.

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.

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. *Counselors are legally and ethically required to take responsible action in two cases: (1) when someone's life is in clear and imminent danger, and (2) when it appears that a child or dependent adult is being abused.*

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 358 Garland Hall, 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. Emergency and crisis intervention services are also offered at night, on weekends, and during university breaks. 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 courses 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 the HopkinsNet, 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.

Student Employment Services provides students the opportunity to apply their academic lessons 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 the School of Medicine to Web Manager at a local library; from Lifeguard at the athletic center to Lab Assistant in the Krieger School of Arts and Sciences; from Data Entry Clerk in Academic Advising to Tutor for a local family. In addition, Student Employment Services works with area businesses to develop student job opportunities in a variety of fields in and around the Baltimore area.

All of the many services offered through Student Employment can be found on our Web site at www.jhu.edu/stujob. Here students can search for a job, create an online application, download tax forms, view their pay stub, sign up for the ‘Student Temp-Job’ Program (a program designed for students looking for short-term job assignments). They can link to key offices like Student Financial Services and the JHU Tax Office. In addition, they can search for community service opportunities, discover where to find internships, and “virtually” meet the current JHU Student Employee of the Year.

Student Employment Services provides assistance to all full-time Homewood students. For more information please visit www.jhu.edu/stujob or call us at 410-516-8421.

Multicultural Student Affairs

The Office of Multicultural Student Affairs develops and maintains programs to support the needs of multicultural students, for whom the director of Multicultural Student Affairs serves as a primary advocate. The office directs the Mentoring Assistance Peer (MAP) program, designed to assist multicultural freshmen to become integrated into campus life. The office also oversees the S.E.E.D. (Students Educating and Empowering for Diversity) program, in which trained student leaders facilitate workshops throughout the campus community. OMSA has developed a yearlong program, Student Success Series, that is specifically designed to assist multicultural freshmen throughout their first-year experience via workshops and cultural programming. The office works to enhance the educational experience of all students through programs and activities that promote cross-cultural understanding, such as Latino Heritage Month, Asian Awareness Month, Black History Month, the Cultural Festival, and the Martin Luther King Jr. Convocation.

Office of International Student and Scholar Services

The Office of International Student and Scholar Services 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 Office of International Student and Scholar Services immediately after their initial arrival on campus, at the beginning of each academic year, 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 3103 N. Charles Street, directly across from the Homewood campus. Information can be obtained by calling 410-516-1013, by faxing 410-516-1018 (from campus dial 113-61013/fax 113-61018), by e-mail: theworld@jhu.edu, or on our Web site at www.jhu.edu/~iss.

Admissions and Finances

Undergraduate Admission

Every year The Johns Hopkins University enrolls a freshman class of approximately 1,200 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. 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 Committee.

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 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. Candidates should call 410-516-8171 to schedule their appointment at least two weeks in advance. 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 seniors only and can be requested during the fall semester.

Information Sessions

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

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 Web site.

Open Houses and Overnight Visits

Special Open House programs are offered in the fall. Seniors participating in an Open House program are also able to spend an overnight visit with a student host the evening before an Open House. Space is limited, and online reservations through the Web site 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 one case, 3) on the Advanced Placement (AP) examinations listed below. Students who take any AP examinations should have the results forwarded to the Undergraduate Admissions Office. If a student enters the university with advanced placement credits for a course and then takes an equivalent course offered at the university, his/her advanced placement credits will be disallowed.

AP Examination	Credits Awarded
Biology***	8
Calculus AB	4
Calculus BC (score of 3)	4
Calculus BC (score of 4 or 5)	8
Chemistry****	8

Computer Science AB	3
Environmental Science	3
French Language	6
German Language	6
Macroeconomics*	3
Microeconomics*	3
Physics C (first part)**	4
Physics C (second part)**	4
Spanish Language	6
Statistics	4

*Credits awarded with department's permission.

**A score of 4 or 5 on the first part of Physics C will excuse the student from 171.101 and 173.111; on the second part, from 171.102 and 173.112.

***A score of 4 or 5 on the Biology exam will excuse the student from 020.151 and 020.152, and the corresponding labs 020.153 and 020.154.

****A score of 4 or 5 on the Chemistry exam will excuse the student from 030.101, 030.102, and 030.105.

No credit is awarded for the following AP examinations: American History, Art History, English Composition and Literature, English Language and Composition, European History, French Literature, German Literature, Government and Politics (American or Comparative), Latin: Horace and Catullus, Latin: Vergil, Physics B, Psychology, or Spanish Literature.

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 the following subjects:

IB Examination	Credits Awarded	Courses Waived
Biology	8	020.151-152 020.153-154
Chemistry	8	030.101-102 030.105-106
Computer Science AB	3	none
Environmental Science (score of 4 or 5)	4	none
French	6	210.101-102
German	6	090.101-102
Mathematics	4	110.106-108
Mathematics with Further Math (score of 6 or 7)*	8	110.106-108, 110.107-109
Physics (score of 6)	4	171.101 173.111
Physics (score of 7)	8	171.101-102, 173.111-112
Spanish	6	210.111-112

*With a score of 5, a student is awarded 4 credits and may waive 110.106-108.

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).

A viewbook with undergraduate admission applications can be obtained by writing or calling Johns Hopkins University, Office of Undergraduate Admissions, Mason Hall, 3400 N. Charles Street, Baltimore, MD 21218; 410-516-8171; gotojhu@jhu.edu. A Web version of the viewbook, and downloadable application, can be found at <http://apply.jhu.edu/onlineapp>. The Common Application and the Universal Application are both accepted. The completed application should be returned with a nonrefundable \$70 application fee. If the fee presents financial hardship, the university will consider waiving it. 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.

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 366.)

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 deposit by the Candidate Reply Date of January 15 for Early Decision and May 1 for Regular Decision.

Secondary School Preparation

Applicants are responsible for seeing that all supporting materials 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.

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.

The following is recommended as preparation for all students:

English	4 years
Mathematics	4 years
Foreign language	4 years
Science with laboratory	4 years
History and social science	4 years

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 standardized test results; 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 entirely 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. Students who plan to study engineering are recommended to take the Mathematics Level 2 exam and at least one science exam.

Early Decision Plan

Students whose first choice is Johns Hopkins are encouraged to apply under the Early Decision Plan. Each year, about 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 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.

Financial aid decisions are made at the time of acceptance. Students who believe that their Early Decision aid packages are not sufficient to enable them to attend may submit a written request to the director of admissions to release them from the Early Decision agreement and have their application withdrawn.

Students not accepted under the Early Decision Plan are generally reconsidered in the spring along with Regular Decision applicants.

Early Decision applicants who are admitted to Johns Hopkins but whose status as a biomedical engineering major has been deferred for reconsideration under Regular Decision will be allowed to apply to and consider offers of admission from other institutions. The commitment to matriculate at Hopkins if accepted, as stated in the Early Decision Agreement, is null and void in this circumstance. Such candidates have until May 1 to reply to Johns Hopkins' offer of admission.

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 students to defer their entrance into the freshman class for one year after graduation from high school. Requests for deferment are evaluated and approved on an individual basis. Students who want to postpone their entrance are asked to inform the Office of Undergraduate Admissions as early as possible. This will in no way prejudice the admission decision. Such students must notify the director of undergraduate admissions of their intention to defer entrance 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. Students who want to pursue academic studies while living either in a foreign country or the United States during the deferment period may do so provided that they do not intend to seek academic credit to be applied toward the degree requirements at Johns Hopkins. Students must provide a written statement acknowledging and agreeing to this provision.

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. The transfer application deadline is March 15 for entry in the fall semester. Decisions on transfer applications are usually announced in late 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.

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 normally 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 42.)

Admission of International Students

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. A letter of recommendation in English or with an English translation from at least one teacher is 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 establish their ability to finance their education in the United States before their applications are reviewed by submitting the Certification of Finances form, contained in the materials booklet. 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 applicants whose native language is not English and who attend a non-English-speaking high school. Students attending an English-language school but who do not speak English at home should take the TOEFL. If the student's native language is not English and he/she attends high school in the U.S., he/she must take the TOEFL if he/she has been in the U.S. for fewer than five years. A minimum TOEFL score of 600 (paper test), 250 (computer test), or 100 (Internet-based test) is required. Applicants taking the Internet-based TOEFL (iBT) should have minimum sub-scores of 26 (Reading), 26 (Listening), 22 (Writing), and 25 (Speaking). International students with SAT Critical Reading scores of 670 or higher are exempt from the TOEFL requirement.

Graduate Admission

Each year academic departments carefully select about 400 men and women for graduate study, representing a wide range of interests and diverse backgrounds. Because a larger number of qualified candidates apply than can be admitted, every effort is made to select those who will profit most from the strengths of the programs and departments of

the Krieger and Whiting Schools. Visit www.grad.jhu.edu.

Application Procedures

Within the Krieger School of Arts and Sciences and the Whiting School of Engineering, each department or program has its own set of admissions requirements. Please consult with the appropriate admissions coordinator for specific admissions questions and requirements. For general admissions information, an applicant needs to complete the online inquiry form. The appropriate program will respond immediately.

Application Policy

Accuracy is expected in all documents provided by applicants to the full-time graduate programs. 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 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 dean of research and graduate education for the Krieger School of Arts and Sciences or the associate 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.

General admissions requirements

For specific departmental application deadlines please visit Programs of Study on our website (www.grad.jhu.edu/admissions/programs.htm):

- Application
- Statement of Purpose
- Application Fee
- Letters of Recommendation

- Transcripts
- GRE
- TOEFL and/or IELTS
- Sample of Work (selected departments)

Application Instructions

The 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 department must submit a separate application for each department.

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 (www.wes.org).

Application Fee

A nonrefundable fee of \$65 is required of all applicants to the Krieger School of Arts and Sciences and the Whiting School of Engineering, with the following exceptions: The departments of Computer Science and Electrical and Computer Engineering, and the Information Security Institute charge a \$25 application fee. Materials Science and Engineering waives the application fee for U.S. citizens and U.S. permanent residents.

Students applying to two or more departments must submit a separate and complete application packet to each department or program.

Transcripts

Sealed envelopes containing official transcripts of all college and university study should be obtained by the applicant. Students applying to more than one department must submit copies for each department. If information on current courses is not included on the transcript, applicants should send a list of current courses and any other courses that will be taken before beginning graduate study at Johns Hopkins. Sealed envelopes should be mailed directly to departments.

Letters of Recommendation

Applicants should ask faculty to write letters of recommendation. Most graduate departments require at least two recommendations, others require three. Please review the Programs of Study page (www.grad.jhu.edu/admissions/programs.htm) for specific listings.

Samples of Work

The following departments require each applicant to submit a sample of work: Anthropology, Classics, Cognitive Sciences, English, German and Romance Languages and Literatures, History, History of Art,

History of Science and Technology, the Humanities Center, Near Eastern Studies, Philosophy, Political Science, Psychological and Brain Sciences, Sociology, and The Writing Seminars.

Financial Assistance

Complete the Financial Aid Request section on the Application for Admission in order to be considered for university financial assistance. There are no separate forms for this purpose. Federal loans and work study are available on the basis of financial need to U.S. citizens and permanent residents. Interested students should request an application from the Office of Student Financial Services, 146 Garland Hall, Baltimore, MD 21218, 410-516-8028.

Applicants with Disabilities

Applicants with disabilities need not disclose during the applications process, but are welcome to contact the Office of Institutional Equity, Disability Services to discuss in confidence any aspect of the anticipated graduate school experience which might be influenced by health or disability concerns.

Admission Decisions

Applicant files are maintained by the academic departments, and admission decisions are made by departmental faculty committees. Each department, therefore, will notify applicants when decisions are made. Inquiries regarding the status of an application should be directed to the appropriate department.

Graduate Record Examination (GRE)

Applicants are required to submit recent GRE scores to departments. Applicants must include an institution code and a department code when requesting scores from ETS. We cannot guarantee that departments will receive your scores without both the institution and department code. Applicants will not be considered until score reports are received. Johns Hopkins University Schools of Arts and Sciences and Engineering's institution code is 5332. For department codes, please consult the GRE page (www.grad.jhu.edu/admissions/GRE.htm).

Final scores should be submitted by the appropriate application deadline. Arrangements may be made to take the GRE by contacting: GRE/Educational Testing Service, P.O. Box 6000, Princeton, NJ 08540 or the Web site at www.gre.org.

International students whose native language is not English must take the Test of English as a Foreign Language (TOEFL) and have the results submitted directly to The Johns Hopkins Univer-

sity. Hopkins requires a minimum score of 600 on the paper test and 100 on the internet-based test. Photocopies will not be accepted. For information, the applicant should contact the nearest American Embassy or write to TOEFL, Educational Testing Service, P.O. Box 6151, Princeton, NJ 08541.

Johns Hopkins University Schools of Arts and Sciences and Engineering's institution code is 5332. For department codes, please consult the TOEFL page (www.grad.jhu.edu/admissions/TOEFL.htm).

To determine whether or not a department will accept the IELTS in lieu of the TOEFL, please contact the department directly. Information about the IELTS can be found at www.ielts.org.

Mailing Instructions

Please mail all documentation directly to departments.

Johns Hopkins University
Department Name
3400 N. Charles Street
Baltimore, MD 21218

ATTN: Application for Admission for
Graduate Study

General inquiries: Graduate Admissions Office
410-516-8174 or (graduateadmissions@jhu.edu)

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 e-mail fin_aid@jhu.edu for more information or for an appointment with one of our professional staff members.

Application Process

Each year, students must apply for financial aid adhering to the published deadlines. The Free Application for Federal Student Aid (FAFSA) must be filled out completely and sent to the federal processor (or filed on the Web at www.fafsa.ed.gov). The following additional documents must be submitted:

- The CSS/Financial Aid Profile form (available from the College Board Web site at www.collegeboard.com).
- Signed copies of the student's prior year federal individual tax returns, all pages, including W-2s. If a tax return was not filed, the student should submit a non-filer statement of income.
- Signed copies of the parents' prior year federal individual tax returns, all pages, including W-2s. 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.
- Other documents required if applicable: Non-Custodial Parent Aid Supplement; appropriate corporate tax returns.

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

Renewal of Financial Aid

Students must reapply for financial aid each year. Financial aid awards cover one academic year and are not automatically renewed. (Hopkins grant aid is not available for summer study.) The deadline for completed applications is May 1.

Students may expect comparable awards for a total of eight semesters (a fifth year may be available, but only on appeal) if they meet all the following conditions:

- The family financial situation remains the same.
- The student submits all the required documents on time.
- The student maintains satisfactory academic progress.

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 for Financial Aid

All students who are eligible to register are also eligible to apply for financial aid.

However, students should be aware that JHU scholarship funds are awarded for a maximum of eight semesters. Under some circumstances, a ninth semester of scholarship may be awarded on appeal. Federal and state aid may be available for additional semesters.

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, 2007–2008

(see www.jhu.edu/finaid for current cost of attendance)

Tuition	\$ 35,900
Matriculation Fee	500 *
Room and Board	11,092**
Allowance for Commuting Students	1,500
Personal and Books	2,000
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.

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 \$8,600 for nine months of room and board expenses.

Financial Aid Package

Once a student's eligibility has been established, Hopkins 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 Scholars are awarded 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.

Federal Pell Grant

If a student meets the strict eligibility criteria, she/he is entitled to this federal grant, which ranges from \$400 to \$4,310 and up for a student attending full time.

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.

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/Programs/bastmp/SHEA.htm.

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 cam-

pus 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 \$6.15 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

Hopkins 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 6.8 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. 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 Direct Loan. Hopkins will provide a master promissory note to all borrowers. Loan proceeds will be credited directly to the students' accounts. No separate loan application other than the FAFSA form is necessary.

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**, worth \$24,000 per year, to approximately 20 first-year students. 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. Information about these scholarships is available through a free scholarship search on the Web at www.jhu.edu/finaid and through high school guidance offices, local libraries, and community organizations.

Students must report all such awards received to the Office of Student Financial Services. All scholarship checks should be sent to that office. In recognition of student effort to obtain outside private scholarships, and as an acknowledgment of student achievement, the university will not reduce a student's freshman year Hopkins grant when a private scholarship is received.

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 the Web.

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. The deadline for the Federal Perkins and FWS programs is April 1. Further information is available at the Office of Student Financial Services or at www.jhu.edu/finaid.

Graduate Student Budget, 2007–2008

Tuition	\$ 35,900
Room and Board (9 mo.)	11,300
Personal and Books	2,000
Transportation	500
Matriculation Fee	500*

* 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 2007–2008.

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 2007–2008 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 2007–2008 academic year is \$35,900 for undergraduate and graduate students alike. Undergraduate students must make arrangements to pay each term's tuition one month before the date of registration; graduate students must pay each term's tuition on or before registration.

Part-Time Students

Tuition is \$1,200 per credit hour for students enrolling in courses numbered 1-599 and \$3,600 per course for students enrolling in courses numbered 600 and above. Students enrolled in Advanced Academic Programs in Arts and Sciences, or in Engineering Programs 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. Unless the student participates in a Hopkins-sponsored or CIEE-affiliated study abroad program, an administrative fee of 10 percent of the university's undergraduate tuition is assessed to students who undertake study abroad. The Johns Hopkins University sponsors certain programs for study abroad for which financial aid may be used. A 10 percent fee is not required. The study abroad counselor in the Office of Academic Advising 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 2007–2008.

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 micro-filming 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 2007–2008 the room charges are \$6,340 for a double-occupancy room in the Alumni Memorial Residences and \$6,974 for a double-occupancy room in Buildings A and B, Wolman Hall, and McCoy Hall. Single room charges are \$7,372 in the Alumni Memorial Residences and \$8006 in Buildings A and B, Wolman Hall, and McCoy Hall. The food plan charges are: \$4,752 for a 19 (+100) or 14 (+200) meal plan.

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 PLUS loans 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 3 percent origination fee will be deducted from loan proceeds. In addition, there is a 1 percent federal default fee, but this fee may be waived by the lender. Interest on the PLUS loan is fixed at 8.5 percent. Some lenders offer reduced interest rates under certain conditions.

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. Some lenders may offer delayed principal payments while the student is enrolled, but interest will accrue.

There are many lenders that participate in the federal PLUS loan program. The Johns Hopkins University schools of Arts and Sciences and Engineering will work with any lender the parent chooses. Searching the web using “student loans” or related wording should generate a listing of education-related lending sites. In addition to considering interest rates and loan terms, families may want to inquire about lender capability to process loans electronically. We find that fewer delays are experienced with electronic transfer of funds.

Once you have chosen a lender, you should contact the lender to initiate an application using

our school code (002077-02 for Arts, Sciences, and Engineering). If your loan application is approved, your lender will ask the financial aid office to certify your enrollment and eligibility for the loan.

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 AMS Payment Plan. An \$80 fee is assessed. No interest is charged. Further information on the AMS Plan may be obtained from AMS at 1-800-635-0120 or on the Web at www.tuitionpay.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 e-mailed 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 with the approval of the assistant dean of academic advising (Arts & Sciences) or associate dean for academic affairs (Engineering).

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.

Concurrent Bachelor's/Master's (Predoctoral), School of Arts and Sciences and School of Engineering

Concurrent students are also full-time students and are charged full tuition. This category is reserved only for current Hopkins 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. Students must be accepted into a concurrent program no later than their junior year. See page 54 for a listing of departments that offer a concurrent program.

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 e-mailed 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 its time by accessing Online Registrar Service (<https://registration.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 adviser or the dean.

A student is considered to have withdrawn if all registered courses are dropped. The student should then follow the procedures outlined under Withdrawal (see page 32).

Veterans

Johns Hopkins is approved by the Maryland Higher Education Commission for the training of veterans and the widows and children of deceased veterans under the provisions of the various federal laws pertaining to veterans' educational benefits. Information about veterans' benefits and enrollment procedures may be obtained at 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. Reimbursement is made by the Department of Veteran Affairs on a monthly basis. The amount of reimbursement is governed by the student's program and number of dependents and is based on the following table:

12 credits per term:	full-time
9-11 credits per term:	three-quarter time
6-8 credits per term:	one-half time
1-5 credits per term:	one-quarter time

In all of the above cases, payments cover only a portion of assigned fees.

Graduate students whose courses do not carry credit hours will be certified on an equivalent basis. To be reimbursed the student must comply with the following procedures:

Initial Enrollment

Once admitted to the university, the student must obtain an Application for Program of Education or Training (VA Form 22-1990) from either the Department of Veterans Affairs or the university. The completed application, along with a certified copy of the DD-214, copy 4, 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 either the Department of Veterans Affairs or the university. 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 monthly payment from the VA. 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 41.) 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 42.)

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 consecutive 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 fulltime graduate student for a least two consecutive semesters.

(For information on graduate study abroad status and predoctoral nonresident status, see Academic Information for Graduate Students, page 50.)

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 advisers and their academic advisers. 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 pro-rated 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 50–53, 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 54 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 presented at the annual commencement ceremonies each spring. Students who complete degree requirements and who have been formally recommended for the degree by the faculty body or department may receive an Interim Certificate from the Registrar's Office. This will serve as documentation before commencement.

A graduate student who completes the doctoral requirements in the first eight weeks of the fall semester and who is recommended for the degree by the Graduate Board at its November meeting is entitled to a tuition remission for that semester.

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 in May will receive a final bill from the university on May 1. 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. 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 1998: 982

returning as sophomores	95%
graduating within 4 years	84%
graduating within 5 years	90%
graduating within 6 years	91%

Transfer Trends

As of fall 2004, transferring students who had been enrolled in 2003–2004:

freshmen	2
sophomores	12
juniors	17
seniors	0

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

The university, in keeping with its basic mission, recognizes that its primary response to issues of alcohol and drug abuse must be through educational programs, as well as through intervention and treatment efforts. In addition to providing appropriate educational programs throughout the year, each division of the university will include such programs as part of its orientation for new students. The university further recognizes that alcoholism and drug addiction are illnesses that are not easily resolvable by personal effort and may require professional assistance and/or treatment. Participation in such programs may be required of a student as a condition of continued enrollment. The university will adhere to strict policies of confidentiality for all participants in drug/alcohol abuse rehabilitation programs as described in university and federal regulations covering confidentiality of student health records.

Maryland and the District of Columbia laws prohibit the possession of consumption of alcoholic beverages by persons under the age of 21. The possession, use, or distribution of illegal drugs as defined by federal, state, and local statutes is prohibited. Students are expected to obey the law. Individuals who violate the law, in addition to being subject to criminal penalties, may be subject to university disciplinary measures. The university will not excuse acts of misconduct committed by students whose judgment is impaired due to alcohol or drug abuse.

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 univer-

sity 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.

Equal Opportunity/Nondiscrimination Policy

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 characteristic in any student program or activity administered by the university or with regard to admission or employment. Defense Department discrimination in ROTC programs on the basis of sexual orientation conflicts with this university policy. The university continues its ROTC program, but encourages a change in the Defense Department policy.

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.

Policy on the Reserve Office Training Corps

Present Department of Defense policy governing participation in university-based ROTC programs discriminates on the basis of sexual orientation. Such discrimination is inconsistent with Johns Hopkins University nondiscrimination policy. Because ROTC is a valuable component of the university that provides an opportunity for many students to afford a Hopkins education, to train for a career, and to become positive forces in the military, the university, after careful study, has continued its ROTC program but encourages a change in federal policy that brings it into conformity with the university's policy.

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 violation of the student's rights; (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.

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.

Policy on Sexual Harassment

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, 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; (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.

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 accor-

dance with its educational mission, the university works to educate its community regarding sexual harassment. The university encourages individuals to report incidents of sexual harassment and provides a variety of avenues, both formal and informal, by which individuals can report complaints of 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 any member of the Sexual Harassment Prevention and Resolution System. 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 Susan Boswell, dean of student life, Shriver Hall, 410-516-8208; Ray Gillian, vice provost for institutional equity; or the associate director for compliance & conflict resolution, Garland Hall, Suite 130, 410-516-8075, sexual harassment hotline: 410-516-4001, TTY: 410-516-6225.

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 Web site, 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 at 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 Communication 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 will enter in the fall 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 advisers 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 54 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 of choosing a school, select the program that offers the greatest intellectual rewards and challenges, turning to the academic or faculty adviser 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 studies is one that initially exposes them to a variety of disciplines. With the help of their academic or faculty advisers, 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 adviser 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 specific 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 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, Near Eastern studies, 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 advisers. 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 particular 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 advisers can be very helpful to those who seek their advice. An academic adviser in Arts and Sciences or a faculty adviser in Engineering can help them become a part of the campus academic life more rapidly than they could on their own. A permanent faculty adviser 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 Advising—with two health professions advisers and a prelaw adviser—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 pre-medical major at Johns Hopkins. Medical schools value a broad undergraduate experience. Beyond a few basic courses (typically, general and organic chemistry, biology, physics and the appropriate laboratories, English, and calculus), students are encouraged to major in what they enjoy, with the result that successful applicants to medical schools come from nearly every major at Hopkins. 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. Many find that the tutorials at the Johns Hopkins Medical School offered to sophomores, juniors, and seniors give 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.

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 vastly 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-Professional adviser 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., where, at the university’s Paul H. Nitze School of Advanced International Studies (SAIS), students may take courses or a full semester. Qualified undergraduates can spend a year at the university’s campus in Bologna, Italy. 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 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. Those enrolled in this program can receive the B.A. and M.A. degrees in five years instead of the usual six. The last two years are spent in Washington at SAIS. 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 Applied Mathematics and Statistics Department in the School of Engineering, helps prepare students for careers in business and finance or to continue to business graduate school programs. The minor accepts courses in five areas to satisfy requirements: business and finance, quantitative studies, leadership and organizational behavior, international trade, and operations management. Departmental majors in economics and applied mathematics and statistics and majors in engineering and natural sciences are prepared for either graduate study or an immediate career in business and industry.

Elementary, Secondary School Teaching, and English for Speakers of Other Languages

The Graduate Division of Education in the School of Education offers a master of arts in teaching, which prepares students for initial certification in Maryland. The following teacher certification areas have been approved by the Maryland State Department of Education: Elementary (grades 1–6 and middle school); Secondary (grades 7–12) in English, math, foreign language (French and Spanish), social studies, and science (biology, chemistry, earth science, physics, and physical science); and English for Speakers of Other Languages (ESOL) (grades pre-K to 12). This 39-credit master’s program is designed for individuals with bachelor’s degrees in content area subjects such as engineering, the sciences, social sciences, mathematics, foreign languages, or English. Highly qualified Hopkins undergraduates may also be considered for early admission into the Accelerated Master of Arts in

Teaching program during their junior or senior years. Students who qualify for early admission may take up to 12 graduate credits before receiving the bachelor's degree and complete the remaining graduate-level requirements during a fifth year of study. Completion of this program qualifies individuals for Maryland state teacher certification. Full-time and part-time options are available.

For further information, students should contact Ms. Zipporah Gilchrist, Graduate Division of Education, School of Education, Columbia Center, 410-290-0747 or 410-309-1289.



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 get faculty advisers 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 individual tutors and study consultants, as well as drop-in tutor programs, to help students succeed. OAA handles all cases of academic difficulty.
- **Scholarships and fellowships**—OAA supports Hopkins students competing for prestigious scholarships such as the Rhodes, Fulbright, and Luce.

Study Abroad Office

The Study Abroad Office helps undergraduates in Arts and Sciences and in Engineering to find exciting and challenging educational opportunities overseas. Students will find many resources through the office: a Web site 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 director of engineering advising and her staff coordinate faculty advising, maintain student records, assist students with academic problems, and provide information concerning academic regulations. The office maintains and distributes undergraduate advising manuals for each of the engineering majors. 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.

Student Handbook

The *Student Handbook* is issued annually to all incoming freshmen as a supplement to the catalog for undergraduates. This handbook, available online through www.advising.jhu.edu and <http://engineering.jhu.edu/undergraduate-policies>, contains academic information, rules, and requirements in more detail than in 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 student handbook. In addition, a guide on "Academic Ethics for Undergraduates" has been published to help students and faculty better understand the rules and procedures.

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 42.

Grade reports are prepared shortly after 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 students in academic difficulty are reviewed at the end of each term, and all factors bearing on their problems are considered. A student whose term average is below C or who has completed less than 12 credits may be placed on probation, and a letter of probation is sent to the student. Copies are also sent to the parents and to the faculty adviser. Academic probation is regarded as a warning action rather than academic censure.

Continued inability to maintain a C average for two consecutive semesters, or if a student falls behind in credit accumulation by 24 or more credits, will normally result in dismissal for academic failure. A student is usually not dropped without warning or probation unless he/she has lost interest and has ceased to make an effort to keep up his/her studies.

Students with serious academic problems should talk with the director of academic advising (Arts and Sciences) or the director of engineering advising (Engineering).

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 *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" 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 below C- receive the grade of U (for Unsatisfactory). Credit is awarded only for courses that are completed with a Satisfactory mark, with the following exception: In the first semester of a student's freshmen year, credit will be awarded for U grades if the actual grade is a D or D+.
- 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 GPA of 2.0 or better, that is, a C average or better, 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 given to the student nor mailed to the student's parents, and is not released to anyone outside the School of Arts and Sciences or Engineering. Academic advisers and faculty advisers receive copies of the first-term grades of their advisees. Students are encouraged to meet with their adviser to discuss these grades.
- The official student transcript carries the "S" 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 repeat a course to absolve a grade of C+ or below. The most recent grade for the course will appear on the student's academic record and will contribute to the grade point average, unless the course is taken for satisfactory/unsatisfactory credit. The earlier grade for the course will be replaced with the letter R, to indicate that the course has been repeated, and the credits will be removed from the record (see the *Student Handbook*).

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 com-

pleted. 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 the 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 *Student Handbook*).

Minors

Students may complete requirements for a minor in Ancient Law, Anthropology, Applied Mathematics and Statistics, Bioethics, Civil Engineering, Classics, Computer Integrated Surgery, Computer Science, Economics, Engineering Mechanics, Entrepreneurship and Management, Environmental Engineering, Environmental Sciences (for students trained in other science disciplines), Environmental Studies (for social science majors), Film and Media Studies, 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, NanoBio Technology,

Philosophy, Physics, Psychology, Robotics, Russian, Spanish for the Professions, Spanish Language and Hispanic Culture, Studies of Women, Gender, and Sexuality, Theatre Arts, and Writing Seminars. Students should consult the 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 ele-

ments 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 adviser'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 Office of Academic Advising and the Office of Engineering Advising.

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 *Student Handbook* or the Office of Academic Advising 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 advisers, to ease the transition from high school to college.

Graduation

To be approved for graduation the student must:

- Submit an application for graduation to the Registrar's Office (Engineering students) or the Office of Academic Advising (Arts and Sciences students).
- 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 Academic Affairs (Engineering) of his/her eligibility for graduation. Graduation forms provided by the Registrar's Office must be filed 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, Morgan State University, College of Notre Dame, 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 and the Baltimore Hebrew College. Details of these programs are contained in the *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.

Baltimore Hebrew College faculty give courses in Hebrew language and literature on the Homewood campus as part of a cooperative program.

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 charge of \$165 per credit each semester for private lessons at the Peabody Conservatory.

Peabody faculty also teaches 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 54.)

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 229.)

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 *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. Dean John Bader serves as the primary scholarship adviser for undergraduates. Make an appointment to discuss these opportunities with him by calling 410-516-8216. And visit the OAA Web site 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 advisers.

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 (<i>undergrad</i>)	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 adviser.
- Fulfill the university writing requirement (see page 43).
- 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 stu-

dent and his/her adviser, 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 adviser 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 encourages 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 adviser, who must be a full-time faculty member in Arts and Sciences, and in consultation of Associate Dean John Bader, who oversees the major. Students write a proposal that explains the themes or topics they will explore through the major. 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 may not count.
- Students must earn at least 45 credits in the completion of the major.
- A minimum of 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 no fewer than 30 credits of courses that carry distribution credit of any kind 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 courses. Premedical students would 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.

Humanities 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 43.)

Academic Standards

The student 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

Advanced Degree Programs

The following are general requirements for advanced degrees. The student must be officially admitted to a program. Individual requirements appear under departmental headings. Students should be aware that some departments require service as a teaching assistant for one or two semesters as part of the department's graduate training.

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.

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

- Every student must register for a minimum of two semesters as a full-time, resident graduate student (not applicable to bachelor's/master's concurrent students).
- Every student must be registered in the semester that degree requirements are met.
- Every student must provide certification by a department or program committee that all

departmental or committee requirements have been fulfilled.

- Every student must submit to the library a master's essay approved by at least one reader when the department or program requires an essay.
- 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.*
- 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 10-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.

Dissertation/Thesis Instructions

The student is responsible for obtaining and observing detailed instruction concerning submission of the dissertation/thesis from the departmental office, the Graduate Board Office, or the Commercial Binding Office of the Milton S. Eisenhower Library, www.graduateboard.jhu.edu. The degree requirements are not complete unless the final dissertation/thesis is submitted to the library by the published deadline.

Foreign Language Examination

There is no university-wide foreign language requirement for the master's and doctoral degrees. Each department decides its own language requirement.

Term Reports

Term reports are not routinely prepared for graduate students. Students concerned about their graduate course records can examine them at any time in the Registrar's Office in Garland Hall. It is expected that all incomplete or missing grades in required courses will be resolved before a student sits for the

Graduate Board Oral Examination and before the certificate of completion is signed by the department. Departments will inform students of their standing twice a year.

Course Changes

Graduate students are expected to use the *Graduate Course Change Form* to add and drop courses and to register for credit or audit. Changes should be submitted to the Office of the Registrar within the published timeframes. Approval of changes after the deadline must be submitted to the Dean's Office of the student's respective school.

Application for Change of Status

To petition the Graduate Board (for KSAS graduate students and WSE doctoral students) or the Whiting School of Engineering Office of Academic Affairs (for WSE master's students) for a change of registration status, students must submit an application for a Term Leave of Absence or Nonresidency to their department chair and, in the case of international students, to the director of International Student and Scholar Services for approval before submission to the Graduate Board. Students should follow the instructions on the form. Generally, students will petition the Graduate Board or WSE Office of Academic Affairs for a leave of absence or nonresident status well in advance of the semester for which it is desired. Applications submitted to change registration status for the current term will not be accepted after the second week of the semester.

Graduate Study Abroad Status

Krieger School of Arts and Sciences

The status of Graduate Study Abroad 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.

Whiting School of Engineering

A Graduate Study Abroad student will be required to pay 10 percent of the full-time tuition rate for each semester abroad. The remaining 90 percent will be negotiated among the student, his/her department, and the School of Engineering.

Homewood Graduate Student Nonresident Status

Definition

All Krieger School of Arts and Sciences and Whiting School of Engineering full-time program graduate 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 20 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 must be on salary (not stipend) and paid hourly. *Note:* Research or teaching assistants expected to work more than 20 hours per week do not qualify for Nonresident Status.

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

Tuition

All students on nonresident status will be charged 10 percent 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 one exception—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). The maximum amount of time that a student may retain nonresi-

dent 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. The form will need to be signed by the department, the Office of International Students and Scholars Services (if applicable), and either the Graduate Board for doctoral students or the WSE Associate Dean for Academic Affairs (or designee) for WSE master's students. 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.

Homewood Graduate Student Leave of Absence Status

Definition

All Krieger School of Arts and Sciences and Whiting School of Engineering full-time program graduate students will be eligible for Leave of Absence when one of the following conditions prevents them from continuing with their graduate studies:

- a documented physical or mental medical condition;
- compulsory military service; or
- personal or family hardship

Note: Financial difficulty alone is not a valid reason for requesting a Leave of Absence.

Tuition and Financial Support

Students on leave of absence will not be charged tuition for the semesters for which they are granted the leave; the period of leave is simply regarded as an approved interruption of the degree program. However, the university cannot guarantee that financial support will be available when students resume their studies—students have to reapply for tuition assistance, research assistantships, fellowships and/or teaching assistantships. Such matters are left to the discretion of the department. Before applying for leave of absence, students should consult their department for information regarding funding opportunities upon return from leave.

Restrictions

Students may apply for up to two years (four semesters) of term leave of absence. Continued approval

is based on the reason(s) for the request. Additional information may be requested by the department, the Graduate Board or the WSE associate dean for academic affairs (or designee). Students on leave are not to use any university student services or facilities (e.g., computing labs, library, labs, athletic facilities, etc.) and may not be enrolled at another university. Students on leave who wish to continue working at Johns Hopkins are not eligible to be paid through the Student Payroll Office and must therefore be hired through the appropriate divisional Human Resources Department.

Application Procedures

To be awarded a leave of absence, students will be required to complete and sign an application form and provide a letter stating the reason for their application. The form will need to be signed by the department, the Office of International Students and Scholars Services (if applicable), and either the Graduate Board for all Homewood doctoral and Krieger School of Arts and Sciences master's students or the WSE associate dean for academic affairs (or designee) for all WSE master's students.

Reporting Responsibilities

Departure of a student from one of the Homewood Schools without prior arrangement of a leave of absence or master's/doctoral nonresident status will be deemed a permanent withdrawal from the student's program. While on leave or nonresident status, students are expected to provide the registrar's office 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 residence requirement for the degree following readmission (even if previously satisfied) and pay all outstanding nonresident fees.

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 and to encourage student contribution.

Courses are offered at the Homewood campus in Baltimore, Md.; the Montgomery County Campus in Rockville, Md.; the Arts and Sciences Washington Center in Washington, D.C.; the HEAT Center in Aberdeen, Md.; and 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 in Contemporary Society, Environmental Sciences and Policy, Government, Liberal Arts, and Writing. There is also a variety of certificates and concentrations from which to choose, including the Certificate in Homeland Security, 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.jhu.edu/advanced; 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.

Engineering and Applied Science Programs for Professionals

Since the beginning of the 20th century, The Johns Hopkins University has been a leader in providing working adults with opportunities to continue their engineering education on a part-time basis. The Whiting School of Engineering's Engineering and Applied Science Programs for Professionals maintains as its core mission a dedication to provide a community of excellence to professionals whose personal and career goals include continuing education.

"Where Excellence Surrounds You" is how Engineering Programs for Professionals defines its commitment to students. The Johns Hopkins community of excellence means that students attend classes taught by faculty who are at the top of their fields, receive inspiration from the high

caliber of classroom interaction, and have access to exemplary administrative services. Consequently, the Programs are among the largest such programs in the nation, attesting to the students' enthusiasm for the programs as well as the Whiting School's concern for engineers and scientists who pursue study after working hours.

As they have grown, Engineering Programs for Professionals have extended their reach into the surrounding community, providing students a variety of classroom locations, as well as selected online courses, suited to their academic needs and busy schedules. Graduate students take courses at the Homewood campus in Baltimore, the Applied Physics Laboratory in Laurel, the Montgomery County Campus in Rockville, the Dorsey Center near Baltimore/Washington International Thurgood Marshall Airport, the Southern Maryland Higher Education Center in St. Mary's County, the Washington Center in Washington, D.C., and the Higher Education and Applied Technology Center in Harford County. Students take courses during the late afternoon and evening, on Saturday, or online.

Accredited by the Middle States Commission on Higher Education, Johns Hopkins University is privately endowed. Founded in 1876 as the first American educational institution dedicated to research, it established the model for advanced study in this country.

Nine divisions of the University grant degrees. They are the Whiting School of Engineering; the Krieger School of Arts and Sciences; and the School of Education on the Homewood campus; the schools of Medicine and Nursing and the Bloomberg School of Public Health adjacent to The Johns Hopkins Hospital; the Peabody Institute and the Carey Business School in downtown Baltimore; and The Paul H. Nitze School of Advanced International Studies based in Washington, D.C. (with foreign study centers in Bologna, Italy, and Nanjing, China). The 10th division of the University is the Applied Physics Laboratory (APL), a research institute located in Laurel, Maryland.

Further information, applications, and catalogs may be obtained by calling 410-540-2960 or 800-548-3647. Inquiries can also be made via email, epp@jhu.edu. The catalog for the Engineering and Applied Science Programs for Professionals is available on the Web at www.epp.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				
Anthropology	x		x ⁵	x
Biology	x	x	x ⁹	x
Biophysics	x	x	x ¹⁴	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
Environmental Earth Sciences	x			
Film and Media Studies	x			
French	x		x ¹³	x
German	x	x	x ⁵	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	x ⁴	x
International Studies	x	x		
Italian	x		x ¹³	x
Latin American Studies	x			
Mathematics	x	x	x ²	x
Near Eastern Studies	x	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	
Engineering				
Applied Mathematics and Statistics	x ¹²	x	x	x
Biomedical Engineering	x	x	x	
Chemical and Biomolecular Engineering	x	x	x ¹	x
Civil Engineering	x	x	x ^{1,7}	x

Program Major	Bachelor's	Accelerated Bachelor's/ Master's	Master's	Doctor of Philosophy
Computer Engineering	x			
Computer Science	x ¹²	x	x ¹	x
Electrical Engineering	x	x	x	x
Engineering Mechanics	x			
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				
Humanistic Studies	x			
Natural Sciences	x			
Behavioral Biology Option	x			
Social and Behavioral Sciences	x			

Notes on the Master's Degrees

- Candidates for the master's as a terminal degree are accepted, but financial aid generally is not available.
- Candidates for the master's as a terminal degree may be accepted in special cases, but financial aid generally is not available.
- 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.
- Candidates are accepted only for the accelerated bachelor's-master's program.
- 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.
- Both a master of science in engineering and a master of materials science and engineering are offered.
- Both a master of science in engineering and a master of civil engineering are offered.
- See department listing.
- B.A./M.S. or B.S./M.S.—Available only to Arts and Sciences baccalaureate students.
- B.A. in geography and B.S. in environmental engineering.
- B.A. only.
- B.A. or B.S. available.
- 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.
- Applicants must currently be JHU undergraduates who will receive their B.A. from the university prior to admission. Financial aid is not available.

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

Master of Business Administration
 Master of Business Administration: Fellows Program
 Master of Business Administration in the Life Sciences

Master of Science Degrees

Finance
 Information and Telecommunication Systems Marketing
 Organization Development and Strategic Human Resources
 Real Estate

Dual and Joint Degrees

Master of Arts Communications/Master of Business Administration
 Master of Arts Government/Master of Business Administration
 Master of Business Administration in Medical Services Management
 Master of Business Administration/Master of Science in Information and Telecommunication Systems
 Master of Public Health/Master of Business Administration
 Master of Science Biotechnology/Master of Business Administration
 Master of Science in Nursing in Health Systems Management/Master of Business Administration

Graduate Certificate Programs

Business of Medicine
 Business of Nursing
 Business Transitions
 Competitive Intelligence
 Financial Management
 Investments
 Information and Telecommunication Systems
 Information Security Management
 Leadership Development Program for Minority Managers
 Leadership and Management in the Life Sciences
 Skilled Facilitator
 Technical Entrepreneurship and Innovation

Advanced Graduate Certificate Program*

Information and Telecommunication Systems

School of Education

Master of Arts in Teaching

Elementary, Secondary, English for Speakers of Other Languages (ESOL)

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
 Differentiated/Inclusive Education
 General Special Education Studies
 Mild to Moderate Disabilities
 Severe Disabilities
 Technology in Special Education

Master of Science in Counseling

Clinical Community Counseling
 Organizational Counseling
 School Counseling

Graduate Certificate Programs in Education

Addictions Counseling*
 Adult Learning
 Assistive Technology for Communication and Social Interaction
 Clinical Community Counseling*
 Counseling At-Risk Youth*
 Data-based Decision Making and Organizational Improvement
 Differentiated/Inclusive Education: Advanced Methods for Instruction
 Early Intervention/Preschool Special Education
 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
 English as a Second Language (ESL) Instruction
 Gifted Education
 Leadership for School, Family, and Community Collaboration
 Leadership in Technology Integration
 Organizational Counseling
 Play Therapy
 School Administration and Supervision
 Spiritual and Existential Counseling and Therapy
 Teacher Leadership
 Urban Education

*Open only to students with master's degrees.

Certificate of Advanced Graduate Study*

Counseling
Special Education

*Open only to students with master's degrees.

Doctorate

Special Education
Teacher Development and Leadership

Division of Public Safety Leadership

Master of Science in Management

School of Advanced International Studies

International Relations

School of Public Health

Biochemistry and Molecular Biology
(reproductive biology)

Biostatistics (bioinformatics)

Environmental Health Sciences (toxicology,
occupational and environmental health,
molecular imaging, physiology, and environ-
mental health engineering)

Epidemiology (general epidemiology, clinical
epidemiology, occupational and environmental
epidemiology, infectious disease epidemiol-
ogy, human genetics/genetic epidemiology,
cancer epidemiology, cardiovascular disease
epidemiology, clinical trials, and epidemiology
of aging)

Health Behavior and Society (behavioral
sciences and health education, genetic coun-
seling, social and behavioral sciences)

Health Policy and Management (health services
research, health and public policy, health
finance and management, health care man-
agement and leadership, health policy)

International Health (social and behavioral
interventions, health systems, disease
prevention and control, and human nutrition)

Mental Health

Molecular Microbiology and Immunology

Population, Family and Reproductive Health
(child health and development, demography,
population and health, reproductive/
perinatal/women's health)

School of Medicine

Biochemistry/Cellular and Molecular Biology
Biological Chemistry

Biophysics/Molecular Biophysics
Cell Biology

Cellular and Molecular Medicine

Cellular and Molecular Physiology

Functional Anatomy and Evolution

Health Sciences Informatics

History of Medicine

Human Genetics

Immunology

Medical and Biological Illustration Medicine (M.D.)

Molecular Biology and Genetics

Neuroscience

Pathobiology

Pharmacology and Molecular Sciences

Interdivisional Programs

Biomedical Engineering

Molecular Biophysics

Libraries

University Libraries

The 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 55,000 e-journals and more than 700,000 e-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 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 2.8 million printed volumes, more than 55,000 print and electronic journals, 4 million microforms, 8,000 videos and DVDs, and over 215,000 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. For more information, visit www.library.jhu.edu.

Albert D. Hutzler Undergraduate Reading Room

The Hutzler Reading Room, located in Gilman Hall on the Homewood campus, houses a collection of noncirculating materials for undergraduates. A popular study space, the "Hut" is open 24 hours daily during the fall and spring semesters.

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 volumes collection contains 16th- and 17th-century English literature and history, works on natural history, architectural history, American colonial travel and history, and maps.

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.georgepeabodylibrary.jhu.edu.

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, serve 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.

William H. Welch Medical Library

The William H. Welch Medical 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 Web site (<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) are being created for Hopkins communities in such as Oncology, the basic sciences (<http://bsdlibrary.jhmi.edu/>) and the Population Center (<http://poplibrary.jhmi.edu>) to provide a range of library services and digital resources supporting teaching, research, and patient care.

The Welch Library also operates satellite libraries. The Lilienfeld Library in the Bloomberg School of Public Health is the largest, and is the primary resource for information in public health, management science and social sciences. Other satellite libraries are located in the Meyer Building and the School of Nursing. 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 Peabody campus at Mt. Vernon Place. University bus service brings the resources of this distinguished music library of 95,000 books and musical scores, and about 23,000 sound recordings within easy reach of the Homewood community. For more information visit www.peabody.jhu.edu/lib.

The Gibson Library

The R. E. Gibson Library of the Applied Physics Laboratory is located in Howard County. The Gibson Library 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 collection contains over 60,000 volumes and 400 print periodicals. For more information visit www.jhu.apl.edu/education/gibson/gibson.asp.

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.

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.

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/explore/library.html.

The vast collections of the Library of Congress, www.loc.gov and the National Library of Medicine at 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
 520 Electrical and Computer Engineering
 060 English
 370 English as a Second Language
 660 Entrepreneurship & Management
 061 Film and Media Studies
 500 General Engineering
 570 Geography and Environmental Engineering
 210–212 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 Mathematical Sciences
 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
 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 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 Center for Africana Studies (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, 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

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

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

Jane Guyer, Professor, Department of Anthropology: Africa.

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

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

Sara Berry, Professor, Department of History: Africa

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

Franklin Knight, Professor, Department of History: Caribbean and Latin America.

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

Affiliated Faculty

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

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.

Paul Kramer, Professor, Department of History: comparative imperialism, race, and identity.

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

John Russell-Wood, Professor, Department of History: Latin America.

Malanie Shell-Weiss, Professor, Department of History: African-American.

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

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

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

Neil Roberts, JHU Center for Africana Studies, Postdoctoral Fellow: political theory, Caribbean, African diaspora.

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 the Americas (Larson, Brown)

- AS 100.121 Introduction to Africana History
Before 1880 (Berry, Larson)
- AS 100.122 Introduction to Africana History
Since 1880 (Berry, Larson)
- AS 362.111 Introduction to Africana American
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 adviser 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 hours

362.175 (H) Freshman Seminar: Remembering the Black Power Movement

How should we remember the Black Power Movement of the late 1960s and 1970s? What lessons can we learn from this complex social movement that redefined black identity and confronted white supremacy and economic exploitation in America? This course examines the historical and social conditions that led to the rise and students to the leadership, organizations, and ideologies representative of the movement.

Hayes 3 hours

362.200 (H) African American Poetry and Poetics

This course will explore the category, history and development of African American poetry from Phillis Wheatly to the present. We will focus on poetry and poetics specifically but will consider the general movement of literature produced by African American writers over the course of three centuries. We will read works by the key contributors to this particular American literary tradition with the goal of understanding the aesthetic, cultural, and critical legacy of African-American poetry to the American literary and musical sensibility of 21st century. From 18th-century odes to 19th-century shouts and spirituals to the jazz poets of the Harlem Renaissance to Black Arts poetry to the blues, hip-hop, and rap traditions, we will examine the role that race, cultural identity, legal status, and the impersonal structures (or shackles) of poetic forms have played in shaping and reshaping African American verse.

Robbins 4 hours

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 hours

362.360 (H) Political Freedom in Africana Thought

Roberts 2 hours

Anthropology

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 hours

070.393 (H,S) Law and Development: Postcolonial Perspectives

Upper-level undergrads only and open to graduate students. 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.

Obarrio 3 hours

Economics

180.252 (S) Economics of Discrimination

Morgan 3 hours

English

060.391 (H,W) Introduction to 20th-Century African American Literature

This course explores a wide range of 20th-century African-American writing. Topics and writers include Du Bois, the Harlem Renaissance, Wright, Hurston, the Black Arts Movement, Morrison, and Octavia Butler.

Conn 3 hours

History

100.223 (H,S,W) Civil War to Katrina: Reconstructing New Orleans

Hurricane Katrina exposed how Mardi Gras existed alongside poverty and inequality to produce a national tragedy. This course examines the city’s past of riots, corruption, and racial politics to today.

Staff 3 hours

Language Teaching Center

379.151-152 Beginning Kiswahili

Cross-listed with Language Teaching Center.

Mugambi 3 hours

379.162 Beginning Hausa II

Continuation of 379.161. Cross-listed with Language Teaching Center.

Staff 3 hours

379.251-252 (H) Intermediate Kiswahili II

Prerequisite: 379.151-152. Continuation of 379.251. Cross-listed with Language Teaching Center.
Mugambi 3 hours

Political Science**190.214 (S) Introduction to Racial and Ethnic Politics**

Freshmen only. 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.

Hanchard 3 hours

190.302 (S) Politics of Black Cultural Productions

Spence 3 hours

190.384 (S) Urban Politics

Spence 2 hours

Public Health**280.399 (S) Practicum in Community Health**

Seniors and juniors only. Permission required. 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.

Bone/Goodyear 3 hours

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 community, 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 hours

Sociology

230.112 (S) 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. 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 hours

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 hours

360.469 (H,S) Issues in Globalization

Cross-listed with Sociology and Political Science.

Grovogui 3 hours

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. We see teaching and research as integrally linked, and invite undergraduate students to participate in research as they take introductory and advanced courses in anthropology.

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. Majors in anthropology also have the opportunity to explore theory, method, and the history of anthropology through the majors seminar, and a core course in ethnographic theory and method. 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.

The training of graduate students in the Department of Anthropology focuses on providing students with a vocabulary and grammar to engage in anthropological reasoning within the general field of socio-cultural anthropology. 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 Web site at <http://anthropology.jhu.edu>.

The Faculty

Emma Cervone, Adjunct 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 (Chair): history and myth, philosophy and anthropology, violence, social suffering, medical anthropology; South Asia, Europe.

Jane Guyer, Professor: 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, anthropology of science, science and technology studies, market economies, theories of gift and debt, charity and philanthropy, Cold War politics, democracy, forms of authoritarianism, political violence, human rights discourse, subjectivity and the everyday forms of social life and social death; 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, Visiting 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: vitality and representation; race and ethnicity; violence, liberalism, and the state; law and judicial reform; Latin America (Peru, Mexico).

Pamela Reynolds, Professor: ethnography of children and youth labor, healing, ethics; state violence; the political actions of the young and their involvement in armed conflict; ending war; truth, justice, and the archive; philosophers on the young; Southern Africa.

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): health transitions; women's health; illness experiences; health and economic development; Central Africa.

Harry M. Marks, Associate Professor (Medicine): Elizabeth Treide and A. McGehee Harvey Professor in the History of Medicine: history of medicine, 20th century; history of public health; history of disease; U.S. and W. Europe.

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

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 \$16,000 per year plus fellowships that cover tuition. Some additional funds are 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, Program for Latin American Studies, and the Center for Africana 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 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 adviser. 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 adviser. 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 expected to 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 Web site at <http://anthropology.jhu.edu>.

Interdisciplinary Ph.D. Degrees

The Department of Anthropology and the Bloomberg School of Public Health offer a joint Ph.D. in Anthropology and Population and Family Health Sciences. The departments of Anthropology and History jointly offer an interdisciplinary doctoral degree. For details on these programs, students may contact either of the participating departments.

Undergraduate Courses

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

070.132 (H,S,W) Invitation to Anthropology

This course will introduce 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?

Das 3 credits

070.134 (H,S) Religions of the World: An Introduction

This course gives an introduction to the religious vocabulary and practices of different religions in the contemporary world.

Staff 3 credits

070.218 (H,S,W) The Politics of Multiculturalism

This course 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,W) Anthropology and Public Action

Anthropologists are drawn into public interventions such as indigenous rights, truth commissions, mega-projects, and disaster mitigation. The course considers theories of democracy and the relevance of anthropological expertise through case studies.

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

070.303 (H,S,W) Children and Youth in Armed Conflict: Drawing on Ethnographic Perspectives

The situation of children and youth in recent and ongoing conflicts is examined and the nature and causes of their participation analyzed. A particular focus is on the parts played by the young in resistance movements and on their acquisition of political consciousness.

Reynolds 3 credits

070.313 (H,S) Community and Governance in Latin America

This course examines cultural, political, and juridical concepts of community in Latin America, with a special focus on Mexico and the Andean Republics. Readings and class discussions will focus on understanding the relationship between governance, development, and the articulation of indigenous political demands concerning community, collective property, cultural rights, citizenship, and belonging.

Poole 3 credits

070.315 (H,S) Advanced Topics in Medical Anthropology

This course selects 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

This course 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 considers itself to span scientific and humanities logics. The course looks at ethnography as a mode of inquiry and as a genre of writing that negotiates both approaches. Counts as a required course for majors but open to all undergraduates.

Staff 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? We

explore these questions through Mexican and Indian films about banditry and crime.

Khan, Poole 3 credits

070.324 (H,S) The Social History of Languages

A look at 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 the present.

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. This course 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

070.347 (H,S) Discourse Analysis: “Human Foregatherings and Comminglings”

Are conversations and stories we tell within them amenable to systematic investigation? This course examines a variety of approaches to the analysis of conversations, narratives, and oral histories.

Haeri 3 credits

070.348 (H,S,W) Visual Technologies and Racial Difference

This course examines the perceptual and cultural reproduction of racial ideologies in such modern imaging technologies as photography, video, lasers, sonograms, and surveillance scanning.

Poole 3 credits

070.351 (H,S,W) Political Life of Gender

This course 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

This course will 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

070.360 (H,S) Negotiating the Everyday: The Situation of Children in Baltimore

Research seminar in which the class as a group finds out about the situation of children in Baltimore using a variety of methods including the collection of census materials, local survey data, interviews with policy-makers, and narrative sessions with young people.

Reynolds 3 credits

070.363 (H,S,W) Senior Tutorial in Advanced Readings in Anthropology

Readings in special topics in theory and method. Anthropology majors only.

Staff 3 credits

070.368 (H,S,W) Modern South Asia: The City and Everyday Life

This course considers the city as expressive of the collective dreams of states and societies in South Asia. The anthropological treatment of family, religious devotion, caste affiliations, local politics, and popular culture will further locate these dreams within everyday urban life.

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

070.371 (H,S) Linguistic Theory: A Brief History

Overview of linguistic theory starting from American and European structuralism to their subsequent critiques to the present.

Haeri 3 credits

070.377 (H,S,W) Magic, Science, Religion

What models of thinking characterize “magic,” “science,” and “religion”? We will examine classical theoretical writings by Frazier, Weber, Durkheim, Evans-Pritchard, Levi-Straus, and Bergson, and use the insights they provide to read contemporary ethnographies concerned with religion and rationality in the modern world.

Khan 3 credits

070.378 (H,S) Cultural Property and Politics in Latin America

This course 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

070.388 (H,S) Vision and Cultural Experience

How does culture shape the way we see the world? This course will explore how cultural understandings of race, class, and gender are shaped by photographs and other representational technologies; how different cultures value visual experience; and how modern visual technologies have changed the way we think about evidence, knowledge, and privacy. Examples will be drawn from Europe, the United States, Latin America, and Africa.

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? This course explores anthropological critiques of development with a focus on labor, land, and locality.

Obarrio 3 credits

070.394 (H,S) The Gift of Justice

This course explores various expressions of political imagination and collective action in Latin American urban public spaces. It uses anthropological perspectives to analyze.

Obarrio 3 credits

070.397 (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

070.503-504 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 68.

Staff 3 credits

Interdepartmental**360.403 (H,S,W) The Family in Economic and Anthropological Discourse**

This seminar course explores the viability of family as a category in the discourse of economics and anthropology.

Das, Khan 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 are either currently being offered or are planned for the next two years:

070.602 In the Aftermath of Conflict

Ethnographic analysis of revelations to do with pain, investigation, perpetration, and betrayal. Experiences will be drawn on from countries that include Argentina, Chile, Sri Lanka, Northern Ireland, and Germany. Reynolds

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, Haeri

070.611 Intimacy and Corruption

Course takes problem of corruption as an ethnographic site from which we can explore how concepts of visibility, secrecy, intimacy, and transgression inform political life. We will examine how ideas of intimacy and propriety are expressed in public scandals of corruption, as well as the forms of anxiety that surround routine practices of bribery, influence-peddling, and enticement. Poole

070.613 Advanced Topics in Medical Anthropology

This course will examine 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

Course 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

This course will consist of 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 Anthropological Research Methods

An introduction to basic ethnographic and historical methods for anthropological fieldwork. Required course for all second-year anthropology graduate students. Will build on fieldwork conducted during the previous summer. Open only to anthropology graduate students. Staff

070.619 Seminar in Anthropological Linguistics

The course will examine some of the central concerns of the study of language in socio-cultural context, in the framework of a more or less chronological narrative, starting from American and European structuralism. Haeri

070.624 Violence, War, and Social Theory

Course examines the positioning of violence and war in social theory and asks how collective violence folds into everyday life. Das

070.625 The Temporality of Law

This course 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

070.631 Anthropologists, and Some Other Writers, on War

Participants will consider texts that reflect the changing nature of war. Texts will be examined from an anthropological perspective and specific issues will be pursued. Reynolds

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

070.641 Public Space/Public Speech

Privatization and fragmented polities; new media and new discourses. Ethnography explores the domain of the public sphere that was once framed by classic liberal theory. Haeri, Guyer

070.643 Anthropology's Engagement with Philosophy

We will read 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

We will read key texts to ask both theoretical and methodological questions about the relation between the notions of the ordinary, the everyday, and the domestic. Das

070.646 Social Science, Colonialism, and Modernity

Course focuses on the twin emergence of social science and modernity. Critiquing the tunnel view of history, we examine the sites, the institutions, and the events in relation to which discourses of society may be understood.

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

This course 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

070.654 On the Question of Ethics

How are questions of ethics posed in relation to knowledge? This course looks at classical and contemporary writings on this issue.

Das

070.659 Proposal Writing

The seminar will offer 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

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

Han

070.869-870

Pandian

070.871-872 Directed Reading and Research

Das

070.879-880 Directed Reading and Research

Guyer

070.883-884 Directed Reading and Research

Reynolds

070.885-886 Directed Reading and Research

Poole

070.889-890 Directed Reading and Research

Haeri

070.891-892 Directed Reading and Research

Khan

070.893-894

Obarrio

070.895-896 Directed Reading and Research

Schoenberger

070.897-898 Directed Reading and Research

Berry

Interdepartmental**360.669-670 General Seminar of the Institute for Global Studies in Culture, Power, and History**

A colloquium series of the Institute for Global Studies, with invited outside speakers.

Staff

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 cartooning, design, and photography balance studio work with research and critical analysis.

The Faculty

Craig Hankin, Instructor (Director): 19th-century French painting, portraiture, life drawing.

D. S. Bakker, Instructor: aesthetics, visual philosophy, Surrealism.

Phyllis Berger, Instructor (Photography Coordinator): photography, digital imaging, photo collage.

Thomas Chalkley, Instructor: sequential imagery, political and social satire, popular culture.

Barbara Gruber, Instructor: 20th-century American figurative art, *plein air* painting.

Cara Ober, Instructor: watercolor, mixed media, color theory.

Larcia Premo, Instructor: 20th-century sculpture, three-dimensional design.

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. Prerequisite: 371.131 or equivalent. Periodic critiques; final portfolio review. 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 (H) 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 animation. Basic drawing skills preferred but not required. Midterm exam; final paper/project. Limit: 15.
Chalkley 3 credits spring

371.146 (H) Basic Black and White Photography

An introduction to the technical and creative process of producing black and white photographs. Working in the darkroom, students learn the fundamentals of film processing and print development. In-class critiques, discussion, and analysis of historic images develop critical vision. With the instructor's guidance, students work on a project of their choice and produce a portfolio of 10 mounted prints. A trip to the Baltimore Museum of Art will allow students to contrast early photographs with modern-day processes. Requirement: Students must have a 35-mm camera with adjustable shutter speed and aperture. Limit: 7.

Berger 3 credits spring/fall

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 (H) 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 post-mortem 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.

Berger, staff 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 fall

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 spring

371.300 (H) Black and White Photography Seminar

Students develop a project of their choice, working independently in the darkroom and meeting for weekly critiques and discussions. Using the Zone System (a method of pre-visualization pioneered by Ansel Adams), students will experiment with different film, paper, and developer combinations specific to their projects. Frequent gallery trips and visits from guest artists are an integral part of the seminar experience. Students will present a final portfolio of 20 photographs. Prerequisite: 371.146 or permission required. Limit: 14.

Berger 3 credits spring

David S. Olton Behavioral Biology Program

The Behavioral Biology Program offers a specialized natural sciences area major (see page 48) for undergraduates wishing to study the natural and social sciences in relation to human and animal behavior. The program begins with the fundamental concepts of both the natural sciences and the social sciences. Then the interface between these two areas is explored through specialized courses and electives, as well as through additional study emphasizing a particular subject. Courses provide a broadly based yet integrated education focused in the field of behavioral biology, and are taught by instructors from the School of Arts and Sciences, the School of Medicine, and the Bloomberg School of Public Health.

The interaction between behavior and biology takes place in both directions. On the one hand, biology influences behavior. For example, psychopharmacology has demonstrated the importance of neurochemical substances in the brain, and sociobiology has emphasized the role of genetic factors in behavior. On the other hand, behavior also influences biology. An individual's perception and reaction to life events can have substantial effects on hormonal and physiological functions. In recognizing both of these interactions, behavioral biology seeks to establish a greater understanding of them through its interdisciplinary organization. The interdisciplinary characteristics of the behavioral biology major provide excellent preparation for postgraduate work in a variety of fields, including law and medicine. For those interested in the health professions, behavioral biology can be integrated into a premedical curriculum, providing a broad, humanistic perspective. For those who wish to pursue scientific careers in the neurosciences, especially psycho-pharmacology or behavioral neuroscience/physiological psychology, the program provides the appropriate preparation. It is also a major that students interested in the fields of organismal or integrative biology should consider.

Program and Affiliated Faculty

Gregory F. Ball, Professor (Director), Psychological and Brain Sciences.

Eric Fortune, Assistant Professor, Psychological and Brain Sciences.

Linda Gorman, Lecturer, Psychological and Brain Sciences.

Peter Holland, Professor, Psychological and Brain Sciences; Co-Director, Behavioral Biology.

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 the natural sciences area major. The exact courses to be taken are determined by the student in conjunction with the program director. 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 assistant dean.

Hopkins undergraduates may enter the Behavioral Biology Program at any time, provided all requirements can be completed before graduation. The program director, Dr. Gregory Ball, coordinates undergraduate advising for the program and should be consulted prior to declaring the major. Additional information regarding the Behavioral Biology Program is available through Aaron Williams, Program Coordinator, 140 Ames Hall, and on the Web at <http://behavioralbiology.jhu.edu>.

This curriculum is being reviewed. Please consult our Web site for the most recent updates.

Requirements for the B.A. Degree

- 030.101 and 030.105 Introductory Chemistry I and Lab
- *Either* 030.205 Organic Chemistry I *or* 030.204 Introductory Intermediate Chemistry II
- *Either* 030.225 Organic Chemistry Lab *or* 030.106 Introductory Chemistry Lab II
- 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

- 290.490 Senior Seminar in Behavioral Biology (capstone course)
- Twelve additional credits of science and mathematics courses at any level
- Fifteen credits of humanities and social science courses at any level
- Fifteen credits of humanities and social science courses at 300-level or above, divided among at most three departments
- Fifteen credits of electives at any level, in any department

The following courses must be included among those taken to fulfill the above requirements:

- 200.141 Physiological Psychology
- 200.146 Animal Behavior
- 020.207 Intro to Biological Anthropology
- 080.305 The Nervous System
- 290.420 Origins of Human Sexual Orientation and Variation
- Nine Credits of Advanced Biobehavioral Science Courses (refer to Curriculum Checklist)
- Six Credits of Intermediate/Advanced Social/Developmental/Cognitive Sciences Courses (refer to Curriculum Checklist)

Courses

290.420 (S,W) Origins of Human Sexual Orientation and Variation

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

290.490 (N) Senior Seminar in Behavioral Biology

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 3 credits

360.236 Tropical Biology and Ecology in Ecuador and the Galapagos Islands

This course is an introductory field 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.

Staff 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.

Ruth Faden, Professor, Bloomberg School of Public
Health.

Andrew Siegel, Assistant Professor, School of
Medicine.

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, the department participates in a collaborative program with the National Institutes of Health. Students in biology 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 and Chair: retroviral RNA synthesis and processing.

Maurice J. Bessman, Professor: biochemistry and enzymology, synthesis of nucleic acid derivatives, biochemical basis of spontaneous mutations.

Ludwig Brand, Professor: mechanisms and control of enzyme activity, with emphasis on the use of fluorescence techniques.

Xin Chen, Assistant Professor: understanding how genes are expressed in an ordered way to regulate germ cell differentiation, and in particular, the epigenetic mechanisms that participate in this regulation.

Kyle W. Cunningham, Professor: calcium transport and signaling mechanisms in yeast.

Michael Edidin, Professor: membrane organization and dynamics, immunology.

Douglas Fambrough, Professor Emeritus: membrane proteins, targeting, structure, function, and regulation, Na, K-ATPase, Ca-ATPase.

Ernesto Freire, Professor, Henry A. Walters Professor in Biology: biophysical chemistry, thermodynamics of macromolecular assemblies in membranes, protein-lipid interactions, microcalorimetry.

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.

Robert Horner, Lecturer: photophosphorylation.

M. Andrew Hoyt, Professor: genetics of chromosome segregation and signal transduction in yeast.

Ru-Chih Huang, Professor: gene regulation and chromosomal structure and function.

Rejji Kuruvilla, Assistant Professor: local retrograde signaling by target-derived neurotrophins in neuronal development.

Yuan Chuan Lee, Professor: glycoproteins, glycolipids, carbohydrate receptors, and cell-surface substances.

Richard E. McCarty, Professor: 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: developmental neurobiology.

Rebecca Pearlman, Lecturer: biology education, emerging infectious diseases, plant response to the environment.

Peter Privalov, Professor: physics of protein structure.

Saul Roseman, Professor, Ralph S. O'Connor Chair in Biology: functions of cell membranes in cell recognition and sugar transport.

Joel F. Schildbach, Professor: 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: primordial germ cell migration in development.

Beverly R. Wendland, Associate Professor: endocytotic mechanisms and membrane trafficking events.

Haiqing Zhao, Assistant Professor: cellular and molecular mechanisms underlying the development and function of olfactory sensory neurons.

Adjunct Appointments

Alex Bortvin, Assistant Professor: Genetic and epigenetic controls of germ cell development and function in vertebrates

Donald D. Brown, Professor Emeritus: biochemistry of development, nucleic acids.

Victor G. Corces, Professor (Emory): control of gene expression, molecular mechanisms of mutagenesis by transposable elements.

Jonathan Eisen, Professor (UC-Davis): DNA repair, mechanisms of adaptation to extreme environments, endosymbioses, phylogenomics, genome evolution, evolution of multigene families, environmental microbiology.

Chen-Ming Fan, Associate Professor: molecular and cellular interactions that contribute to vertebrate embryogenesis.

Stephen Farber, Assistant Professor: Real-time imaging of lipid metabolism in live zebrafish; identification of genes which regulate cholesterol absorption using biochemical and genetic strategies.

Andrew Z. Fire, Professor (Stanford): Mechanisms by which cells and organisms respond to genetic change.

Joseph G. Gall, Professor: chromosome structure and functions, nucleic acids in development.

Marnie Halpern, Professor: zebra fish development.

Douglas Koshland, Professor: analysis of mitosis in yeast.

Allan Spradling, Professor: molecular genetics of *Drosophila*.

Yixian Zheng, Associate Professor: centrosome function.

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).

Tamara Hendrickson, Assistant Professor (Chemistry)

George Rose, Professor (Biophysics)

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 47.)

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 grade 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 or approved by the advising coordinator.

- **Biology:**
080.304 Cellular and Molecular Neuroscience
020.304/604 Cellular and Molecular Neuroscience
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
- 020.324 Bioinformatics/DNA Microarray Technology
- 020.331/630 Human Genetics
- 020.332 Plant Biochemistry
- 020.333 Adaptations of Plants to Their Environment
- 020.335 Landmarks in Biochemical Research
- 020.342 Proteins
- 020.346 Immunobiology
- 020.347 AIDS
- 020.349 Microbial Pathogenesis
- 020.365 Introduction to the Human Skeleton
- 020.366 Human Evolution
- 020.375 Human Anatomy
- 030.376/606 Molecular Evolution
- 020.379 Evolution
- 020.380 Molecular Biology
- 020.629 Cancer Biology
- 020.634 Chromatin and Transcription
- 020.637 Advanced Genetics 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
- 020.650 Eukaryotic Molecular Biology
- 020.651 Retroviruses
- 020.667 Bioconjugate Techniques
- 020.668 Advanced Molecular Biology
- 020.674 Graduate Biophysical Chemistry
- 020.679 Advanced Biological Microscopy
- 020.676 Functional Interpretation of Biological Structures
- 020.682 Molecular Recognition and Signaling
- 020.685 Bioinformatics Survey
- 020.686 Advanced Cell Biology
- **Biomedical Engineering:**
 - 580.421 Physiological Foundations I
 - 580.422 Physiological Foundations for Biomedical Engineering II
 - **Biophysics:**
 - 250.345 Cellular and Molecular Physiology
 - 250.351 Reproductive Physiology
 - **Chemistry:**
 - 030.301-302 Physical Chemistry I, II
 - 030.425 Advanced Mechanistic Organic Chemistry I
 - 030.426 Advanced Mechanistic Organic Chemistry II
 - 030.451 Spectroscopy
 - **Earth and Planetary Sciences:**
 - 270.320 Global Change and Human Health
 - 270.321 Introductory Oceanography
 - **Geography and Environmental Engineering:**
 - 570.303 The Environment and Your Health
 - 570.309 Microbiology
 - 570.328 Geography and Ecology of Plants
 - 570.411 Engineering Microbiology
 - 570.443 Aquatic Chemistry
 - **Mathematical Sciences:**
 - 550.310 or 550.311 Probability and Statistics
 - 550.420 Introduction to Probability
 - 550.430 Introduction to Statistics
 - **Neurosciences:**
 - 080.304 Cellular and Molecular Neuroscience
 - **Physics:**
 - 171.319-320 Intermediate General Physics for the Biosciences
 - **Psychological and Brain Sciences:**
 - 200.310 Multivariate Statistical Methods
 - 200.314 Advanced Statistical Methods
 - 200.329 Brain, Communication, and Evolution
 - 200.341 Biological Basis of Learning and Memory
 - 200.344 Behavioral Endocrinology
 - 200.347 Human Neuropsychology
 - 200.370 Functional Human Neuroanatomy
 - 200.374 Behavioral Medicine
 - 200.376 Psychopharmacology

B.S. Degree in Molecular and Cellular Biology

The Biology Department offers a B.S. degree in molecular and cellular biology. This degree will increase the breadth of undergraduate training and afford current Hopkins majors a greater range of educational possibilities and career options. 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 is 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. The competitive nature of the medical school admission process requires an increasing number of students to postpone application until the senior year, creating a one-year void between the undergraduate and medical school programs. The combined bachelor's/master's program in Molecular and Cellular Biology will help students fill that void by providing them with advanced training in modern biology. The students will then be better prepared for medical school admission.

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. The eligible courses are listed below.
- 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 3-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.

Admission

Admission to the B.A./M.S. Molecular and Cellular Biology program is selective. Hopkins biology majors who have achieved an overall grade-point average of 3.0 or higher 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 3.0 might be considered for admission to the program under special circumstances if the MCB Program Committee judges the student to be capable of completing the requirements for the master's program. 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, and (c) an interview with the student.

Courses fulfilling the advanced course requirements for the B.A./M.S. program

- 020.304/604 Cellular and Molecular Neuroscience
- 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
- 020.324 Bioinformatics/DNA Microarray Technology
- 020.331/630 Human Genetics
- 020.332 Plant Biochemistry
- 020.333 Adaptations of Plants to Their Environment
- 020.335 Landmarks in Biochemical Research
- 020.342 Proteins
- 020.346 Immunobiology
- 020.347 AIDS
- 020.349 Microbial Pathogenesis
- 020.365 Introduction to the Human Skeleton
- 020.366 Human Evolution
- 020.375 Human Anatomy
- 030.376/606 Molecular Evolution
- 020.379 Evolution
- 020.380 Molecular Biology
- 020.629 Cancer Biology
- 020.634 Chromatin and Gene Expression
- 020.637 Advanced Genetics 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
- 020.650 Eukaryotic Molecular Biology
- 020.651 Retroviruses

020.667 Bioconjugate Techniques
 020.668 Advanced Molecular Biology
 020.674 Graduate Biophysical Chemistry
 020.676 Functional Interpretation of
 Biological Structures
 020.679 Advanced Biological Microscopy
 020.682 Molecular Recognition and Signaling
 020.685 Bioinformatics Survey
 020.686 Advanced Cell Biology

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

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 either have had 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 50), 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 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 in a format for publication, 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
 020.687 Methods and Logic in Cell Biology

Spring Semester

020.637 Advanced Genetics and Development
 020.674 Graduate Biophysical Chemistry

Elective Courses:

020.604 Cellular and Molecular Neuroscience
 020.606 Molecular Evolution
 020.612 Introduction to the Human Brain
 020.613 Biology Science Writing
 020.614 Signaling in Development and Disease
 020.623 Neurobiology of Sensation
 020.629 Cancer Biology
 020.630 Human Genetics
 020.634 Chromatin and Gene Expression
 020.638 Regulation and Mechanisms of the
 Cell Cycle
 020.639 Macromolecular Assemblies in Biology
 020.642 Proteins: Structure, Folding, and
 Interactions
 020.646 Biological Spectroscopy**
 020.650 Eukaryotic Molecular Biology
 020.651 Retroviruses
 020.667 Bioconjugate Techniques
 020.676 Functional Interpretation of
 Biological Structures
 020.679 Advanced Biological Electron
 Microscopy

020.730 Seminar: Membranes from Models to Cells

020.731 Seminar: Molecular Morphogenesis

020.735 Seminar: Membrane Trafficking

020.739 Seminar: Topics in Biochemistry

250.685 Proteins and Nucleic Acids

250.689 Physical Chemistry of Biological Macromolecules

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 Embryology

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

020.103 (N) Freshman Seminar: Foundations of Biomedical Research

Roseman 1 credit fall

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 credit fall and spring

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

020.107 (N) Freshman Seminar: Cancer, Science, and Society

Bessman 1 credit fall

020.110 (N) Freshman Seminar: The Biology of Plastids

Plastids are remarkable organelles that are unique to plants. The function of plastids varies and depends on where the tissue cells are located. The structure, function, and developmental aspects of plastids will be considered. Limit: 12 students.

McCarty 1 credit fall

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.

Schroer 1 credit spring

020.151 (N) General Biology I

This course begins with an overview of the biosphere, followed by analysis of ecosystem and exploration of animal behavior in the context of ecosystems and evolution. Next, the cellular and molecular basis of life and the energetics 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. Mechanisms 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.

McCarty, Pearlman, Shingles 4 credits fall

020.152 (N) General Biology II

This course builds on the concepts presented and discussed in General Biology I. The primary foci of this course will be on the diversity of life and on the anatomy, physiology, and evolution of plants and animals. There will be a special emphasis on human biology. The workshops that were introduced in 020.151 General Biology I will include the use of simulation software, a critique of the primary literature, and an exploration of current trends in medicine. Prerequisite: 020.151 General Biology I.

McCarty, Pearlman, Shingles 4 credits spring

020.153 (N) General Biology Lab I

This course reinforces the topics covered in 020.151. Laboratory exercises explore subjects 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.

Pearlman 1 credit fall

020.154 General Biology Lab II

This course reinforces the topics covered in 020.152. Laboratory exercises explore subjects 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.

Pearlman 1 credit spring

020.161-162 (N) Biology Workshop I and II

The Biology Workshop covers applications and current trends in biology, through guest lectures from researchers and hands-on computer programs.

Pearlman 1 credit fall and spring

020.207 (N,S) Introduction to Biological Anthropology

The biology and evolution of humans and their closest living relatives.

Teaford 3 credits fall

020.209 (N) Dinosaurs

This course covers all of the major groups of dinosaurs, from Triceratops to T. rex and its 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

020.214 (N) Seminar: Self-Organization

Moudrianakis 3 credits spring

020.296 Foreign Gene Expression in *E. coli*

This laboratory will introduce molecular cloning techniques that allow bacteria to be used to produce a particular gene product. Recombinant plasmids, carrying 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

020.304 (N) Cellular and Molecular Neuroscience

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. Prerequisite: Chemistry 030.104. Corequisite: Chemistry 030.201.

Bessman, 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.

Schroer, Wendland 4 credits spring

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 020.305 Biochemistry. Some enzymes will be discussed in detail and some of the experimental methods used to understand mechanisms of action will be explored.

Brand 2 credits fall/even years

020.312 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 to 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 2 credits spring

020.313 (N) Neurobiology of Sensation

An in-depth introduction to the working principles of sensory systems that sense light, sound, pressure, temperature, chemicals (odor, taste), and pain. Emphasis is given to the cellular and molecular mechanisms of signal transduction processes, which transform the information

of stimuli into nerve impulses. Prerequisite: 080.304 or 020.309 or the equivalent.

Zhao 2 credits fall

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. Topics include pH, proteins, carbohydrates, lipids, nucleic acids, and enzymes. Corequisite: 020.305.

Horner 2 credits fall

020.316 Cell Biology Laboratory

This course will reinforce the topics presented in 020.306 Cell Biology 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. Corequisite: 020.306.

Horner 2 credits spring

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 microscopies 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 Intersession

020.324 (N) Bioinformatics/DNA Microarray Technology

This course is designed to provide experience with the design, analysis, and interpretation of experiments using powerful new techniques involving DNA microarrays. The course includes lectures and hands-on experience in the wet lab and computer lab. Students will help perform new experiments and analyze the data with the intention of generating results for publication. Prerequisite: 020.330, preferred 020.340.

Cunningham 2 credits spring/even years

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. Prerequisite: 020.305. Corequisite: 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) Plant Biochemistry

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: 020.305-306.

Moudrianakis, Horner 2 credits spring

020.333 (N) Adaptations of Plants to Their Environments

This course is an introduction to the ecological physiology of higher plants. Plants grow in the tropics and the tundra, in extremely dry or wet situations, and even in salt water. The adaptations of plants to their environments will be discussed. Prerequisite: General Biology 020.151-152 or advanced placement.

McCarty 2 credits spring

020.335 (N) Landmarks in Biochemical Research

An advanced biochemistry course designed for upperclassmen. Emphasis will be on the origins of important biochemical concepts, and on the essential role of quantitative thinking in the experiments that led to these ideas. Original and current papers will be analyzed, and problems will be assigned to illustrate the basic principles involved. Prerequisites: Grades of B or better in the following: Biology 020.305, 020.315, Chemistry 030.104, 030.201. Permission of instructors required.

Roseman 4 credits spring

020.340 Genetics Laboratory

Laboratory investigations designed to deepen the student's understanding of prokaryotic and eukaryotic genetics using both classical genetic and state-of-the-art molecular genetic approaches. Corequisite: 020.330.

Staff 2 credits fall

020.342 Proteins (N)

Introduction to the protein world; the immense versatility of protein function. Primary, secondary, tertiary, and quaternary structures of proteins. The forces involved in folding these hetero-polymers into unique conformations and their association with partners, other proteins and nucleic acids, forming supra-molecular constructions—the "molecular machines."

Privalov 3 credits spring

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

AIDS is the world's deadliest infectious disease. This course will cover the biology of the infectious agent that causes AIDS, human immunodeficiency virus (HIV), 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. Because HIV drugs cannot cure HIV-infected individuals, we will also study the long-term consequences of HIV infection including opportunistic infections and the HIV-related cancers Kaposi's sarcoma and lymphoma. Prerequisite: 020.306.

Schroer 3 credits spring/even years

020.349 (N) Microbial Pathogenesis

The course will examine a dozen infectious diseases that have demonstrated a capacity for causing widespread illness and death. In lectures, the microbiology of the organisms and the pathology of the diseases they cause will be discussed. The impact of these diseases on society will be studied using assigned readings. Prerequisite: 020.330 or permission required.

Schildbach 3 credits spring/odd years

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, Norris 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, and forensic anthropology (sexing and aging, body size reconstruction, bone pathology). Lectures will be combined with hands-on experience with bone models and real bone specimens.

Ruff 3 credits spring

020.366 (N) Human Evolution

A close look at the fossil evidence for human evolution. Topics include introduction to taxonomy, evolutionary theory, paleoclimatology and dating techniques; Miocene hominoids; the earliest hominids; the first members of our genus; the position of the Neanderthals in our ancestry; and the origins and fate of modern humans. Prerequisite: 020.379 or permission.

Teaford 3 credits spring

020.367 Primate Behavior and Ecology

A close look at our closest living relatives. Topics to be discussed: the past and present distributions of primates, primate taxonomy, feeding and diet, reproduction, social organization, communication, community relationships, and conservation.

Teaford 3 credits spring

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.

K. Rose 3 credits spring

020.373 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. To accommodate seniors who need this course to graduate, sophomores and juniors may register only by permission of instructor. Corequisite: 020.363.

Norris 2 credits spring

020.375 (N) Human Anatomy

This course is meant to be an introduction to human gross anatomy. It will seek to give students enough background in anatomical knowledge and vocabulary to help them in their initial training in medical school; however, it will not be a substitute for anatomy courses in medical school. It will focus on normal adult anatomy, and it will cover each of the main regions of the body—i.e., thorax, abdomen and pelvis, back and limbs, and head and neck. Lectures will cover descriptive and functional anatomy, ultimately leaving students with a better understanding of anatomical terminology and 3D relationships of structures within the human body, and better problem-solving skills as they begin to relate symptoms to causes, again at the gross anatomical level.

Teaford 3 credits fall

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 3 credits spring

020.379 (N) Evolution

This course will explore the principles of natural selection and examine the origin of species from both the geologic record (paleontology) and the genetic record. One goal of the course is to explore the role of DNA as the driving force for evolution. Prerequisites: Cell Biology (020.306) and Genetics (020.330). Students who have not had genetics may get permission for the course after talking to the instructor.

Norris 3 credits fall

020.380 (N) Molecular Biology

This course will analyze the molecular mechanisms responsible for the control of gene expression in eukaryotic cells. Topics will include the mechanisms governing transcription initiation, elongation, and termination; mechanisms of RNA processing and export; role of chro-

main structure in transcription; nuclear organization; imprinting and X-chromosome inactivation.

Beemon, Huang, Moudrianakis 3 credits fall

020.395 Introduction to Biological Electron Microscopy

Introduction to the principles, practice, and application of electron microscopy to biological/cell biological questions. The course will have both a practical component, in which students learn basic, conventional electron microscopy including sample processing (fixation and embedding), grid/film preparation, ultramicrotomy, contrast enhancement techniques, scope operation, and basic photographic skills; and a theoretical component in which students learn the details/specifics of various techniques, and considerations for their application and uses. Prerequisite: approval of the instructor.

McCaffery intersession

020.397 (N,E) 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).

McCaffery intersession

020.401-402 (N) Seminar: Current Progress in Cellular and 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 student presentations of research and discussion of topics of current interest in the field. 020.401 is offered in the fall; and 020.402 in the spring.

Homer 3 credits

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 student 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: 020.151-152. Permission required. S/U Only

Pearlman 1 credit

020.501-502 Introduction to Independent Study in Biology

An independent course of study may be pursued under the direction of an adviser on those topics not specifically

listed in the form of regular courses. Consent of adviser required. Freshmen and sophomores only.

020.503-504 Introduction to Research in Biology

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.

020.505-506 Internship in Biology

020.511-512 Independent Study

An independent course of study may be pursued under the direction of an adviser on those topics not specifically listed in the form of regular courses. Consent of adviser required.

020.513-514 Research Problems in Biology

Original laboratory investigations on biological problems. Prerequisite: permission of faculty member in charge.

020.551, 020.552, and 020.553 Mentored Research Program in Molecular and 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. 020.551 is offered in the fall, 020.552 in the intersession, and 020.553 in the spring.

Staff 4 credits

Cross-Listed

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

All 600-level courses are open to undergraduates with permission.

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 2 hours 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 Development and Disease

The proper functioning of the nervous system relies on the establishment of precise neuronal circuits through a developmental program including proliferation, axonal growth and guidance, and neuronal survival. This course pertains to the extracellular cues and downstream neuronal signaling pathways that coordinate these key events during neuronal development.

Kuruvilla fall

020.629 Cancer Biology

Lectures include updates of recent findings in signal transductions in eukaryotic gene expressions and new searches for possible functions of currently unidentified genes based on genomic sequence information.

Huang spring

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 2 credits 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.

Beemon, Moudrianakis 2 credits

fall/even years

020.637 Advanced Genetics 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

020.639 Macromolecular Assemblies in Biology

Multisubunit complexes are emerging as important mediators of many cell biological processes. This course will discuss a variety of macromolecular assemblies. Function, composition, and structure will be addressed.

Schroer, Zheng fall/even years

020.642 Proteins: Structure, Folding, and Interactions

An advanced course devoted to understanding the physical origins and character of the energetics of protein structure, mechanisms, and cooperativity in folding and stabilization of the native protein structure, and physical determinants of macromolecular recognition and assembly. A goal of this course is to develop an understanding of energetics in terms of the interactions between protein groups and between these groups and the components of the solution phase. Protein energetics as measured by experimental approaches will be discussed in detail. The physico-chemical theories that describe quantitatively the contributions by noncovalent forces (electrostatic, hydrogen bonding, van der Waals, hydrophobic) to stabilization will be developed.

Privalov 3 hours spring

020.646 Biological Spectroscopy

This course provides a theoretical background for fluorescence spectroscopy and demonstrates how fluorescence can be used to advantage to address important problems in biochemistry, biophysics, molecular biology, and cell biology.

Brand 2 hours fall/odd years

020.650 Eukaryotic Molecular Biology

Beemon, Huang, Moudrianakis 2 hours fall

020.651 Retroviruses

This course will cover the retroviral life cycle, from infection to assembly of viral particles. In addition, it will discuss endogenous retroviruses in the germ line, retroviral diseases, including AIDS and cancer, and the use of retroviruses in gene therapy. This is a seminar course and will consist mainly of student presentations and discussions.

Beemon 3 hours spring/odd years

020.667 Bioconjugate Techniques

The organic chemistry of the amino acids, peptides, and the carbohydrates. Also selected topics from the inorganic chemistry of phosphorous and sulfur, and the organic chemistry of these elements will be presented.

Lee 3 hours spring/odd years

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 3 hours 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 spring

020.676 Functional Interpretation of Biological Structures

This course is essentially on structural biology with the focus on how the structures of biological macromolecules have impacted our understanding of biology. The emphasis will be on analyses of structures that have informed us on the mechanisms of fundamental biological processes, as well as structures that helped shape principles of molecular recognition, signal transduction, and rational drug design. This is not a course in the methods of biological structure determination, nor is it a survey course intended to cover all of "The Greatest Hits of Structural Biology." Instead, we will explore in depth a few classic

examples from this "Greatest Hits" list with the idea that the principles learned from these examples will have implications beyond the system of study. Prerequisite: Biochemistry 020.305 or equivalent.

Hill 3 hours spring/even years

020.679 Advanced Biological Electron Microscopy

This course is intended to build upon the basic skills students acquired in the previous course. Students will be required to work on actual ongoing research projects. The course will emphasize the integration and use of various light and electron microscopic techniques and their application to various research related questions. The course will have primarily a practical "hands-on" component; but will also include theoretical considerations as students will read, analyze, and discuss current journal articles. Prerequisites: Introduction to Biological Electron Microscopy and approval of the instructor.

McCaffery intersession

020.681 Drug Discovery—Preclinical Aspects

Freire spring

020.682 Molecular Recognition and Signaling

Biological function requires the interaction between macromolecules and between macromolecules and small molecules. These interactions trigger specific signals that result in the activation or inhibition of specific pathways in the cell. Molecular interactions require the ability of the interacting partners to recognize each other. Understanding the way in which molecules recognize each other provides a way to understand cell function and the basis for the development of new medical strategies aimed at treating conditions such as cancer, diabetes, Alzheimer's, etc. This course will provide an in-depth coverage of the fundamentals of molecular recognition, using as specific examples some of the most important and recognized targets for drug development.

Freire spring

020.685 Bioinformatics Survey

Staff 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.

Staff 3 hours fall

020.687 Methods and Logic in Cell Biology

Wendland, Kuruvilla fall

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, Rose fall

250.689 Physical Chemistry of Biological Macromolecules
Introduction to the principles, methods, and approaches of thermodynamics and kinetics as applied to the study of the relationship between structure, energy, dynamics, and biological function of proteins and nucleic acids. 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: 250.685 and 250.689, or equivalent course work.

Fleming and Staff spring

020.730 Seminar: Membranes from Models to Cells

Edidin

020.731 Seminar: Molecular Morphogenesis

Fan, Hill, Koshland 2 hours fall/even years

020.739 Seminar: Topics in Biochemistry

Bessman 2 hours spring

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

Courses at the Medical Institutions

Pathobiology Department, School of Public Health

26A01 Biological Basis of Public Health

26A15 Comparative Animal Behavior

26A17 Principles of Ecology

26A18 Field Studies in Ecology

26A19 Histology and Cell Structure

Immunology Council

188.670 Injury, Inflammation, and Repair (Public Health)

260.600 Principles of Immunology (Medicine)

260.611 Principles of Immunology (Public Health)

260.613 Diagnostic Immunology (Public Health)

260.616 Nutritional Aspects of Infection and Immune System Competence (Public Health)

260.622 Principles of Bacterial Infection (Medicine)

260.702 Advanced Topics in Molecular Immunology (Medicine)

260.703 Seminars in Immunology (Medicine)

260.712 Graduate Immunology (Public Health)

260.714 Immunogenetics (Public Health)

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: experimental and computational studies of protein energetics and electrostatics.

Eaton E. Lattman, Professor, (Dean of Research and Graduate Education): X-ray diffraction, studies of biological macromolecules, theoretical studies.

George Rose, Professor (Chair): modeling and simulation of protein folding and protein structure.

Sarah A. Woodson, Professor: folding and assembly of RNA and RNA-protein complexes.

Research Faculty

Ana Damjanovic, Associate Research Scientist (part-time): protein structure, dynamics and function.

Carolyn Fitch, Assistant Research Scientist (part-time): protein energetics: stability and function.

Patrick Fleming, Principal Research Scientist: computational studies of protein folding structure and solvation.

Ilana Nodelman, Assistant Research Scientist: biophysical and biochemical characterization of chromatin-remodeling proteins; x-ray crystallography.

Secondary Appointments

Department of Biology Faculty

Karen Beemon, Professor: retroviral RNA synthesis and processing.

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.

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.

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.

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.

Daniel J. Leahy, Associate Professor: X-ray diffraction studies of cell-surface receptors and extracellular matrix components.

Jon Lorsch, Assistant Professor: techniques of mechanistic enzymology to study process of translation initiation in eukaryotes.

Hershel 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 structure and protective roles of mucus secretions, the ability of membrane permanent acids to inactivate viral and bacterial pathogens, and how normal microflora of the vagina, lactobacilli, fend off 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 HIV protection is being sponsored by NIH in collaboration with ReProtect, Inc. and Starpharma Pty, Ltd, through a research agreement with Johns Hopkins University. Research on developing nanoparticles for enhanced delivery of drugs to mucosal surfaces is being done in collaboration with Dr. Justin Hanes in Chemical and Biomolecular Engineering.

Macromolecular Energetics (Dr. Garcia-Moreno E.)

One of the most important challenges in contemporary molecular biophysics is to understand the relationship between the structures, stability, dynamics, and function of biological macromolecules. The structure-energy problem is studied in our lab with both experimental and computational techniques. Equilibrium thermodynamic methods are used alongside crystallographic and NMR approaches to measure the stability of proteins. The experiments contribute the physical insight needed to develop algorithms for the structure-energy calculations, as well as the data needed to benchmark the computational methods. Current focus is on the study of electrostatic contributions to the stability and dynamics of proteins.

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 spectroscopic, ultracentrifugation, and calorimetric methods. Atomic structure information is being obtained by X-ray crystallography. The ultimate goal is to determine the thermodynamic partition function for a signal transduction system and interpret it in terms of atomic structure.

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 computational 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 will lead to 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 a computer cluster, high-end graphics workstations, a digital image-processing microscope, and many other items.

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, and neurobiology. The biophysics major also fulfills 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 individual research.

For updated information on changes in academic requirements and department events for majors, check the undergraduate Web site, www.jhu.edu/~biophys/undergrads.

Requirements for the B.A. Degree

(See also General Requirements Departmental Majors, page 47.)

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

- 171.101 General Physics for Physical Science Majors I (4)*
- 171.102 General Physics for Physical Science Majors II (4)*
- 173.111 General Physics Lab I (1)*
- 173.112 General Physics Lab II (1)*
- or*
- 171.103 General Physics for Biological Science Majors I (4)
- 171.104 General Physics for Biological Science Majors II (4)
- 173.111 General Physics Lab I (1)
- 173.112 General Physics Lab II (1)
- or*
- 171.105 Introduction to Classical Physics I (4)
- 171.106 Introduction to Classical Physics II (4)
- 173.111 General Physics Lab I (1)
- 173.112 General Physics Lab II (1) and one of the following sequences:
- 171.201 Special Relativity and Waves (4)
- 171.202 Modern Physics (4)
- or*
- 171.209 Wave Phenomena with Biophysical Applications (3)
- 171.210 Biological Physics (3)

• **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**

020.305 Biochemistry (4)*

020.315 Biochemistry Lab (2)*

020.306 Cell Biology (4)*

* Denotes science or math courses required for premedical students.

• **Biophysics**

250.345 Cellular and Molecular Physiology (3)

250.372 Intro to Biophysical Chemistry (3)

250.521 Research Problems in Biophysics I (3)

250.531 Laboratory in Biophysics (3)

and two of the following:

250.353 Computational Biology (3)

250.391 Proteins and Nucleic Acids (3)

250.401 Advanced Seminar in Biophysics (3)

II. Electives

Three other 300- or higher-level courses in biology, chemistry, physics, or biophysics, at least two of which should be chosen from the following:

• **Biophysics**

250.351 Reproductive Physiology (2)

250.353 Computational Biology (3)

250.391 Proteins and Nucleic Acids (3)

250.401 Advanced Seminar in Biophysics (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)

030.423 Statistical Thermodynamics and Chemical Dynamics (3)

030.425 Advanced Mechanistic Organic Chemistry (3)

• **Physics**

171.204 Classical Mechanics (4)

171.301 Introduction to Electromagnetic Theory (4)

171.312 Statistical Physics and Thermodynamics (4)

171.411 Geometrical and Physical Optics (3)

• **Biology**

020.330 Genetics (3)

020.346 Immunobiology (3)

020.363 Developmental Biology (3)

020.380 Molecular Biology (3)

• **Computer Science**

600.226 Data Structures (3)

600.271 Automata and Computation Theory (3)

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 adviser to determine how these conflicts have been resolved. A grade of C or higher is mandatory for courses fulfilling departmental degree requirements.

* Denotes science or math courses required for premedical students.

Sample Program for the B.A. in Biophysics

• **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	<u>3</u>
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	<u>3</u>
Total	16

• Year 2*Fall*

030.205 Intro Organic Chemistry I	4
030.225 Organic Chemistry Lab	3
020.305 Biochemistry	4
Elective H/S/W	3
Elective H/S/W	<u>3</u>
Total	17

Spring

030.206 Intro Organic Chemistry II	4
020.306 Cell Biology	4
250.372 Intro Biophysical Chemistry	3
Elective H/S/W	<u>3</u>
Total	14

• Year 3*Fall*

110.202 Calculus III	4
250.531 Laboratory in Biophysics	3
250.345 Cellular & Mol. Physiology	3
020.315 Biochemistry Lab	2
Elective H/S/W	<u>3</u>
Total	15

Spring

110.201 Linear Algebra	4
250.521 Research Problems I	3
Biophysics Major Elective I	3
Elective H/S/W	3
Elective H/S/W	<u>3</u>
Total	16

• Year 4*Fall*

171.209 Wave Phenomena	3
Biophysics Major Elective II	3
Upper-level Science Elective I	3
Elective H/S/W	3
Elective H/S/W	<u>3</u>
Total	15

Spring

171.210 Biological Physics	3
Upper-level Science Elective II	3
Upper-level Science Elective III	3
Elective H/S/W	3
Elective H/S/W	<u>3</u>
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.

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:

250.683 Introduction to UNIX-Python
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 and Computational Biophysics

The Program in Molecular and Computational Biophysics (PMCB), 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 biophysics 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 and Computational 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 Computer Modeling of Biological Macromolecules, and 330.702 Bioorganic Mechanisms.

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 (CMDDB) 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 CMDDB, please check its Web site (www.jhu.edu/emdb). Interested applicants can apply online via the program Web site or by U. S. mail to:

Ms. Joan Miller (joan@jhu.edu)
Graduate Admissions Coordinator
CMDDB 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 PMCB 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 adviser 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 the Biophysics faculty discuss their current work or contemporary areas of research in biophysics and students pursue projects related to biophysics. Open to freshmen and sophomores only.

K. Fleming, Cone, Staff 1 credit

250.265 (N) Bioinformatics

How to quantify comparisons in biological systems? Through lectures and labs, this course introduces bioinformatic applications and algorithms. It covers basic programming, sequence comparison, structural comparison, and structural prediction.

P. Fleming 3 credits

Intermediate

250.300 (N) Introduction to Biomedical Research and Careers II

(See 250.106)

250.306 (N) Introduction to Biomedical Research and Careers III

(See 250.106)

250.332 (N) X-ray Crystallography of Biological Molecules

Course emphasizes use of crystallography to determine atomic structure of biological macromolecules, but also covers basics such as lattices, space groups, and symmetry. A text will be used. Prerequisites: elementary physics and calculus. Staff 3 credits

250.345(N) Cellular and Molecular Physiology

How cells and molecules function as parts of whole organisms. Topics depend in part on student interests and will include the role of diffusion in cellular and organismic anatomy and physiology, speeds of cellular and organismic processes molecular motors, sensory mechanisms, osmosis and membranes, and virus host interactions. Prerequisite: 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 020.305.

Zirkin, Cone, Staff 2 credits

250.353 (N) Computational Biology

This course introduces several computational approaches to the study of biological macromolecules. Students will learn to use computational tools to analyze protein structure and to develop a basic understanding of computer programming. The focus is biological rather than mathematical and no programming experience is required. Prerequisites: Biochemistry 020.305; Organic Chemistry 030.101-201.

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 proteins and nucleic acids, ligand binding thermodynamics, cooperativity and anticooperativity, allosteric models, lattice statistics, helix-coil transition, polymer theory, and kinetics of biological reactions. When appropriate, students visit the laboratory to set up data collection and learn to analyze the resulting data computationally, using nonlinear least-squares methods. Prerequisite: calculus, organic chemistry, and introductory physics.

Barrick 3 credits

250.391 (N) Proteins and Nucleic Acids

Begins with a two-week introduction to UNIX Python. Proteins as nature's molecular robots, and DNA/RNA as the genetic material. Explores the link between structure and function of biological macromolecules. Experimental and theoretical approaches to macromolecules, including modeling, simulating, and visualizing. Prerequisite: 020.305 Biochemistry; 250.372 Biophysical Chemistry.

Bowman, Woodson 3 credits

250.401 (N) Advanced Seminar in Biophysics

Topics will change from year to year. In 2006-2007 the course focused on structural and molecular virology. Topics included structural and physical aspects of viruses, replication cycles, and evolution. The discussions were focused on the structural basis of the life cycle of human pathogens such as the influenza virus and HIV. Topics chosen for this seminar are meant to illustrate integration between the quantitative and physical approaches and contemporary biological questions. There are no formal prerequisites, but 020.305 Biochemistry and 250.372 Introduction to

Biophysical Chemistry would be helpful.

Garcia-Moreno 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

250.644 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: 020.305 Biochemistry and 020.668 Advanced Molecular Biology 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.

K. Fleming, Staff

250.683 Introduction to UNIX-Python

Two-week course required for 250.685 Proteins and Nucleic Acids.

Rose

250.685 Proteins and Nucleic Acids

Proteins as nature's molecular robots, and DNA/RNA as the genetic material. Experimental and theoretical approaches to macromolecules, including modeling, simulating and visualizing three-dimensional structures. Advanced readings and a student presentation are intended to explore the link between the structure and function of biological macromolecules. Prerequisite: 250.683 Introduction to UNIX-Python.

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.

K. Fleming

250.693 Biological Principles of Physical Science

Introduction to modern biology at cellular and subcellular level, focusing on molecular and cell biology and

biochemistry. Course is for individuals with engineering and physical sciences background with little or no exposure to biology or chemistry. It is meant to give a basic biological framework for quantitative computational and physical studies of biological problems.

Garcia-Moreno

(*Note:* This course will not be taught 2007–2008)

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.

Paul J. Dagdigan, Arthur D. Chambers Professor: experimental chemical physics—dynamics of gas-phase chemical reactions, collisional energy transfer, molecular electronic spectroscopy, laser-induced fluorescence and ionization.

John P. Doering, Research Professor: experimental chemical physics and geophysics—electronic and ionic collision phenomena including electron energy loss spectroscopy, electron ionization coincidence spectroscopy, planetary atmospheres.

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, Associate 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.

Tamara Hendrickson, Assistant Professor: bioorganic chemistry and enzymology—chemical, biochemical, and mechanistic studies of complex enzyme systems, including C-terminal protein glycosylation, microbial protein biosynthesis, and tRNA-protein molecular recognition.

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, O₂-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.

Gerald Meyer, 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, Assistant 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, Assistant 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, Alsoth H. Corwin Professor:—organic and bioorganic chemistry—biosynthesis and chemistry of natural products, stereochemical 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.

Adjunct, Emeritus, and Joint Appointments

David Gracias, Assistant Professor (Chemical and Biomolecular Engineering).

John W. Gryder, Professor Emeritus.

Blake Hill, Assistant 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 Kriebel Professor Emeritus.

Lawrence M. Principe, Professor (joint appointment in History of Science and Technology).

Dean W. Robinson, Professor Emeritus.

Michael (Seungju) Yu, Assistant Professor (Materials Science and Engineering).

Lecturers

Jane Greco, Senior Lecturer.

Louise Pasternack, Senior Lecturer.

Tina Trapani, Senior Lecturer.

Facilities

The department is well-equipped with the 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)
- (2) VG Instruments VG70S magnetic sector mass spectrometer, with FAB, DCI, EI, and CI ionization
- Finnigan LCQ ion trap mass spectrometer with electrospray ionization (APCI available as an option)
- Kratos SEQ Kompact MALDI-TOF mass spectrometer
- 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 Spectrometry Facility. High-resolution mass spectra of submitted samples are obtained on a service basis by a staff member using a magnetic sector instrument 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 pre-medical student interested in medical research.

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 47.)

Core Courses:

- 030.101-102 Introductory Chemistry I, II
- 030.105 Introductory Chemistry Lab
- 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 adviser, 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 is 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
 - Calculus
- **Freshman/Spring Term**
 - 030.102 Introductory Chemistry 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
Calculus
- **Freshman/Spring Term**
030.102 Introductory Chemistry 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
030.356 Advanced Inorganic 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
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 adviser.

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, 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 Web site 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 wavefunctions 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

030.206 (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.

Lectka 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.

Silverstone 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

030.345 (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

030.441 (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

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.

Roth 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

030.449 (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 fall

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.
Dagdigan 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 spring

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

030.521-522 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 spring

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. Most 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.

Tovar 3 credits 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.

Greenberg 3 credits 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.

Hendrickson 3 hours spring

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 stoichiometric 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 co-requisite: 030.449 or equivalent
Meyer 3 hours spring

030.690 (N) A First Course in 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 well 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

Classics

The first modern Classics Department was organized at Johns Hopkins in 1876. Its inspiration came from the German seminar, which combined teaching with research and offered the most effective model of scholarship at that time. Thus, the Department of Classics has from the beginning played a central role in the teaching and research missions of the university.

Today, the Classics Department seeks to maintain and enhance its long 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.

Marcel Detienne, Basil L. Gildersleeve Professor (Humanities Center): Greek, social history, cultural history, mythology, anthropology and classics. Retired effective January 1, 2008.

Matthew Roller, Professor and Chair: Latin literature, Roman social and cultural history, Roman material culture, Graeco-Roman philosophy.

H. Alan Shapiro (Graduate Adviser), W. H. Collins Vickers Professor of Archaeology (History of Art): Greek and Roman art and archaeology, Greek mythology and religion.

Hérica N. Valladares, Assistant Professor (Director of Undergraduate Studies): Roman art and archaeology, Latin poetry, Ovid in the Renaissance, 18th-century reception of antiquity.

Dimitrios Yatromanolakis, Assistant Professor: Greek literature, Greek social and cultural history, theory and anthropology of Greek music, papyrology, epigraphy, performance cultures of Greece and Rome.

Emeritus

Georg Luck: 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, and palaeology.

Michael Koortbojian, Professor (History of Art): Hellenistic and Roman art and architecture; Renaissance antiquarianism.

Raymond Westbrook, Professor (Near Eastern Studies): Greek, Roman, and biblical law; Assyriology.

Visiting Appointments

Irad Malkin, Professor, Fall term 2007 (University of Tel Aviv): ancient history, Archaic Greek culture and society.

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 Collection (shared with Near Eastern Studies). Additionally, we enjoy 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 International Center for Classical Studies at Rome.

Undergraduate Programs

The department offers undergraduate courses in the Greek and Latin languages and literatures, ancient history, classical art and archaeology, Greek and Roman civilizations, history of sexuality, 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-(intermediate) level or above. Majors must also take at least two history courses, normally the introductory Greek and Roman Civilization courses (040.111 and 040.112). The other six 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, the anthropology of ancient cultures, ancient philosophy and thought, 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 the minimum requirements: 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 yearlong, semesterlong, 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.

Minor in Ancient Law

This minor is a combined program of the Classics and Near Eastern Studies departments. The minimum requirement is 18 credits, all in courses at 300-level or higher. The distribution requirement is:

- Three survey courses in ancient law
- Two survey courses in ancient history/civilization
- One course in an aspect of modern law or legal theory (e.g., Constitutional Law, Law and Psychology, Philosophy of Law)

For students interested in learning an ancient language, an alternative configuration is possible.

- Two semesters of a language (Akkadian, Biblical Hebrew, Egyptian, Greek, or Latin)
- Three courses in ancient law
- One course in ancient history/civilization

The minor is directed by Professor Raymond Westbrook, Near Eastern Studies.

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 during the first term.

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 towards 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 Web site (www.jhu.edu/classics).

Application forms and information may be obtained from Professor Matthew B. Roller, Chair, Department of Classics, 130 Gilman Hall, The Johns Hopkins University, 3400 North Charles Street, Baltimore, MD 21218. Telephone: 410-516-7556; fax: 410-516-4848; e-mail classics@jhu.edu. The application deadline is on or about January 15. For the exact deadline, please check the Graduate Admissions Web site (www.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

040.111 (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

040.121 (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

040.132 (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

040.301 (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

040.315 (H) Family, Gender and Sexuality in Ancient Greece

Greek social history of the Archaic and Classical periods (ca. 600-300 B.C.) based on the ancient sources, both textual and visual.

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

040.325 (H) Introduction to Roman Law

A historical survey of the legal system of ancient Rome from its beginnings to the great code of Justinian, which is the basis of many modern systems. No knowledge of Latin is required.

Westbrook 3 credits

040.339 (H) Readings in Roman Law

An advanced Latin reading course in the works of the Roman jurists, especially from Justinian's *Digest*.

Westbrook 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

040.501-502 Independent Study

040.521 Honors Research

Cross-Listed

010.145 (H) The Arts of Rome

An introduction to the artistic and architectural forms of the Romans.

Koortbojian 3 credits

010.378 (H) Roman Historical Art

The tradition of historical representation (and its mythic parallel) from its Greek and Etruscan precedents to its apogee in Imperial Rome.

Koortbojian 3 credits

010.390 (H) Art Museum Policy and Practice

This hands-on seminar looks behind the scenes at displays and exhibitions, museum operations and programs, as signs of current thinking about what art, past and present, may be. Limit: 12.

E. D. Maguire 3 credits

010.392 (H) Creating a Museum Exhibition

Research, interpretation, and presentation; a hands-on introduction. Permission required. Limit: 12.

E. D. Maguire 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

150.401 (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 ideas 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

010.552 Museum Internship

An opportunity for firsthand experience in museum work on the Homewood campus or in local museums.

E. D. Maguire up to 3 credits

010.660 The Imagery of the Roman Dead

Koortbojian

010.664 Triumphal Forms

The republican triumph provides the background for a focus on the new "triumphalist" ethos of the imperial period and its innovative monumental forms.

Koortbojian

010.666 The Roman Portrait

The historical development of Rome's fundamental artistic contribution.

Koortbojian

212.761 Books, Readers, and Writers in Pre-Modern Europe

This course is designed to familiarize students with the basics of Latin paleography; to offer them resources and skills in the study of textual transmission and editing; to understand the changes in Western graphic culture that went along with the emergence of printing with movable type; to study the emergence in the 18th century of the auxiliary disciplines of paleography and diplomatics as part of the intellectual history of Western Europe; and to become familiar with current scholarly concerns which center around the history of the books and the history of written culture. Prerequisite: basic reading knowledge of Latin or permission of instructor.

Celenza, Izbicki

Graduate Courses

This is a listing of seminars offered in recent years. Some are offered regularly; others have been offered just once.

040.601 Mythology of Greek Gods: Hermes and Apollo

Hermes and Apollo in cults and representations of the ancient polytheism. Readings of W. Burkert, W. F. Otto, J. Strauss Clay, and others.

Detienne

040.602 Comparative Historicities: Nation, Historiography, Myth Ideology

Nation and historicity; historiography and myth ideology. In ancient Israel, ancient Greece and Rome, contemporary France, and Europe. Readings: Paul Ricoeur, Martin Heidegger (seminars 1933-35), Pierre Nora, Gerard Noiriel, and others.

Detienne

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

040.605 The Romans and Their Past: "Historicism" vs. "Exemplarity" in Ancient Historiography

This seminar, focusing on both monuments and texts, examines the ways in which Romans engaged and constructed their past in these two media. Topics include the culture(s) of commemoration and monumentalization, ancestor portraiture, historiography and exemplarity, historical art, and the Romans' sense of their own antiquity. These topics are considered in light of recent theories of historical understanding.

Roller, Koortbojian

040.608 Anthropologies of Pollution and Purification: From Oedipus of Thebes to the People of Kosovo

To be born impure—pure and impure ancestors—pollution and contamination—the blood between pure and impure. Readings of M. Douglas, R. Parker, M. Grmek, Sacred Laws of Cyrene and Selinous.

Detienne

040.609 Sexuality in Egyptian and Roman Art

This seminar will focus on the representation of sexuality in Egyptian and Roman art. Attention will be paid to questions of context and patronage. Key primary texts will also be discussed. Cross-listed with History of Art, Near Eastern Studies, and Women, Gender, and Sexuality.

Bryan, 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

040.612 Ancient Greek Prose Composition

Translating modern English prose into ancient Greek. Emphasis on the Attic dialect.

Yatromanolakis

040.659 Archaic Greek Vase-Painting in the Walters Art Museum

The seminar explores the various regional ceramic workshops of the seventh–sixth centuries, focusing on selected examples in the Walters Art Museum collection. Cross-listed with History of Art.

Shapiro

040.672 Anthropologies of Music and Politics in Ancient Greece

Inquiry into the interaction between music, social and political discourses, and ancient modes of thought. Topics investigated include music and philosophy, music and ritual, music and astronomy, music and medicine. Cross-listed with Humanities Center and Political Science.

Detienne, Yatromanolakis

040.678 Roman Masculinities

This seminar investigates ideology and construction of elite Roman “manhood” in forms of representation such as invective poetry, forensic oratory, rhetorical theory, and honorific statuary, as well as an examination of pertinent recent scholarship.

Roller

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

040.680 Roman Sculpture in the Walters Art Museum

An advanced course that uses statuary in the Walters Art Museum as a starting point for discussion of the styles, meanings, uses, and techniques of Roman sculpture. Attention will be paid to the formation of the collection. Cross-listed with History of Art.

Staff

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

040.686 Return to the City of Images

This seminar explores recent approaches to the interpretation of Greek visual imagery. Twenty years after the pioneering exhibition/catalogue *La cité des images*, we reconsider issues of image and reality principally in Athenian vase-painting.

Shapiro

040.687 Classical Proseminar

An overview of research areas in Classics, including epigraphy, papyrology, textual transmission, numismatics, metrics, and critical approaches centering on literary theory, reception, gender theory, visual culture, and anthropology.

Staff

040.688 Comparative Approaches to Ancient Ritual, Religion, and Society

Inquiry into the anthropology of ritual in ancient and modern traditional societies. The course focuses on religious and secular contexts and discourses. Cross-listed with Anthropology, History, and Humanities Center.

Detienne, Yatromanolakis

040.690 Imperial Historiography

Survey of Latin historical writers of the Empire: Livy, Valerius Paternus, Tacitus, Ammianus. Substantial weekly readings in Latin, with sampling of current scholarly approaches to each author.

Roller

040.693 Bacchus and Dionysus Today

Face and mask; wine and mysteries; sexuality and gender; Dionysus with the philosophers. Readings: Euripides, F. Nietzsche, J. Burckhardt, W. F. Otto, Ch. Segal, and others.

Detienne

040.718 Topics in Roman Law

Undergraduates may take this seminar for three credits. Prerequisites: Elementary Latin or equivalent; Introduction to Roman Law. Fulfills a requirement of the ancient law minor.

Westbrook

040.739 Readings in Roman Law

(See description of undergraduate course 040.339.)

Westbrook

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.

Detienne

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

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. As a consequence of this diverse ancestry, cognitive science incorporates a variety of perspectives and methodologies. Cognitive scientists share 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

William Badecker, Associate Professor: language processing and representation, syntax and morphology, neurolinguistics.

Luigi Burzio, Professor (Chair): theoretical phonology, morphology, and syntax, Romance linguistics.

Robert Frank, Associate Professor: natural language syntax and grammatical theory; computational linguistics; formal, computational, and empirical studies of language acquisition and processing.

Barbara Landau, Dick and Lydia Todd Faculty Development Professor: language acquisition, cognitive development, spatial representation, and acquisition of the lexicon.

G eraldine Legendre, Professor: syntax, optimality theory, Romance and Balkan morphology and syntax, acquisition of syntax.

Michael McCloskey, Professor: cognitive neuropsychology, vision, spatial and lexical representation, and foundations of cognitive science.

Brenda Rapp, Professor: cognitive neuropsychology, spelling, spoken language production, spatial frames of reference, reading and neural bases of recovery of function.

Paul Smolensky, Professor: grammatical theory and neural networks; optimality theory: phonology, learnability, computation, syntax.

Joint/Adjunct Appointments

Dana Boatman, Associate Professor (Neurology and Otolaryngology, Medicine): speech perception, auditory processing disorders, auditory neurophysiology.

Howard Egeth, Professor (Psychological and Brain Sciences): perception, attention.

Jason Eisner, Assistant Professor (Computer Science): computational linguistics (syntax and phonology), natural language processing, statistical machine learning.

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.

Jordan Grafman, Professor and Chief, Cognitive Neuroscience Section, National Institute of Neurological Disorders and Stroke/National Institutes of Health: cognitive neuroscience, functional neuroimaging, frontal lobe functions, thematic knowledge, recovery of function after brain surgery, planning, reasoning, social cognition, economic behavior, executive function, human prefrontal cortex, cognitive neuroplasticity.

Steven Gross, Associate Professor (Department of Philosophy): philosophy of language, philosophy of mind, metaphysics.

Justin Halberda, Assistant Professor (Psychological & Brain Sciences): cognitive development, reasoning and word learning, attention, symbolic and connectionist modeling.

Argye Hillis, Associate Professor (Neurology, Medicine): language impairments in acute stroke, hemipatial neglect after stroke, relationship between cognitive impairments and regions of hypoperfused brain.

Frederick Jelinek, Julian Sinclair Smith Professor (Electrical and Computer Engineering; Director, Center for Language and Speech Processing): speech recognition, statistical methods of natural language processing, information theory.

Guy McKhann, Professor (Neurology and Neuroscience, Medicine): neurological and cognitive changes after cardiac surgery.

Maureen Stone, 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.

Raffaella Zanuttini, Associate Professor (Linguistics, Georgetown University): theoretical syntax, syntax/semantics interface, Romance linguistics.

Facilities

Offices and laboratories are located in Krieger Hall. The department provides laboratory and office space for graduate students. The laboratories are equipped for experimental and computational research in language and speech processing, auditory and visual perception, and other cognitive processes. Computer facilities include a number of technical workstations suitable for computational modeling. Facilities for the computational analysis and manipulation of acoustic data are available. A number of smaller computers are also available for other research purposes and for the design and control of psychological experiments.

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)

- Two introductory courses:
050.101 Cognition
050.102 Language and Mind

- 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- to 600-level. Not to include research, readings, or practica.
- One course at any level from each of the three nonfocal areas.
- Three additional courses at the 300- to 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.

- Any two of the following, except as noted below:
110.106 or 108 Calculus I
110.107 or 109 Calculus II
550.171 Discrete Mathematics
110.201 Linear Algebra
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
or the statistics sequence, consisting of
550.111-112 Statistical Analysis
200.114 Laboratory in Analysis of
Psychological Data

Note: For purposes of this requirement the statistics sequence forms an inseparable set. If one of the focal areas is Cognitive Psychology and Neuropsychology, the statistics sequence is required and should be completed by the end of the sophomore year if possible.

- 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.

Note: Up to 12 credits taken for departmental requirements may be used to fulfill university distribution requirements. See the Undergraduate Academic Manual.

Areas of Concentration

Most of the courses which fulfill the requirements for the five areas of concentration are listed below. However, please note that some of these courses are not offered every year. The department maintains a complete list, which is available from the director of undergraduate studies.

A. Cognitive Psychology/Neuropsychology

- 050.105 Introduction to Cognitive Neuropsychology
- 050.203 Cognitive Neuroscience: Exploring the Living Brain
- 050.208 Language Acquisition
- 050.306 Laboratory in Cognitive Neuropsychology
- 050.311 Written Language: Normal Processing and Disorders
- 050.314 Classic Papers in Language Learning
- 050.315 Cognitive Neuropsychology of Visual Perception
- 050.332 Developmental Cognitive Neuroscience
- 050.333 Psycholinguistics
- 050.339 Cognitive Development
- 050.358 Language and Thought
- 200.101 Introduction to Psychology
- 200.109 Introduction to Human Memory
- 200.118 Introduction to Sensation and Perception
- 200.132 Introduction to Developmental Psychology
- 200.141 Introduction to Physiological Psychology
- 200.155 Introduction to Developmental Cognitive Neuroscience
- 200.206 Foundations of Mind
- 200.312 Imaging the Mind
- 200.321 Topics in Perception and Attention
- 200.347 Human Neuropsychology
- 200.357 Cognitive Neuroscience of Memory
- 200.383 Mental Models and Mental Logic

B. Linguistics

- 050.205 The Structure of English
- 050.208 Language Acquisition
- 050.240 The World of Language
- 050.247 Topics in the History of the Romance Languages
- 050.311 Written Language: Normal Processing and Disorders
- 050.314 Classic Papers in Language Learning
- 050.316 Morpho Phonology
- 050.317 Semantics I
- 050.320 Syntax I
- 050.321 Syntax II
- 050.325 Phonology I
- 050.326 Foundations of Cognitive Science
- 050.327 Phonology II
- 050.329 Advanced Phonological Analysis
- 050.333 Psycholinguistics
- 050.358 Language and Thought
- 050.362 Field Methods

- 050.370 Formal Methods in Cognitive Science: Language
- 070.221 Language, Culture and Society
- 070.324 The Social History of Languages
- 070.347 Discourse Analysis: Stories and Their Structures
- 130.307 Writing: Its Origins, Functions, and Manifestations
- 600.465 Introduction to Natural Language Processing

C. Computational Approaches to Cognition

- 050.109 Minds, Brains, and Computers
- 050.313 Introduction to Cognition for Math Scientists
- 050.326 Foundations of Cognitive Science
- 050.334 Computational Models of Cognition
- 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
- 050.666 Information Extraction from Speech and Text
- 520.414 Image Processing and Analysis I
- 520.415 Image Processing and Analysis II
- 520.447 Introduction to Information Theory and Coding
- 550.437 Information, Statistics, and Perception
- 600.226 Data Structures
- 600.271 Automata and Computation Theory
- 600.335 Artificial Intelligence
- 600.363 Introduction to Algorithms
- 600.435 Artificial Intelligence
- 600.461 Computer Vision
- 600.463 Algorithms I
- 600.465 Introduction to Natural Language Processing
- 600.471 Modern Complexity Theory

At most, one of the following courses:

- 500.200 Computing for Engineers and Scientists, *or*
- 600.107 Introduction to Programming in JAVA, *or*
- 600.109 Introduction to Programming in C/ C++, *or*
- 600.111 Practical C, *or*
- 600.120 Intermediate Programming

D. Philosophy of Mind

- 050.326 Foundations of Cognitive Science
- 140.323 The Natural and the Artificial: The Concept of Man-Made Man
- 150.245 Philosophy of Mind

- 150.439 Philosophy of Science
- 150.440 Philosophy of Language I
(from Frege to Quine)
- 150.441 Philosophy of Language II
(from Quine to present)
- 150.444 Advanced Philosophy of Mind:
Representational Theory of Mind
- 150.446 Consciousness
- 150.459 Theory of Knowledge
- 150.476 Philosophy and Cognitive Science

E. Neuroscience

- 020.309 Cellular and Molecular
Neurophysiology
- 020.310 Developmental Neurobiology
- 020.312 Introduction to the Human Brain
- 050.203 Cognitive Neuroscience: Exploring
the Living Brain
- 080.101 Topics in Neuroscience*
- 080.203 Cognitive Neuroscience
- 080.205 Systems Neuroscience
- 080.304 Cellular and Molecular Neuroscience
- 080.305 The Nervous System
- 080.306 The Nervous System II
- 200.141 Introduction to Physiological
Psychology
- 200.155 Introduction to Developmental
Cognitive Neuroscience
- 200.312 Imaging the Mind
- 200.347 Human Neuropsychology
- 200.370 Functional Human Neuroanatomy
- 580.439 Models of Physiological Processes in
the Neuron

*Two-credit course

Sample Programs for Area Concentrations may be found on the department Web site at www.cogsci.jhu.edu

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 above. 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 eight 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.
Frank 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.
Badecker 3 credits

050.105 (N,S) Introduction to Cognitive Neuropsychology

Explores cognitive deficits caused by brain damage (including language, perceptual, and spatial deficits), and considers how the deficits shed light on normal mental processes. Cross-listed with Neuroscience.
McCloskey 3 credits

050.109 (N,S,Q) Minds, Brains, and Computers

Mental processes such as language comprehension and visual perception involve complex computations carried out by the brain. But how do brains compute? What exactly does it mean to “compute” anyway? How do the brain and mind relate? These questions will be explored from a range of interdisciplinary perspectives, including recent attempts to develop “neural network” computers which strive to be models of how both the mind and the brain compute. Prerequisite (recommended): Calculus I.
Smolensky 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, Badecker 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 electrophysiological 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. Cross-listed with Neuroscience.
Rapp 3 credits

050.205 (N,S,H) The Structure of English

Our knowledge of English has a complex and yet regular structure in all major linguistic domains: word-formation (morphology), sound structure (phonology), and structure of phrases (syntax). For instance, we form words from other words with prefixes and suffixes as in *in+accurate* and *parent+al*. We also regularly adjust sounds depending on their context, so that we pronounce the final *s* of *cat+s* differently than the one of *dog+s* and the first vowel of *natur-al* differently than the one of *nature*. When forming sentences, we know for example, that the “him” in “John bought the book for him” is not John, while the one in “John brought the book with him” is John. This course uncovers some of the principles that make up our knowledge of English, also looking into its history and some of its regional dialects. No prerequisites.
Burzio 3 credits

050.208 (H,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 3 credits

050.227 (N,S,H) Topics in the History of the Romance Languages*(also 050.637/upper-level)*

The major Romance languages—French, Spanish, Italian, and Portuguese—are only a few of the myriad of local languages, all descendants of Latin, that the collapse of the Roman Empire gave rise to. This course explores the major changes both in sound structure and in general grammatical organization that marked the transition between Latin and the Romance languages, and their different territorial distributions. The general perspective is that of contemporary linguistic theory. Hence, some familiarity with linguistic concepts will be helpful, but no specific theoretical background is required. No prerequisites. Cross-listed with Romance Languages and Literatures.

Burzio, Legendre 3 credits

050.240 (H,N,S) The World of Language

This course exposes students to the fascinating variety—and uniformity—to be found among the world's languages. Students discuss languages whose sound systems include clicks or tones, sign languages, languages with words that grow to the size of entire sentences, and reconstructed ancient languages that have given rise to huge families of modern languages. They will examine a range of fundamental questions such as: Is knowledge of language encoded in the genes? Is it unique to mankind? How do new languages emerge from the contact of two very different languages? How did English change over time? Are all languages related? No prerequisites.

Legendre 3 credits

Intermediate and Advanced Courses**050.306 Laboratory in Cognitive Neuropsychology**

Intended for students with a solid background in theory and research about human cognition. This lab provides the opportunity to participate actively in the examination of the impaired performance of a small number of brain-damaged individuals. Students read relevant research literature, develop tasks to probe the nature of the deficits, assist in the administration of tasks to brain-damaged subjects, conduct analyses of data, and assess the implications of results for theories of normal cognition. Prerequisites: 050.105 and either 050.311 or 050.333 or permission of instructor.

McCloskey, Rapp 3 credits

050.311 (N,S,W) Written Language: Normal Processing and Disorders

This course surveys both the historical development of written language and current cognitive theories that account for the manner in which the written language is represented and processed by “readers/ writers” of a language. Issues regarding the relationship between the written and the spoken language, the acquisition of written language skills, and developmental and acquired disorders of reading and writing will be examined. Prerequisite: 050.101, 050.102, or 050.105 or permission of instructor. Cross-listed with Neuroscience.

Rapp 3 credits

050.314 (H,N,S) 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

When the visual areas of the brain are damaged or fail to develop normally, remarkable perceptual deficits may result (for example, inability to determine where objects are even though the objects can be seen clearly). This course explores a variety of visual deficits, focusing on what the deficits can tell us about normal visual perception. Topics include object recognition and visual agnosia, spatial perception and spatial deficits, and attention and visual neglect. Prerequisite: either 050.101 or 050.105. 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.

Burzio 3 credits

050.317 (N,S) Semantics I*(also 050.617/upper-level)*

This course is an introduction to the formal semantics of natural language. We address both the conceptual and empirical issues that a semantic theory must grapple with, as well as some of the logical machinery that has been developed to deal with such problems. After discussing some foundational questions, analyses are built up for central phenomena including patterns of inference, quantification, scope ambiguities, anaphoric dependence, and tense and modality.

Frank 3 credits

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. Prerequisite: 050.102, 050.240, and 050.427, permission required.

Frank, 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.

Frank, Legendre 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.

Burzio, Smolensky 3 credits

050.326 (N,S,H,W) Foundations of Cognitive Science*(also 050.626/upper-level)*

This course explores general issues and methodology 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 from 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, philosophy, or psychology.

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 linking phonology with both morphology and phonetics. Topics include the typology of stress systems; the role of Optimality Theory in reduplicative and non-reduplicative morphology, auto-segmental phonology, and feature geometry. Prerequisite 050.325 or permission.

Burzio, Smolensky 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. Prerequisite: 050.326/626, 050.327/627 highly recommended.

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 natural language processing. Topics include the recognition and production of words, the planning and production of sentences, and how listeners understand spoken sentences. The types of evidence examined include speech errors, the analysis of acquired language impairments, eye-tracking and Event-Related Brain Potential (ERP) measurements, and various measures of lexical access and relative processing complexity that can be exploited to reveal how the brain represents and processes language.

Badecker 3 credits

050.334 (N,S,Q) 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.

Frank 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 (H,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. Prerequisite: Limit 20 juniors and seniors only—others by permission. Majors in Cognitive Science, Psychology and Philosophy, welcome but course is open to all majors. Cross-listed with Psychological and Brain Sciences.

Landau 3 credits

050.362 (N,S) Field Method Linguistics

Linguistic fieldwork has a long and venerable tradition in the field of linguistics. It has made it possible for linguists to analyze many of the 5,000 languages of the world, revealing the extent of variation among the languages, and propose theories of what a possible human language is like. In this course, students will construct their own description of a language from scratch, through direct elicitations from a native-speaker consultant. The language chosen by the instructor will most likely be a non-Indo-European language.

Legendre 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 3 credits

050.370 (N,S,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.

Frank 3 credits

050.371 (N,S,Q) Formal Methods in Cognitive Science: Inference*(also 050.671/upper-level)*

This course introduces a variety of techniques for modeling human reasoning and induction. Possible topics include computational complexity, computability and Turing machines, with special focus on applications in the formal modeling of learning; propositional and predicate logic, as applied to natural language semantics, knowledge representation, and deductive inference; probability theory and statistical inference; statistical learning theory; information theory; Bayesian networks. No prerequisites.

Frank, Smolensky 3 credits

050.372 (N,S) 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. No prerequisites.

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/Sophomore
- 050.507 Research in Cognitive Science/Sophomore
- 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/Sophomore
- 050.508 Research in Cognitive Science/Sophomore
- 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

050.612 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)
Burzio 3 hours

050.617 Semantics I

(co-taught with 050.317, see description)
Frank 3 hours

050.620 Syntax I

(co-taught with 050.320, see description)
Frank, Legendre 3 hours

050.621 Syntax II

(co-taught with 050.321, see description)
Frank, Legendre 3 hours

050.625 Phonology I

(co-taught with 050.325, see description)
Burzio, Smolensky 3 hours

050.626 (W) 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)
Burzio, Smolensky 3 hours

050.629 Advanced Phonological Analysis

(co-taught with 050.329, see description)
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.
Badecker 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)
Badecker 3 hours

050.634 Computational Models of Cognition

(co-taught with 050.334, see description)
Frank 3 hours

050.637 Topics in the History of the Romance**Languages**

(co-taught with 050.227, see description)

Cross-listed with German and Romance Languages and Literatures.

Burzio, Legendre 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

050.662 Linguistic Field Methods

(co-taught with 050.362, see description)

Legendre 3 hours

050.664 Advanced Topics in Cognitive**Neuropsychology**

(co-taught with 050.364, see description)

McCloskey 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 520.665 and/or 600.465 but is independent of either. 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 Electrical and Computer Engineering and Computer Science.

Jelinek

050.670 Formal Methods in Cognitive Science: Language

(co-taught with 050.370, see description)

Frank 3 hours

050.671 Formal Methods in Cognitive Science: Inference

(co-taught with 050.371, see description)

Frank, Smolensky 3 hours

050.672 Formal Methods in Cognitive Science: Neural Networks

(co-taught with 050.372, see description)

Smolensky 3 hours

050.680 Learning Theory

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.

Smolensky, Frank 2 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 individual 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 3 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 ongoing research.

Frank, Legendre 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.

Burzio, Smolensky 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.

Badecker, Burzio 2 hours

050.825 Research Seminar in Optimality Theory

This seminar will read selected chapters from the book, Smolensky & Legendre (2006), *The Harmonic Mind: From Neural Computation to Optimality*, Vol. 1, *Theoretic Grammar*.

Burzio, Legendre, Smolensky 2 hours

050.826 Research Seminar in Formal Approaches to Cognitive Science

Topics range from mathematical analysis of neural networks to computational studies of linguistic structure. Focus is on ongoing research and current literature.

Frank, Smolensky 2 hours

050.827 Research Seminar in Language Acquisition

Focus is on current research in acquisition of syntax. Prerequisite 050.620.

Legendre 2 hours

050.830 Topics in Cognitive Science

Staff 2 hours

050.832 Research in Language Processing

Current topics in human language processing, with discussion of recent developments in theory and experimental study.

Badecker 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.

Badecker, Smolensky 2 hours

050.839 Research in Cognitive Science

Staff 2 hours

050.849 Teaching Practicum

Staff 2 hours

050.850 Departmental Reading Course

(Offered on non-Colloquium Thursdays)

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 the basic Earth sciences: in geology, the science of the solid Earth; in geochemistry, devoted to understanding the chemistry of the solid Earth, natural waters and the chemistry of the mineral-water interface in geophysics, concerned with a quantitative description of physical processes in the Earth and planetary sciences; in physical oceanography, the study of ocean currents and waves, and their role in climate; in atmospheric sciences, particularly the dynamics of atmospheric circulation both on Earth and the outer planets and their satellites; and in geobiology and evolutionary biology, the study of the relationships between organisms and their environment today and in the geologic past.

The department's primary goals are basic research and the training of scholars who will contribute to the future of these disciplines. The programs emphasize basic principles and concepts rather than applied aspects.

The flexible undergraduate program lets the student, in consultation with a faculty adviser, devise a program that is challenging, individual, and rigorous. The graduate program develops skill 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 Faculty

Clinton Conrad, Assistant Professor: solid earth geophysics.

John M. Ferry, Professor: metamorphic geology.

Thomas W. N. Haine, Professor: physical oceanography.

Lawrence A. Hardie, Professor: geology (geochemistry and sedimentation).

A. Hope Jahren, Professor: stable isotope geochemistry, paleoclimatology, and geobiology.

Bruce D. Marsh, Professor: igneous petrology and geophysics.

Peter L. Olson, Professor: geophysical fluid dynamics.

Thomas R. Osborn, Professor: physical oceanography.

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.

Other Faculty

Albert Arking, Principal Research Scientist: atmospheric sciences.

Linda Hinnov, Associate Research Professor: quantitative stratigraphy and paleoclimatology

Sakiko Olsen, Senior Lecturer: metamorphic petrology.

Katalin Szlavetz, Associate Research Professor: soil ecology.

Joint Appointments

Robert A. Dalrymple, Professor, Civil Engineering.

Kevin J. Hemker, Professor, Mechanical Engineering.

Emeritus Appointments

George W. Fisher, Professor Emeritus: global earth systems and religious ethics.

Owen M. Phillips, Professor Emeritus: geophysics (fluid mechanics and oceanography).

Facilities

The Department of Earth and Planetary Sciences is housed in Olin Building, 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 Academic Computing Center. In addition, 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 and in the environmental earth sciences. In addition, the department offers students planning careers in the health professions a major consistent with those interests.

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. It is also possible to take additional courses in the Advanced Academic Program in environmental sciences and policy.

Undergraduates are strongly encouraged to become involved in research with the faculty. Such research may be taken for credit, and may lead to

the completion of a senior thesis. We also offer help and advice to majors seeking internship opportunities in the Earth and planetary and environmental earth sciences. Advice for those who wish to become involved in research can be obtained from the coordinator for undergraduate programs. Students who major in this department often attend graduate or professional school, and go on to careers in academic institutions, natural resource-oriented industries, or government agencies.

Requirements for the B.A. Degree

Undergraduates majoring in the department must satisfy the general university requirements for the B.A. degree (see General Requirements for Departmental Majors, page 47). In addition, students are required to take the following courses:

Required courses outside the Department of Earth and Planetary Sciences

030.101 Introductory Chemistry (4)

and either

110.106-107 Calculus I and II for the biological and social sciences (8)

or

110.108-109 Calculus I and II for the physical sciences and engineering (84)

and either

171.101-102 General Physics for physical science majors (84)

or

171.103-104 General Physics for biological science majors (8)

Note: Additional requirements are listed under the detailed descriptions of the majors, depending on the specific area of interest of the student.

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 (3) (E,Q)

500.211 Technical Communication (3) (H,S,W)

500.212 Effective Oral Presentations (3) (H,W)

550.291 Linear Algebra and Differential Equations (4) or an equivalent course

570.108 Environmental Engineering (3) (E)

570.109 Environment and Society: Toward Sustainability (3) (E,N)

570.239 Current and Emerging Environmental Issues (3)

570.303 The Environment and Your Health (3) (E)

- 600.107 Intro to Programming in Java (3) (E)
 600.109 Intro to Programming in C/C++ (3) (E)

Honors in Your 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.

Earth and Planetary Sciences Major

In addition to the requirements listed above, the student can design a specific plan of appropriate courses in consultation with the coordinator for undergraduate programs in the department. The department requires a total of 9 credits at the 100- or 200-levels and a total of 12 credits at the 300-level. Courses should be selected to reflect an Earth and Planetary Sciences emphasis and should include the following:

- 270.104 Oceans and Atmospheres
 270.220 Dynamic Earth
 270.221 Dynamic Earth Laboratory

Environmental Earth Sciences Major

This major is for undergraduates interested in a thorough study of the processes that shape Earth's environment, drawing on the disciplines of geology, geochemistry, hydrology, ecology, geobiology, oceanography, and atmospheric science.

In addition to the requirements listed above, the student can design a specific plan of appropriate courses in consultation with the coordinator

for undergraduate programs in the department. The department requires a total of 9 credits at the 100- or 200-levels and a total of 12 credits at the 300-level. Courses should be selected to reflect an environmental Earth sciences emphasis and should include the following:

- 270.103 Our Changing Planet
 270.104 Oceans and Atmospheres

Relevant courses from outside the department can count toward the department required credits. Possible courses include:

- 570.303 The Environment and Your Health
 420.614 Environmental Policymaking and Policy Analysis
 420.633 Geographic Information Systems (GIS)

Minor in Environmental Earth Sciences

The Environmental Earth Sciences minor (EPS) 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.

Minor in Environmental Studies

This minor is for international studies majors and other social science or humanities majors who wish a general introduction to the disciplines that are concerned with Earth's environment. Students will take 12 credits in the department, at least six of which are at the 300-level.

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 advisers, 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 adviser 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.

Sedimentology

The teaching and research program in sedimentology is dedicated to seeking fundamental principles of deposition and diagenesis of carbonate, siliciclastic, and chemical sediments and sedimentary rocks. The field is where geologic questions are defined and where they ultimately must be answered. Ours is a field and petrography-oriented program in the tradition established by Francis Pettijohn, but thermodynamics, fluid dynamics, computer modeling, chemical and isotopic analysis, and experimental work are basic tools. We rely heavily on comparative sedimentology principles

established through studies of modern depositional environments.

Students have always been encouraged to develop and follow their own research interests, and the result is a wide pool of ideas and a wide range of thesis projects. The sedimentology student group normally ranges from three to five doctoral candidates in residence at any one time. There is no master's program. The main menu of sedimentology courses offered consists of Sedimentary Environments, Carbonate Rock Environments, Diagenesis Seminar, and Stratigraphy Seminar, all of which are given by Professor Hardie and involve field trips to the wide spectrum of sedimentary rocks exposed in the nearby Appalachians. Supporting courses in paleontology are offered by Professor Stanley; in thermodynamics and aqueous geochemistry by Professor Sverjensky and Professor Alan Stone, of the Department of Geography and Environmental Engineering (DOGEE); in hydrology by Professor Garven; in geomorphology by Professor M. Gordon Wolman, of DOGEE; and in sediment transport and hydraulics by Professor Peter R. Wilcock, also of DOGEE. Emphasis is placed on acquisition of additional skills in a field outside of traditional sedimentology but fundamental to its advance. For example, students interested in diagenesis must become facile in thermodynamics, aqueous geochemistry, and hydrology.

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 solidus 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.

Molecular Surface 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-min-

eral-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.

Geobiology and Paleoclimatology

Research emphases within this discipline include soil ecology, soil formation, bihydrology, plant-soil-animal interactions, paleoecology, and paleoclimatology. 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. 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, Sedimentary Geochemistry, Evolution, Paleontology, Groundwater Geology, and a Field Course in Soil Formation. 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.

Paleobiology

The paleobiology program combines the concepts and methodologies of biology, paleontology, and sedimentology to study the processes that control the distribution and abundance of organisms and the direction and rate of evolutionary change. Methods of stable isotope geochemistry are used to investigate changes in the cycling of C, H, N, and O through Earth history. When biological principles are used to interpret fossil assemblages, the fossil record becomes a rich source of data for generating evolutionary hypotheses.

Students in paleobiology are encouraged to employ functional morphology, biometrics, and sedimentology to reconstruct the interactions within fossil communities and the shifting milieu of natural selection through geologic time. Study of communities and individual lineages is seen as

a tool for the analysis of larger patterns of speciation, diversification, and extinction.

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, macroevolution, stable isotope geochemistry, geobiology, and introductions to evolutionary biology.

Oceans and Atmospheres

The atmospheres and oceans program focuses on the study of fluid motions, wave phenomena, and transport in atmospheres and oceans. 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.

Current research interests in dynamical oceanography include the structure of surface waves generated by winds and remote sensing of the sea surface, understanding internal gravity waves and turbulence in stably stratified fluids, and turbulent boundary layers. Thorough attention is given to different aspects of air-sea interaction processes, in particular problems such as gas transfer between ocean and atmosphere, wave breaking, wave-turbulence interactions, and mixing processes in the upper ocean and atmospheric boundary layers.

Research in physical oceanography addresses the processes that maintain the global ocean circulation and the oceans' role in climate. 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.

Research in atmospheric dynamics focuses on large-scale dynamics, the transport of trace con-

stituents, 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 include study of the global climate system and its response to radiative forcing due to changes in greenhouse 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.

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.

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, Conrad, 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) Our Changing Planet

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 includ-

ing weathering, erosion, sedimentation, and the record of climate change. No prerequisites.

Olson, Szlavecz 3 credits

270.104 (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

270.105 Natural Disasters

Introductory study of how natural events interact with human activities to create hazards for society. Case studies include earthquakes, volcanic eruptions, landslides, tsunamis, tornados, hurricanes, bolide impacts, and climate change. We will discuss the natural processes that lead to natural disasters, as well as the implications for society.

Conrad, Waugh 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

270.108 (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

270.109 (N) Exploring Earth's History Through Fossils

This freshman seminar seeks to expose students to the most timely and exciting issues of paleontology, as well as to field geology. We will learn the sequence of the early land plant evolution, and see examples of how this information was obtained from rock records. We will also study maps and geological descriptions related to the field trip site, and prepare for and perform a one-week field trip (usually in early December). Must be declared EPS major or have strong interest in becoming an EPS major to take this course.

Jahren 2 credits

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

270.120 (N) The Extinction of the Dinosaurs

A study of current and past theories concerning what caused the extinction of the dinosaurs; emphasis placed on potential linkages between climate change and extinction. Open to all JHU students; no prerequisites; limit 100; high school math, chemistry, and physics strongly recommended.

Jahren 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 co-requisites: 030.101 or 171.101-102; 270.221 is co-requisite 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. Co-requisite: 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

270.231 (N) The Ecology of a Changing Planet

Large-scale ecological patterns will be the primary focus of this course. Major transitions for environments late in Earth's history will be discussed as a background for considering present and possible future influences on life of such human activities as deforestation, desertification, overfishing, pollution, emission of greenhouse gases, and introduction of species.

Szlavec 3 credits spring

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 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.

Conrad 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

270.306 (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) Combining Measurements with Models

An introduction to modern ways to interpret observations in the context of a conceptual model. Topics include model building, hypothesis testing, and inverse meth-

ods. 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.

Szlavec 3 credits fall

270.311/611 (N) Geobiology

Dynamic processes that transfer elements across the biosphere/geosphere interface, with special emphasis on terrestrial ecosystems. We focus upon soils as a cycling reservoir of water, nitrogen, carbon, and other important Earth elements; and we focus upon plants as the living link between the terrestrial hydrosphere, geosphere, and the atmosphere. Field trips included.

Jahren 3 credits

270.314/619 (N) Field Course in Soil Formation

This course includes both the basics of the chemistry and physics of soil processes, as well as beginning and advanced practice in soil characterization and field analysis. The field route includes select examples of each of the nine soil orders found in the United States. Each soil sampled along the route will be characterized for texture, structure, color, pH, and horizonation and classified according to standard pedologic procedure. In addition, we will analyze each site extensively in terms of its climatic, geologic, and vegetative context.

Jahren 6 credits summer

270.315 (N) Principles of 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

270.327 (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.

Szlavec 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 Environments

Introduction to sedimentary processes and petrology of sedimentary rocks. Origin of siliciclastic, carbonate, and chemical deposits with emphasis on depositional models and facies complexes. Weekend field trips. Prerequisite: permission of instructor. Corequisite: 270.351. Minimum enrollment: 5.

Hardie 3 credits spring

270.351 (N) Sedimentary Rocks Laboratory

Laboratory work in petrology of sedimentary rocks. Corequisite: 270.350.

Hardie 1.5 credits 3 hours lab

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 fall/odd years

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 Climates of the Past

An overview of Earth's climatic components, global climate regimes, climate variability, the climate-sensitive Earth archives, paleoclimate through geologic time, episodes of extremes, and models of paleoclimate change. For upper-level and beginning graduate students. Prerequisite: 270.115 or 270.120 or instructor's permission.

Hinnov 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 adviser on those topics not specifically listed in the form of regular courses.

270.401 (N) Introduction to Physical Oceanography

This course is designed for first-year graduate students in oceanography, graduate students in engineering disciplines that will involve ocean processes (Civil, Environmental and Mechanical Engineering departments), and advanced undergraduates who want to understand the application of their knowledge of physics and mathematics to the ocean. This first semester of the sequence is an introduction to a wide range of oceanic phenomena. Prerequisites: Students are to be knowledgeable about partial differential equations.

Haine 3 credits

270.402 (N) Introduction to Dynamical Oceanography

This course is designed for first-year graduate students in oceanography, graduate students in engineering disciplines that will involve ocean processes (Civil, Environmental, and Mechanical Engineering departments), and advanced undergraduates who want to understand the application of their knowledge of physics and mathemat-

ics to the ocean. This second semester is designed to cover the dynamics of the processes that are relevant for coastal and open ocean dynamics. Prerequisites: 270.401.

Haine 3 credits

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 physico-chemical 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 extraction 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/Olson 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 adviser on those topics not specifically listed in the form of regular courses.

270.507-508 Internship**Cross-Listed****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 achieve two cardinal goals: high stability and durability of materials, including natural and living tissues; and low resistance during deformation and treatment, independence from surrounding media and other environmental conditions. Prerequisites: 570.444 or general physics and chemistry.

Shchukin 3 credits fall

Graduate Courses

270.601 Fluids Seminar

Graduate discussion group ranging over all aspects of fluids in Earth and planetary sciences.

Haine 1 hour

270.602 Seminar in Environmental and Health Geosciences

An introduction to topics of current interest in the environmental and health geosciences. Prerequisite: Permission required.

Jahren, Sverjensky

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 Journal Club

A weekly seminar series in which graduate students present their latest research results. Each week, two students give presentations of 20 minutes each. Journal Club is required for all graduate students in the Department of Earth and Planetary Sciences.

Staff 1 hour

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 alternate springs

270.616 Mantle Convection and Plate Tectonics

A graduate seminar exploring the interaction between Earth's tectonic plates and mantle convection. We examine the plate tectonic revolution, the fluid dynamics of mantle flow, the forces that drive plate motions, the rheological requirements for plate tectonics and the ramifications of plate tectonics for the mantle and Earth's surface environment.

Conrad 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

270.624 Seminar in Stable Isotope Techniques

This laboratory course will compare the new automated preparation systems attached to the Isoprime mass spectrometer with more traditional off-line vacuum apparatus, on the basis of ease/rapidity of analysis, sensitivity, precision, and flexibility. We will focus on the stable isotopes of C in organic matter (modern and fossil) and D/H and O in water.

Jahren 2 hours

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

270.636 Stable Isotope Biogeochemistry

Theory and measurement of stable isotopes are discussed, with relevant emphasis on instrumentation. The record of stable isotope measurements of carbon, oxygen, and hydrogen are examined in detail, with special emphasis upon the breadth of applications across geology, biology, archaeology, biogeochemical cycling, and global climate reconstruction.

Jahren 3 hours

270.640 Computer Geoscience

Investigation of computational methods (e.g., finite element, finite difference, spectral) and computing techniques (e.g., visualization, parallel computing) that are used to solve complex and computationally-intensive problems in the geosciences. Laboratory exercises will provide some practical experience.

Conrad 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 key dynamic and thermodynamic processes causing climate fluctuations on timescales of seasons to decades. The focus is on phenomena that involve the ocean and topics will cover, depending on the class's interest, ocean circulation theories, large-scale ocean waves and eddies, thermohaline circulation, air/sea interaction, and modes of climate variability. Geophysical understanding and the links to fundamental mechanisms are emphasized.

Haine 2 hours

270.646 Geophysical Fluid Dynamics

A first course in the mechanics of Earth and planets fluids systems. The focus is on fundamental fluid processes and their applications to phenomena occurring in the atmospheres, oceans, and interior of Earth and other planets.

Olson, Waugh 3 hours fall

270.647 Mechanics of the 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 Fluid Dynamics of the Earth and Planets II

A sequel to 270.646 concentrating on planetary-scale atmospheric and oceanic circulation. Physical understanding of the underlying fluid dynamics will be emphasized.

Haine, Waugh 3 hours spring

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 Our Changing Planet
 270.104 Oceans and Atmospheres
 270.108 History of Earth and Its Biota
 270.109 Exploring Earth's History Through Fossils
 270.114 A Guided Tour of the Planets
 270.120 The Extinction of the Dinosaurs
 270.220 The Dynamic Earth: An Introduction to Geology
 270.221 The Dynamic Earth Laboratory
 270.222 Earth Materials
 270.231 Ecology of a Changing Planet

General

270.307 Combining Measurements with Models
 270.308 Population and Community Ecology
 270.315 Principles of 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 Mechanics of the 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
 270.636 Stable Isotope Biogeochemistry
 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 Combining Measurements with Models
 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
270.311 Geobiology
270.314/619 Field Course in Soil Formation
270.332 Soil Ecology
270.377 Climates of the Past
270.624 Seminar in Stable Isotope Techniques
270.636 Stable Isotope Biogeochemistry

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
270.351 Sedimentary Rocks Laboratory

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 452).

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 specialized professional paths relating to China, Japan, and Korea, including but not limited to advanced academic research. Under the supervision of an adviser drawn from the Committee on East Asian Studies, students create an individualized program of study.

The Committee on East Asian Studies

William T. Rowe, Director of East Asian Studies,
Professor (History): history of East Asia.

Joel Andreas, Assistant Professor (Sociology):
sociology of China.

Erin Chung, Assistant Professor (Political Science):
politics of Japan.

Marta Hanson, Assistant Professor (History of
Medicine): history of Chinese medicine.

Tobie Meyer-Fong, Associate Professor (History):
history of East Asia.

Kellee Tsai, Professor (Political Science): politics of
China.

Associated Faculty

Li-chuang Chi, Lecturer (Language Teaching
Center): Chinese.

Liping Feng, Lecturer (Language Teaching
Center): Chinese, Chinese literature.

Rebecca Hsieh, Lecturer (Language Teaching
Center): Chinese.

Choonwon Kang, Lecturer (Language Teaching
Center): Korean.

Bavo Lievens, Visiting Lecturer (History):
Buddhism, Chinese thought.

Liman Lievens, Lecturer (Language Teaching
Center): Chinese.

Makiko Nakao, Lecturer (Language Teaching
Center): Japanese.

Sharlyn Moon Rhee, Visiting Lecturer (Humanities
Center): Korean literature.

Kazue Y. Zon, Lecturer (Language Teaching
Center): Japanese.

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 47.) 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. Language competency acquired prior to enrollment at Hopkins will not satisfy this requirement.
- Complete eight other East Asian Studies courses under a program of study worked out with his/her academic adviser. Two of these eight may be made up of additional language courses (beyond the required six semesters) or of “comparative” courses with a significant East Asian component, as approved by the director of East Asian Studies. At least one of the eight courses must be an introductory history course chosen from among the following:

100.131 History of East Asia
100.208 China: Neolithic to Song
100.347 Early Modern China
100.348 Twentieth-Century China

All courses required for the major must be passed with a grade of C- or higher; none may be taken satisfactory/unsatisfactory.

Courses

Language

373.115-116 Beginning Chinese
Feng, Hsieh 4.5 credits

373.215-216 (H) Intermediate Chinese
Lievens 4.5 credits

373.315-316 (H) Upper Intermediate Chinese
Chi, Hsieh 3.5 credits

373.415-416 (H) Advanced Chinese
Chi 3 credits

373.422 (H) Literary (Classical) Chinese
Feng 2 credits

378.115-116 Beginning Japanese
Zon 4.5 credits

378.215-216 (H) Intermediate Japanese
Kato 4.5 credits

378.311-312 (H) Japanese Conversation

Nakao 2.5 credits

378.315-316 (H) Upper Intermediate Japanese

Kato 3.5 credits

378.415-416 (H) Advanced Japanese

Zon 3.5 credits

380.101-102 (H) Elements of Korean

Kang 3 credits

380.201-202 (H) Intermediate Korean for Reading and Writing

Kang 3 credits

380.301-302 (H) Advanced Korean

Kang 3 credits

East Asian Studies**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 Seminar

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

100.434 (H,S,W) Women in Modern Chinese History

Meyer-Fong 3 credits

100.470 (H,S) Monuments and Memory in Asian History

Meyer-Fong 3 credits

100.477 (H,S,W) Seventeenth-Century China

Meyer-Fong 3 credits

100.478 (H,S) Chinese Agrarian History

Rowe 3 credits

100.479 (H,S,W) Chinese Urban History

Rowe 3 credits

100.482 (H,S,W) 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

190.336 (S,W) Chinese Foreign Policy

Tsai 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) Revolution, Reform, and Social Inequality in China

Andreas 3 credits

300.332 (H) Korean-American Fiction

Rhee 3 credits

373.303 (H) Chinese Calligraphy

Hsieh 3 credits

373.307 (H) Traditional Chinese Short Stories in Translation

Feng 3 credits

373.310 (H,W) Stories from Hong Kong and Taiwan in Translation

Feng 3 credits

380.310 (H) Pre-Modern Korean Literature in Translation

Rhee 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 entire faculty and student body participate in a regular general seminar.

The Faculty

Laurence M. Ball, Professor: macroeconomics.

Christopher Carroll, Professor: macroeconomics.

Carl F. Christ, Professor Emeritus: macroeconomics, econometrics.

Jon Faust, Professor: econometrics, macroeconomics, financial economics.

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, Assistant Professor: econometrics, applied microeconomics.

Edi Karni, Professor: economics of uncertainty and information, microeconomic theory, decision theory.

M. Ali Khan, Abram G. Hutzler Professor: mathematical economics, microeconomic theory, intellectual history.

Louis J. Maccini, Professor: macroeconomics, econometrics.

Robert A. Moffitt, Krieger-Eisenhower Professor: labor economics, econometrics, public finance, population economics.

Stephen H. Shore, Assistant Professor: labor economics, applied econometrics, financial economics.

Matthew Shou-Chung Shum, Associate Professor: industrial organization, applied econometrics.

Tiemen Woutersen, Assistant Professor: econometrics, labor economics, financial economics.

H. Peyton Young, Scott and Barbara Black Professor: game theory, evolutionary economics, microeconomic theory.

Research Faculty

Caroline Fohlin, Research Professor: financial economics, economic history.

Lecturers

Barbara Morgan, Senior Lecturer: economics of discrimination, comparative economic systems.

Joint Appointments

Burton Barnow, Adjunct Professor (Institute for Policy Studies): labor economics, public finance.

David Bishai, Associate Professor (Bloomberg School of Public Health): health economics.

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.

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, co-requisites), as well as Elements of Economics and Calculus. 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 47.)

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 Inter-session 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 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 Inter-session 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.

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 2007–2008 academic year, full stipends or assistantships will carry an award of approximately \$14,000 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 in 2007–2008 will pay an annual stipend of \$16,000 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 \$19,000 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 2007–2008 and 2008–2009. 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). Prerequisite: 180.102.

Young 3 credits

108.218 (S) Economics in/of the 18th Century

This seminar traces the extent to which theory, particularly as it pertains to exchange and trade and to economic development, is grounded in and responds to 18th-century texts. The interdisciplinary nature of the writing and its implications for epistemological questions in economics are emphasized. Students in the humanities and social sciences are welcome. Prerequisites: 180.101-102 or permission of instructor.

Khan 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

180.231 (S) Comparative Economic Systems

An examination of the important features of different economic systems, including the nature of pre-modern economies, the evolution of laissez-faire economy, planned economies, and several variants of advanced market economies existing today. Prerequisite: 180.101-102.

Morgan 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.

Staff 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 inflation. 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.

C. Fohlin 3 credits

180.280 (S) Population Economics

This course includes the historical background of demographic trends and their economic manifestations; their relationship to the labor force, consumption, productivity and technical change, and to the demand for health, education, and housing; the accumulation of human capital; living standards and the quality of life; population planning. Prerequisites: 180.101-102.

Staff 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 (can be taken concurrently with 180.101-102) and Differential Calculus 110.106, or permission of instructor.

Staff 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

180.305 (S) Topics in Macroeconomics

This course covers selected issues such as inflation, monetary policy, government debt, and economic growth. There is a mix of theoretical and applied topics. Prerequisites: 180.301-302 or permission of instructor.

Ball 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, Levy 3 credits

180.311-312 (S) Introduction to Economics of Uncertainty and Information

In this course, we study economic phenomena that may be attributed to the existence of risk and imperfect information in the economy. Starting from the theory of individual decision making under uncertainty, we examine the role of insurance and financial markets in the allocation of risk, and the consequences of the failure of such markets in the presence of adverse selection and moral hazard. Market responses to the existence of asymmetric information are illustrated and analyzed. Prerequisite: 180.301.

Karni 3 credits

180.314 (S,Q) Mathematical Economics

This course traces the extent to which modern economic theory, particularly as it pertains to the allocation of resources over time in multi-agent societies, is grounded in the language of mathematics. This course will explore how notions of existence, cardinality, stability, and optimality of equilibria are formalized through the use of basic conceptual vocabulary of calculus, analysis and point-set, and differential topology. Special attention will be paid to the formal mathematical expression of economic ideas and the ability to give a loose economic intuition a coherent logical meaning. In terms of specific topics within economics, the course will revolve around the canonical model of normal form games associated with Cournot-Nash-Harsanyi, the Arrow-Debreau-McKenzie model of general economic equilibrium, the von-Neumann growth model, the Allais-Samuelson overlapping generations model, and the basic recursive model of dynamic economics associated with Lucas-Prescott. Prerequisite: 180.301.

Khan 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.

Staff 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

180.351 (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.

Barnow 3 credits

180.365 (S) Public Finance

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.

Carroll 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.

Staff

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

180.371 (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.

Harrington 3 credits

180.375 (S) Economics of Electronic Commerce

This course examines how online markets function with a focus on competition, market dynamics, and the role of technology. The format will be a blend of lecture and general discussion. Open to economics majors ONLY. Prerequisites: 180.301 and 180.315.

Harrington 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 adviser, and develop a thesis topic and research plan for the thesis itself. By the end of fall semester the student and adviser 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 adviser, depending upon the topic). (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 adviser, 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 adviser 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. Prerequisites: 180.301-302 or equivalent and Differential Calculus 110.106 or permission of instructor.

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. Prerequisites: 180.301-302 or permission of instructor.

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, Maccini, Carroll 2 hours

180.611-612 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 mathematical theory of general static equilibrium. The course will emphasize the formal mathematical expression of economic ideas and the ability to give a loose economic intuition a coherent logical meaning. Different mathematical structures in general equilibrium theory are isolated and discussed. Prerequisites: 180.601-602 or permission of instructor.

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.

Staff 2 hours

180.617 Topics in Mathematical Economics

The subject matter of this course will vary from year to year, according to the interests of the instructor. Such topics as convex analysis, functional equations, and non-convex global optimization may be studied. Prerequisite: permission of instructor.

Khan, Karni 2 hours

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.

Staff 2 hours

180.619 Evolutionary Economics

Neoclassical economics stresses the rationality of economic agents and the equilibrium that results when rational agents pursue their self-interest. Evolutionary economics, by contrast, stresses the complex, organic, and somewhat unpredictable nature of economic change. Instead of relying on mechanical paradigms like equilibrium, it borrows its metaphors from biology: growth, mutation, and adaptation are the central focus of attention. This course focuses on four topics: the emergence of social norms, evolutionary models of industrial competition, the adoption of industry standards, and models of learning. The course will cover the necessary concepts in stochastic dynamical systems theory. Prerequisite: graduate-level knowledge of game theory and mathematical methods.

Young 2 hours

180.622 Political Economy

This course will discuss topics in political economy.

Staff 2 hours

180.627 Economic Development

A review of experience in less-developed countries (LDCs) since 1945, theories of development, economic planning in the LDC context, and models of the development process. Corequisites: 180.601, 180.603.

Khan 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.

Staff 3 hours

180.633-634 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.

Staff 2 hours

180.635 Advanced Econometrics

Estimation and inference within the context of a system of nonlinear parametric simultaneous equations. The large sample properties of many useful econometric estimators are investigated within the framework of a general theory of estimation. Prerequisite: 180.634 or permission of instructor.

Staff 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.

Staff 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.

Staff 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.

Staff 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

180.661 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

180.665-666 Public Finance

First term: A theoretical and empirical analysis of the economics of the public sector. Particular topics include criteria for an optimal tax base, consequences of existing tax structures, public-expenditure criteria, an introduction to the theory of public goods, problems of fiscal federalism. Attention is also given to specific current policy issues. Second term: A seminar on research topics in public finance. Prerequisites: 180.601 and 180.603 or permission of instructor.

Staff 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 2 hours

180.694 Applied Microeconomics Seminar

Staff 2 hours

180.695 Microeconomics Workshop

Staff 2 hours

180.696 Macroeconomics Workshop

Staff 2 hours

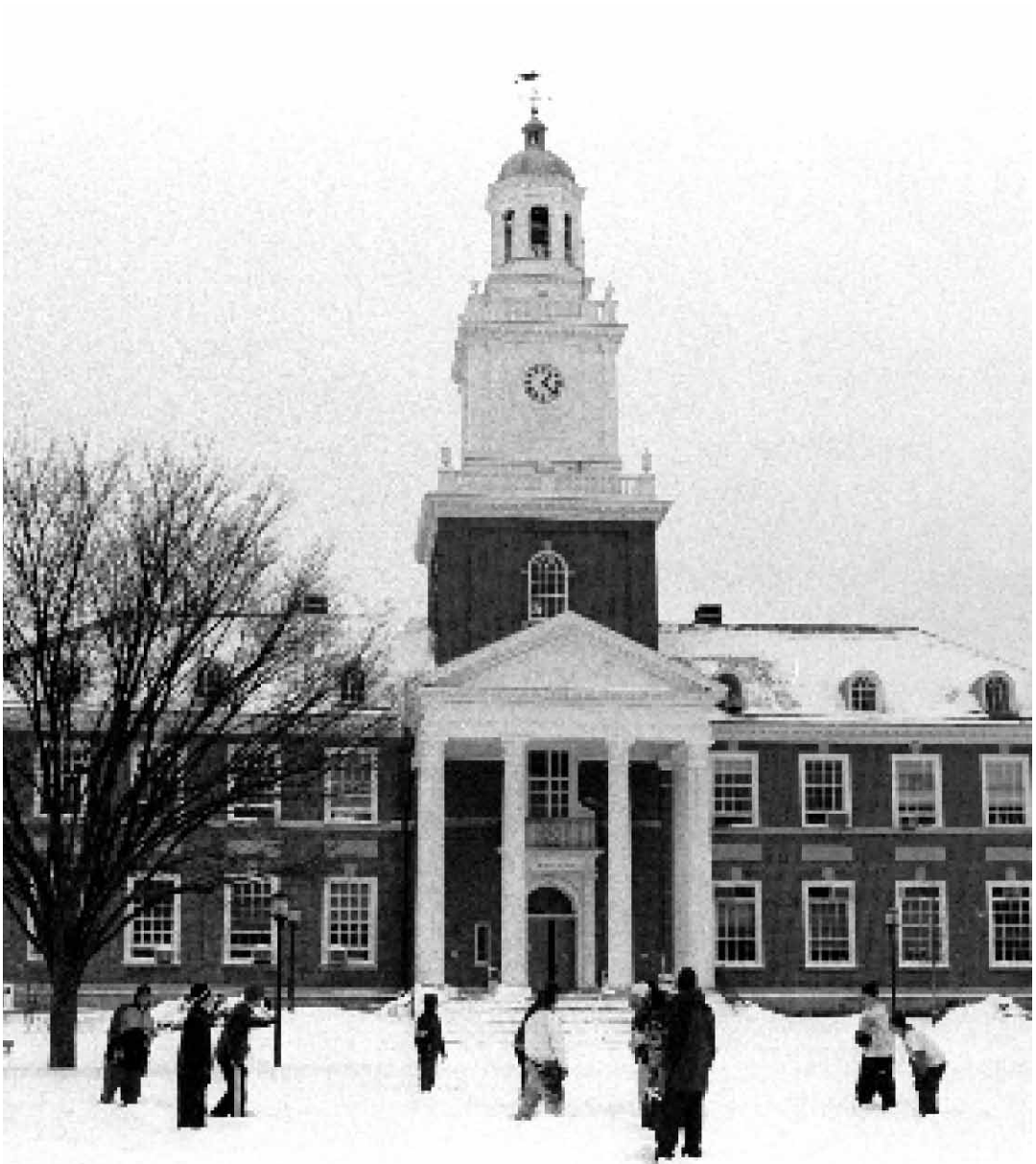
180.697 Trade and Development Workshop

Staff 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 adviser. The faculty member or adviser 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 adviser 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 undergraduate 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 (Chair): 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.

Simon During, Professor: cultural/media studies, postcolonialism, 18th- and 19th-century literature.

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, Professor: Renaissance literature, Shakespeare, science and literature, critical theory.

Douglas Mao, Professor: British, Irish, and U.S. poetry and fiction since 1860; interdisciplinary study of modernism.

Ronald Paulson, William D. and Robin Mayer Professor Emeritus of the Humanities: 17th- and 18th-century literature and Romanticism.

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.

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. The Study of Literature series 060.101-104 includes introductory courses dealing historically with selected works of English and American literature and with methods of literary study. These courses 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 47.)

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 100.103-104, or Political Science 190.101 or 280.
- One year of any classical language or modern spoken language at the intermediate level.
- Ten semester courses in the Department of English. These should consist of (a) three semester courses at the introductory level (ideally taken in the freshman and sophomore years), one of which must be Introduction to Literary Studies 060.107, (b) seven semester courses of advanced work (200- and 300-level generally) taken in the junior and senior years. 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.

- 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 adviser to suit their individual needs and satisfy departmental requirements. Students who have not yet been assigned to a major adviser 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.

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 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

The two Expository Writing courses (060.113-060.114) 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

060.101 (H) The Study of Literature

Selected authors from the Middle Ages to the 18th century. Staff 3 credits

060.103 (H) The Study of Literature

Selected authors from the 19th century to the present. Staff 3 credits

060.104 (H) The Study of American Literature

Selected authors in American literature. Cameron, Ziff 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

060.123 (H,W) The Bible as Literature

Staff 3 credits

060.151-152 (H) Shakespeare

Halpern 3 credits

060.176 (H,W) Russian Novel

Cameron 3 credits

060.201 (H) The 19th-Century British Novel

Anderson 3 credits

060.206 (H) Major American Authors

Cameron 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,W) Introduction to Literary Research

Staff 3 credits

060.222 (H,W) Introduction to Women's Studies

Staff 3 credits

060.256 (H,W) Postwar British Literature

During 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

060.307 (H,W) Training in Writing Consultation

Limit: 15

Staff 1 credit

060.315 (H,W) 17th-Century Literature

Halpern 3 credits

060.316 (H,W) Milton

Staff 3 credits

060.319 (H,W) Age of Dryden

Staff 3 credits

060.323 (H,W) British Literature and the French Revolution

During 3 credits

060.336 (H,W) Victorian Literature

Staff 3 credits

060.343 (H,W) Jane Austen and Charlotte Brontë

Anderson 3 credits

060.345 (H,W) Romantic Writing

Ferguson 3 credits

060.349 (H,W) Literature and Empire

During 3 credits

060.352 (H,W) Whitman, Frost, Stevens

Cameron 3 credits

060.357 (H,W) Victorian Poetry and Non-fiction Prose

Anderson 3 credits

060.359 (H,W) India and the Novel

During 3 credits

060.363 (H,W) Henry James

Cameron 3 credits

060.368 (H,W) The Bloomsbury Group

Mao 3 credits

060.370 (H,W) Literary Research Seminar

Staff 3 credits

060.371 (H,W) Literary Theory

Staff 3 credits

060.372 (H,W) Melville, Poe, Hawthorne

Cameron 3 credits

060.379 (H,W) The Postcolonial Novel

During 3 credits

060.394 (H,W) Literature and Magic

During 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

Graduate Courses**060.601-602 Victorian Literature**

Staff 3 hours

060.610 What Is Baroque?

Halpern 3 hours

060.611 Economics of Early Modern Theater

Halpern 3 hours

060.615 Shakespeare

Halpern 3 hours

060.617-618 Renaissance Proseminar

Staff 3 hours

060.629 Literature, Religion, and British Modernity
During 3 hours

060.630 Sterne, Johnson, and Burney: Literary Lives
During 3 hours

060.634 Richardson's *Clarissa*
Ferguson 3 hours

060.640 London—World City 1800
During 3 hours

060.641 Romantic Literature
Ferguson 3 hours

060.642 Theory and Practice of Education in the Late 18th and Early 19th Centuries
Ferguson 3 hours

060.645 Morals and Legislation in 18th and Early 19th Centuries
Ferguson 3 hours

060.646 History of Reading and Practical Criticism
Ferguson 3 hours

060.647 Realism, Romanticism, and Everyday Life
During 3 hours

060.648 George Eliot
Anderson 3 hours

060.649 Eliot, Trollope, Wilde
Anderson 3 hours

060.651 (W) Victorian Realism
Anderson 3 hours

060.652 Victorian Internationalism
Anderson 3 hours

060.655 Gender and Modernity
Anderson 3 hours

060.656 Joseph Conrad
During 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

060.678 Melville, Poe, Hawthorne
Cameron 3 hours

060.681 Literary Theory
Staff 3 hours

060.686 Cultural Criticism
During 3 hours

060.691 Modernism and the Place of Utopia
Mao 3 hours

060.711 Argument and Ethos
Anderson 3 hours

060.713 Readings in Psychoanalytic Theory
Halpern 3 hours

060.714 Psychoanalysis, the Rejection of Psychoanalysis, and Justice
Ferguson 3 hours

060.716 Marxist Aesthetics
Halpern 3 hours

060.721 Global Cultures
During 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 environmental earth sciences major (EPS) is for undergraduates interested in a thorough study of the processes that shape Earth's environment, drawing upon the disciplines of geology, geochemistry, hydrology, ecology, geobiology, oceanography, and atmospheric science.

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 environmental earth sciences minor (EPS) is for science undergraduates interested in applying their major discipline to Earth's environment through geology, geochemistry, hydrology, ecology, geobiology, oceanography, and atmospheric science.

The environmental studies minor (EPS) is for international studies majors and other social science or humanities majors who wish a general introduction to the disciplines that are concerned with Earth's environment and the availability of natural resources.

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.

Major in Environmental Earth Sciences and Minors in Environmental Sciences and Engineering and in Environmental Studies

Descriptions of the major and minor programs in environmental science and engineering 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 designed to foster critical understanding and historical knowledge of film and media forms, as well as their relationship to modern cultures, literatures, art, history, and philosophy. The program offers courses in film and media history, theory, and aesthetics, as well as film production and screenwriting. We also provide a central, unifying focus for film and media studies across the humanities at Hopkins, drawing on faculty from English, German and Romance Languages, History, History of Art, the Humanities Center, Philosophy, and the Writing Seminars, in addition to our own instructors.

Director

Simon During, Professor (English): media and the public sphere.

Associate Director

Linda DeLibero (Film and Media Studies): film history and criticism, American cinema.

The Faculty

Lucy Bucknell, Instructor: film genres, screenwriting, American film.

Eduardo González, Professor (German and Romance Languages and Literatures): Latin American cinema, Spanish cinema, film criticism.

John Irwin, Decker Professor in the Humanities (Writing Seminars): film and literature.

Mark Lapadula, Adjunct Instructor (The Writing Seminars): screenwriting.

Richard A. Macksey, Professor (Humanities Center, Writing Seminars, History of Science, Medicine, and Technology): film studies, critical theory.

John Mann, Professor (Film and Media Studies): film production, documentary film theory.

Mark Lapadula, Adjunct Instructor (The Writing Seminars): screenwriting.

Suzanne Roos, Adjunct Instructor (German and Romance Languages and Literatures): French cinema, cultural theory.

Karen Yasinsky, Adjunct Instructor: visual arts, animation, photography.

Visiting Faculty

Anne Eakin Moss, Visiting Assistant Professor (Humanities Center: Film and Media Studies): Soviet and Russian cinema.

Robert Roper, Visiting Associate Professor (Film and Media Studies): screenwriting.

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 47.)

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. Students also garner a strong background in the humanities and have ample opportunities to polish their skills in verbal, visual, and written expression.

Majors often participate in the projects of the Hopkins Film Society, including the planning and organization of the Hopkins Film Festival, and may 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.
- Two core courses: Introduction to the Study of Film (061.140) and Introduction to Visual Language (061.145).
- At least two of the following courses: Film Genres (061.244); Introduction to Theory (061.245); Special Topics in Film and Media (061.246).
- An area of emphasis comprised of three related courses outside the program.
- 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 six courses in film and media studies. These must include:

- One core course.
- One introductory production course.
- Four 300-level courses. These must be drawn from at least three different departments, and must include at least one course on a national cinema other than that of the United States.

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 the Study of Film

DeLibero 3 credits lab fee \$40

061.142 (H) Introduction to Film Production

Mann 3 credits lab fee \$100

061.145 (H) Introduction to Visual Language

Yasinsky 3 credits lab fee \$40

061.230 (H) Intermediate Film Production

Mann 3 credits lab fee \$100

061.244 (H,W) Film Genres

Bucknell 3 credits lab fee \$40

061.245 (H) Introduction to Film Theory

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 3 credits lab fee \$100

061.303 (H) Intermedia Studio

Staff 3 credits

061.306 (H) Introduction to 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 & Character Design for the Screenplay

Bucknell 3 credits lab fee \$40

061.328 (H,W) Gangster Films

Bucknell 3 credits lab fee \$40

061.331 (H) America Since Brando

DeLibero 3 credits lab fee \$40

061.334 (H,W) Technology in Hollywood Film

Bucknell 3 credits lab fee \$40

061.335 (H) Monster Films

Bucknell 3 credits lab fee \$40

061.336 (H,W) American Landscapes in Film

Bucknell 3 credits lab fee \$40

061.337 (H,W) Films of the Fifties

Bucknell 3 credits lab fee \$40

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

061.363 (H,W) The Short Film

Mann 3 credits lab fee \$40

061.364 (H,W) Hitchcock and Film Theory

DeLibero 3 credits lab fee \$40

061.365 (H,W) The Film Generation: Auteurs and Alternatives in 70s Cinema

DeLibero 3 credits lab fee \$40

061.388 (H) Russian Cinema from Avant-Garde to Socialist Realism

Eakin Moss 3 credits lab fee \$40

061.412 (H,W) Kubrick and His Critics

DeLibero 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

211.360 (H) Women and Film

Staff 3 credits

211.409 (H) La Nouvelle Vague

Roos 3 credits

211.411 (H) Introduction au Cinéma Français

Roos 3 credits lab fee \$40

211.412 (H) Political Cinema

Roos 3 credits lab fee \$40

211.413 (H) Le Cinéma Français Contemporain

Roos 3 credits lab fee \$40

211.416 (H) Cinéma et Littérature: Problèmes de l'Adaption Littéraire

Roos 3 credits

212.352 (H) Narration in Text and Film

González 3 credits

212.451 (H) Films of Almodóvar

González 3 credits lab fee \$40

The Humanities Center

300.333 (H) The Dramatic Event

Macksey 3 credits

300.337 (H,W) Thinking Films

Marrati 3 credits

The Writing Seminars

220.336 (H,W) Art of the Screenplay

Lapadula 3 credits

220.337 (H) Advanced Screenwriting

Lapadula 3 credits

220.399 (H,W) Hard-Boiled Fiction and Film Noir

Irwin 3 credits lab fee \$40

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 French, German, Italian, Portuguese, and Spanish, languages, and in the 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, Lecturer: Spanish medieval literature.

Wilda Anderson, Professor: French Enlightenment literature, science and literature.

Margaret Beauvois, Senior Lecturer: French.

Mary M. Bensabat-Ott, Portuguese Language Director, Senior Lecturer: Brazilian culture.

Rüdiger Campe, Professor: German literature.

Andrew Marc Caplan, 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.

Kristin Cook-Gailloud, Senior Lecturer: French.

William Egginton, Professor: Spanish and Latin American literatures.

Pier Massimo Forni, Professor: Italian literature and culture.

Eduardo González, Professor: Latin American literature, film and media studies.

Ivette González, Intermediate Spanish Course Coordinator, Lecturer.

Claude Guillemard, Intermediate French Course Coordinator, Lecturer.

Michel Jeanneret, Professor: 16th-century French literature.

Deborah McGee Mifflin, German Language Director, Senior Lecturer.

Yasmina Mobarek, French Conversation and Composition Course Coordinator, Senior Lecturer.

Jacques Neefs, Professor: genetic criticism, 19th- and 20th-century literature, theory of the novel.

Stephen G. Nichols, James M. Beall Professor of French (Chair): medieval language, literature, and culture, interrelation of literature with history, philosophy, and art history.

Katrin Pahl, Associate Professor: German.

Suzanne Roos, French Elements Course Coordinator, Senior Lecturer, *MLN* Managing Editor: French cinema and theory.

Elena Russo, Professor: interrelations of Enlightenment philosophy and literature.

Loreto Sánchez-Serrano, Spanish Language Director, CALL Specialist, Senior Lecturer.

Harry Sieber, Professor: Renaissance and Baroque literature of Spain.

Walter Stephens, Director, Villa Spelman, Charles S. Singleton Professor of Italian: medieval and Renaissance literature and its relation to philosophy and theology.

Rochelle Tobias, Assistant Professor: German.

Sue Waterman, Lecturer: research methods.

Bernadette Wegenstein, Associate Professor: media theorist.

Barry Weingarten, Spanish Language Director, Senior Lecturer.

Heidi Wheeler, Vice Coordinator of German Language Instruction, Lecturer.

Alessandro Zannirato, Italian Language Director, Senior Lecturer.

Joint Appointments

Eckart Förster, Professor of Philosophy.

Richard Kagan, Professor of History.

David Nirenberg, 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.

Visiting Faculty

Jack Abecassis, Professor (Pomona College).

Alicia Borinsky, Professor (Boston University): Latin American literature.

Dominique Brancher, Professor (University of Geneva).

Renzo Bragantini, Professor: Italian literature.

Marina Brownlee, Professor (Princeton University).

Rip Cohen, Professor (Universidade Nova de Lisboa)

Danièle Cohn, Professor: French literature (École Normale Supérieure).

Rita Costa-Gomes, Professor (Universidade Nova de Lisboa).

Cristina Della Coletta, Professor (University of Virginia).

Guglielmo Gorni, Professor (University of Geneva).

Jean Marie Goulemot, Professor (University of Tours).

Wolfram Groddeck, Professor (University of Basel).

Rita Guerricchio, Professor (Università degli Studi di Firenze).

Uwe Hebekus, Professor (University of Konstanz).

Laurent Jenny, Professor (University of Geneva).

Silvia Kurlat-Ares, Professor (George Mason University).

Joachim Küpper, Professor (Freie Universität Berlin).

Francesco LaRubia-Prado, Professor (Georgetown University).

Horacio Legrás, Professor (Georgetown University).

Christophe Menke, Professor (Universität Potsdam).

Alberto Morieras, Professor (Duke University).

Gerhard Neumann, Professor (Humboldt Universität Berlin).

François Noudelmann, Professor (Université Paris VIII).

Gustavo Pellón, Professor (University of Virginia).

Jacques Rancière, Professor.

Hans-Jörg Rheinberger, Professor (Max Planck Institute for the History of Science).

Jorge Schwartz, Professor (University of São Paulo): Spanish American literatures.

Barbara Vinken, Professor (Ludwig-Maximilian-Universität München).

Klaus Weimar, Professor (University of Zürich).

Alejandro Yarza, Professor (Georgetown University).

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 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 vice chair 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 of language courses through 210.301-302 Conversation and Composition I and II or equivalent placement; 212.201-202 Introduction à la littérature française I and II; a combination of six courses from the 211.300-400 and 212.200-400 series in French cultural studies and literature, including 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.

Minor in French Literature

Requirements consist of six courses beyond 210.201-202 (Intermediate French) or 210.203-204 (Advanced Intermediate French) and must include two semesters of 210.301-302 (Conversation et Composition Française I and II), both semesters of 212.201-202 (Introduction à la littérature française) and two courses in the 212.200-400 series or one in the 212.200-400 series and one in the 211.300-400 series.

Minor in French Cultural Studies requirements consist of six courses beyond 210.201-202 (Intermediate French) or 210.203-204 (Advanced Intermediate French), and must include two semesters of 210.301-302 (Conversation et Composition Française I and II), one semester of 211.401-402 (La France Contemporaine), and three courses in the 210.300-400 series and 211.300-400 series, or a combination of courses from the 212.300-400 series and 211.300-400 series with one or two semesters of 212.201-202 (Introduction à la littérature française).

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 adviser. 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

Though a major is currently unavailable, courses are offered in Brazilian Culture and Portuguese language at the Elements through Advanced levels.

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 Conversation and Composition I and II
- 212.201 Intro La Lit Française I *or*
- 212.202 Intro La Lit Française II
- Three upper-level courses plus senior thesis or independent 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:** Conversation and Composition 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:** Conversation and Composition 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 III:

- If French:** Conversation and Composition I and II
- If Spanish:** Advanced I and II
- If Italian:** competency through Intermediate I

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

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; 212.231 Introduction to Literature in Spanish; a combination of five courses from the 212.200-400 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 212. xxx literature or culture course. Native speakers should consult with the Spanish major adviser. 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, and also endorses the intersession exchange program with Cuba, as well as the Argentina and Peru summer programs organized by the Program in Latin American Studies. Students should consult with the directors of undergraduate studies or their department adviser 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 or 210.213 Advanced Intermediate Spanish levels 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 Hopkins') or at another institution may be used 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 or 210.213 Advanced Intermediate Spanish 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 Internship. The sixth course may be selected from 210.413 Curso de Perfeccionamiento or 211.280 Modern Latin American Culture or 211.290 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. Native speakers should consult with the Spanish minor adviser.

Spanish Language and Hispanic Cultures

Students must complete six courses beyond 210.212 Intermediate Spanish II or 210.213 Advanced Intermediate Spanish 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 211.280 Modern Latin American Culture or 211.290 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 adviser.

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 pro-

gram 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 at least one other language besides English. (See below for further information according to specialization.)

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. in Romance languages is available to Ph.D. students in other departments who complete eight graduate seminars in the Department of Romance Languages and Literatures.

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 advisers, 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 five semesters of graduate courses. After this period the students are expected to complete three field examinations during their third year, which include a formal written examination and two other examinations that take the form of a long bibliographic essay or a substantial paper, 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 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 adviser. 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), as well as at the

Ecole Normale Supérieure (Fontenay/St Cloud), and at the Ecole des Hautes Etudes en Sciences Sociales, all 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 \$16,000 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 Web site at <http://web.jhu.edu/romance> for further information on programs and faculty. All questions regarding the programs offered by the department should be e-mailed to romance@jhu.edu. Prospective students are encouraged to apply online through the secure Graduate Admissions Web site (<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 Webcapex (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 Webcapex.

Beauvois 4.5 credits

210.103-104 Learner Managed Section of French Elements

This course is designed for students with scheduling conflicts. Special section meets two times a week for one and one-quarter hours. Online materials are designed for one and one-half more hours a week required for the course. It must be noted that there is less classroom contact time in this course, and therefore this course is recommended for those who have some knowledge of French and need a review of the language. Only highly self-motivated students should attempt this course. Year course; must complete both semesters successfully in order to receive credit. May not be taken on a satisfactory/unsatisfactory basis. Prerequisite: No previous knowledge of French or Webcapex score of 0-250. See description for 210.101-102.

Beauvois 4.5 credits

210.201-202 (H) Intermediate French

A two-semester course conducted entirely in French. Taught in French, this course develops the four communication skills through multimedia material. Movies and readings from French-speaking destinations and extensive study of *Manon des Sources*. WebCT-based. Prerequisites: 210.101-102 or 210.103-104 or appropriate score on Webcapex exam.

Guillemard 3.5 credits

210.203-204 (H) Advanced 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 Webcapex exam. Credit will not be given if previously enrolled in 210.201-202 or the equivalent.

Roos 3.5 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.

Beauvois 3 credits

210.206 (H) Scientific French

Introduction to the languages of science, technology, and research in contemporary France. Emphasis on technical terminology. This course prepares students for the exam and the certificate offered by the Chambre de Commerce et d'Industrie de Paris. The course will be conducted in French, and both oral and written participation will be required. Prerequisites: 210.201-202 or 210.203-204, or permission of instructor. More advanced students should register for 210.305.

Staff 3 credits

210.301-302 (H,W) French Conversation and Composition I, II

This third-year course is conducted exclusively in French. It is intended to bridge the intermediate level and more advanced classes in French literature and cultural studies. Over two semesters, students will be given the opportunity to strengthen oral and aural skills through films, audiotapes, class discussions, oral presentations and written skills through the writing and correction of essays. The course will offer students an individualized review of grammar based on the students' written work. Students will be presented with a diversity of texts, from current newspaper articles covering different issues to poems and literary texts.

Mobarek 3.5 credits

210.303-304 (H) Business French

Introduction to fundamental aspects of the business world. The French language as a means of communica-

tion in the business world; commercial and economic vocabulary, trade and business practices, public and private sectors. Prepares students for the exam for the Chambre de Commerce et d'Industrie de Paris certificate. Only the second semester of 210.303-304 counts as credit for the major. Prerequisites: 210.301-302.

Staff 3 credits

210.305 (H) Advanced Scientific French

Prepares students for the exam for the Chambre de Commerce et d'Industrie de Paris. Same lecture as 210.205, but texts and assignments are at a more advanced level. Prerequisites: 210.301-302 or permission of instructor.

Staff 3 credits

210.307 (H) Legal French

Introduction to the language of French legal studies. Emphasis on legal terminology and logic. Prepares students for the Chambre de Commerce et d'Industrie de Paris certificate. Conducted in French; both oral and written participation required. Prerequisites: 210.301-302 or permission of instructor.

Staff 3 credits

210.500 (W) French Language Independent Study

Beauvois 3 credits

211.401-402 (H) La France Contemporaine I, II

Contemporary French culture and society studied through newspapers, French broadcast news, videos, and directed readings. During the first semester students study general trends in French society; during the second semester they concentrate on French youth and family. Oral presentation and independent research are required. Prerequisites: 210.301-302 or 210.301 and permission of instructor.

Roos 3 credits

211.407 (H) La Mémoire de la 2^{ème} guerre mondiale en France

This fourth-year seminar examines the sequelae of the 1939-1945 period on French society and analyzes the multiple forms that its memory has taken, depending on political and social circumstances. How do the French deal with their "dark years"? The course provides a historical background on the defeat, the occupation, the Resistance movement, and the collaboration. Students read firsthand accounts of the period, as well as articles and recent analyses. They explore how the representation of the occupation particularly evolved in French movies. Taught in French.

Guillemard 3 credits

211.409 La Nouvelle Vague

Introduction à l'analyse et à l'appréciation des films: exploration des films les plus importants et des principaux cinéastes de la Nouvelle Vague. Conducted in French. Prerequisite: 210.301 or permission of instructor. Cross-listed with Film and Media Studies.

Roos 3 credits

211.411(H) Introduction au Cinéma Français

Study of a representative series of major French films from the '30s to the present. Course serves both as a survey of historical tendencies in French cinema and as an introduction to the study of film. Cross-listed with Film and Media Studies.

Roos 3 credits

211.412 (H) Topics in French Cinema: Regards sur l'enfance

This course will explore different topics in French cinema. This semester the course will focus on childhood as depicted in French film. The emphasis of the course will be discussion and analyses of film sequences in class. Additional homework assignments will involve vocabulary and grammar study and an independent project. Requirements for this course include completion of Conversation and Composition, or equivalent score on the WebCAPE placement test.

Beauvois 3 credits

211.416 (H) Cinéma + Littérature: Problèmes de l'adaptation littéraire

Peut-on traduire des textes littéraires en images cinématographiques? Existe-t-il des textes impossibles à adapter au cinéma? Films de Bresson, Renoir, Truffaut; textes de Diderot, de Maupassant. Conducted in French. Cross-listed with Film and Media Studies. Prerequisite: 210.301 or permission of instructor.

Roos 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 4.5 credits

210.163-164 Elementary Yiddish

Year long 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. Stu-

dents 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 3.5 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

210.265 (H) German for Professional Communication in Science and Engineering

This Intermediate level course is designed to provide students in engineering and sciences with “real life skills” and cultural background necessary for internship or research trips to Germany. Taught in German.

Staff 3 credits

210.361 (H,W) Advanced German Composition and Conversation I. German Culture and Society, 1945–1989

This is a writing-intensive course aimed at the refinement of grammatical use and modes of expression. The topic of the semester is Germany after World War II, up until the eve of reunification in 1990 to include reconstruction after the war, *Wirtschaftswunder*, 68 Generation, and everyday life in the former East Germany. Several films of the period and one full-length novel are incorporated into the curriculum. Special emphasis is on the development of self-editing skills in writing. Prerequisites: 210.261-262 or equivalent. Taught in German.

Mifflin 3 credits

210.362 (H,W) Advanced German Composition and Conversation II. Introduction to Contemporary German Issues

Typically, this course focuses on contemporary issues such as national identity, multiculturalism, and the effects of globalization. Pertinent historical and cultural developments of the 19th and 20th centuries are highlighted to help students understand contemporary German society. Readings include literary and journalistic texts. Emphasis on style and clarity in both written and oral expression. Review of advanced grammar. Taught in German. Prerequisites 091.301 or equivalent.

Mifflin 3 credits

210.363-364 (H) Business German

This course sequence is designed as a two-semester intensive 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 Web publishing through the design and maintenance of a course Web page. 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 Genre & Stylistics

Introduction to major literary periods and genres in German literature. Course will provide a background for further literary study. Students will develop critical, interpretive reading skills through the analysis of genre-specific language, as well as improve written and spoken German. Taught in German. Prerequisite 361-362 or equivalent.

Wheeler 3 credits

210.462 (H) Introduction to German Literature and Culture

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

210.561 (H) German Language Independent Study **Mifflin**

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 reading, writing, and speaking the language through the use of grammatical texts, elementary readings, videos, and electronic didactic 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 3.5 credits

210.251-252 (H) Intermediate Italian

Intensive review of grammatical and syntactical structures; improvement of reading and composition skills through the use of contemporary literary texts, reinforcement of the student's knowledge of the language through weekly oral and written presentations on pre-determined subjects. Class participation is essential. All classes are conducted in Italian. May not be taken satisfactory/unsatisfactory. Prerequisites: 210.151-152 or equivalent.

Zannirato 3.5 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 3.5 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

211.581 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 3.5 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 3.5 credits

210.391-392 (H,W) Advanced 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 3.5 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 to be taken during orientation week and in the department office at other times, or by the previous completion of a Spanish class at Hopkins. See the Spanish language director to arrange to take the exam.

210.111-112 Spanish Elements I, II

Development of the four basic language skills of reading, writing, listening and speaking. Extensive use of an online component delivered via WebCT, 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.

Weingarten 3.5 credits

210.211-212 (H) Intermediate Spanish I, II

Continues building on the four essential skills for communication presented in Spanish Elements courses. Extensive use of an online component delivered via WebCT, 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 equivalent.

I. Gonzalez 3.5 credits

210.213 (H) Advanced Intermediate Spanish

Continues building on the foundation of the four essential skills for communication that was laid in introductory courses taken outside of JHU. Extensive use of an online component delivered via WebCT, sustained class participation, and three hourly exams (no midterm and no final). May not be taken satisfactory/unsatisfactory. Prerequisites: Appropriate S-Cape score. Entrance by placement exam only.

I. Gonzalez 3.5 credits

210.311 (H) Advanced Spanish I

Advanced Spanish I is designed to improve the four skills: Reading, writing, listening, and speaking, essential for communication. This third-year course aims to improve the students' reading and writing skills by focusing on various types of texts. Students will also engage in more formal levels of written communication. This course also focuses on refinement of grammar. Students are exposed to a deeper understanding of the cultures of the Spanish-speaking world. Extensive use of an online component delivered via WebCT, sustained class participation, and three hourly exams (no midterm and no final). May not be taken satisfactory/unsatisfactory. Prerequisites: 210.212 or 210.213 or appropriate S-Cape score.

Sánchez-Serrano 3 credits

210.312 (H) Advanced Spanish II

This third-year course aims at improving the students' oral skills by focusing on the use of standard, spoken Spanish with an emphasis on colloquial and idiomatic expressions. Students will also 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 WebCT, 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. Sánchez-Serrano 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 S-Cape score. Sánchez-Serrano 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 S-Cape score. Sánchez-Serrano 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 S-Cape score. Sánchez-Serrano 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 WEB-CAPE score.

Sánchez-Serrano 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 S-Cape score. Sánchez-Serrano 3 credits

210.411 (H,W) Curso de Traducción para las Profesiones

Students will learn 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. Sánchez-Serrano 3 credits

210.412 (W) Spanish Language Internship

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 S-Cape score.

Sánchez-Serrano 3 credits

211.250 (H) Cinema in Latin America

Taught in Spanish with focus on film appreciation, criticism, and theory. A selective review of cinematic practice from early to current films in various countries including Brazil.

E. Gonzalez 3 credits

211.280 Modern Latin American Culture

Prerequisites: 210.311 and highly recommended 210.312. Staff 3 credits

211.290 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: 210.311 and highly recommended 210.312.

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: 210.311 and highly recommended 210.312.

Staff 3 credits

211.576 (H) Independent Study Spanish Civilization

Staff 3 credits

Undergraduate Literature Courses

French

101.101 (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, Pere.

Neefs 3 credits

212.201-202 (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

212.300 (H) Erotisme et Religion

Introduction à l'oeuvre de Georges Bataille et ses grands thèmes: l'érotisme, etc. Textes de Bataille, Sade, Nietzsche, Baudelaire, Caillois, Leiries, etc.

Mobarek 3 credits

212.301 (H,W) L'Amour et le rire au Moyen Âge

Old French literature contributed much to the Romance form as we know it. In the Middle Ages, Romance was a vigorous and varied literary genre. Using poetry and verse, it explored the dimensions of passion and desire in human terms, in spiritual terms, in social, economic, and political terms. Romance offered the Middle Ages a vehicle for creating a new philosophy of human nature as well as a subject for exploring the limits of language and poetic forms. Old French literature also contributed a literature of laughter to the European scene. In new genres adapting old folk tales, like the fabliaux and the *sottie*, or in new forms of theater like the *jeux* and *farces*, medieval authors developed human dimensions of satire and irony. This course will explore the evolution of Romance and courtly love in such works as the *Lais de Marie de France*, the *Lancelot* and *Grail* romances of *Chrétien de Troyes*, *La Quête du Saint Graal*, and the *Roman de la Rose*. Love and laughter in different configurations form the basis for fabliaux and works like *Aucassin et Nicolette* and *Le Jeu de Robin et Marion*. Texts will be read in modern French translation.

Nichols 3 credits

212.302 (H,W) Love, Death, and the Supernatural in Medieval and Modern French

L'amour, la mort, et l'irréel—three themes connected by the belief that love and death operate in a zone apart from the everyday world. Some of the most extraordinary and little-known works of the Middle Ages explore the links between love and death passing through the space of fantasy known in French as *l'irréel*. Beginning with the development of these themes in four medieval works, the course will then show the transformation of the same impulse in 19th- and 20th-century French novels. Among the works read will be *Le Roman de Tristan*, *Mélusine*, *Le Coeur mangé*, *La Manekine*, Victor Hugo: *Notre Dame de Paris*, Flaubert: *Saint Julien l'Hospitalier*, Jean Giono: *Le Hussard sur le Toit*, Montherlant: *La Reine Morte*, Céline: *Guignol's Band*.

Nichols 3 credits

212.303 (H,W) Monsters, Maidens, and Meals in Medieval French Literature

The fascination of a period as different from ours as the Middle Ages derives in part from our seeing the ease with which the boundaries of the “real” and the “imaginary” overlap. The categories of “human,” “animal,” and “monstrous” were less separate than they are today. Women, monsters, and food play roles in medieval narrative in ways that tell us much about the people of the period. Studying selected romances, fabliaux, chronicles, epics, and plays will show the historic reality of the imaginary world of the European Middle Ages.

Nichols 3 credits

212.310 Versailles et la Cour

The extravagant construction of Versailles, the rigorous order imposed through it on life at court are both part of Louis XIV's strategy to establish and demonstrate his absolute control over France. Acknowledging the power of public media such as the arts and literature, the king also mobilizes the writers and artists in his political agenda. Molière produces plays for the festivals at Versailles and La Fontaine describes the marvels of the park as it is being constructed. Others, like La Bruyère and Saint-Simon, analyse the complexities and eccentricities of the courtly society. Some admire the brilliance of the Sun King's universe, others discreetly denounce the growing tyranny of the Crown and ridicule the submissive behavior of puppet-like courtiers. The underlying theme of the class will be a reflexion on the complex relationship between literature and power at a time when most freedoms are curtailed. The seminar will be held in French.

Jeanneret 3 credits

212.316 (H) 18th-Century French Theater

The development of the drama bourgeois and the theater criticism of the French Enlightenment. Authors to be studied include Racine, Le Sage, Marivaux, Voltaire, Diderot, and Beaumarchais. Prerequisite: 212.201.

Anderson 3 credits

212.317 (H,W) The 18th-Century French Novel

Key novels will be studied from a variety of approaches. Readings include Marivaux, Montesquieu, Prévost, Diderot, Crébillon, Rousseau, Laclos, and Voltaire. Prerequisite: 212.201.

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. Prerequisite: 212.201.

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: 212.201.

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

212.323 (H,W) Reading Poetry (19th and 20th Centuries)

A close reading of prominent poems. This course will present an opportunity to question the historical variations of poetry and the tension between verse and prose.

Neefs 3 credits

212.324 (H) Reading the Novel

Neefs 3 credits

212.325 (H) Short Stories, Fantasy, Realism

This course will offer a close reading of 19th- and 20th-century short stories by Gautier, Mérimée, Flaubert, Maupassant, Colette, and Beckett.

Neefs 3 credits

212.329 (H) Rire et Philosophie

Mobarek 3 credits

212.330 (H) Le Roman Noir Francophone

The significance of the "roman noir" in francophone literature of the 20th century starting with an overview of its evolution. Authors: Manchette, Dutrizac, Mad, Ndione, and Ngoye.

Giraud 3 credits

212.340 (H) Diderot and Rousseau Between 1749 and 1756

This course will look at five major texts written by these two philosophers at a time when they were also close friends. Diderot's two letters examine whether there is a firm basis for our knowledge, universal to all men. His letters are hard to interpret, but seem to point to language and pedagogical tradition as the answer to this question. He is an atheist. Rousseau probes into the moral value of human culture, and then into whether there is a possible social basis in man for man's development. He comes to realize that he is not an atheist. The course will help students become familiar with texts that are at the very basis of mid 18th-century free-thinking and political thought. The texts will be read in French, but translations exist for all but one.

Hobson 3 credits

212.375 (H) French Culture Through Poetry: From Early Modern to Modern

This seminar has two objectives: (1) Students will learn how to read poetry, how to understand the significance of forms and will get a chance to improve their skill in close reading and interpretation of poems. (2) The selection of texts, ranging from the 16th century, with Ronsard, to the late 19th century, with Rimbaud, and including such major poets as Malherbe, La Fontaine, and Baudelaire,

will provide insights into the ideology and aesthetics of different cultures in premodern and modern France: the Renaissance, the Classical period, Romanticism, and finally the outbreak of a radical modernism. The seminar will be held in French.

Jeanneret 3 credits

212.399 (H) La Poursuite de Bonheur

Etude thématique à travers des textes littéraires et philosophiques du 17^{ème} siècle au 20^{ème} siècle (poésie, théâtre, romans, discours théoriques). Cours dirigé en français.

Mobarek 3 credits

212.400 (H,W) Histoires d'Amour

Une étude du discours amoureux à travers les siècles. Course conducted in French.

Mobarek 3 credits

212.401 (H,W) Introduction to Old French

The course will introduce students to old French language through close reading of representative texts. Permission of the instructor required.

Nichols 3 credits

212.402 (H) Le Roi Artur, le Saint Graal, et les Chevaliers de la Table Ronde

Qui est le roi Artur et pourquoi la légende du saint graal s'est-elle évoluée autour de sa cour? D'où vient l'idée d'une chevalerie consacrée à la quête du saint graal? Pourquoi la France au 12^e siècle est-elle devenue le berceau de ce mythe perdurable? Et, enfin, pourquoi cette légende a-t-elle exercé une fascination continue sur l'imagination moderne? En lisant des romans de Chrétien de Troyes et d'autres auteurs médiévaux, ce cours tâchera de répondre à de telles questions. On examinera, pour terminer, quelques traitements cinématographiques contemporains du thème.

Nichols 3 credits

212.408 (H) Love, Poetry, Eroticism

The course will develop two approaches to the theme of love, one historical, one theoretical. The historical approach will enable us to understand significant changes in social behavior and ethics. Using the theoretical approach, we will explore the limits of what is tolerated in the expression of erotic desire. Texts studied will be borrowed from a variety of French poets, from the Renaissance to Romanticism. Course conducted in French.

Jeanneret 3 credits

212.409 (H) Sade: Philosophie et Littérature

Religion, sexualité, éthique, et politique dans l'œuvre de Sade.

Mobarek 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 cruelties of libertinage, love was seen in turn as an instrument

of social initiation, a civilizing force, a source of dissolution, a disenchanting 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, Laclous, Denon, Choisy.

Russo 3 credits

212.415 (H) 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*, *Michel Strogoff*.

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/Course Vault/Undergrad/Enlighten/home.html. Prerequisite 212.201 or permission of instructor.

Anderson 3 credits

212.418 (H) Une Littérature Révolutionnaire

The French Revolution, studied through the 18th-century works that led to it, the memoirs, poems, plays, and speeches written during it, and the 19th-century literature that culturally digested it. Authors included Rousseau, Rétif de la Bretonne, Mercier, Robespierre, Sta'1, Michelet, Dumas. This course uses a digital archive of the texts and an online writing workshop.

Anderson 3 credits

212.424 (H) The Essayistic Self, Montaigne

Close study of representative essays, focusing on the ontological, political, aesthetic, and erotic themes in Montaigne's *Essais* and their relationship to liberal modernity.

Abecassis 3 credits

212.425 (H) 20th-Century Jewish Fiction in France

This course will examine the fictional and autobiographical works of Albert Cohen, Irène Nemirovsky, Romain Gary, Georges Perec, and Patrick Monfiano. Course discussions will be thematically centered on the historical and aesthetic contexts for these representative works, which include Judaism and French/European identities, modernist aesthetic of the novel, and the centrality of auto-fictions in the works of these authors.

Abecassis 3 credits

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

212.501-502 Independent Study**German****213.250 (H) German Modernity**

We will read and discuss masterpieces by four German writers and four German philosophers who have defined and redefined modernity: Goethe and Kant; Büchner and Nietzsche; Kafka and Benjamin; Bachmann and Adorno. Reading and discussion in English. Freshmen only.

Campe 3 credits

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

213.255 (H) Voices: From the Romantic Text to Gramophone and Telephone

Artificial production and reproduction of the human voice is an age-old desire. We will follow the development from the 'Speaking Machine' in Romanticism to the invention of gramophone and telephone in literary stories, essays, and documentary material. Discussion will probe into the theory of modern media and the philosophy of the voice. Readings include Schiller, E.T.A. Hoffmann, Jules Verne, Cocteau, Proust, Kafka, Wellershof, Nicholson Baker. Readings in German and English.

Campe 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

213.317 (H) Robert Walser

Examination of Robert Walser's novels (*Geschwister Tanner*, *Der Gelhülle*, *Jakob von Gunten*, *Der Räuber*) with emphasis on psycho-sexual dynamics of text, narrative structure, and philosophy of the small.

Tobias 3 credits

213.318 (H) Kafka and Robert Walser: Narrating the Institution

Kafka, writing in German in Prague, and Robert Walser, a Swiss author living in Berlin, created their own type of novel at the beginning of the last century. The subjects of their narration are not persons or protagonists, but institutions that frame their being in the world: bureaucracy in Kafka's *Castle*, pedagogy in Walser's *Institute Benjamin*. Reading will focus on what can still be narrated under modern conditions. Readings and discussion in German.

Campe 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

213.335 (H,W) Technology and Sexuality in Berlin

This class will focus on the transition from the literary and artistic concern with transience and finitude to the uncanny presence of eternity NOW that defined the development of techno-sexuality in the modern media. The city of Berlin is the playground on which this transformation takes place and will make a regular appearance in the materials we will engage.

Kolarov 3 credits

213.345 (H) Chess Games

Chess surfaces frequently in literary and philosophical works as metaphor or allegory of battle of pure wits. Course will examine status assigned chess and, more generally, games in texts by Hoffmann, Zweig, Nabokov, Wittgenstein, Lyotard, Beckett, Freud. Texts available in original and translation; discussions in English. Prerequisites: 091.201-202 or equivalent.

Tobias 3 credits

213.349 (H) Speaking Philosophically: Enlightenment

In the Enlightenment philosophers take on a role in public affairs. What have been their basic claims? What were their fundamental ways of making those claims? Readings of selections from Leibniz to Kant. Conducted in English with a reading section in German.

Campe 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

213.356 (H) Experimental Writing

In the early 20th century German authors who also were scientists or doctors engaged in experiments of narrative writing. It is their style and narrative technique which can be called experimental, but experiments are also subject matters in these stories. Readings will include Musil, Schnitzler, and Benn. Reading and discussion in German.

Campe

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 creatures with webs between their fingers, and women with fish-tails? 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

213.385 (H) In Transit: German-Jewish Literature of Exile

Examination of 20th-century German-Jewish works which were written in exile and which write of exile as existential condition and literacy space. Authors include Roth, Canetti, Becher, Seghers, Zweig, Döblin. Readings and discussions in German. Prerequisites: 091.201-202 or equivalent.

Tobias 3 credits

213.386 (H) German-Jewish Thought Since the Enlightenment

Survey of trends in German-Jewish thought since Has-kala (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

213.405 (H) From Print to Electronic Media

Introduction to the history of media, tracing the transformation triggered by the invention of the printing press in the early modern period to the impact that media as diverse as the microscope, camera, radio, film, and television have had on 20th-century culture.

Campe 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

213.420 Human and Machine in German Literature and Film

Human machines and mechanical humans haunt the imagination of writers, filmmakers, and their audiences, particularly in Germany. Discussion of influential works like Hoffmann's "Sandmann," Kafka, Fritz Lang's "Metropolis" and contemporary cyborgs. Readings and discussion in German.

Pahl 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

213.501-502 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.

214.251 (H) Survey of Italian Literature

An overview of the key texts of the Italian literary canon from the Middle Ages to the present. Taught in Italian. Staff 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

214.366 (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

214.370 (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

214.374 (H) Italian Identity: Autobiography From Now Until Dante

Being Italian has meant different things in different historical periods. This course examines autobiographies, both real and fictional, from the present time to that of Dante, working backward in time. Entirely in Italian.

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 Leon-

ardo 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

214.390 (H) Machiavelli in Context

This seminar course will offer students the chance to read most of Machiavelli's major works in English translation. 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

214.462 (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

214.472 Tasso: The Epic and Tradition

Stephens 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 Spanish Literature

A writing intensive course designed to (1) continue to develop the student's linguistic proficiency through the careful reading of a wide-range of literary texts written in Spanish; (2) help the student develop and refine the skills and terms required for advanced studies in literature; and (3) provide the student with an overview of Spanish and Spanish-American literary history. Although the course focuses on texts written in Spanish, students who go on to study literature in other languages will benefit from the critical skills developed in this course. This course is required for the major in Spanish.

Staff 3 credits

215.336 (H) *Don Quijote*

A close reading and discussion primarily in Spanish of Cervantes' masterpiece, with concentration on its major themes and contributions to the formation of the modern novel. Prerequisite: Advanced Spanish or equivalent.

Sieber 3 credits

215.337 (H) Teatro español del siglo de oro

Sieber 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

215.341 (H) Autobiography and the Novel in Latin America

The course explores the constitution of the subject in the narrative project of the novel. Autobiographical fictions by Ocampo, Vargas Llosa, Poniatowska, Arguedas, Piñón, etc.

Castro-Klarén 3 credits

215.342 (H) Introduction to the Formation of Latin American Cultures and Their Literatures I

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

215.344 (H) Contemporary Latin American Novel and Short Story

An examination of the span of Latin American narrative after Modernismo. Discussions will be in English, but students have the option of reading the materials and writing in Spanish or Portuguese.

Castro-Klarén 3 credits

215.345 (H) Introduction to the Formation of Latin American Cultures and Literatures II

Independence wars, the Republican and modern periods in Spanish American literatures (1780–). Core readings: selections from the work of Sarmiento, Echeverría, Mancilla, Villaderde, modernist and avant-garde poetry and prose, Borges, Cortázar, Carpentier, Arguedas, Castellanos, Fuentes, Peri-Rossi, García Marquez, Vargas Llosa, Rivera Martínez.

Staff 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, José María Arguedas, Rosario Castellanos, Clarise Lispector, Carlos Fuentes, and García Marquez.

Castro-Klarén 3 credits

215.347 (H) 20th-Century Latin American Literature

A survey of the major prose writing in Latin American in the 20th century.

Castro-Klarén 3 credits

215.352 (H) Narration in Text and Film

Focus on 20th-century authors from Spanish America in comparative reference to European and American fiction and film.

E. González 3 credits

215.353 (H) Advanced Spanish: The Art of Reading

Learning how to read prose and poetry in Spanish from a literary perspective. Authors are from Spain and Latin America.

E. González 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

215.357 (H) Realism, Magic, Religion, Amor y Locura

Three classics of realismo mágico studied in reference to religious and magical phenomena and cross-cultural conceptions of madness and passion. Gabriel García Márquez (*El amor en los tiempos del cólera* and *El amor y otros demonios*); Isabel Allende (*La casa de los espíritus*); and Laura Restrepo (*Delirio*). Taught in Spanish.

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—Rubén 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

215.436 (H) The Cid

This course traces the figure of the Cid from medieval warrior to national hero. Readings include the *Poem of Mio Cid*, re-creations of the legend, and the history of scholarship.

Altschul 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. 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) The Post-Colonial Debate in Latin American Culture and Literature

Castro-Klarén 3 credits

215.444 (H) Mexico: su historia y cultura

Castro-Klarén 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 *Peñi* to *Hable con ella*, the films will be studied in form, content, and socio-political terms.

E. González 3 credits

215.452 (H) Che Guevara and Magical Realism

A consideration of the career and myth of Latin America's best known individual in counterpoint with its most influential literary style. Taught in English, cross-listed with Latin American Studies.

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

215.454 (H) Medieval and Contemporary Literatures and Cultures Face Off

Taking into account comparative studies in medieval and modern literatures and theory, this seminar examines ways in which these temporally distant and apparently incommensurable cultural productions reflect on

and dialogue with one another. Classes will discuss modern works and selections from medieval texts including *Tirante el blanco* and *Amadís de Gaula* face to face with Alejo Carpentier's *Los pasos perdidos*, *Cárcel de amor* and *El collar de la paloma* with Gabriel García Márquez's *El amor en los tiempos del cólera*, and *Siete infantes de Lara* and *Poema del Cid* with *Crónica de una muerte anunciada*. Additional texts include *El amor y otros demonios* (García Márquez), *El beso de la mujer araña* (Manuel Puig), *Eric y Enide* (Manuel Vázquez Montalbán), and *El señor de los últimos días* (Homero Aridjis). Theory includes psychoanalysis, the location of medievalism in the development of contemporary critical theory, and studies on spatialization and temporality.

E. González/Altschul 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 low 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

215.467 (H) Mexico en su Literatura y su Artes

Estudio del México contemporáneo en su literatura, música, pintura y cine. Clase dictada enteramente en español.

E. González 3 credits

215.468 (H) Reconquest and Crusade

In 1096 Christianity embarked on the first of a series of Crusades to recapture the "Holy Land" from Muslim rule. Yet closer to home, most of the Iberian Peninsula had been under Muslim rule since 711. Through the standpoint of literature, this course will discuss the ideologies of Christian territorial expansion in Muslim Spain during the crusading era. Readings include Gonzalo de Berceo, the poems of Alfonso XI, Fernán González, and the Infantes de Lara.

Altschul 3 credits

215.484 (H) From Manuscript to Copyright and Beyond: The Life of Medieval Iberian Text

This course will examine texts beginning with *El Conde Lucanor* by don Juan Manuel through medieval versions and modern scholarly adaptations. This collection of framed narratives, contemporary to *Canterbury Tales* and Boccaccio's *Decameron*, will lead us to current discussions on copyright and individual authorship, open source

and hypertextuality. Taught in Spanish. Prerequisites: Advanced Spanish or permission of instructor.
Altschul 3 credits

215.485 (H) Introduction to Spanish Medieval Literature

Among the classics of medieval Spanish literature, this course will present medieval “biographies” and oriental tales from Muslim Spain as well as the *Mio Cid*, *the conde Lucanor*, and the *Libro du buen amor*.
Altschul 3 credits

215.491 (H) Muslim, Jewish, and Christian Literatures in Iberia

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 Sendebār.
Altschul 3 credits

215.497 (H) Chivalry in Spain

This course examines chivalry in the Spanish Middle Ages through literary and theoretical accounts. Readings include Arthurian, Antique, and Carolingian subject matter as well as knightly manuals.
Altschul 3 credits

215.525-526 Spanish Independent Study

Staff 3 credits

Interdepartmental Courses

360.130 Introduction to Latin American Studies I

Kurlat-Ares 3 credits

360.133 Great Books: Western Tradition or The Humanities: A Tradition of Classics

Egginton/Patton/Talle/Valladares 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

360.323 Culture in Society in Modern Latin America

(Cross-listed with History, and Women, Gender, and Sexuality.)

Castro-Klarén, Knight 3 credits

360.324 Modern Latin America II

(Cross-listed with History.)

Castro-Klarén, Knight 3 credits

360.391 (H) Manuscripts, Texts, Hypertexts:

History of the Book

This course will trace the history of the codex (the “book”) to its apparent dissolution in the age of television and the Internet. We will discuss the technology of the book as it interacts with the dissemination of knowledge and literature by examining topics such as orality and literacy, book manufacture and layout, intellectual property and reproducibility. (Cross-listed with History of Science and Technology.)

Staff 3 credits

360.410 Light and Enlightenment: Newton’s *Opticks* and 18th-Century Culture

This seminar 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.)

Kargon, Anderson 3 credits

360.443 (H) Subverting the Text

Seminar examines the process of subverting texts. Cases include Cartesian/Newtonian physics, phlogiston chemistry, Darwinian biology, Rousseau’s *Botanical Letters*, Diderot and d’Alembert’s *Encyclopedia*, the Munich 1937 exhibit *Degenerate Art* and staging non-theatrical literature. (Cross-listed with History of Science and Technology.)

Anderson, Kargon 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

212.692 Research Methods

Waterman

212.673 Graduate Seminar in Film and Film Theory: European

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

212.600 Reading and Seeing in Medieval Lyric Poetry

Theories of reading and a new poetry of love evolved simultaneously in 12th-century France. Both stressed the role of vision and cognition. The seminar will examine medieval reading theory in conjunction with practices of writing and painting in 13th-century troubadour and *trouvère chansonniers* (manuscript song-books).

Nichols

212.601 Varieties of Theater and Theatricality in the Middle Ages

Nichols

212.602 Marie de France, Mythology, and the "Invention" of Writing

A study of the way Marie de France, followed by other writers of Breton lays, tapped a new vein of mythology in 12th-century France, with the consequences of a novel consciousness of the written text in French letters. Readings: Marie de France *Lais*, *Fables*, Martianus Capella *De Nuptiis Philologiae et Mercurii*, and diverse Breton lays, including *Le lai d'Ignauré*.

Nichols

212.603 Medieval Poetics and the Invention of "Historical" Narrative

A study of the theory, practice, and meaning of narrative in the Middle Ages through contemporary texts and treatises. We will examine what was meant by "history" and see why it was closely associated to different narrative and poetic modes. Comparison with classical treatises and examples will help to situate medieval theory and practice.

Nichols

212.604 Vision and Illumination in *Le Roman de la Rose*

A study of the role of visual theories as developed and utilized by Guillaume de Lorris and Jean de Meun in the

13th-century *Roman de la Rose*. Central to the seminar will be study of illuminated manuscripts of the Rose and the problematics of text and image that they raise.

Nichols

212.605 Nom et poésie au Moyen Age

Nichols

212.606 Modes of Poetic Knowledge in the Middle Ages

The seminar will examine medieval innovations in knowledge, particularly theories of vision and perspective, moral philosophy, and esthetics as they were elaborated by thinkers like Roger Bacon, Grosseteste, Aquinas, Dante, and others. We will also study the impact of such knowledge on the development and evolution of important literary works from the 12th to the 14th centuries.

Nichols

212.608 Thinking With Dreams: Poetry and Philosophy in the Middle Ages

Medieval authors composed dream fictions as a useful framework for mediating between the everyday world and the otherworld of divine providence. Conceived as a liminal space where the virtual might confront the real, dream worlds offered a mechanism for epistemological debate ranging from pious allegory to bold exposition of heterodox thought. The seminar will look at classical theories of dreams from Plato and Aristotle to Cicero, then read key works of the genre like Macrobius's *Commentaire sur le songe de Scipion*, the anonymous *Vision de Saint Paul*, Guillaume de Lorris's & Jean de Meun's *Le Roman de la Rose*, Christine de Pisan's *La Cité des Dames*, Villon's *Le Testament*.

Nichols

212.609 Le Théâtre et Ses Censeurs (XVIIe Siècle)

Far from being the expression of wisdom and order, as literary history would have it, XVIIth century theater, either tragic or comic, challenged the morality and rationality of the time. Its assault on conventional values, whether those of religion, of sex, or of poetics, upset censors of different sorts, who tried to tame or silence it. We will meditate on the flamboyance and courage of the great playwrights and show that their plays allow the expression of what is usually repressed—the world of desires and fantasms. The quarrels around Corneille's *Le Cid* and Molière's infamous trilogy (*L'Ecole des femmes*, *Tartuffe*, *Don Juan*) will be center stage. Under such pressure, self-censorship was also active; the balance between provocation and restraint will be studied through the example of Racine. The seminar will be held in French.

Jeanneret

212.610 The Sacred and the Secular: The Manuscript Codex, 1200–1500

This course discusses manuscript production and consumption in the high Middle Ages, including relations of text and image. It concentrates particularly on manuscript evidence for reading practices, in monastic, private, and courtly contexts. After the initial meeting (September 11) classes will be held in the Walters Art Museum, where students will be able to examine origi-

nal manuscript material, and will be introduced to the many different ways in which manuscripts can be displayed and studied to provide insights into medieval art and culture.

Nichols/Noel

212.612 Theories of Illusion in the 17th- and 18th-Century French Novel

An exploration of the theory and practice of 17th- and 18th-century fiction at a time when the practice of the novel always included a theoretical, self-reflexive mode that underscored radical transformations in the genre. Focus on the relationship between genre, truth, reality, and the reading public; between the discourse of the novel and that of history; between the high style of the Romanesque and its parodies. Readings from d'Urfé, Sorel, Furetière, Chapelain, Madeleine de Scudéry, Boileau, Marivaux, Crébillon, Diderot.

Russo

212.613 Marivaux et l'Esthétiques des Modernes

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

212.614 Morality of Spectatorship

Russo

212.616 Rousseau

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, and Beaumarchais.

Anderson

212.618 Buffon

Buffon's project of writing natural history was tightly linked to the literary, philosophical, and natural philosophical context of the Enlightenment. His work will be used as a starting point to discuss the interrelationships of literature and science at a moment when they were not distinguished from each other according to the same criteria that we use today.

Anderson

212.619 The Aesthetics of the French Enlightenment

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 intel-

lectual 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

212.621 Flaubert, From *Bovary* to *Bouvard*

The seminar will propose a reading of the first published novel of Flaubert, *Madame Bovary* and the last novel he was writing when he died, *Bouvard et Pécuchet*. The other works by Flaubert will be occasionally considered. The new fiction patterns that Flaubert invented, the deep irony of those novels, the narrative integration of knowledge and sciences, will be among the main topics that will be examined in those two novels. Drafts, scenarios, manuscript materials will be examined to stress the strength that Flaubert gave to the art of prose. October 2006 will be the 150th anniversary of *Madame Bovary*. Text; *Madame Bovary*. Le Livre de poche classique; *Bouvard et Pécuchet*, GF Flammarion.

Neefs

212.622 Representing and Thinking Equality in the 19th Century: Memories of the Revolution

Study of 19th-century texts by novelists, poets, historians, and philosophers about the French Revolution, focusing on episodes, texts, and representations that concern modern versions of the question of equality.

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

212.624 Modern Fictions

The course will examine the uses and the forms of narrative fictions in 19th and 20th century from examples taken from Balzac, Flaubert, Maupassant, Michelet, Queneau, Perec, including the study of recent theories of fiction (Ricoeur, Genette, Schaeffer, Cohn).

Neefs

212.626 Baudelaire, Verse and Prose

The seminar will propose a close reading of *Les Fleurs du mal* and *Petits poèmes en prose*, stressing the aesthetic change involved between verse and prose, and questioning the conception of prose as a modern art. We will also study critical and theoretical texts by Baudelaire on literature, painting, and other arts. A way to examine the historical, political, and esthetical meaning of what Baudelaire called "modernity." The seminar will be held in French.

Neefs

212.628 Racine

A partir de la lecture de l'oeuvre de Racine on se propose d'analyser la poétique de la passion tragique et la spécificité de l'écriture dramatique classique.

Russo

212.629 Flaubert et La Tradition: *Madame Bovary* / *L'Education Sentimentale*, *Trois Contes*

Flaubert est devenu l'auteur réaliste par excellence, le père du roman moderne. Que ce réalisme est fruit de lecture qui filtre toute expérience vécue, est désormais acquis. Le séminaire propose, dans un premier pas, à travers a «close reading» des textes majeurs de Flaubert, de préciser ce constat: Flaubert déchiffre son temps, lui donne un sens, à travers la lecture des textes antiques et des textes bibliques. Dans un deuxième pas sera explorée la relecture que subissent les textes antiques, et spécialement les textes bibliques, et leur interprétation romantique dans les textes flaubertiens. Le religieux et le politique apparaîtront sous un autre jour. Flaubert érige son autorité, en inscrivant son époque, sa vie, dans la tradition, tout en la déformant violemment. En ce sens, l'autorité de Flaubert serait tout à fait canonique.

Vinken

212.630 The Essayistic Self, Montaigne

Close study of representative essays, focusing on the ontological, political, aesthetic, and erotic themes in Montaigne's *Essais* and their relationship to liberal modernity.

Abecassis

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

212.645 Pascal, A Philosophical Anthropology

Close reading of Pascal's *Pensées*, *Lettres Provinciales* and other writings, primarily set against the background of Augustine, Montaigne, and Descartes, but also extending forward to Rousseau, Schopenhauer, and Nietzsche as well as contemporary critical theory. We will study a series of issues ranging from Christian vs. modern anthropology, existential analytics of subjectivity, rhetorical theory. Primary readings in French where applicable. Seminar language to be determined at first meeting dependent on seminar composition. Also open to humanities, history, and religious studies graduate students.

Abecassis

212.653 The Psycho-Picaresque Modernist Novel

Centered on Marcel Proust, Louis-Ferdinand Céline, and Albert Cohen, we will study four modernist novels thematically (the specific nature of the French moral(iste) imagination coupled with the traditional trope of the wayward quest) and narratologically (action as pure parody, subjective interiority as narrative, etc.). Readings: *La*

prisonnière, *La fugitive*, *Voyage au bout de la nuit*, *Belle du seigneur* and critical essays on modernism, the picaresque, and narratology distributed in class.

Abecassis

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

212.690 What About Aesthetics?

During the 20th century, artists, historians of art, and philosophers tried to deny the meaning and even the relevance of aesthetics. Modernity developed in counteraction with aesthetics. How and why did this happen? Today we are witnessing a new rise of interest in aesthetics for ethical and social reasons. Pleasure, disgust, compassion, surprise, the whole aesthetical system could become the basis of an ethical new deal. Emotions, feelings, empathy are studied by neuro- and cognitive sciences and are given a second conceptual life. Reading books, watching movies, hearing music, looking at paintings, etc., could help us to live together, deepen our experience and contribute to educate us as human beings. What is aesthetics, what does an aesthetical point of view mean? Do we need aesthetics to understand and/or analyze works of art? Can works of art contribute to our self-improvement? To explore these issues, we shall study in this seminar two decisive periods, crossing the French and the German development of aesthetics:

- 1) the birth of aesthetics in the 18th century;
- 2) its key point at the end of the 19th century.

Cohn

212.693 Pour Une Esthétique Morphologique

Cohn

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

212.700 Medieval Lyric I: The Troubadours

This course will examine the rise of the European lyric of love, politics, religion, and the invention of a vernacular literary language. The seminar will read selected works, paying particular attention to the variation in texts between editions and manuscripts.

Nichols

212.701 Historiography, Literature, and Society in Medieval France, 1000–1400

From 11th-century chronicles to the vernacular prose histories of the Crusades and Froissart's chronicles of the Hundred Years War, French historiography engages momentous social issues. Inevitably, it also engages vernacular literature, sometimes altering its forms and subjects irrevocably. The seminar will study this phenomenon, its causes, manifestations, and results.

Nichols

212.702 The Visual Text: Word and Image in a Manuscript Culture

The course will examine the proposition that medieval literature, when perceived as a function of the manuscript that preserved it, participates in a dual system of expression: it is both work and image, literary artifact and visual image. Viewing medieval vernacular literature from this perspective involves a cultural construction that incorporates a range of social, political, economic, religious, and intellectual structures all interacting with the literary work. These may not normally be apparent from reading a version of the work in a modern critical edition. The course will examine how literary and visual texts are jointly constituted by the manuscript and, consequently, how the manuscript functions as supplement, that is as a matrix for commentary, annotation, and metacritical speculation. A selection of medieval works will be studied, including the *Roman de la Rose*, Jean de Meun's translation of Boethius's *Consolation of Philosophy*, and texts of troubadour lyrics. The course will also examine theoretical works dealing with text and image (e.g., Derrida, Mitchell) as well as textual criticism (e.g., Jerome McGann).

Nichols

212.703 Introduction to Old French

See 212.401 for description.

Nichols

212.704 Geography and the Crusades

Nichols

212.705 Les Fontières du rire au Moyen Âge

Y a-t-il un rire théâtral ou autre au Moyen Âge? Quel est le statut du rire à cette époque? Selon une légende fort répandue, le Christ ne rit pas. Et pourtant le héros de chanson de geste rit régulièrement pour signifier... quoi, au juste? Tertullian fulminait contre le jeu théâtral et surtout contre la comédie. Et pourtant c'est l'église elle-même qu'inaugure le drame médiéval, ce drame qui aboutit au délire linguistique qui sont sottise, fatrasie et farce. Que veut dire cette contradiction? A travers tout une série de textes littéraires, philosophiques, et théoriques—de l'antiquité jusqu'à nos jours—le séminaire étudiera ce que Baudelaire appelle <<De l'essence du rire>>.

Nichols

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 Baudoilino 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

212.712 Être auteur au Moyen Âge: Entre l'anonymat et le mythe

Une étude de l'idée de ce que c'est qu'un auteur et l' (authorial agency) au moyen âge. L'auteur médiéval jouit d'un statut très différent de celui de l'auteur moderne, et cela en dépit des efforts de certains penseurs de l'«effacer».

Nichols

212.715 The French Enlightenment Novel

Readings include Prévost, *Manon Lescault*; Montesquieu, *Les Lettres persanes*; Marivaux, *Le Paysan parvenu*; Diderot, *La Religieuse* and *Le Neveu de Rameau*; Rousseau, *La Nouvelle Héloïse*; Laclos, *Les Liaisons Dangereuses*. Full description at www.wilda.org.

Anderson

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

212.728 Philosophe en Littérature

Depuis 1945 les relations entre littérature et philosophie ont pris un tour nouveau, l'après-guerre modifiant leurs répartitions discursives et politiques. L'écriture de Sartre a dès lors bouleversé les rapports entre concept et métaphore, entre vérité et fiction, entre spéculation et imagination. Le séminaire suivra ces articulations et leur contestation à travers les écrits de philosophes sur la littérature jusqu'à nos jours. Il abordera la question des genres (poésie et philosophie, philosophies du théâtre),

les raisons du choix des écrivains commentés, la concurrence entre théorie littéraire et philosophie de la littérature, l'histoire des conflits disciplinaires. Il analysera la modification des régimes de discours (les polémiques liées à la «littérisation» de la philosophie ou à la conceptualisation anhistorique de la littérature) et tentera d'évaluer les effets de ces débats aujourd'hui, dans la reformulation d'une pensée de la littérature. Corpus : Badiou, Bourdieu, Deguy, Deleuze, Derrida, Foucault, Kristeva, Lacoue-Labarthe, Lyotard, Macherey, Milner, Nancy, Rancière, Sartre.

Noudelmann

212.730 Quelques Concepts Clefs des Lumières Françaises

Le cours portera sur trois plans—1. Qu'est-ce que les Lumières? en insistant sur leur historicité, sur leur construction, déconstruction et reconstruction dès la Révolution française et jusqu'à aujourd'hui. 2. Epistémologie de la Philosophie des Lumières: rôle de l'observation, rôle de l'expérimentation, la définition du philosophe, le refus de la métaphysique, l'utilité sociale, le sensualisme lockien... 3. Notions et pratiques des Lumières: Pour les notions: la tolérance, la liberté, le bonheur, la vertu, le primitivisme, le sens de l'Histoire... Pour les pratiques: l'engagement du philosophe, la taxinomie (Buffon et *l'Encyclopédie*), la nouvelle écriture philosophique, la diffusion du savoir, le philosophe et la politique.

Anderson

212.731 Passé, Present, Futur au 19ème Siècle

Neefs

212.732 Styles of Prose: 19th Century

Neefs

212.734 De l'Écriture au Livre, Questions de Genétique

Le séminaire s'attachera à la tension entre l'écriture comme pratique et and 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'éditions problématiques en ce sens: Chateaubriand, *Les Mémoires de'outré-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'édition et de genèse.

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

212.740 History and Tragedy: Shakespeare, Corneille, and Racine

History seems to go on; tragedy stops. Tragedy from the Greeks until the 20th century has been considered the most important dramatic form; and since Aristotle,

at least, questions have been raised about its relation with history. This course looks at the relation to history expressed in five plays: Shakespeare's *Hamlet*, Corneille's *Horace* and *Surena*, Racine's *Britannicus* and *Athalie*. It will not be concerned with how the dramatists have arranged the historical sources they have used so much as how they have presented their human actors' relation to some kind of historical process implied in their play. The texts will be studied in detail, in relation especially to one modern theoretical work on tragedy, Walther Benjamin's *The Origin of the German Mourning Play*, together with some reference to other theoretical works on tragedy. Assessment: by one long essay at the end of the course. Ability to read French essential.

Hobson

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

212.746 Monsters, Prodiges, and Mysterious Signs in Renaissance

The modern era has neutralized the enigma of the monster by relegating it to the fantastic or by rationalizing it as a medical accident. In Renaissance culture, on the other hand, monsters were ubiquitous, uncanny, and ominous. The word designates an unusual phenomenon, biological or cosmological, which is supposed to carry a supernatural message. If it is a sign, it invites interpretation; if it is a superstition or an illusion, it requires demystification. Reading texts by Ronsard, Rabelais, Montaigne, and others, we will work out the strategies provided by literature to face up to the challenges of the monsters, whether by decoding their hidden meaning or by emptying them of their threatening potential. The seminar will be held in French.

Jeanneret

212.753 Representations of America in 16th-Century France

The responses of French writers and scholars to the progressive discovery of America through the 16th century reveal a great deal about the Renaissance worldview and the period's epistemology. How is radical novelty handled? What sets of values are applied to Indians? What theological, moral, and anthropological issues are at stake? Authors studied will include Ronsard and Montaigne as well as travelers such as Jacques Cartier, André Thevet, and Jean de Léry. Course conducted in French.

Jeanneret

212.774 Travail, Écriture, et Pensée de la Fin

L'idée de la fin a hanté l'Occident qui s'est représenté sa propre histoire en termes de mort et de renaissance. Elle est devenue constitutive d'un geste artistique, littéraire et philosophique cherchant à promouvoir une ère régénératrice sur le deuil affirmé d'une époque révolue. À partir de la fin du XIXe siècle, ce fantôme apocalyptique, manifesté par les avant-gardes, n'est plus

seulement une prophétie mais un travail consistant à mener au bout le processus de l'achèvement. On étudiera les machines conceptuelles et textuelles visant à réaliser la fin, à la fois terminus et finition, augurant une possible recomposition à partir des figures déchues de l'humanisme. L'objectif du séminaire consistera à suivre des œuvres-vie (Nietzsche, Artaud, Sartre, Beckett) qui se sont confrontées à la question de la fin, pour montrer ce qui les différencie de la thématique largement repérable de la génération corrompue, et pour dégager à partir d'elles une perspective post-généalogique.

Noudelmann

212.801 French Independent Study

Staff

212.802 French Dissertation Research

Staff

212.803 French Proposal Preparation

Staff

German

210.661-662 Read/Translate German

This course 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

213.602 Pseudo-Autobiographies

Tobias

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

213.606 Rhetoric and Aesthetics: Literary Theory I

Campe

213.607 Places of Sovereignty

Modern drama's stage often is specifically related to sovereignty—as the antechamber of the king, as the place of acclamation or expulsion, or the ambivalent zone between territories. Readings from 16th to 20th century will include Shakespeare's *Richard II*, Racine's *Britannicus*, Hölderlin's *Empedokles*, and Handke's *Königsdrama*. They will be supplemented by materials from legal and theatrical history. Readings in English and German; discussion in English.

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. All readings and discussions conducted in English; enrollment open to graduate and advanced undergraduate students.

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

213.620 Modern Verse: Individual Poems, Poetic Cycles

Consideration of the questions of composition in the case of poetic works by Rilke, George, Heym, and Celan. Examination of different strategies required in reading an individual poem and a series or cycle.

Tobias

213.622 Negative Theologies: Meister Eckhart and Georges Bataille

Examination of Meister Eckhart's sermons with attention to tension between a God identified with Being and one identified with Not-Being, such that this God is removed from the realm of all lived or conscious experience.

Tobias

213.625 Redemption and Utopia: The History of a Concept

An examination of the concepts of redemption and utopia as they appear in the works of 20th-century German-

Jewish thinkers, including Adorno, Benjamin, Rosenzweig, Scholem, and Buber. To what extent is redemption presented as a specifically Jewish concept in these authors' works, one which is opposed to the Western metaphysical tradition?

Tobias

213.626 Tropologie—Die Ordnung Der Tropen

Tobias

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

213.635 Guilt in Heidegger and Kafka

Investigation of concept of guilt in Heidegger and Kafka with emphasis on theological precedents and ramifications of concept. Primary texts: *Sein und Zeit* and *Octavhefte*, ancillary readings in Augustine and Kierkegaard.

Tobias

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

213.641 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

213.645 Rhetorics of Visuality

We will explore figures of visuality such as evidence, ekphrasis, and graphic metaphor along with their epistemological contexts and media effects; poetic examples range from baroque to Romanticism.

Campe

213.647 Modernity, Aesthetic and Political: Hofmannsthal – Brecht – C. Schmitt – Reifenhastl

In recent theories of the political (Claude Lefort, Ernesto Laclau) totalitarianism no longer appears to be a revolt against modernity but, on the contrary, an intrinsically modern project. The course will focus on configurations of the aesthetic and the political in the early 20th century. We will ask the question to what extent this configuration might have contributed to making (German) totalitarianism possible. Reading and discussion in German.

Hebekus

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, David 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

213.654 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

213.662 Advocacy/Führsprache

We will discuss instances of advocacy—peaking/acting on behalf of someone before someone—in different areas: ancient rhetoric, legal and cultural theory, poetry and the novel. The goal of the course is to develop an understanding of "Fürsprache" as a basic feature of communication. Readings include Aristotle, Quintilian, Derrida, Rawles, Lacan, Austin, Hölderlin, and Kafka. Readings and discussion in English.

Campe

213.664 Theater of Institution: German Baroque

Trauerspiele (Gryphius, Lohenstein)

Institutionality is at the heart of the baroque Trauerspiele: Gryphius' and Lohenstein's plays were mostly staged in pedagogical institutions, the Protestant gymnasium. Institution of sovereignty is the centerpiece of their theological/political debates; institutionality, finally, characterizes the status of the language spoken on the stage. "Institutionality" may be the key term for an intensive reading of the most important Trauerspiele in the same way as "negotiation" is said to be the key term for Elizabethan theater.

Campe

213.665 Goethe, Wilhelm Meister

Campe

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

213.685 Hegel: *The Phänomenology 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

213.692 Political Realism

Campe

213.702 Aphoristic Writing Around 1800

Focus on Lichtenberg's Waste books. Readings include the ancient (Hippocrates), early modern (Montaigne) traditions, and Romanticism (Schlegel, Novalis). Key issues: poetics of aphorism as form; concept of "literary technology" and science.

Campe

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 translanguaging. 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

213.716 Contingencies: Semantics of Probability and Narrative Forms in the 18th Century

Focuses on Wieland's *Agathon* and Kleist's novellas for exploring variants of a poetics of contingency. Discussion on event, chance, and probability from philosophy, science, and poetics of the time will be included. Readings and discussion in German.

Campe

213.745 (H) Ontological Aesthetics

Comparison of Heidegger's and Benjamin's claims about the work of art as purveyor of truth and truth as event. Primary emphasis will be on ontological value assigned art in modernity.

Tobias

213.781 (H) Theory of Meaning, History of Science

The emergence of post-phenomenological studies on the history of science in the 1960s made a strong impact on theories of meaning and representation in literature. Readings and discussion in English.

Campe

213.800-801 Independent Study

Staff

213.811-812 Directed Dissertation Research

Staff

Italian**210.652 Corso 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

214.665 Letturatura Italiana III

This is a basic course presenting the Italian literature of the 18th, 19th, and 20th centuries.

Forni

214.666 Seminar on Petrarch

The main focus of this graduate course is on Petrarch's lyric poems. Petrarch's philosophical Latin works (especially the *Secretum*) form the background for the discussion. The "poetry of praise," which is a main concern in the course on early Italian poetry, is investigated in the context of Petrarch's works.

Forni

214.667 Poesie Italiane del Novecento

A study of several poems by Novecento poets such as Gozzano, Montale, Noventa, and Erba, will serve as an introduction to the skill of writing about literary texts.

Forni

214.668 First Seminar on Boccaccio (Boccaccio I)

Readings from Boccaccio's early works (*Filocolo*, *Filosttrato*, *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

214.673 The Literature of Humanism

Readings in the major texts of Latin and vernacular humanism produced by Italians between 1300 and 1600. History and validity of the concept of humanism, its varieties, its major exponents, major 19th- and 20th-century interpretations. Texts by Petrarch, Salutati, Valla, Pico, Ficino, Machiavelli, Bruno, Campanella, and others. Reading knowledge of Italian required.

Stephens

214.674 Literature and Witchcraft

The intersection of theology, philosophy, and social theory in the stereotype of the witch and its influence on Italian literature. Readings in witchcraft treatise and literary texts of the period 1400-1700, medieval and early modern theology and philosophy, and contemporary criticism and theory. Reading knowledge of Italian required.

Stephens

214.675 The Invention of the Secular Theater

The Italian Humanists of the Quattrocento rediscovered lost and neglected texts of the Roman theater. More crucially, they discovered the theater as a cultural institution, and fully secularized it, making possible the classics of modern theater from Shakespeare to Pirandello and beyond. Survey of texts from early 1400s to late 1500s; related discoveries and innovations in narrative literature, stagecraft, and stage machinery.

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

214.679 *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

214.680 Italian Comedy

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 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.

Stephens

214.683 Philology Becomes Philosophy:

The Lamia of Angelo Poliziano (1454–94)

Angelo Poliziano (1454–94) represents the final phase of the Latin intellectual movement of Italian Renaissance humanism. During his intellectual generation humanists were poised, finally, to go beyond criticizing the style of late medieval scholastic philosophy, moving instead to its substance. Poliziano found himself in a position—teaching Aristotelian logic at the Florentine university and faced with the prospect of giving a *praelectio*, or opening oration, to the course he was to teach in the 1492 academic year—where he was able to launch one of the most scathing attacks on scholastic styles of thought. In his *Lamia*—the word denotes a vampiric kind of witch and for Poliziano connotes a reputation-mongering, back-biting rapacity—he sent up contemporary philosophy: anti-metaphysical, witty, and at times profound, this short treatise has only recently been critically edited and has never been translated into English. In this seminar, we will work through the treatise methodically, and in so doing open up a window onto one of the most intellectually exciting (and little studied) phases of Italian humanism.

Celenza

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

214.721 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

214.749 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

214.760 Italian Humanism from Petrarch to Poliziano

What were Italian humanists doing when they decided to write in a "new," seemingly classicizing Latin? Concentrating on five generations of humanists, from Petrarch to Poliziano, and focusing on leading figures in each generation, we will see that classicizing Latin prose served as a unique means of pre-modern philosophical expression, a form of "spiritual exercise" that energized and gave direction to the Italian humanist movement. Yet, as classicizing Latin became part of elite educations and as near-perfect imitation of Ciceronian Latin grew increasingly common, the tasks changed for leading scholars and intellectuals. By the generation of Lorenzo Valla (+1457), important thinkers moved beyond technical imitation; philology began to challenge institutionalized philosophy on its own ground and at the same time to give impetus to a different kind of philosophy, deliberately anti-institutional, resistant to orthodoxies, and highly attentive to the complexities of language. After Poliziano, that same anti-institutional energy was transferred into European vernaculars, and an important phase of the Italian Renaissance came to an end. Prerequisite: some basic reading knowledge of Latin.

Celenza

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

214.768 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 favourite 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**215.631 Calderón de la Barca: Golden Age Drama**

In this course we will discuss two dramas by Calderón, the auto-sacramental *El divino Orfeo* (second version, 1663) and the comedi *El médico de su honra* (1635). Classes will focus on a close reading of these texts. In addition we will consider such general problems related to Golden Age literature as the relation to humanism, the function of the references to theology and dogma, the status of allegory, and the prominence of quasi-archaic patriarchal structures. This course will be open to graduate students and to advanced undergraduates.

Küpper

215.632 Celestina

"*Celestina*" is one of the most famous dramas written in castellano, but in the present day its resonance can seem difficult to explain. Course offers close reading of the text and proceeds to more general topics.

Küpper

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 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 chorals will be the primary topic covered; analysis of individual plays from the viewpoint of court theater will also be included.

Sieber

215.637 Patrons and Writers in Golden Age Spain, Part I

Sieber, Kagan

215.638 Patrons and Writers in Golden Age Spain, Part II

Sieber, Kagan

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

215.648 Writing Mexico: Anonymous Nahuatl Authors and the Work of Sahagún

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 Sahagún's work.

Castro-Klarén

215.649 The Cid

This course traces the figure of the Cid from medieval warrior to national hero. Readings include the *Poem of Mio Cid*, re-creations of the legend, and the history of scholarship.

Altschul

215.650 Across the Avant-Garde: Race, Culture, Nation

The study in comparative perspective of socio-cultural issues in race and cultural formation during the post romantic emergence of distinct modernist literary and artistic movements and trends in Spain, Cuba, and Ireland, from the 1830s through the 1920s. Of central concern will be Terry Eagleton's depiction of an "archaic avant-garde" in the Irish case, examined through James Joyce's *The Portrait of the Artist as a Young Man*, and related to equivalent (though not similar) affirmations and critiques of ethnic and national identities in Spain and

Cuba, across the crisis created by the demise of empire and the troubles and challenges of post-colonial nation-building.

E. González

215.653 Goya and Carpentier

A study of Enlightenment mythology and its revolutionary aftermath through a close examination of *El siglo de las luces* and the significance of Goya's work in the novel's conception of romantic irony and satire.

E. González

215.654 Poet, Nation, and Democracy

Selected readings in poetry and socio-political issues through critical legacies of José María Heredia, Ralph Waldo Emerson, Walt Whitman, José Martí, Pablo Neruda, Gabriela Mistral, Federico García Lorca, and Nicolás Guillén.

E. González

215.665 Vargas Llosa and the French Connection

The course will explore the genealogy of Vargas-Llosa's art and literary criticism. The course will consider the relationship of Vargas Llosa's narrative art and French realism. Assignments will be on the theory of the novel, novels authored by Flaubert and Hugo, and four novels by Vargas Llosa.

Castro-Klarén

215.684 From Manuscript to Copyright and Beyond: The Life of Medieval Iberian Text

This course will examine texts beginning with *El Conde Lucanor* by Don Juan Manuel through medieval versions and modern scholarly adaptations. This collection of framed narratives, contemporary to *Canterbury Tales* and Boccaccio's *Decameron*, will lead us to current discussions on copyright and individual authorship, open source and hypertextuality. Taught in Spanish.

Altschul

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

215.691 Muslim, Jewish, and Christian Literatures in Iberia

Please see description for 212.491.

Altschul

215.697 Chivalry in Spain

This course examines chivalry in the Spanish Middle Ages through literary and theoretical accounts. Readings include Arthurian, antique, and Carolingian subject matter as well as knightly manuals.

Altschul

215.714 Philosophico-Political Marginality

This seminar will examine the work of four prominent thinkers of the political outside-mainstream philosophical traditions in 20th-century Europe. We will study their intersections and differences, as well as their approaches to political theology. The emphasis will be on Zambrano, as the least known of the four. We will read primary works and secondary bibliography.

Morieras

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

215.725 Conceptualization of History in Spanish Golden Age Drama

By comparing Calderón's dramas to the 16th-century sources they are based on (Alvares, Garcilaso) it should be possible to draw conclusions regarding the concept of history which dominated or was intended to dominate in the Golden Age of Spain.

Küpper

215.736 Indelible Footprints: Islam in Spain

This course explores the effects of the Muslim invasion of the Iberian peninsula in 711—its impact during the 800-year occupation and beyond. Spain's unique "orientalism" the hybrid realities of *moros* and *moriscos* in a predominantly Christian society, of *mudejares* and *mozarabes*, their variations over space and time, religious and occult associations and inquisitorial practices, as well as intriguing representations of the gendered Other will be topics for discussion based on our analysis of literary, historical, and theoretical texts.

Brownlee

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, Bakhtin, 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

215.743 The Coloniality of Power and the Counter Reformation in Mexico and the Andes

Readings will include texts written without words, Saha-gun's informants, Guaman Poma, Garcilaso de la Vega Inca, hagiographies, and mystics' and Inquisitors' texts.
Castro-Klarén

215.744 Representations, Nature, and Social Formations in Modern Latin America

Castro-Klarén

215.747 Borges in Theory

An in-depth reading of Borges major work and its relation to critical theory.

Castro-Klarén

215.750 Medieval and Contemporary Literatures and Cultures Face Off

Taking into account comparative studies in medieval and modern literatures and theory, this seminar examines ways in which these temporally distant and apparently incommensurable cultural productions reflect on and dialogue with one another. Classes will discuss modern works and selections from medieval texts including *Tirante el blanco* and *Amadís de Gaula* face to face with Alejo Carpentier's *Los pasos perdidos*; *Cárcel de amor* and *El collar de la paloma* with Gabriel García Márquez's *El amor en los tiempos del cólera*, and *Siete infantes de Lara* and *Poema del Cid* with *Crónica de una muerte anunciada*. Additional texts include *El amor y otros demonios* (García Márquez), *El beso de la mujer araña* (Manuel Puig), *Eric y Enide* (Manuel Vázquez Montalbán), and *El señor de los últimos días* (Homero Aridjis). Theory includes psychoanalysis, the location of medievalism in the development of contemporary critical theory, and studies on spatialization and temporality.

E. González/Altschul

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, María Rostworosky, 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 Huaro-chiri 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 y del al 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 Gal-

lego (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 17th-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 America's 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

Interdepartmental**360.606 In Search of the Sacred: Pilgrimage and Crusade in Medieval Europe**

(Cross-listed with History of Art.)

Nichols, Weiss

**360.610 Culture, Communications, and Technology:
New Research Paradigms in the Digital Age**

Permission required. (Cross-listed with History of Science, Medicine, and Technology.)

Kargon, Anderson

360.641 Subverting the Text

Seminar examines the process of subverting texts. Cases include Cartesian/Newtonian physics, phlogiston chemistry, Darwinian biology, Rousseau's Botanical Letters, Diderot and d'Alembert's *Encyclopedia*, the Munich 1937 exhibit *Degenerate Art* and staging non-theatrical literature. Anderson, Kargon

360.653 (H,S) Culture of Reason

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 360.453. (Cross-listed with History of Science and Technology.)

Anderson, Kargon

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. A Mellon Postdoctoral Fellowship is offered every other year, and visiting resident fellowships are offered annually. Summer research grants for graduate and undergraduate students associated with institute programs are available on a competitive basis.

The undergraduate component of the program is the minor in Multicultural and Regional Studies.

Advisory Committee

Giovanni Arrighi, Professor, Sociology.

Sara S. Berry, Professor, History.

Sara Castro-Klarén, Professor, Romance Languages and Literatures.

Veena Das, Professor, Anthropology.

George Fisher, Professor, Earth and Planetary Sciences.

Siba Grovogui, Associate Professor, Political Science.

Margaret Keck, Professor, Political Science.

M. Ali Khan, Professor, Economics.

Felicity S. Northcott, Senior Lecturer (Associate Director), Anthropology.

Beverly Silver, Professor, Sociology.

Minor in Multicultural and Regional Studies

The minor offers undergraduates a chance to concentrate on a region, population, or theme from a cross-cultural perspective. It was developed to enable students to pursue studies of non-Western societies or aspects of American and European cultural pluralism.

The student selects a region, theme, or population and discusses his/her intention with the assistant director. The specific geographical, historical, and cultural foci are worked out in active discussion. With the assistance of a faculty adviser specializing in the relevant sphere of study, the student then prepares a brief written proposal outlining and explaining the intended minor program.

Students interested in overseas research may apply for funding through the institute. Summer research must be completed prior to the senior year.

Requirements for the Minor

The minimum course requirement is six courses (18 credits). Four courses should deal specifically with the students chosen region, population, or theme. At least two courses should deal explicitly with cross-cultural issues. Two courses must be upper-level. Upper-level language courses may be used to complement other upper-level courses. The list of courses below should be regarded as partial. A complete list of courses is provided each semester. Students may propose courses not on the list that are related to their minor. Course descriptions may be found under the individual departments.

Courses

Global Studies

360.336 Minor in Multicultural and Regional Studies Methods Seminar

360.669-670 General Seminar of the Institute for Global Studies in Culture, Power, and History

A colloquium series for faculty and graduate students. During the fall semester, the seminar welcomes visiting scholars from around the world to present their work in progress. During the spring semester, both visiting scholars and graduate students present works in progress. Attendance is mandatory.

Anthropology

070.324 The Social History of Languages

070.331 Gypsies, Tramps, and Thieves: Outsiders in Urban Society

070.345 Who Framed Koreans in Japan?

070.364 Japan as the Other

070.365 Ethnography and Autobiography

070.367 The Anthropology of Love

070.371 Linguistic Theory: A Brief History

070.374 Introduction to Modern South Asia

Arabic

All upper-level Arabic courses.

Chinese

All upper-level Chinese courses.

Economics

Courses identified by faculty that include discussion on race, ethnicity, gender, or non-Western cultures.

German and Romance Languages and Literatures

Most upper-level French courses.

212.645 Colonial Texts and Postcolonial Theory

History

100.121-122 History of Africa

100.131 History of East Asia

100.347 Early Modern China

100.348 Twentieth-Century China

100.427 Ancient Civilizations of Central and South America

100.429-430 The History of Colonial Brazil

100.461 Power, Identity, and the Production of African History

100.478 Colloquium: Problems in Chinese Agrarian History

100.479 Colloquium: Problems in Chinese Urban History

100.482 Colloquium: Historiography of Modern China

100.491 The Age of Exploration

100.492 Comparative Urban History

100.497 Comparative Agrarian History

Japanese

All upper-level Japanese courses.

Music

376.401 Music and Ritual

376.402 Music, Language, and Culture

Near Eastern Studies

130.325 Women in Ancient Egypt

130.326 Egyptian Religion and Mythology

Political Science

190.209 Contemporary International Politics

190.411 Environment and Development in the Third World

190.414 Topics in U.S. Foreign Policy

Courses identified by faculty that include discussion on race, ethnicity, gender, or non-Western cultures.

Sociology

230.150 Issues in International Development

230.390 Theories of Social Change and Evolution

230.391 Theories of International Development

Courses identified by faculty that include discussion on race, ethnicity, gender, or non-Western cultures.

Interdepartmental

360.344 Africans in Motion

360.353 U.S.–Latin American Relations: Past and Present

360.386 Do You Want Fries With That? A History of Food and Eating in America

360.509 Seminar Practicum: Gender, Justice, Social Policy, and Political Action

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 advisers 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.

David A. Bell, Professor: early modern European history, with emphasis on France, and the origins of nationalism.

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.

Philip Curtin, Herbert Baxter Adams Professor Emeritus.

Jane Dailey, Associate Professor: history of the 19th- and 20th-century 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: early modern colonial British America.

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.

Pier M. Larson, Associate 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, Assistant Professor: Jewish history, modern Russian, and East European history.

David Nirenberg, Charlotte Bloomberg Professor of the Humanities: social and cultural relations between Christians, Jews, and Muslims in medieval Europe.

John G. A. Pocock, Harry C. Black Professor Emeritus.

Orest Ranum, Professor Emeritus.

Willie Lee Rose, Professor Emerita.

Dorothy Ross, Arthur O. Lovejoy Professor of History: American intellectual history, the history of the social and behavioral sciences.

William T. Rowe, John and Diane Cooke Professor of Chinese History: modern East Asia, especially socioeconomic, urban history.

A. J. R. Russell-Wood, Herbert Baxter Adams Professorship of History: pre-Columbian and colonial Latin America with emphasis on Brazil, an interest in the Portuguese seaborne empire and comparative colonialism.

Mary Ryan, John Martin Vincent Professor: 19th-century United States history with emphasis on

women, gender, urban history, and the cultural landscape.

Gabrielle Spiegel, Krieger-Eisenhower Professor: medieval history, with special interest in historiography and linguistic analysis.

Nancy Struever, Professor Emerita.

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 47.)

Programs are prepared in collaboration with the student's adviser, 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 adviser, 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.

Nirenberg 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, Nirenberg 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.

Bell, 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, eco-

nomical, 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 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, Dailey 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

100.115-116 (H,S,W) History of Latin America

General trends from the pre-Columbian period to the eve of Independence. Special emphasis on the socioeconomic nature of colonization and the extent to which colonial institutions reflected those of Spain and Portugal.

Russell-Wood 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

100.159 (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

100.180 (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

100.191 (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

100.204 (H,S) The French Revolution

Political, social, and cultural history of one of the great turning points in European history.

Bell 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, 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

100.243 (H,S) Brazil for Beginners

Eleven keys to an understanding of contemporary Brazil have been selected and put in historical perspective in a discussion of continuity and discontinuity.

Russell-Wood 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

100.286 (H,S) Women in the American South

An introductory seminar that investigates the history of Southern women from the Revolution to the civil rights movement.

Dailey 3 credits

Advanced Courses**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

100.312 (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 distintegrative force; class conflict and socialism in Jewish life.

Moss 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

100.325 (H,S,W) Cultural History of Imperial Russia

The development of a modern Russian culture. Topics include literature, intellectual life, the revolutionary movement, and popular culture. The emphasis is on the 19th and early 20th centuries.

Brooks 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

100.330 (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

100.338 (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

100.345 (H,S) Portuguese Seaborne Empire

Using a variety of literary and historical sources available in English, this course will trace the period from the conquest of Ceuta in 1415 to the independence of Portugal's colonies.

Russell-Wood 3 credits

100.346 (H,S) Portugal and the Wider World

Exploration and Portuguese settlement in Africa, Asia, and America, and integration of these regions into a multi-continental, multi-oceanic system. Political, commercial, military, cultural, and social aspects examined in the context of European/non-European interactions.

Russell-Wood 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) Narratives of Conquest and Discovery: Europe and the Wider World

Kagan 3 credits

100.352 (H,S) Politics and Culture in the Age of Pasternak

Brooks 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

100.359 (H,S) The French Enlightenment

Major works of the French Enlightenment and some recent interpretations.

Bell 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

100.367 (H,S) France in America

Open to undergraduate and graduate students.

Bell 3 credits

100.368 (H,S) The Art of Historical Narrative

After examining some of the great historical narratives (including Gibbon, Michelet, Parkman, etc.), the course will look at recent debates over the genre, and recent attempts to reinvent it.

Bell 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

100.373 (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

100.396 (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

100.399-400 (H,S,W) American Intellectual History

A study of basic traditions in American thought and their leading exemplars, from the Puritans to contemporary advocates of postmodern culture. Lectures, readings, and discussions.

Ross 3 credits

100.405 (H,S,W) European Socialist Thought, 1840–1940

Extensive reading of works by Proudhon, Marx, Bakunin, Sorel, Bernstein, Luxemburg, 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

100.426 (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

100.427 (H,S) Ancient Civilizations of Central and South America

The rise and fall of the Mesoamerican and Andean peoples of pre-Columbian America. Special emphasis will be placed on the interrelationship between man and his environment and the interplay between economic, technological, political, and religious factors in these societies.

Russell-Wood 3 credits

100.428 (H,S,W) London—World City (1790–1918)

Walkowitz 3 credits

100.429-430 (H,S,W) The History of Colonial Brazil

Development of Brazilian civilization from 1500 to 1822 with special reference to the interrelationship of socio-economic determinants and Crown policy.

Russell-Wood 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

100.438 (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

100.453 (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 discontent, 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

100.463 (H,S) The African Diaspora: The Brazilian Experience

Outside of Africa, the largest population of persons of African descent is in Brazil. This course will examine this diaspora through literature, iconography, and historical documentation.

Russell-Wood 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) Classics and Counter-Classics in American Thought

Seminar on some of the classic texts and newly classic oppositional texts in the history of American thought.

Ross 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 Americas and the Africa. 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

100.491 (H,S,W) The Age of Exploration

An interdisciplinary and comparative perspective on the chronology and geography of terrestrial and maritime exploration (800 A.D. to 1777) and its social, technological, economic, and political repercussions.

Russell-Wood 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 indus-

trialization; 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

100.602 Auxiliary Disciplines of Medieval History

Izbicki

100.614 The New History of the Social Sciences

Reading seminar on histories of the social sciences written since the 1970s, with attention to their theoretical background.

Ross

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

100.652 European Socialist Thought

Socialist, communist, and anarchist theories since Marx.

Jelavich

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.

100.658 The European Revolutions of the 1790s

Bell

100.660-661 France: Culture, Society, Politics, 1700–1950

Intensive introduction to this period of French history, emphasizing political culture, cultural politics, and the French Revolution, as well as themes in social history.

Bell

100.666-667 Approaches to the Enlightenment

Bell

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

100.673-674 Research Seminar in Colonial British America and Early United States

Ditz

100.675-676 Colloquium: Sociology of Early Modern British-American Colonization, 1580–1783

Greene

100.677-678 Research Seminar in Early Modern Colonial British America

Greene

100.680-681 Research Seminar in Atlantic History, 1600–1800

Morgan

100.687-688 American Economic and Political History

Galambos

100.695-696 Problems in American Social and Cultural History

Walters

100.699-700 American Intellectual History

Ross

100.707-708 Colonial Latin America

Russell-Wood

100.709-710 Modern Latin America

Knight

100.711-712 Topics in Brazilian History

Russell-Wood

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

100.714-715 Christians, Muslims, and Jews: Religious Identity in Medieval Spain

Large populations of Muslims, Christians, and Jews coexisted in medieval Iberia. We will explore the dynamics of that coexistence, and its consequences for the religious identities of the three communities.

Nirenberg

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, Greene, 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

100.743 Graduate Reading Seminar: Topics in Jewish History

Intensive introduction to modern Jewish history.

Moss

100.749 Social Theory for Historians

Jelavich

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

100.771-772 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

100.778 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

100.801-802 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.
Berry, Carter

Interdepartmental

360.321 The Social History of Languages

Bell, 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 of unsurpassed 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, Professor (Chair): Italian Renaissance art.

Charles Dempsey, Professor: Renaissance and baroque art.

Michael Fried, Professor, Herbert Boone Chair in the Humanities (The Humanities Center): Modern art.

Herbert L. Kessler, Professor: early Christian and medieval art.

Michael Koortbojian, Professor: Roman art.

Henry Maguire, Professor: Byzantine and medieval art.

Kathryn Tuma, Assistant Professor, Second Decade Society Career Development Chair: modern art

Adjunct, Associate and Visiting Faculty

Doreen Bolger, Adjunct Professor; Director of The Baltimore Museum of Art: modern art.

Betsy M. Bryan, Adjunct Professor (Near Eastern Studies, Chair): Egyptian art and archaeology, Egyptology.

Elizabeth Cropper, Adjunct Professor; Dean, Center for Advanced Study in the Visual Arts, National Gallery of Art: Italian Renaissance and baroque art.

Lisa DeLeonardis, Lecturer (and Curator, Baltimore Museum of Art): ancient art of the Americas.

Eik Khang, Adjunct Professor, Curator of 18th- and 19th-Century Art, The Walters Art Museum: Modern art.

Marcia Kupfer, Adjunct Professor: medieval art.

Eunice Dauterman Maguire, Senior Lecturer: museum studies, ancient and medieval art.

Barksdale Maynard, Visiting Lecturer: modern American and British art and architecture.

William Noel, Adjunct Professor; Curator, Walters Art Museum.

Peter Parshall, Adjunct Professor; Curator of Prints and Drawings, National Gallery of Art: northern Renaissance art.

Ronald Paulson, Adjunct Professor (English): 18th- and 19th-century English art.

Elizabeth Rodini, Adjunct Professor, Renaissance art and museum studies.

Salvatore Settis, Adjunct Professor; Scuola Normale Superiore, Pisa: ancient and Renaissance art.

H. Alan Shapiro, Adjunct Professor (Classics, Chair): Greek and Roman art.

Carl Strehlke, Adjunct Professor; Adjunct Curator of the John G. Johnson Collection, Philadelphia Museum of Art: Italian Renaissance art.

Gary Vikan, Adjunct Professor; Director of The Walters Art Museum: Byzantine 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 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 47.)

Because the department emphasizes the historical, cultural, and social context of art, art history is an excellent program for undergraduates interested in a humanistic education as well as for those preparing for a career in the field. A departmental adviser 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: two in Medieval, two in Renaissance/Baroque, two in Modern, and the seventh either in one of those fields or in Ancient, Asian, or African Art. A secondary field consisting of three courses outside art history is developed with the undergraduate adviser.

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.

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 and two courses in each of the following periods: Medieval, Renaissance/Baroque, and Modern.

Graduate Programs

The M.A. and Ph.D. programs are designed to give students a systematic knowledge of the history of European art and an understanding of the methods of art-historical research. The programs emphasize close working relationships among students and faculty in seminars and acquaintance with the outstanding art treasures in the Baltimore-Washington area.

Courses offered at the Hopkins-owned Villa Spelman in Florence are open to qualified graduate students in the department. 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. Applications must be completed before January 15. 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 and grants to the Villa Spelman. 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.

Requirements for the M.A. Degree

Students applying to the M.A. program are expected to have a basic knowledge of art history comparable to that provided by the undergraduate requirements of the department. Applicants must demonstrate their ability to read both French and German, and M.A. students must pass the departmental examination in one during their first term and in the other at the beginning of the second.

The M.A. curriculum is intended to introduce areas of European art the student has not studied before and to deepen the student's general background in the history of art. A minimum of six graduate courses is required. In addition, students are expected to familiarize themselves with the basic art-historical writings in all areas of European art and to become well acquainted with the major collections in the Baltimore-Washington area. The M.A. degree is awarded upon completion of the course and 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 French 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 advisers, 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 Michael Koortbojian 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 and Henry Magu-

ire. As an adjunct member of the faculty, Gary Vikan is available for consultation. Stephen Nichols of the Department of German and Romance Languages and Literatures offers courses on illuminated manuscripts and related topics.

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

An annual seminar for Hopkins students at the Villa Spelman dramatizes the special interests and resources for Renaissance and Baroque art available to Hopkins graduate students. Located on six acres of gardens a short walk from the center of Florence, the villa is growing into a major center of Renaissance studies to which Hopkins graduate students have access.

In Baltimore, students work with Professors Stephen Campbell and Charles Dempsey. Associates of the department, Professors Elizabeth Cropper, Peter Parshall, Salvatore Settis, and Carl Strehlke, also work with students.

Modern

Students interested in 18th-, 19th-, and 20th-century art work with Professors Michael Fried, Ronald Paulson, 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 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

010.306 (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, and occasional meetings at the Villa Spelman, the Johns Hopkins Center for Italian Studies in Florence. 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

010.314 (H,W) Art of the First Millennium

Complicated interactions among pagans, Jews, and Christians provide the historical context for tracing the emergence of a distinctive Christian art before A.D. 1000.

Kessler 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

010.332 (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

010.335 (H) Ancient Latin American Visual Expressions

This course addresses the social, cultural, and historical contexts of ancient Latin American art.

DeLeonardis 3 credits

010.338 (H) Italian High Renaissance and Mannerist Art

The development of humanist and anti-humanist art in the 15th and 16th centuries, with special emphasis on

the works of Botticelli, Leonardo da Vinci, Michelangelo, Raphael, Giorgione, Titian, and their followers in central and north Italy.

Dempsey 3 credits

010.339 (H) Renaissance Florence

Transformations in the visual arts in Florence, Italy, during the Renaissance, with an emphasis on the social context and function of key works of art.

Staff 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

010.341 (H) Ovid in the Renaissance

A range of Renaissance attitudes to pagan antiquity will be considered through an examination of mythological themes in both text and image, with an emphasis on the reading and imitation of Ovid's *Metamorphoses*.

Campbell 3 credits

010.351 (H) Renaissance Art and the Revival of Antiquity

A lecture course devoted to problems of style, subject matter, and interpretation.

Staff 3 credits

010.355 (H) Artistic and Intellectual History of Florence, 13th–16th Centuries

Readings, lectures, site visits, and field trips. Course is held in Florence, Italy.

Staff 6 credits

010.356 (H) Poussin and the Origins of Neoclassicism

Poussin was the founder of a permanent idea of classicism in French art, an idea that continued to engage artists as late as Cézanne. We will be examining the formation of that style in 17th-century Rome.

Staff 3 credits

010.363 (H) Italian Baroque Art: Naturalism and Idealism in 17th-Century Art from Caravaggio to Poussin and Bernini

A chronological survey of primary critical and historical developments in Italian 17th-century art. Special emphasis will be given to the works of Caravaggio, the Carracci, and their Bolognese followers, Pietro da Cortona, Bernini, and Poussin.

Staff 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

010.370 (H) Art of Ancient Peru

Centers on visual traditions of the Inka and antecedent civilizations. Held in Peruvian museums/research repositories, exposes the student to portable sculpture and woven arts of the Chavín, Moche, Nasca, and Inka.
DeLeonardis 3 credits

010.378 (H) Roman Historical Art

The tradition of historical representation (and its mythic parallel) from its Greek and Etruscan precedents to its apogee in Imperial Rome.
Koorbojian 3 credits

010.384 (H) Early Christian and Early Medieval Art

This course will cover the art of the late Roman Empire, of early medieval Europe, and of the eastern Mediterranean from the third to the eighth centuries.
H. Maguire 3 credits

010.385 (H) Byzantine Art

This course will cover the arts of Byzantium in the medieval period, from the eighth to the 15th centuries.
H. Maguire 3 credits

010.386 (H) Romanesque Art

This course looks at the flowering of art and architecture in Western Europe during the Romanesque period, in the 11th and 12th centuries.
H. Maguire 3 credits

010.387 (H) History of Ceramics

This course surveys the technical, aesthetic, and social aspects of Eastern and Western ceramic art from the ancient world up to the 19th century through lectures and museum visits.
H. Maguire, E. Dauterman Maguire 3 credits

010.390 (H) Art Museum Policy and Practice

This hands-on seminar will look behind the scenes at displays and exhibitions, museum operations and programs, as signs of current thinking about what art, past and present, may be.
E. Dauterman Maguire 3 credits

010.392 (H) Creating a Museum Exhibition

Research, interpretation, and presentation: a hands-on introduction.
E. Dauterman Maguire 3 credits

010.405-406 (H,W) Proseminar

Taught on a rotating basis by members of the History of Art faculty, the proseminar is designed for advanced undergraduates seeking highly focused study in the discipline.
Staff 3 credits

010.521-522 (H,W) Honors Thesis

Open to students by arrangement with a faculty adviser in the History of Art Department. Interested students should review program description available in department office.
Staff 3 credits

010.552 Museum Internship

An opportunity for firsthand experience in museum work on the Homewood campus or in local museums.
E. Dauterman Maguire up to 3 credits

Cross-Listed**040.320 (H) Myth in Classical Art**

Shapiro 3 credits

040.322 (H) Roman Art: Between Myth and History

Shapiro 3 credits

070.103 (H) Africa and the Museum

Guyer 3 credits

300.336 (H) Classics of Art Criticism I: Diderot and Baudelaire

Fried 3 credits

300.355 (H) Classics of Art Criticism II: Fry and Greenberg

Fried 3 credits

300.365 (H,W) Eye and Mind

Fried 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

010.610 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 Medieval Art

Examination of select monuments in light of recent methodological trends.
Kessler 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

010.621 Recent "Art" Photography and Photographic Painting

Artists to be studied include Richter, Wall, Struth, Gursky, Dijkstra, di Corcia, Streuli, and Welling.

Fried 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

010.633 Renaissance Art Before Raphael: The Importance of the Vernacular Style

An examination of the importance to the early Renaissance of the conventions of naturalistic representation in the context of a concept of vernacular expression.

Staff 2 hours

010.641 Art in Florence under Lorenzo deMedici

A seminar devoted to art produced in the context of humanist culture as promoted by Lorenzo deMedici and his cultural policies. Subjects chosen for particular emphasis will vary and will include such artists as Botticelli, Verrocchio, the Lippi, Pollaiuolo, as well as such phenomena as the rise of engraving, manuscript illumination, and festival celebrations.

Staff 2 hours

010.643 Florentine Art in the Time of Lorenzo deMedici

An examination of painting and sculpture produced in Florence with particular attention paid to that art directly related to the patronage and humanist culture of Lorenzo the Magnificent.

Staff 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

010.645 Problems in Renaissance Iconography

A seminar in sources and methods of iconographical interpretation for Renaissance art.

Staff 2 hours

010.647 The Carracci and the Reform of Art in Italy

A seminar in the Carracci, their Academy, and the development of their art.

Staff 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

010.652 Botticelli

A close examination of Botticelli's career and development with special attention paid to his relation to other artists and poets also partaking in the cultural policies sponsored by Lorenzo the Magnificent.

Staff 2 hours

010.658 Special Topics in the Art of Lombardy and the Veneto, 1500–1600

Campbell 2 hours

010.664 Triumphal Forms

The republican triumph provides the background for a focus on the new "triumphalist" ethos of the imperial period and its innovative monumental forms.

Koortbojian 2 hours

010.677 Secular Arts of Byzantium

This seminar will study the secular arts of Byzantium from the eighth to the 14th centuries, including metalwork, ivories, stone sculpture, ceramics, and silks.

H. Maguire 2 hours

010.682 Medieval Art and Architecture of Venice

This seminar will study the art and architecture of Venice and its colonies from the ninth to the 15th centuries, including architecture, sculpture, wall and floor mosaics, painting, and metalwork.

H. Maguire 2 hours

010.683 Late Antique and Byzantine Floor Mosaics

This seminar will study the techniques, iconography, and social contexts of secular and ecclesiastical floor mosaics of the late Roman and Byzantine empires, from the fourth to the 13th centuries.

H. Maguire 2 hours

010.684 Early Christian and Byzantine Textiles

This seminar will study the techniques, decoration, and social functions of textiles from the late Roman and Byzantine worlds, including secular furnishings and costumes, liturgical cloths and vestments, and imperial silks.

H. Maguire 2 hours

010.685 Early Christian and Byzantine Wall Mosaics

This seminar focuses on the techniques and iconographic programs of wall and vault mosaics and on problems of their interpretation. The alteration of mosaics by medieval and modern restorers is also considered.

H. Maguire 2 hours

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

010.801-802 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 advisers.

Staff

Cross-Listed**040.615 Sanctuaries of Attica**

Shapiro

040.648 Programmatic Painting in Pompeii and Rome

Shapiro

040.659 Archaic Greek Vase-Painting

Shapiro

040.686 Return to the City of Images

Shapiro

060.643 William Blake's Illuminated Books: Studies in Blake's Truth

Grossman

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

300.604 Literature of the City

Hertz

300.602 Theory, Painting, Vision

Fried

300.625 Theories of Representation

Fried

300.627 Walter Benjamin's *The Arcades Project*

Fried

Interdepartmental**360.606 In Search of the Sacred: Pilgrimage and Crusade in Medieval Europe**

Nichols

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 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.

Morris Low, Adjunct Associate Professor: Japanese physics and technology, cultural history of science in Japan.

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.

Harry M. Marks, Associate Professor, Elizabeth Treide and A. McGehee Harvey Professor in the History of Medicine: history of medicine, 20th century; medical research, history and policy; history of public health; history of disease.

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.

Daniel P. Todes, Professor: history of Russian medicine and science, social relations of scientific thought, history of biomedical sciences.

Part-Time and Joint Appointments

James D. Goodyear, Senior Lecturer: history of tropical medicine, history of 18th and 19th centuries.

Latin America

Elizabeth Rodini, Associate Director, Program in Museums and Society

Undergraduate Program

(See also General Requirements for Departmental Majors, page 47.)

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 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 distribution requirements. Laboratory courses in science count toward this requirement.

• History of Science and Technology:

A total of 24 credits of course work in the history of science 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 adviser.

Minor in the History of Science 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 adviser'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 department at:

The Department of the History of
Science and Technology
3505 North Charles Street
Baltimore, Maryland 21218

For further information on our faculty and programs, please visit our Web site at: <http://web.jhu.edu/host>.

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.

Program in the History and Philosophy of Science

The Center for the History and Philosophy of Science was created in 1969 for the purpose of fostering a closer relationship at Johns Hopkins University between the two disciplines of the history and the philosophy of science. The center administers a graduate program, described below, and a speakers program, in which visiting scholars are invited to the campus to deliver lectures and participate in colloquia and discussions.

Graduate students in either the Department of Philosophy or the Department of the History of Science and Technology may apply to enroll in the special program of studies in the History and Philosophy of Science coordinated by the center. Those accepted for this program take six semester courses in the history and philosophy of science, as follows:

- Two semester courses at the 300-level in the history of science
- Two semester courses in the philosophy of science, including the survey course 150.431
- One course in the philosophy of science
- One course in the history of science

These last two courses are to be drawn from an approved list in history of philosophy, philosophy of science, and history of science. At least one course in the history of science and one course in the philosophy of science must be at the 600-level.

Students who fulfill the requirements for this special program are certified by the Center for the History and Philosophy of Science. They receive their Ph.D. from one of the two departments in accordance with that department's requirements.

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 adviser 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.
Staff 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 Amer-

ica, from the 18th century to the present. Graduate students register for 150.701, School of Medicine.
Fissell, Marks 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

140.301 (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

140.309 (H,S) History of the American Automobile

The technological development, business context, and social impact of the American automobile. Topics include history of recurrent fuel crises and their effect on engine design, evolving business structure of automobile firms and their response to new competitive environments, and the social implications of the automotive technological networks.
Leslie 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.
Tode 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.
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

140.329 (H,S) Seven Wonders of the Modern World

Everyone knows the Seven Wonders of the ancient world, but what about their modern counterparts? Course explores seven modern engineering marvels (e.g., Eiffel Tower, Hoover Dam) to discover the ingredients of successful large-scale engineering.
Leslie 3 credits

140.331 (H,S) History of Chemistry

This course surveys the development of chemistry from antiquity to the modern period. It will stress the changing ways of visualizing and explaining the nature and changes of material substances, and the historical context and ramifications of such views. Recent reevaluations of the history of chemistry will be examined. Topics include atomism/corpuscularianism, alchemy, Paracelsianism, mechanical chemistry, and the 19th-century rise of modern chemistry.
Principe 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

140.360 (H,S,W) Changes in the Land: Science, Technology, and the American Environment

Introduces students to topics and methods in environmental history through readings in U.S. history beginning with the settlement of New England through the ecology movement of the 1960s.

Kingsland 3 credits

140.382 (H,S) Sickness and Health in Early Modern Europe

The social history of birth, death, sickness, and health is discussed in conjunction with the development of health-care institutions and state and social responses to disease, 1500-1800.

Fissell 3 credits

140.384 (H,S) Analogy and Metaphor in Science, Medicine, and Technology

How do metaphors in science, technology, and medicine originate and how do they influence human thought? The course explores such examples as William Harvey's analogy between the heart and a pump, Charles Darwin's concepts of the struggle for existence and natural selection, military metaphors in the history of public health, the use of metaphors of production in medicine, and the comparison of the brain to a computer.

Todes 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, Todes

140.619-620 Seminar in the History of Medicine

Fissell, Marks

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

140.701 History of Medicine: Antiquity to Scientific Revolution

Bylebyl

140.702 Outline of the History of Medicine, 18th–20th Centuries

Marks

140.703 Seminar in the Social History of Early Modern Medicine

Fissell

140.708 Rise of Modern Science

Kingsland

140.710 Scientific Revolution

Staff

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

140.837-838 Directed Reading and Dissertation
Low

140.853-854 Directed Reading and Dissertation
Packard

140.871-872 Directed Reading and Dissertation
Marks

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 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.

Hent de Vries, Professor (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 (Director) (History): history and theory of psychoanalysis, history of psychiatry and psychology, 19th- and 20th-century intellectual history, feminist theory.

Richard A. Macksey, Professor (The Writing Seminars; History of Science and Technology): comparative literature, critical theory, film studies.

Paola Marrati, Professor (Philosophy): modern and contemporary French thought, phenomenology, philosophies of life (Bergson, Dilthey, Canguilhem, Deleuze), philosophy and cinema, aesthetics.

Elizabeth Patton, Visiting Assistant Professor: Renaissance and early modern literature with special emphasis on women writers.

Nancy S. Struever, Professor Emerita.

Joint Appointments

Primary appointments in parentheses.

Christopher Celenza, Professor: Italian literature.

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

Marcel Detienne, Basil L. Gildersleeve Professor (Humanities Center): Greek, social history, cultural history, mythology, anthropology, and classics. Retired effective January 1, 2008.

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: metaphysics, history of philosophy, Kant and German idealism.

Stephen G. Nichols, James M. Beall Professor of French and Humanities (Chair, German and Romance Languages and Literatures): medieval language, literature and culture; interrelation of literature with history, philosophy, and art history.

Undergraduate Programs

The Humanities Center's activities for undergraduates address two different needs. For students interested in a general liberal arts preparation or in one of the university's preprofessional programs, the center provides a broad introduction to the documents and thought of Western culture. For students interested in pursuing their interests in graduate school, the center 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. 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 individual's program depends upon careful consultation with the faculty adviser.

Honors Program in Humanistic Studies

The Honors Program offers all qualified undergraduates the possibility for pursuing an independent, often interdisciplinary, research project. Students can propose to do research in some area of intellectual or cultural history, English, foreign and comparative literatures, women's studies, film studies, anthropology, philosophy, or any other humanistic discipline. Students who wish to pursue such a program need not be humanities majors, as the program also gives majors outside the humanities a chance to broaden and combine their studies. To be eligible, a student's performance in courses taken in the humanities should be distinctly above average, and his/her proposed program should show coherence, focus, and seriousness of purpose. Candidates should apply to the Honors Board at the end of sophomore year or the beginning of junior year. Questions about the application procedure and current deadlines should be directed to Dr. Richard Macksey, 114 Gilman. Each project must be sponsored by two faculty members. Frequently, members of the Honors Board serve as advisers, and in special cases an appropriate adviser may be found outside the university.

Requirements for the Honors Program

No fixed number of courses is required for completion of the program. Students usually, however, are expected to participate in the program for four semesters. The chosen advisers assist in designing a program, which generally includes humanities area (H) or other related courses and up to two tutorials or independent studies per semester (designated as honors work on the transcript). In addition, honors students are encouraged to apply for research and travel funds through the Provost's grants and the Rose Traveling Fellowship. Studies will culminate in an honors essay written in the senior year.

At the end of the senior year, the student's work is reviewed by his/her advisers. The Board of Honors Advisers, taking into account the recommendations of the advisers, must approve the honors essay as fulfilling the requirements for the B.A. honors degree. Seniors who complete the program

successfully are awarded honors at the commencement ceremony and on their transcripts.

The B.A./M.A. Program

Students whose work in the Honors Program in Humanistic Studies shows exceptional promise may apply at the end of junior year or the beginning of senior year for admission to candidacy for the concurrent B.A./M.A. degree. This degree requires a reading knowledge (usually at the third-year level) of one foreign language, either ancient or modern. In the case of some individual programs a second foreign language may be necessary. In the senior year, the candidate presents a thesis of criticism or research more extensive in scope and depth than that required for the honors B.A. Subject to the advisers' recommendation and the board's approval, the candidate will receive the B.A. and M.A. degrees concurrently.

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/her advisers. The course of studies, seminars, and tutorials lead 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 Humanities Center.

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.

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

300.105 (H,W) Introduction to the Fictions of Detection

Readings in the analytic, "hard-boiled," and postmodern versions of the detective story.

Macksey 3 credits

300.116 (H,W) Forms of Comedy: Theory and Practice

A comparative survey of comic forms in drama and narrative from classical antiquity to the present. Texts will be read with representative theoretical statements.

Macksey 3 credits

300.118 (H,W) The Uses of Comedy: Theory and Practice

A comparative study of writing and theory with special attention to the devices of satire, irony, and parody.

Macksey 3 credits

300.123 (H) Film as Autobiography

Autobiographical narratives in film, with a focus on recent women film-makers (Armstrong, Sanders, Brahm, von Trotta, et al.). Corequisite: 200.112.

Macksey 2 credits

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

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 Lanier, Elizabeth Cary, Katherine Philips, Margaret Cavendish, Theresa of Avila, Maria de Medici, and Sor Juana Ins de la Cruz.

Patton 3 credits

300.308 (H,W) Comic Relief: Comedy and Catharsis

Versions of comic theory from Aristotle to Freud, Bergson, and Koestler, with an emphasis on psychological explanations of comic design and response. Illustrations will be drawn from examples in literature, film, and the graphic arts.

Macksey 3 credits

300.317 (H) Introduction to Comparative Drama and Film

Macksey 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

300.319 (H, W) The History of Ideas

A tour of interdisciplinary activities largely focused on Hopkins, from Peirce's Metaphysical Club and Lovejoy's History of Ideas Club to more recent developments in cooperative studies in philosophy, history, and literature:

a narrative of people, ideas, institutions, and their consequences.

Macksey 3 credits

300.329 (H) Freud, Religion, and Ethics

A seminar on the history and reception of Freud's ideas about the origin of religion and ethics.

Leys 3 credits

300.330 (H) The Ghost and The Machine

The seminar explores the modern obsession 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 3 credits

300.331 (H,W) Marcel Proust and the Idea of the Novel

The role of books and the metaphor of the Book in the conception of *A la recherche du temps perdu*. Proust's novel is read in its entirety along with his own critical writings and those of a few of his critics.

Macksey 3 credits

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

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, Jaus, 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

300.341 (H) Film as Case History

Course, designed as a satellite to 200.339, will examine detection strategies in both documentary and narrative film.

Macksey 2 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

300.347 (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

Taking Stanley Cavell's *Cities of Words* as our guide, this course explores themes and principles of moral perfectionism in philosophy, literature, and film. Attendance at weekly film screenings is mandatory.

de Vries 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

300.355 (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

300.369 (H) Lush Life: Episodes in the History of Romanticism

A comparative tour of European, English, and American Romantic prose and poetry. The German and French texts will be available in translation.

Macksey 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

300.372 (H,S) Holocaust Testimonies

A seminar on written, oral, cinematic, and other forms of Holocaust testimony.

Leys 3 credits

300.377 (H) Radical Enlightenment: 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.

deVries 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

300.379 (H) The Rhetoric of Fiction: Realistic and Fantastic Narrative?

A comparative study of representation in 19th- and 20th-century fiction, including selected film adaptations.

Macksey 3 credits

300.383 (H) What Makes Us Desire?

This course will analyze different philosophical and literary conceptions of desire. Readings will include Plato, Pascal, Freud, Proust, V. Wolf, Levinas, Deleuze, and others.

Marrati 3 credits

300.386 (H, W) The Satiric Muse

A comparative study of satiric writing from Petronius to contemporary practitioners. Issues will include the variety of satiric genres; the uses of parody, invective, and irony; the devices of verbal and visual satire including some examples from film.

Macksey 3 credits

300.394 (H,W) Films and Fictions of Robert Bresson

A seminar on the development of Bresson's career as filmmaker and on the fictions that he has adapted for the screen. Texts by Diderot, Dostoevsky, Tolstoy, Bernanos, and Bresson's own critical writings (*Notes sur le Cinématographe*). Some considerations of an ancestor (Dreyer) and a successor (Godard).

Macksey 3 credits

300.398 Tragedy and Philosophy

This class will explore the intersection between tragedy and philosophy. We will attempt to delineate what precisely qualifies as tragedy and the tragic. Readings include Sophocles, Euripides, Plato, Aristotle, Nietzsche, Cavell, and Shakespeare. Towards the end of the class, and only peripherally, we will examine the possible connections between tragedy and modernity.

Macksey 3 credits

300.501 Independent Study in Humanities (Tutorial)

Staff

300.502 Independent Study Comparative Literature

Staff

300.503-504 Individual Honors Work Juniors

Open only to students in the Humanistic Studies Honors Program.

Macksey

300.505-506 Individual Honors Work Seniors

Open only to students in the Humanistic Studies Honors Program.

Macksey

300.507 (H) Honors Seminar

A workshop on honors projects in progress and their relation to methods in humanistic studies. Open only to those admitted to the Honors Program.

Macksey 1 credit

300.508 (H,W) Honors Seminar: Methods and Motives

Open only to students admitted to the Honors Program in Humanistic Studies.

Macksey 1 credit

300.526 (W) Editorial Internship

Students with a serious commitment to critical journalism in arts and letters may contract a supervised internship with one of the university publications, the JHU Press, or cooperating sponsors in the community (newspapers, magazines, TV stations). Admission by interview. Satisfactory/Unsatisfactory.

Macksey 3 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

300.602 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, Laplanche, Kristeva, Abraham, Torok, and others.

Leys

300.609 Rhetoric of Fiction

Macksey

300.611 Identification/Disidentification

The concepts and politics of identification and disidentification in psychoanalytic, feminist, queer, and postcolonial theories of identity. Texts by Butler, Bhabha, Borch-Jacobsen, Fanon, Ferenczi, Freud, Sedgwick, and others.

Leys

300.612 (H) 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 (H) 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

300.616 Readings in Classic and Contemporary Film Theory

From early French, German, and Russian theorists to recent discussions of cinematic representation, medium, syntax, style, semiotics, and sociology.

Macksey

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

300.623 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

300.625 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

300.629 Madness after Foucault

Selections of Foucault's texts on psychiatry and psychoanalysis will be read with and against commentaries by historians (e.g., Goldstein, Micale, Lunbeck, Toews), philosophers (e.g., Derrida, Deleuze), feminist critics (e.g., Butler), and others.

Leys

300.631 Topics in Esthetics and Criticism

This seminar will be taught successfully by four "estheticians," Richard Moran (Harvard), David Wellbery (University of Chicago), Michael Fried (JHU), and James Conant (University of Chicago).

Fried

300.635 American Modernism: Stevens, Williams, and Moore

Poetry and selected prose by three American originals: Wallace Stevens, Marianne Moore, and William Carlos Williams. An interlude will be devoted to the home-made worlds of Charles Ives, George Herriman, and Chuck Jones. Seminar meets at instructor's home.

Macksey

300.637 History and Event

This seminar analyzes different conceptions of historicity and temporality. Readings include Husserl, Derrida, Foucault, Deleuze, Badiou, and others.

Marrati

300.640 Ironic Narrative: Theories and Practices

Romantic, modern, and postmodern concepts of irony; verbal and situational instances; perpetual parabasis and the limits of communication.

Macksey

300.652 Versions of Narrative Voice:**Readings in Short Fiction**

The rise of the modern Récit and the narrative fragment; parables and fables; Kafka, Bataille, Beckett, and Blanchot.

Macksey

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

300.659 The Idea of the Novel

Questions of text, temporality, authorship, and audience in narrative contexts.

Macksey

300.665 Versions of the Elegy: The Poetry of Mortality

Elegiac tradition from the Romantics to their 20th-century inheritors. Utility and limits of genre criticism and historic periodization. Critical readings consider recent approaches to the tension between loss and mourning, and the human needs to which this poetry responds.

Macksey

300.670 (W) 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. Cross-listed with Philosophy, Anthropology, Political Science, English, and German and Romance Languages.

de Vries

300.372 (H,S) Holocaust Testimonies

A seminar on written, oral, cinematic, and other forms of Holocaust testimony.

Leys 3 credits

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

300.676 The Elegiac Muse

The literature of mortality from the Romantics to their modern inheritors.

Macksey

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.

deVries/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

300.679 Transcendence and Imminence: Theodor W. Adorno and Gilles Deleuze

Time in the novel: Narrative strategies from Sterne to Pynchon.

Macksey

300.683 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.

Staff

300.800 Independent Study

Staff

300.801 Independent Study: Field Exams

Staff

300.803-804 Dissertation Research

Discussion of dissertations in progress. Limited to students writing dissertations.

Staff

300.805 Literary Pedagogy

Staff

International Studies

The International Studies Program is located in the Department of Political Science (see page 297), which offers international studies as a second major.

There are three programs in international studies: a regular program 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 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 298.)

Undergraduate Program

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 47.)

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: two History of Occidental Civilization classes (100.101-105), Elements of Economics (180.101-102), and one of Contemporary International Politics (190.209), International Politics (190.213), or Topics in Foreign Policy (190.308).

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.

Core Courses

- Three semester courses in history in addition to the two taken in Occidental Civilization (100.101-105). At least one of these additional courses must be taken in the History Department and at least one must focus on a non-Western region.
- One course in international politics, designated (IR) in the catalog, in addition to one of the core IR courses listed above (209, 213 and 308).

- One course in American politics, designated as (AP) in the catalog.
- Two courses in comparative politics, designated (CP) in the catalog.
- One course in political theory, designated (PT) in the catalog.
- Two semester courses from the list of approved courses updated each semester in the area of international economics in addition to 180.101-102. At least one of these additional courses must be taken in the Economics Department.

Senior Thesis

Students may write a thesis during their senior year. Students electing this option enroll in 190.471 Senior Thesis Seminar designed to prepare them for the 190.499 Senior Thesis. The seminars and thesis together account for nine credits.

Field of Interest

Every major in international studies selects a field for intensive and specialized work. The field of interest may be organized in terms of area (Latin America, East Asia); function (security studies, international economics), or language (an additional language for study). The student, in other words, has the widest possible choice. Although there is no set amount of course work for this particular requirement, it normally consists of four semester courses or the equivalent.

Study Abroad

Studying abroad is especially valuable for international studies majors. Participating students generally 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 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 an adviser 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 apply to the director of the International Studies Program in the beginning of the second term of their sophomore year.

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.

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

Vivian Braun, Lecturer (Near Eastern Studies)

Andrew Marc Caplan, Professor (Department of German and Romance Languages and Literatures): Zelda and Myer Tandetnik Professorship in Yiddish Language, Literature, and Culture

Beatrice Caplan, Lecturer (Department of German and Romance Languages and Literatures): Zelda and Myer Tandetnik Lecturer in Yiddish.

Steven R. David, Professor (Political Science), Associate Dean for Academic Affairs: international relations, security studies, comparative politics; .

Hent DeVries, Professor, (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; .

Allen Grossman, Andrew W. Mellon Professor of the Humanities (English).

Herbert L. Kessler, Professor (History of Art): Early Christian and medieval art.

Ruth Leys, Professor (Humanities): history and theory of psychoanalysis, history of psychiatry and psychology, 19th- and 20th-century intellectual history, feminist theory.

Theodore J. Lewis, Blum-Iwry Professor (Near Eastern Studies): Hebrew Bible, Northwest Semitic philology and religion.

Kyle P. McCarter, Professor, William Foxwell Albright Chair in Biblical and Ancient Near Eastern Studies (Near Eastern Studies).

Kenneth Moss, Felix Posen Professor (History): modern Jewish history, Russia and Eastern Europe, nationalism, theory and practice of cultural history.

Ellen Ann Robbins, Lecturer (Near Eastern Studies).

Glenn M. Schwartz, Whiting Professor of Archaeology (Near Eastern Studies): Near Eastern archaeology.

Rochelle Tobias, Associate Professor (German): modern literature.

Raymond Westbrook, Professor (Near Eastern Studies): ancient law and Assyriology.

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 adviser, 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

090.322 Fin de Siècle Vienna

090.371 Franz Kafka: Writer of Modernity

090.769 Walter Benjamin: The Parisian Arcades
—Passagen Arbeit

History

100.129 Introduction to Modern Jewish History,
1789–2000

100.241 Visions of the Self: The Autobiography as
History

100.320 The Invention of Modern Jewish Culture:
Genealogies, Formations, Dilemmas

100.349 Narratives of Conquest and Discovery

100.714 Christians, Muslims, and Jews: Religious
Identity in Medieval Spain

Humanities

300.372 Holocaust Testimonies

Near Eastern Studies

130.101 Ancient Near Eastern Civilization

130.140 Introduction to Hebrew Bible/Old Testament

130.301 History of Ancient Syria-Palestine

130.305 Law in the Ancient World

130.306 The Origins of Diplomacy

130.340 The History of the Religion of Israel

130.343 The Dead Sea Scrolls in English

130.440 Elementary Biblical Hebrew

130.442 Reading of Hebrew Prose

130.444 Reading of Hebrew Poetry

130.450 Elementary Modern Hebrew

130.452 Intermediate Modern Hebrew

130.454 Advanced Modern Hebrew

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

190.344 Anti-Semitism

191.335 Arab-Israeli Conflict

Language Teaching Center

The Language Teaching Center (LTC), established in 1992, offers language courses that are not taught in the language and literature departments.

Languages presently offered in the Language Teaching Center are Arabic, Chinese, English for International Teaching Assistants, Hindi, Japanese, Kiswahili, Korean, Persian/Farsi, Russian, and Sanskrit. The LTC also offers evening, non-credit English as a Second Language (ESL) courses for professionals, as well as an Intensive English Language Program for visiting and pre-college students during the summer.

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

Liping Feng, Lecturer: Chinese.

Rebecca Hsieh, Lecturer: Chinese.

Choonwon Kang, Lecturer: Korean.

Satoko Katagiri, Lecturer: Japanese.

Liman Lievens, Lecturer: Chinese.

Makiko Nakao, Lecturer: Japanese.

Uma Saini, Director; Lecturer: Hindi and Sanskrit.

Doris Y. Shiffman, Lecturer: English for International Teaching Assistants.

Khalil Tahrawi, Lecturer: Arabic.

Kazue Y. Zon, Lecturer: Japanese.

Adjunct Appointments

Annalisa Czczulin, Adjunct Lecturer: Russian language and literature.

Olya Samilenko, Adjunct Associate Professor: Russian.

Part-time Faculty

Dariush Dehghan, Lecturer: Persian/Farsi

Hannah Mugambi, Lecturer: Kiswahili

Patricia Palmer, Coordinator; Lecturer: ESL.

Swadesh Rana, Lecturer: Hindi.

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 37).

Minor and Double Major in Russian

The Russian minor, 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 18 credits beyond, but not including 377.208 (Intermediate Russian I).

Russian minors and double-majors 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.

Courses

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 Language Teaching Center for language programs created on an ad hoc basis.

Arabic

375.111-112 Accelerated Beginning Arabic

This course is for students who have some written and spoken knowledge of standard Arabic. The course focuses on reading and writing. The teaching materials are the same as the materials used in 375.115-116 Beginning Arabic; however, supplemental materials are used. May not be offered every semester.

Staff 4.5 credits

375.115-116 Beginning 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.

Tahrawi 4.5 credits

375.215-216 (H) Intermediate 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 Beginning Arabic.

Tahrawi 4 credits

375.301-302 (H) Advanced Arabic Reading and Writing

Designed to enhance students' ability to read, discuss, and write about various topics covered in traditional and contemporary Arabic texts. Prerequisite: 375.215-216 or equivalent.

Tahrawi 3 credits

375.401-402 (H) Upper Advanced Arabic

This is an introductory course to different periods of the Arabic literature. Selections of famous Arabic poetry and short prose works are the substance of the course. Prerequisite: 375.301-302 or equivalent.

Tahrawi 3 credits

Chinese

373.111-112 Accelerated Beginning Chinese

For students who have a significant, previously acquired ability to understand and speak Modern Standard Chinese. The course focuses on reading and writing. The teaching materials are the same as the materials used in 373.115-116 Beginning Chinese; however, both traditional and simplified versions of written Chinese characters are used. Lab required. Prerequisite: Existing demonstrable skills in spoken Chinese.

Hsieh 3.5 credits

373.115-116 Beginning 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.

Lievens 4.5 credits

373.211-212 (H) Accelerated Intermediate Chinese

For students who possess native-like abilities in comprehension and speaking. The course focuses on reading and writing. Students will work with either simplified or traditional characters.

Staff 3.5 credits

373.215-216 (H) Intermediate 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 Accelerated Intermediate Chinese.

Lievens 4.5 credits

373.301 (H) Chinese Conversation

Advanced training in spoken Chinese for students who have completed Intermediate Chinese or have equivalent knowledge and fluency. Communicative activities such as task-oriented acts, role plays, and group discussions will assist in the development of good interactive skills including how to support opinions. Students will also enhance

their listening skills using recorded interviews, reports, TV broadcasts, etc. May not be offered every semester.
Staff 2.5 credits

373.303 (H) Chinese Calligraphy

This is an introductory course on Chinese brush writing. The course is conducted in English and is for all those who are interested in learning how to use the brush to write Chinese characters. Knowledge of the Chinese language is useful but not essential. The class meets once a week for two and a half hours. The first hour will be lectures on the history, theory, and techniques of the brush writing plus aspects of Chinese culture associated with the characters used. The remaining time will be for hands-on practice.
Hsieh 3 credits

373.311 (H) Chinese Literature: Passions of Ancient China

This course focuses on love, war, and rectitude in the classic literary era. Taught in English.
Staff 3 credits

373.315-316 (H) Upper Intermediate 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: 373.216 or equivalent.
Hsieh, Staff 3.5 credits

373.415-416 (H) Advanced Chinese

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 need not focus primarily on detailed explanation of grammar. Discussion, to be conducted in Chinese, will concentrate on the cultural significance of the readings content. Prerequisite: 373.215 or equivalent.
Feng 3 credits

373.422 (H) Literary (Classical) Chinese

Students are required to have knowledge of traditional Chinese characters in order to read short selections of literary prose.
Staff 3 credits

English as a Second Language for International Teaching Assistants

370.600 Oral Skills for International Teaching Assistants

Through a variety of communicative activities, aided by small classes, students work to improve fluency, accuracy, and intelligibility in speaking and increase active listening comprehension. Activities include interviewing undergraduates, watching online videos of Hopkins students discussing campus life, and creating online speaking practices. Open to international TAs and other full-time graduate students in Arts and Sciences and Engineering.
Shiffman 3 hours

370.601 Communication Strategies in the American Classroom

This course is designed to assist international teaching assistants to strengthen the skills needed to carry out teaching duties smoothly and effectively, and improve oral fluency as it pertains to the classroom. Videos of each student's classroom teaching practices are integrated online into the course. Students are required to meet individually with the instructor to analyze teaching progress. Open to international TAs and other full-time graduate students in Arts and Sciences and Engineering.
Shiffman 3 hours

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 is taught in its original Dayva-nagari script. Oral-aural drills in class and work in the Language Lab is required. *Note:* Students with existing demonstrable skills in spoken Hindi should take 381.105-106 Accelerated Beginning Hindi.
Saini 3 credits

381.105-106 Accelerated Beginning Hindi

For students who have some previously acquired ability to understand and speak basic Hindi. The course focuses on reading and writing Dayva-nagari script from day one, and on the refinement of the basic language skills of listening and speaking. Expansion of vocabulary and grammatical structures and further development of communicative skills. Content focuses on cultural patterns in the Hindi-speaking world. Not offered every semester.
Staff 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.
Rana 3 credits

381.301-302 (H) Advanced Hindi

Promotes the active use of Hindi in culturally authentic contexts. Development of fluency in oral and written communication is emphasized. Selection of excerpts from famous Hindi poetry and prose including short stories are read. Prerequisite: 381.201-202.
Saini 3 credits

381.311-312 (H) Hindi/Urdu Conversation

This course is designed especially for students interested in a refinement of their conversation skills on a wide range of current topics. Teaching strategies include Web-based exercises for vocabulary enhancement in medicine, public health, law and international affairs, reviews of popular radio and TV shows, interpretations of classic and modern literature, and role playing as interviewers and media anchors. Students completing this course are expected to speak Hindi-Urdu fluently with correct pronunciation and diction as well as understand its wide idiomatic and accentual variations. Prerequisite: 381.202 or equivalent is required for IR majors.

Rana 3 credits Not offered every semester

Japanese**378.101-102 Slower-Paced Beginning Japanese**

A two-semester introductory course for students who want to study Japanese at a slower pace, attending three classes rather than five classes per week. Goals of this course are mastery of pronunciation while acquiring basic vocabulary and a foundation in structural patterns of the language. Students work first with romanization, then are introduced into the native Kana syllabary in the first semester, and increase their familiarity with the Japanese orthographies further in the second semester. Oral-aural drills in class and work in the language laboratory are important in the course. *Note:* Those who wish to continue beyond these two semesters must enroll in Beginning Japanese 378.116 the following spring. Also, students who need to fulfill their language requirement of third-year Japanese by the end of their junior year or who want to take the Advanced Japanese course in their senior year should take 378.115-116.

Katagiri 3 credits

378.115-116 Beginning Japanese

A two-semester introductory course in Japanese. Goals of the course are mastery of pronunciation, basic grammar, and basic vocabulary. The native kana syllabary as well as romanization will be taught early in the course, and Chinese characters, or Kanji, will be introduced in the second semester. In addition to written exercises and tests, oral-aural drill in class and work in the language laboratory are important.

Nakao 4.5 credits

378.215-216 (H) Intermediate 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.

Zon 4.5 credits

378.311-312 Japanese Conversation

Advanced training in spoken Japanese for students who have completed Intermediate Japanese or have equivalent knowledge and fluency. Communicative activities such as task-oriented acts, role plays, and group discussions will assist in the development of good interactive skills including how to support opinions. Students will also enhance their listening skills using recorded interviews, reports, TV broadcasts, etc.

Zon 2.5 credits

378.315-316 (H) Upper Intermediate Japanese

In this two-semester course, emphasis shifts toward reading, while development of oral-aural skills continues apace. The course presents graded readings in expository prose and requires students to expand their knowledge of Kanji, grammar, and both spoken and written vocabulary. Through their readings, students will also deepen their understanding of Japanese culture and society. Students will improve their speaking skills through participatory classroom activities in Japanese and will further develop listening comprehension of spoken narrative and descriptive passages.

Katagiri 3.5 credits

378.415-416 (H) Advanced Japanese

Offered for students who have completed 378.315-316 or the equivalent. Students will further develop reading skills in modern Japanese through exposure to a variety of authentic reading materials from expository prose to simple technical materials written for the general reader. Part of the course materials will be selected based on individual student's needs and interests, so students will be able to develop a good foundation for becoming advanced readers in their chosen fields.

Nakao 3.5 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.

Mugambi 3 credits

379.251-252 (H) Intermediate Kiswahili

This course places emphasis on conversational skills as well as reading, writing, and composition skills. It includes analyses of the culture, history, and *socio aspects* of this linguistic group. Resources in the Language Lab are incorporated in the course. Prerequisite: 379.151-152 or permission of instructor.

Mugambi 3 credits

Korean

380.101-102 Elements of 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 holidays.

Kang 3 credits

380.201-202 (H) Intermediate Korean for

Reading and Writing

This course aims at improving writing skills with correct spelling. Reading materials of Korean people, places, and societies will enhance cultural understanding and awareness, including discussion on family tree. Prerequisite: 380.101-102 or existing demonstrable skills in spoken Korean.

Kang 3 credits

380.301-302 (H) Advanced Korean

This course emphasizes reading literacy in classic and modern Korean prose. By reading Korean newspapers and professional articles in one's major, it enables one to be well-versed and truly literate. Prerequisite: 380.201-202 or equivalent.

Kang 3 credits

Persian

382.101-102 (H) Beginning Persian

The basic modern Persian enables students to learn the Persian alphabet, phonology, morphology, and the basic syntax. They also learn reading and translating basic sentences.

Dehghan 3 credits

382.201-202 (H) Intermediate Persian for

Reading and Writing

Designed for students who are proficient in listening and speaking skills and have an ability to read and write at a high novice level. Course is taught in Persian. Prerequisite: 382.102 or equivalent. Prerequisite: 382.101-102 or equivalent.

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.

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, dis-

ussion centered on contemporary Russian culture. Prerequisite: 377.131 with a minimum grade of C-

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-

Czczulin 4 credits fall

377.209 (H) Intermediate Russian II

In the continuation of 377.208 students hone their knowledge of cases and verbal aspects, and are introduced to participles. One day a week is devoted to a discussion of short readings and film segments based on daily life in Russia. Prerequisite: 377.208 with a minimum grade of C-

Czczulin 4 credits spring

377.210 (H) Conversation and Comprehension

Students develop conversational skills through classroom discussions based on a variety of readings, films, and tapes. Activities include skits, role-playing, and interviews with native speakers in a variety of settings. Prerequisite: 377.208.

Samilenko 3 credits spring

377.211 (H) Introduction to Russian Literature I

Students learn about the major literary genres and periods of pre-revolutionary Russia and read several annotated short stories by Pushkin, Lermontov, Gogol, and Turgenev, as well as selected poetry by Pushkin and Lermontov. All texts are adapted to the intermediate level. Prerequisites: 377.208 and 377.210.

Samilenko 3 credits fall

377.237 (H) The Russian Press

Readings taken from the Russian press expose students to specialized vocabulary in the areas of history, political science, and economics, while providing a deeper insight into the dynamics of everyday life in Russia. Prerequisite: 377.209 or 377.210.

Czczulin 3 credits

377.253 (H) The Soul of Russia: Russian Culture and Civilization

The evolution of Russian culture and civilization from the Mongol invasion to the present day conducted through a 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.

Czczulin 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.

Czczulin/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.

Czczulin/Samilenko 3 credits

377.261 (H,W) Advanced Grammar through Readings

Application of essential topics in Russian grammar (verbs of motion, aspects, participles, cases) through a wide range of readings. A portion of this course will include translating. Multimedia will be used when appropriate. Prerequisite: 377.209.

Czczulin/Samilenko 3 credits

377.269 (H,W) The Russian Fairytale

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 1-credit language option. At Goucher.

Czczulin 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

In this advanced course a close reading and in-depth stylistic analysis of Chekhov's short stories, novellas, and plays takes place against the social, political, and philosophical background of his time. Prerequisite: 377.211 or instructor's permission.

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.

Czczulin 3 credits

377.351 (H) Introduction to Russian Literature II

An advanced-level survey of prose and poetry of the major writers of the late second half of the 19th century and beginning of the 20th. Prerequisite: 377.211 or instructor's permission.

Samilenko 3 credits

377.395 (H,W) Seminar I

Yearly rotating topics in 19th-century literature, poetry, or drama. May focus on the works of a single author (Pushkin, Tolstoy), a single novel (*Anna Karenina*), a literary movement (Romanticism), or a genre (narrative poem, satire, short prose, drama). This advanced course may be taken more than once. The cycle of topics repeats every four years. Prerequisite: 377.318 or instructor's permission.

Samilenko 3 credits fall

377.396 (H,W) Seminar II

Yearly rotating topics in 20th-century prose, poetry, drama, or film. This advanced course may include the study of a single author (Bulgakov, Solzhenitsyn, Voinovich), a single genre (satire, Symbolism), or novel (Bulgakov's *Master and Margarita*). This course may be taken more than once. The cycle of topics repeats every four years. Prerequisite: 377.395 or instructor's permission.

Samilenko 3 credits spring

377.500-505 Russian Independent Study

Through arrangement with the instructor.

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 postdoctoral fellows 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

Deborah Poole, Director, Professor,

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

Emma Cervone, Associate Director, Professor (Anthropology): social movements, Andes, Ecuador; indigenous movements, race and gender in Latin America; development and applied anthropology.

Mary M. Bensabott-Ott, Lecturer (German and Romance Languages and Literatures): Portuguese language; Brazilian literature and culture.

Lisa Deleonardis, Assistant Professor (History of Art): archaeology of ancient Americas; pre-Columbian and ancient American art.

William Egginton, Professor (German and Romance Languages and Literatures): Spanish and Latin American literatures; literary theory; and the relation between literature and philosophy.

Eduardo González, Professor (German and Romance Languages and Literatures): Latin American literature, American studies, film and media studies, psychoanalysis and literature.

Michael Hanchard, Professor (Political Science): comparative politics, Latin American politics, and comparative racial politics.

Margaret E. Keck, Professor (Political Science): comparative politics, Latin American politics and the environment.

Sara Castro-Klarén, Professor (German and Romance Languages and Literatures): Latin American literature, colonial studies, discourse analysis, contemporary novel.

Franklin Knight, Professor (History): Latin American and Caribbean social and economic history, comparative history, comparative slave systems.

Beverly J. Silver, Professor (Sociology): historical sociology, labor and social movements, political sociology, international development.

Ben Vinson III, Professor (History): director, Center for Africana Studies; Latin American history with a particular interest in race relations, especially the experience of African diaspora.

A.J. Russell-Wood, Professor (History): pre-Columbian and colonial Latin American with an emphasis on Brazil and an interest in the Portuguese seaborne empire and comparative colonialism.

Visiting Faculty

Walter Delrio, Zitzmann Visiting Scholar Fellow: history relations between indigenous populations.

James D. Goodyear, Associate Director of Public Health Studies Program, Professor (History of Science, Medicine and Technology): history of medicine, Latin American history, Brazil.

Lea Ybarra, Professor (German and Romance Languages and Literatures): Chicano and Latino studies.

Magda von der Heydt-Coca (Sociology): contemporary sociology, Andean region.

Wayne B. Smith (Political Science): U.S.- Latin American relations.

Richard Reitsma (German and Romance Languages and Literatures): comparative Caribbean and Latin American literature.

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 elective 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 Latin American Film: Mini-Course
- 361.131 Introduction to Latin American Studies II
- 361.135 Introduction to Latin American Film
- 361.160 Introduction to Latino Studies
- 361.202 The Body Erotic/The Body Politic
- 361.300 Indigenous Peoples of Chile and Argentina
- 361.502 Independent Study

Anthropology

- 070.218 The Politics of Multiculturalism
- 070.351 Political Life of Gender
- 070.378 Cultural Property and Politics in Latin America
- 070.313 Governance and Community in Latin America
- 070.320 Film, Fate and Law: The Outlaw in Mexican and Indian Film

German and Romance Languages & Literatures

- 211.394 Brazilian Culture and Civilization
- 215.370 Studies in Spanish and Latin American Poetry
- 215.380 Autobiography, Testimonial and Memoir
- 215.455 Cuba Noir
- 215.640 Self-Representation in Latin American Fiction, Testimonial and Memoir

History

- 100.244 Shipwreck and Empire

Interdepartmental

- 360.313 Cuba and U.S. Decision Making
- 360.124 Latin American Film—A Presentation

Political Science

- 190.392 Introduction to Latin American Politics

Sociology

- 230.307 Sociology of Latin America



Mathematics

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

- John M. Boardman**, Professor: algebraic and differential topology.
- Richard Brown**, Director of Undergraduate Studies: dynamical systems, low-dimensional topology.
- Michael Ching**, J. J. Sylvester Assistant Professor: algebraic topology.
- Caterina Consani**, Associate Professor: algebraic and arithmetic geometry.
- Carel Faber**, Professor: algebraic and complex geometry.
- Michael Goldberg**, Assistant Professor: Fourier analysis, partial differential equations, integral operators.
- Eugene Ha**, J. J. Sylvester Assistant Professor: arithmetic and non-commutative geometry.
- Philip Hartman**, Professor Emeritus: differential equations, differential geometry.

Jun-ichi Igusa, Professor Emeritus: algebra, algebraic geometry, modular functions, number theory.

Mahta Khosravi, J. J. Sylvester Assistant Professor: analysis, spectral geometry, analytic number theory.

Jian Kong, Associate Research Scientist/Lecturer: algebraic geometry.

Chikako Mese, Professor: geometric analysis.

Jean-Pierre Meyer, Professor Emeritus: algebraic topology, category theory.

William Minicozzi, Professor: differential geometry, partial differential equations, minimal surfaces.

Jack Morava, Professor: algebraic topology, mathematical physics.

Takashi Ono, Professor: algebra, number theory, algebraic groups.

Joseph A. Shalika, Professor: algebraic groups and representations, number theory.

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.

Richard Wentworth, Professor (Chair): complex geometry, mathematical physics.

Graeme Wilkin, J. J. Sylvester Assistant Professor: symplectic geometry.

W. Stephen Wilson, Professor: algebraic topology.

Steven Zelditch, Professor: quantum dynamics, spectral geometry, microlocal analysis.

Qiao Zhang, Assistant Professor: analytic number theory and arithmetic geometry.

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, turbulence, 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. Students may access the department's Linux and NT machines and the university's three mainframes from terminals in the department. 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 Ordinary Differential Equations (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 Linear Algebra (110.212) and Calculus III (Multivariable Calculus 110.211). Additional courses oriented toward applications include Methods of Complex Analysis (110.311), Partial Differential Equations (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 Algebra I and II (110.401-402), Elementary Number Theory (110.304), Introduction to Real Analysis (110.405), Calculus on Manifolds (110.406), Honors Analysis I, II (110.415-416),

Introduction to Topology (110.413), and Introduction to Differential Geometry (110.439). 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.
- Algebra I (110.401) and one of either Algebra II (110.402) or Elementary Number Theory (110.304).
- Either Introduction to Real Analysis (110.405) or Honors Analysis I (110.415) and one other term of analysis chosen from 110.311, 110.406, 110.413, 110.416, 110.417, 110.421, 110.439, and 110.443.
- Two terms of courses chosen from Linear Algebra (110.201), and mathematics courses at the 300-level or above. Honors Linear Algebra (110.212) may be used in place of 110.201.
- 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 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).
 - *Mathematical Sciences*: 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 Complex Analysis (110.311), as well as 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 two outstanding graduating seniors majoring in mathematics.

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.

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 (or a course in another department or an advanced undergraduate mathe-

- mathematics course, with the approval of the graduate program director) in their first year. (The 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 of the third year. The topic of the exam is chosen in consultation with a faculty member (normally the student's future thesis adviser).
 5. Candidates will have teaching experience in mathematics at the undergraduate level as a teaching assistant for a course. The student will be under the supervision of both the faculty member teaching the course and the director of undergraduate studies.
 6. Candidates must show a reading knowledge of French, German, or Russian, to be demonstrated by passing an examination given in the Department of Mathematics.
 7. Candidates must produce a written dissertation based upon independent and original research.
 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

Most 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 starts from scratch 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.

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.

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 who want to know the “why’s and how’s” of calculus 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) with some additional applications and theory. Recommended for mathematically able students majoring in physical science, engineering, or especially mathematics. 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) with some additional applications and theory. Recommended for mathematically able students majoring in physical sciences, engineering, or mathematics. Prerequisite: B+ or better in Calculus II, or 5 on the Calculus BC AP Exam, or 110.113.

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 an applied course in ordinary differential equations, which is primarily for students in the biological, physical and social sciences, and engineering. Techniques for solving ordinary differential equations are studied. Topics covered include first order differential equations, second order linear differential equations, applications to electric circuits, oscillation of solutions, power series solutions, systems of linear differential equations, autonomous systems, Laplace transforms and linear differential equations, 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 sub-

groups 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 L_p -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. 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, L_p -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 equality 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, L_2 -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 adèles, Iwasawa-Tate theory of zeta functions and connections with Hecke's treatment, semi-simple algebras over local and number fields, adèles 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 projec-

tive 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 in the top 10 in the nation among 270 programs. Over 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, many Hopkins cadets are selected to attend law school or a fully funded medical school. Some serve in the Army Reserves or National Guard; while many join the Army full time for a few years, hone valuable leadership skills, and go on to achieve great success by putting their military leadership experience to good use in business, academia, medicine, and law. 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 can be obtained at the ROTC building (behind the athletic center), by calling 1-800-JHU-ROTC or 410-516-7474, or from the JHU ROTC Web site at www.jhu.edu/~rotc.

The Faculty

Kenneth A. Romaine Jr., Director and Professor;
Lieutenant Colonel.

John Ballesteros, Military Science Instructor,
Sergeant First Class.

Mark S. Butera, Senior Instructor, Master Sergeant.

Heather Levy, Instructor, Major.

Rolando R. Rodriguez, Assistant Professor and
Recruiting Officer; Captain.

Scholarship and Financial Assistance

ROTC offers four-, three-, and two-year scholarships that annually pay full tuition or room and board, \$900 for books and a \$300-500 monthly stipend (depending on the class). Scholarship information can be found on the ROTC Web site listed above. Non-scholarship students who satisfactorily complete the Basic Course, have officer potential, and meet Army standards may enroll in the Advanced Course as a contracted cadet. These students receive the monthly stipend. In the summer before their final year in the program, cadets

attend a 32-day advanced leadership course held at Fort Lewis, Washington. Students are paid approximately \$1,000 for attending this summer course. Afterward, some cadets may be selected to attend a paid three- to four-week leadership internship with an Army unit in Germany, the Republic of Korea, Alaska, Hawaii, or the continental United States.

Curriculum

The curriculum consists of a two-year Basic Course, normally for freshmen and sophomores, and a two-year Advanced Course, normally for juniors and seniors, but it can be taken as part of a graduate program. Students are not required to be involved in ROTC for a full four years to qualify for an Army officer commission. Academic juniors and first-year graduate students (in a two-year program) may enter the Advanced Course if they participated in three years of JROTC, have prior military service, attended a military academy for two years, or completed the five-week summer leadership training course held at Fort Knox, Kentucky. Applications for this program begin early in the spring semester of the sophomore year or senior year for graduate program applicants.

Any student may take Basic Course classes (100- and 200-level courses) without obligation of military service. Junior- and senior-level classes may be taken by non-ROTC students only after successful completion of the Basic Course.

To help produce values-based graduates, Army ROTC sponsors several extracurricular activities such as Officers Christian Fellowship, neighborhood cleanups, Red Cross blood drives, tutoring for at-risk children, etc. Cadets may apply for additional military training such as skydiving, helicopter rappelling, mountaineering, and cold weather training. They may also participate in the Pershing Rifles national honor society and precision drill team, the Society for American Military Engineers, the Army 10 Miler, and the Ranger Challenge team, which competes each fall against other ROTC units in a marathon of team and individual events. Assisted by the assigned military cadre, the upper-class cadets develop their leadership skills by organizing and leading many of these activities on campus.

Courses

Leadership Laboratory

374.100 (S) Leadership Laboratory

This course is required each semester for enrolled ROTC participants who desire to be considered for a commission in the Army. As a leadership practicum, students have the opportunity to serve in leadership positions and receive tactical and technical training. Subjects include leading groups of five to 100 people, first aid, operating Army equipment, and drill and ceremony. Corequisite: an ROTC lecture course.

Butera 1 credit, 2 hours

Basic Classes

374.101-102 Leadership and Management I, II

This two-semester course is recommended for those who have leadership aspirations or are currently in student leadership positions. It is intended to provide a foundation for those desiring to establish a personal leadership philosophy. Both semesters focus on developing a basic understanding of current leadership and management theories as well as values-based decision-making. The course is taught through a series of lectures and 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. Corequisite: 374.001 for ROTC students; none for non-ROTC students.

Butera 2 credits

374.201-202 Leadership and Teamwork I, II

This two-semester course builds on the individual leadership skills and philosophical foundation achieved during 374.101-102, and incorporates teamwork and group practical exercises. The course relies heavily on a historical perspective of leadership and teamwork and is recommended for those who have leadership aspirations or are currently in student leadership positions. Study examines how to build successful teams, various methods for influencing action, effective communication, the importance of timing the decision, creativity in the problem-solving process, and obtaining team buy-in through immediate feedback. Both semesters focus on leadership, group dynamics, and values-based problem solving, as well as life skills. Students are required to participate in whole class and small group discussions and projects, and conduct research and give oral and written presentations on leadership. Co-requisite: 374.001 for ROTC students; none for non-ROTC students.

Levy 2 credits

Advanced Classes

374.301-302 Leadership and Tactical Theory I, II

This two-semester course surveys small organization leadership and tactical theory. The first semester focuses

on the decision-making process, delegation of authority, span of control, and their application to leadership and management issues. The second semester provides the student with knowledge of the fundamentals and techniques of tactics at the squad and platoon level. The course of instruction uses both classroom and field practical exercises to develop the students' leadership and tactical abilities. Focus is on making rapid assessments of complex situations and communicating a plan and order. Corequisite: 374.001 for ROTC students; none for non-ROTC students. Requires completion of Basic Course for non-ROTC students or permission of the director of military science.

Ballesteros 2 credits

374.401-402 Advanced Leadership Theory and Practicum I, II

This capstone year is designed to prepare the student for duty as an officer in the United States Army or for a career as a corporate leader. The student receives training in leadership, staff organization and functions, military law, unit administration, and organizational supply. The student receives practical leadership training and experience by serving as a cadet officer in a command or principal staff position in the ROTC corps of cadets. Corequisite: 374.001 for ROTC students; none for non-ROTC students. Requires completion of Basic Course for non-ROTC students or permission of the director of military science.

Romaine 2 credits

374.501-502 Independent Study

Prerequisite: permission of the professor of military science.

Romaine 1-2 credits

374.505-506 Leadership Internship

Prerequisite: permission of the director of military science.

Romaine 1-2 credits

Air Force ROTC Program

Admission to the Air Force ROTC program is available to JHU students through an agreement with UMD. 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 Web site 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 but not limited to 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. Many courses include visits to or focused work in local and regional institutions, as well as in on-campus collections (including the Archaeological Collection and the University Museums, Homewood and Evergreen).

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.

Associate Director

Elizabeth Rodini, Senior Lecturer, History of Art: museum history, theory, and practice.

Advisory Committee

Wilda Anderson, Professor, German and Romance Languages: French Enlightenment, science and literature, French Revolution and its aftermath.

Catherine Rogers Arthur, Curator, Homewood Museum: American decorative arts, historic house museums, museum practice.

Betsy M. Bryan, Professor and Alexander Badawy Chair in Egyptian Art and Archaeology, Near Eastern Studies: Egyptian art and archaeology, Egyptology.

Jane Guyer, Professor, Anthropology: economic anthropology of Africa.

Stuart W. Leslie, Professor, History of Science and Technology: history of technology, science-based industry, 20th-century American science.

Richard Kagan, Professor, History: Early Modern European history with an emphasis on Spain and Iberian expansion.

Michael Koortbojian, Professor, History of Art: Hellenistic and Roman art and architecture, Renaissance antiquarianism.

Unice Dauterman Maguire, Senior Lecturer, History of Art: museum studies, ancient and medieval art.

Faculty and Staff

Sanchita Balachandran, Visiting Instructor, Near Eastern Studies: conservation history and ethics; archaeological conservation and site management.

John Buchtel, Curator of Rare Books, Department of Special Collections, Sheridan Libraries: history of books and printing, patronage and collecting.

Stephen Campbell, Professor, History of Art: Italian Renaissance art, the studiolo and Renaissance collecting.

Lisa DeLeonardis, Lecturer (and Associate Curator, Baltimore Museum of Art): ancient art of the Americas.

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.

Tobie Meyer-Fong, Associate Professor, History: social, cultural history of China since 1600.

Jacqueline M. O'Regan, Curator, Evergreen Museum: exhibition planning and design, collections management, conservation, contemporary art and artist residencies.

Christine A. Ruggere, Lecturer, and Associate Director and Curator, Historical Collections, Institute of the History of Medicine: anatomical collections, history of the book.

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.

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.

Ronald G. Walters, Professor, History: social and cultural history of the United States with special interest in radicalism, reform, race, and popular culture.

Adjunct Appointments

Doreen Bolger, Adjunct Professor, History of Art;
Director, The Baltimore Museum of Art.

William Noel, Adjunct Professor, History of Art;
Curator of Manuscripts and Rare Books, The
Walters Art Museum.

Peter Parshall, Adjunct Professor, History of Art;
Curator of Prints and Drawings, The National
Gallery of Art.

Gary Vikan, Adjunct Professor, History of Art;
Director, 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, 389.599).

Courses

389.201 (H) 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 alternate falls. Cross-listed with Anthropology, History, History of Art.
Rodini 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 alternate falls. Cross-listed with Anthropology, History, History of Art.
Rodini 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 springs; freshmen and sophomores given priority. M&S practicum course.
Rodini 3 credits

389.340 (H) Critical Issues in Art Conservation

The course examines recent controversies in the conservation of major global art works 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 from the Archaeological Collection 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

389.354 (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. All aspects of museum work are explored, including research, interpretation, presentation, programming, marketing. Cross-listed with History of Art. M&S practicum course.
Rodini 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 culminates in a student curated exhibition. Optional intersession installation earns M&S practicum credit.
Arthur 3 credits

389.362 (H) Curating Culture at the Evergreen Museum

In this hands-on course, students research the Evergreen collection in order to develop an innovative, public exhibition or presentation. The history of the house, its grounds, its books and artifacts are all subject to investigation. M&S practicum course.
Rodini, O'Regan, Staff 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. M&S practicum course. Cross-listed with History of Art.

Rodini 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, Near Eastern Studies.

Rodini 3 credits

389.501 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

389.599 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**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

History**100.353 (H,S) Remembering Vietnam: Documenting, Capturing, and Preserving a Divisive War**

This is a course to teach students about a divisive war, its documentation, and its memorialization through gathering images, interviews, and other data. A lab unit is required.

Walters 4 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 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

History of Art**010.390 (H) Art Museum Policy and Practice**

This hands-on seminar looks behind the scenes at displays and exhibitions, museum operations and programs, as signs of current thinking about what art, past and present, may be.

E. Dauterman Maguire 3 credits

010.334 (H) Problems in the Art of the Ancient Americas

Selected topics vary, but may include the role of ancient American art in the European *Kunstammer*, collection and exhibition of antiquities, antiquities market, and art crimes.

DeLeonardis 3 credits

010.392 (H) Creating a Museum Exhibition

Research, interpretation, and presentation; a hands-on introduction. Permission required. Earns M&S practicum credit.

E. Dauterman Maguire 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

010.552 Museum Internship

An opportunity for firsthand experience in museum work on the Homewood campus or in local museums. Advance arrangement with faculty required. (M&S credit requires approval of associate director and adherence to the university's Independent Work Policy.)

E. Dauterman Maguire 1 credit

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

140.363 (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.

Leslie, Kargon 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)

Sharon Gail Levy, Department of Music Theory:

Piano literature 1750-1950, music analysis, baroque counterpoint, music appreciation.

Paul Mathews, Department of Music Theory: music theory courses. Adviser 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.

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. The Box Office is in the lower level of the Grand Arcade in the Conservatory building; call 410-659-8100, ext. 4415.

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, 410-659-8100, ext. 4410, 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, 410-659-8100, ext. 4425, 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 and Musicianship III	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 adviser	
Total	18 credits plus 4 hours of 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 adviser, 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 sight-singing. 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

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

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 spring

376.213 Music Theory and Musicianship III

Continuation of written and aural work of the previous two semesters. Projects in four-voice writing from figured bass and counterpoint in two and three voices are com-

pleted, using as models a variety of styles and composers. Students study simple binary, rounded binary and ternary forms, and compose a short work in a tonal idiom. Prerequisite: Music Theory and Musicianship II.

Staff 3 credits spring

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.

Talle 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.

Mathews 3 credits spring

376.401 (H) 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

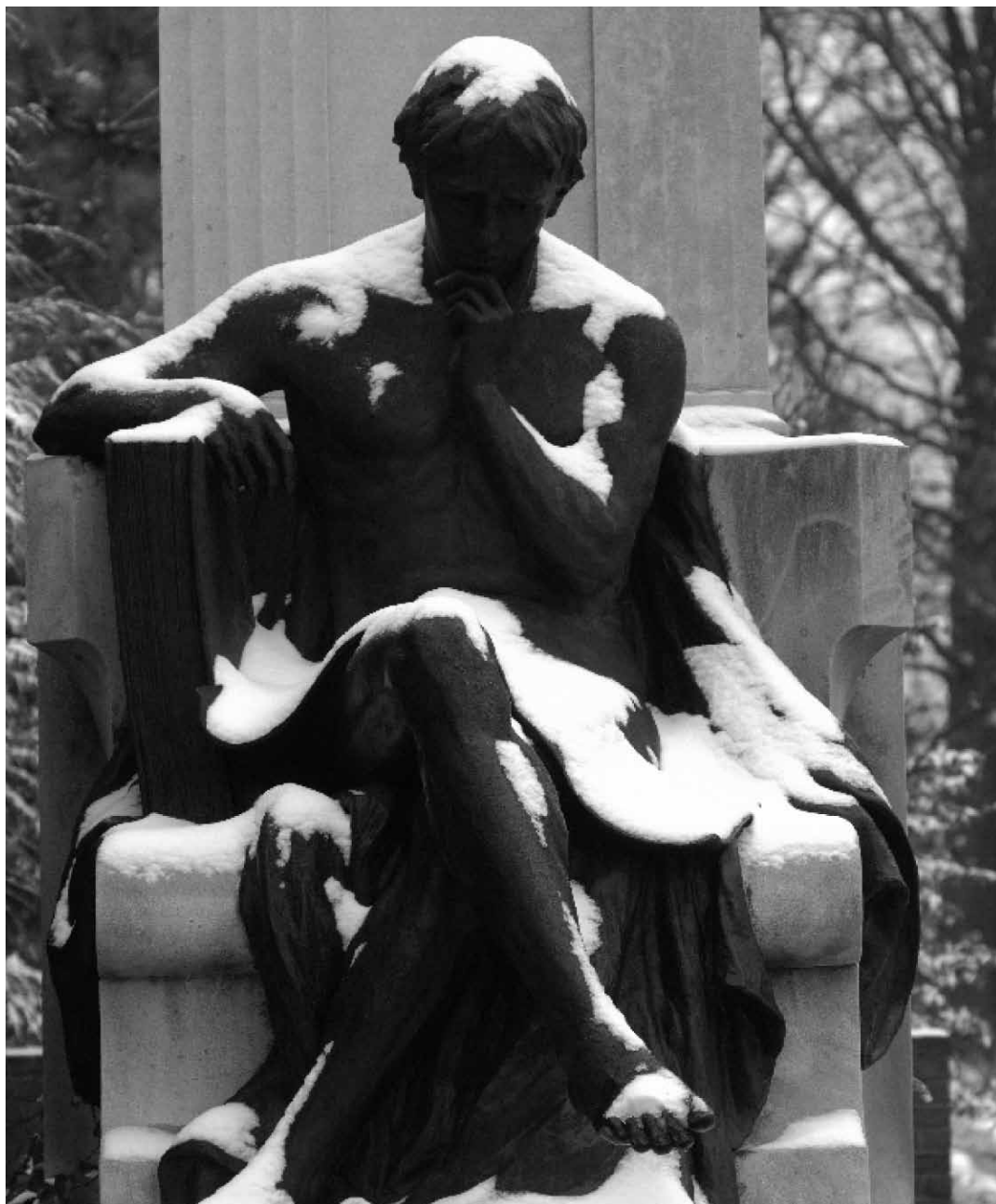
A study of the evolution of musical instruments and their functions from the earliest manifestations of rhythmic sound in prehistoric civilization to the most sophisticated electronic instruments of the 20th century, fusing the disciplines of music, anthropology, and the visual arts. Trips to museums 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. A concentration in Ancient Law is also possible. 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.

Jerrold S. Cooper, W.W. Spence Professor in Semitic Languages: Assyriology.

Richard Jasnow, Professor: Egyptology.

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.

Raymond Westbrook, Professor: ancient and biblical law, Assyriology.

Adjunct, Emeritus

Vivian Braun, Lecturer: modern Hebrew.

Hans Goedicke, Professor Emeritus.

Ann Gunter, Adjunct Associate Professor: Near Eastern art history.

Georg Krotkoff, Professor Emeritus.

Susan McCarter, Adjunct Assistant Professor: prehistory.

Ellen Robbins, Lecturer.

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

(See also General Requirements for Departmental Majors, page 47.)

All students majoring in Near Eastern studies must take two years of one Near Eastern language and at least six additional courses. Four of these should be from the Ancient Near Eastern Cycle (130.300-303) or be equivalent courses tailored to the student's individual interests and needs in consultation with the director of undergraduate studies. The student and adviser will devise a program tailored to the student's interests and needs and may concentrate in history, language, archaeology, or law.

Students intending to continue at graduate level should acquire a reading knowledge of German or French or both. Qualified undergraduates may be admitted to 600-level courses. The department regularly offers Freshman Seminar courses that introduce various aspects of Near Eastern studies. These courses are particularly important for students who wish to consider Near Eastern studies as their major.

Ancient Law Minor

The minor is a combined program of the Classics and Near Eastern Studies departments. The minimum requirement is 18 credits, all in courses at 300-level or higher. The distribution requirement

is three survey courses in ancient law, two survey courses in ancient history/civilization, and one course in an aspect of modern law or legal theory (e.g., Constitutional Law, Law and Psychology, Philosophy of Law).

For students interested in learning an ancient language, an alternative configuration is possible: two semesters of a language (Akkadian, Biblical Hebrew, Egyptian, Greek, or Latin), three courses in ancient law, and one course in ancient history/civilization.

The minor is directed by Professor Raymond Westbrook (Near Eastern Studies): rwestb@jhu.edu.

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 Web site at www.jhu.edu/neareast.

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) Introduction to Human Prehistory: From Neanderthals to the Neolithic

Emphasizing theories about human biological and cultural development, this course consists of an in-depth survey of Neanderthal morphology and culture, a brief discussion of evolutionary theory and our fossil ancestors, and concludes with an exploration of the mechanisms and results of the shift from hunting and gathering to farming.

S. McCarter 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

130.135 (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

130.300 (H,W) History of Ancient Mesopotamia (Sumer, Babylonia, Assyria)
Staff 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

130.304 (H) Art of the Ancient Near East
Surveys the history and development of art and architecture in Mesopotamia, Syria, Anatolia, and Iran, from about 6000 B.C. to the end of the Persian empire in 331 B.C. Emphasis is on understanding works of art in their social, religious, and political setting.
Gunter 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.
Westbrook 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.
Westbrook 3 credits

130.307 (H,W) Writing Systems of the World
An investigation of the phenomenon of writing, the circumstances of its invention, and its development and spread. The course examines various nonalphabetic (Cuneiform, Egyptian, Minoan, Mayan, Chinese) and alphabetic (Semitic, Greek, Latin, Indian, Korean) systems of writing, and theories of the origin of the alphabet. The differences between writing and other semiotic systems are explored.
Staff 3 credits

130.308 (H,W) Creation: Man, the Gods, and the Cosmos in Ancient Myth
Beginning with ancient Near Eastern myths relating the creation of human beings, the gods, and the cosmos, the course explores various theories of myth, compares the Near Eastern materials to ancient Greek accounts, and examines appropriate Asian and "primitive mythologies."
Staff 3 credits

130.310 (H,W) The Origins of Literature in Ancient Mesopotamia
Starting with the invention of writing around 3000 B.C., the course explores the early literary forms of the Sumerians, and the subsequent development of these forms by the Babylonians and Assyrians. 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.
Staff 3 credits

130.311 (H,W) 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.
Staff 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

130.314 (Q) Math, Science, and Technology in the Ancient Near East

Course will focus on the origins of writing systems, mathematics, and astronomy in ancient Mesopotamia, as well as metallurgy, medicine, agriculture, and architecture.

Robbins 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 illustrate 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

130.327 (H) Ancient Egyptian Painting

An investigation of the principles of representation and techniques of execution in Egyptian painting, ca. 2500 B.C.-100 B.C. Emphasis will be on an understanding of the cultural uses of painting as an art form and on how artisans were organized to create for the state and for individual patrons. A major part of the grade will be based on a visual discussion of a painted monument by each student.

Bryan 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 interac-

tions 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

130.333 (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

130.340-341 (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

**130.372 (H) Prophetic Literature of the Hebrew Bible/
Old Testament**

A survey of the prophetic literature of the Hebrew Bible (Old Testament) as it is understood in its ancient Near Eastern cultural and historical context. Freshmen admitted with permission.

Lewis 3 credits

130.375 (H,S) Everyday Law in Biblical Israel

The Hebrew Bible contains not only religious rules but also many laws on mundane matters such as property and inheritance, marriage and divorce, contracts, injury and damage, and legal procedure. We will examine these laws from the viewpoint of a legal historian and try to reconstruct the legal system of biblical society.

Westbrook 3 credits

Near Eastern Languages**130.400-401 Introduction to Middle Egyptian**

(see 133.600-601 for the description)

Staff 3 credits

130.440-441 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

130.450-451 Elementary Modern Hebrew

Credit given only on completion of both semesters. May not be taken on a satisfactory/unsatisfactory basis.

Braun 3 credits

130.452-453 (H) Intermediate Modern Hebrew

Braun 3 credits

130.454-455 (H) Advanced Modern Hebrew

Braun 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**130.650 Seminar in Near Eastern Religion**

Topic varies.

Staff

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

Gunter

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

Westbrook

132.620-621 Legal and Administrative Texts

Westbrook

132.630-631 Literary and Religious Texts

Staff

132.640-641 Historical Texts

Staff

132.644-645 Treaties and Diplomacy

Westbrook

132.650-651 Peripheral Akkadian

Includes texts from Amarna, Emar, Ugarit, Boghazkoi, Nuzi, Alalakh, and Elam.

Westbrook

132.660 Old Akkadian

Staff

132.670-671 Assyrian Dialects

Staff

132.680-681 Neo-Babylonian

Westbrook

132.690-691 Divination and Ritual Texts

Staff

132.700-701 Elementary Sumerian

Staff

132.710-711 Advanced Sumerian

Staff

132.720-721 Sumerian Legal Texts

Westbrook

132.752 Elementary Hittite

Westbrook

132.753 Advanced Hittite

Westbrook

132.800-801 Mesopotamian Seminar

Research and discussion on topics of current interest.
Schwartz, Westbrook

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

133.645 Seminar in Egyptian Law

Staff

133.646-647 Demotic

Jasnow

133.648-649 Coptic

Jasnow

133.656 Advanced Demotic

Jasnow

133.670-671 Seminar in Historical Research

Staff

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

134.640 Seminar in Biblical Law

Westbrook

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

134.700-701 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 that of molecules interacting with cell membranes, to that of brain systems subserving cognitive functions such as language. Dramatic recent progress has been made at all levels, and the field is growing explosively. On the Homewood campus, researchers 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 innovative, interdepartmental programs which offer a broad overview of the neuroscience field, as well as more advanced training in one of three areas of concentration.

Cellular and Molecular Neuroscience 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 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 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).

Michela Gallagher, Professor (Psychological and Brain Sciences).

Linda Gorman, Senior Lecturer (Neuroscience and Psychological and Brain Sciences).

Stewart Hendry, Professor (Neuroscience); Krieger Mind/Brain Institute; Head of Academic Advising (Neuroscience).

Michael McCloskey, Professor (Cognitive Science).

Brenda Rapp, Professor (Cognitive Science).

Eric Young, Professor (Biomedical Engineering).

Haiqing Zhao, Assistant Professor (Neuroscience and Biology).

The Neuroscience Program Committee coordinates course offerings, oversees the program's interdepartmental courses, 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 a five-year 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. program or medicine. All of the mathematics and sciences courses required of premedical students are included in the requirements for the neuroscience major.

Additional information regarding the undergraduate degree programs is available through the program coordinator in 140 Ames Hall and on the Web at <http://undergradneurosci.jhu.edu>.

This curriculum is being reviewed. Please consult our Web site for the most recent updates.

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 47.)

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 two following courses are recommended but not required for neuroscience majors; they are intended for freshmen considering the neuroscience major.

Fall: 200.141 Introduction to Physiological Psychology or 200.211 Sensation and Perception

Spring: 080.203 Cognitive Neuroscience

- **Neuroscience Sequence (12 credits):**

These courses are normally completed during the sophomore and junior years. Students are recommended to take these courses in the following sequence:

080.203 Cognitive Neuroscience (If not already taken freshman year)

080.305 The Nervous System I or 080.205 Systems Neuroscience

080.306 The Nervous System II or 080.304 Cell/Molec Neuroscience

080.250 Neuroscience Lab: A Practical Approach

- **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 any area. Credits for research may not be applied toward this requirement.

- **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, II, and Lab

171.101-102 or 103-104 and 173.111-112
General Physics I, II, and Lab

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:

- A minimum 3.5 grade-point average in all required courses for the undergraduate major,
- Completion of no fewer than three credits of undergraduate research, and
- Completion of the Neuroscience sequence as well as the mathematics and science courses required for the B.A. degree.

- **Statistics (3 credits)**

All students, regardless of concentration, will be required to take 200.314 Advanced Statistical Methods. Students may not substitute alternative statistics courses or Advanced Placement credits for this course.

- **Advanced Seminar in Neuroscience (6 credits)**

The Advanced Seminar in Neuroscience is offered in the fall and spring terms.

- **Specialized Courses (15 credits)**

Degree requirements include 15 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

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

080.205 (N) Systems Neuroscience

This course considers defined neural circuits that mediate behavioral responses. This requires both a consideration of sensory inputs to the brain and the outputs to various effector systems. Specific topics considered include learning and memory, eating and drinking, biological timing, aggression, communication, reproductive behavior, and other social behaviors. Most examples are drawn from vertebrate species, but invertebrates are discussed on occasion. Both the development of these neural systems and their possible modulation by endogenous (e.g., hormones) and exogenous factors are also considered an appropriate.

Fortune, Gallagher 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: 080.203. (Required beginning with the class of 2008).

Gorman 3 credits

080.304 (N) Cellular and Molecular Neuroscience

This course is a survey of the mechanisms through which the nervous system receives sensory signals, transmits signals from neuron to neuron, and drives the activity of target tissues such as glands and muscles. Topics include the molecular basis of the action potential, effect of cell shape and myelination on conduction of action potentials, mechanisms regulating neurotransmitter release, structure and function of neurotransmitter receptors, modulation of neuronal functions, sensory transduction, and muscle contraction. The molecular basis of genetic disorders involving nerve and muscle function will also be studied. Prerequisites: 020.151-152 or 020.305-306.

Fambrough 3 credits

080.305-306 (N) The Nervous System I and II

The nervous system is a fully integrated, two-semester course that surveys the cellular and molecular biology of neurons as well as the structure and function of the nervous system.

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.

Gorman 3 credits

080.335 (N) Neuroscience of Pain

This course will focus on the neurobiological mechanisms and psychological aspects of pain. Experimental (animal and human) and clinical models and methods will be discussed throughout. Prerequisites: 080.205 or 200.141.

Haythornthwaite 3 credits

080.340 (N) 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. Prerequisites: 080.205 or 200.141.

Gorman 3 credits

080.411-414 Advanced Seminar 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. Students register for 080.411-412 during the fourth year and 080.413-414 during the fifth year.

Staff 3 credits

080.450 (E,Q) Computational Neuroscience

This course introduces students to quantitative modeling techniques for the study of nervous systems. Topics include representation and coding of neuronal information, learning and memory, and the development of biological nervous systems. Open to juniors, seniors, and graduate students. Prerequisites: Elementary knowledge of linear algebra and differential equations, at the level of 550.291.

Niebur 3 credits

080.650-652 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. Satisfactory/unsatisfactory.

Staff

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 (B.S.) degree with a major in nursing. This program is accredited by the National League for Nursing.

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

	<i>credits</i>
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

Intro to Psychology	<i>credits</i> 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 B.S. in nursing option is a 13.5-month option which encompasses all of the components of the Traditional B.S. 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:

	<i>credits</i>
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 B.S./M.S.N.

The Direct Entry to Combined B.S./M.S.N. 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 required.

Enhancement Options

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.

Master's Programs

Students seeking a Master of Science in Nursing (M.S.N.) may select from a number of highly individualized programs of study, all fully accredited by the National League for Nursing. 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 dual degree program in nursing and public health (M.S.N./M.P.H.) with Johns Hopkins' Bloomberg School of Public Health; and a dual degree program in nursing and business (M.S.N./M.B.A.) with the Carey Business School. The M.S.N./Ph.D. is also available.

Ph.D. Program

The goal of the Ph.D. 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 or e-mailing jhuson@son.jhmi.edu. You can also visit the School of Nursing Web site at www.son.jhmi.edu.

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.

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.

Dean Moyar, Assistant 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.

Lawrence Principe, Professor (History of Science and Technology): history and philosophy of science.

Maria Merritt, Assistant Professor (Bloomberg School of Public Health): bioethics.

Andrew Siegel, Assistant Professor (Phoebe R. Berman Bioethics Institute): bioethics.

Undergraduate Programs

(See also General Requirements for Departmental Majors.)

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 Introduc-

tion 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 adviser.

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 adviser. 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 adviser 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 adviser.

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 Web site 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 yearlong 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 Web site.

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 Classics

A 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.

Achinstein 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.

Achinstein 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.

Achinstein 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 the works of selected philosophers of the 17th and 18th centuries, including Descartes, Hobbes, Spinoza, Leibniz, Locke, Hume, and Kant. Among the problems to be examined in these works will be those of scientific knowledge, the nature of reality, and the will.

Michael Williams 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 is centered on the topics of freedom and political authority in modern political thought. Texts in the history of political philosophy are discussed, including Machiavelli, Hobbes, Locke, Rousseau, and Mill. Specific questions in contemporary political theory are also addressed, such as free speech and the relation of liberty and justice.

Moyar 3 credits

150.245 (H) Philosophy of Mind

An introduction to the main metaphysical theories about the nature of the mind, thought, and consciousness. Related issues are also discussed such as free will, personal identity, solipsism, and artificial intelligence.

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, Saadia, 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 Enlightenment: 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

150.410 (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

An introduction to Kant's moral philosophy and philosophy of religion, with special concentration on his *Groundwork to the Metaphysics of Morals* and the *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.

Achinstein 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.

Achinstein 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

Achinstein 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 adviser.

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, Moyer 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.

Achinstein 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

Achinstein, 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.

Achinstein 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.

Achinstein 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 *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

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 adviser. The adviser 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 (Chair): theoretical elementary particle physics.

Bruce A. Barnett, Professor: experimental elementary particle physics.

Steven Beckwith, Professor (Astronomer, Space Telescope Science Institute): infrared astronomy.

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. Blumfeld, Professor: experimental elementary particle physics.

Collin Broholm, Professor: 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: theoretical elementary particle physics, astroparticle physics.

Adam Falk, Professor (James B. Knapp Dean, Krieger School of Arts and Sciences): theoretical elementary particle physics.

Gordon Feldman, Professor Emeritus: quantum field theory, theory of elementary particles.

Paul D. Feldman, 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.

Thomas Fulton, Professor Emeritus: quantum electro-dynamics, high energy particle physics, atomic theory.

Riccardo Giacconi, University Professor: astrophysics.

Andrei V. Gritsan, Assistant Professor: experimental elementary particle physics.

Timothy Heckman, 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.

David Kaplan, Assistant Professor: theoretical elementary particle physics.

Chung W. Kim, Professor Emeritus: theory of elementary particles, nuclear theory, cosmology.

Susan Kövesi-Domokos, Professor: theoretical elementary particle physics, astroparticle physics.

Julian H. Krolik, Professor: theoretical astrophysics.

Yung Keun Lee, Professor Emeritus: nuclear physics.

Robert Leheny, Assistant Professor: experimental condensed matter physics.

- Petar Maksimovic**, Assistant Professor: experimental elementary particle physics.
- Nina Markovic**, Assistant Professor: experimental condensed matter physics.
- H. Warren Moos**, Gerhard H. Dieke Professor: astrophysics, plasma physics.
- 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: experimental condensed matter physics.
- Adam Riess**, Professor: astrophysics, experimental cosmology.
- Mark O. Robbins**, Professor: theoretical condensed matter physics.
- David Rust**, Research Professor: solar physics.
- Raman Sundrum**, Alumni Centennial Professor (Director, Theoretical Interdisciplinary Physics and Astrophysics Center): 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**, Assistant Professor: theoretical condensed matter physics, magnetism.
- Zlatko Tesanovic**, Professor: theoretical condensed matter physics.
- Ethan T. Vishniac**, Professor: theoretical astrophysics.
- J. C. Walker**, Professor Emeritus: condensed matter physics, thin films and surfaces, nuclear physics.
- Hal Weaver**, Research Professor: solar system science.
- Rosemary F. G. Wyse**, 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.
- Ann E. Hornschemeier**, Adjunct Assistant Professor (NASA Goddard Space Flight Center): astronomy and astrophysics.

- Michael G. Hauser**, Adjunct Professor (Space Telescope Science Institute): cosmology, especially infrared background radiation.
- 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.
- Bruce Margon**, Adjunct Professor (Space Telescope Science Institute): high energy astrophysics, space astronomy.
- Roeland van der Marel**, Adjunct Professor (Space Telescope Science Institute): black holes, cluster of galaxies, dark halos, galaxy structure and dynamics.
- Antonella Nota**, Adjunct Professor (Space Telescope Science Institute): astronomy.
- Cedomir Petrovic**, Adjunct Assistant 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.
- 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

- Shiyi Chen**, Professor (Alonzo G. Decker Jr. Chair in Engineering and Science, Mechanical Engineering): fluid turbulence, micro- and nano-fluidics, multiscale phenomena and computational methods.
- Gregory Eyink**, Professor (Applied Mathematics and Statistics): mathematical physics, fluid mechanics, turbulence, dynamical systems, astrophysics.
- 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.

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 and flies space instrumentation. Examples include:

- JHU, with CAS oversight, built the Far Ultraviolet Spectroscopic Explorer (FUSE), a satellite for high-resolution spectroscopy, and is now operating it from a control room in the Bloomberg Center. Its primary scientific goals are to measure 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.
- 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.
- 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 now the Principal Investigator institution for the Wilkinson Microwave Anisotropy Probe (WMAP). Launched in June 2001, the WMAP satellite is making the first detailed map of 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 is leading ADEPT, the Advanced Dark Energy Physics Telescope, a concept study for the NASA/DOE Joint Dark Energy Mission.

Several members of the faculty are major users of large ground-based telescopes such as Gemini, Keck, and Magellan, 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 operates the Sloan Digital Sky Survey, a project to systematically survey the entire northern sky in six photometric bands down to very faint levels. This project, which is cataloging 100 million stars and galaxies, and obtaining redshifts for 1 million galaxies, began producing data in late spring 1998. 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, Spitzer, and other observatories to investigate a broad range of topics in galactic astronomy, extragalactic astronomy, and cosmology.

Johns Hopkins is a member of the Large Synoptic Survey Telescope (LSST) consortium and has recently joined the Pan-STARRS 1 Science Consortium. During the years 2008 through 2011, this consortium will use 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 will be 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 will be far deeper than SDSS', 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.

The immense Sloan Digital Sky Survey, GALEX, and Pan-STARRS databases will form the backbone of the emerging National Virtual Observatory (NVO), a concept pioneered at JHU. When complete, the NVO will link all the major astronomical databases into a seamless user-friendly system that will revolutionize astronomical research. Ongoing NVO work at JHU emphasizes the development of cutting-edge tools for data-mining through collaboration between astronomers and computer scientists.

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

The condensed matter physics research in the department spans a wide range of topics, including magnetism, magnetoelectronics, pattern formation, nonequilibrium processes, artificially structured solids, low dimensional solids, low temperature physics, high T_c 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. 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, rheology, 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.

The 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.

Activities in condensed matter theory center on the study of disordered systems, nonequilibrium dynamics, high T_c superconductors, quantum critical phenomena, superfluidity, and electrons in high magnetic fields. Many of these theoretical activities are closely correlated with those of the experimental groups. Work in atomic physics includes electronic transitions involving lanthanide ions in crystals and solutions, the use of orthogonal operators for analyzing the energy levels of free atoms, and the use of group theory in atomic structure and icosahedral systems.

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). 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. The work at both of these facilities continues while the group is actively involved in the construction and commissioning 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 is being readied to 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, 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 are starting to operate in a more 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 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 benchmarked 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 research groups in the department have a wide range of state-of-the-art computer facilities including high performance clusters with hundreds of processors, and database servers with over 100TB of storage capacity. All undergraduate majors and graduate students have access to high performance workstations.

The long history of the Department of Physics and Astronomy in atomic physics and spectroscopy has resulted in the creation of laboratories that are unusually well equipped for research in these and associated fields. There are many laboratory spectrographs as well as the equipment for the assembly and evaluation of ultraviolet spectrometers with sophisticated detectors used in space research and plasma spectroscopy. Associated with these instruments are extensive facilities for absolute calibration and computing.

Among the diverse techniques used for studying condensed matter physics are SQUID (Superconducting Quantum Interference Device) magnetometry/susceptometry, vibrating sample magnetometry, atomic force and magnetic force microscopy, X-ray and electron diffraction, Auger spectroscopy, X-ray fluorescence spectroscopy, and neutron scattering at the nearby NIST Center for Neutron Research and at other leading international facilities. 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 12 Tesla. Apparatus for the preparation of samples includes single-crystal growth vacuum 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. The department maintains a Class-1000 cleanroom for microfabrication and

nanofabrication, and supports an instrument design group with six full-time engineers and a machine shop with three full-time machinists.

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 studies 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 171.209-210). 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 in the Biological Sciences 171.209 and Biological Physics 171.210 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 171.209 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 both classical and modern 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 47.)

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 171.209 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 Phys-

ics 171.210. 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 recommended 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 or from a list of approved physics-related courses in other departments. 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 Equations 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 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 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 faculty adviser 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 171.209-210.

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 279).

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 adviser 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 adviser in his or her field of interest until which time the student chooses an official adviser 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 adviser 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 the exams, students must pass a preliminary oral examination. This exam is usually taken during the second year. Sometime during the second year or early in the third year, students are expected to link up with an adviser and begin progress toward a thesis. Shortly after doing so, students must pass a University Graduate Board oral exam in which they demonstrate their general command of physics and/or astronomy and astrophysics.

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*
- 173.607 Advanced Lab
- or*
- 173.712 Lab of Advanced Instrumentation (one semester)

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 the following list of graduate-level optional courses as offered:

- 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
- 173.607-608 Advanced Laboratory
or
- 173.712 Lab of Advanced Instrumentation
- 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 adviser, the department forms his/her Thesis Committee consisting of the adviser 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 on 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 stu-

dents. 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: 173.111-112, Calculus 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: 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 171.209-210. Corequisites: 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

171.209-210. Corequisites: 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 fall

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

171.119 (N) Discovering the Universe

How did we come to know what we know about the universe? This course will focus on the cosmic discoveries which reveal the universe's constituents and characteristics. We will begin by appraising the mechanics and membership of our solar system. Next we will study the desperate lives of stars. Moving out in space, backward in time, and forward in understanding we will access the nature of distant galaxies and exotic phenomena such as black holes, pulsars, quasars, and supernovae before we address the really big picture: the universe as a whole system; its explosive birth, its expansion, its age, its fate, and its content of undetected dark matter and mysterious dark energy. Through this course students will gain an understanding of not only how the universe works but also the process by which we come to understand it.

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. Prerequisite: 171.201 or 171.209.

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, 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

171.209 (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 4 credits fall

171.210 (N) Biological Physics

This course introduces topics of classical statistical mechanics through the study of biological systems. Additional topics include low-Reynolds number hydrodynamics 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 4 credits spring

171.250 (N) Life in the Universe

This course draws upon a wide array of sciences to study the origin of life in the universe, and the chances for finding extraterrestrial life. Among the topics covered here will be the origin of the chemical components of living organisms, star and planet formation, the origin and evolution of life on Earth, and the search for extraterrestrial intelligence.

Staff 3 hours spring

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 momen-

tum, hydrogen atom, spin, Pauli principle, perturbation theory (time-independent and time-dependent), transition probabilities and selection rules, atomic structure, scattering theory. Prerequisites: 171.202, 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

A broad exposure to modern laboratory procedures such as holography, chaos, and atomic, molecular, and particle physics.

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, 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 is included. Prerequisites: 171.202 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 and Calculus 110.108-109.

Staff 3 credits spring

171.318 (N) Plasma Physics

An introduction to the elementary concepts of plasma physics; particle motion, plasma as a fluid, waves and applications. Prerequisites: 171.202, 171.301-302, Calculus 110.108-109.

Staff 3 credits

171.403 (N) Relativity

Special relativity, formalism, and interpretation in connection with electromagnetism and mechanics. Some discussion of the general theory. Prerequisites: 171.204, 171.301-302, Linear Algebra and Calculus 110.201-202.

Staff 2 credits

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: 171.403 or equivalent.

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

The professor gives formal lectures on the physics behind contemporary problems in cosmology, and then the students study selected papers from the research literature. Discussion in class with each student being expected to give a formal presentation. Examination is by essay.

Staff 2 credits fall

171.410 (N) Physical Cosmology

This course provides an insight into modern physical cosmology, probably the most dynamically evolving part of astronomy today. Within the next five years we measure the precise details of how the universe expands and understand the major principles of how the basic building blocks of the universe form. The course provides a non-technical overview of the physical principles governing the expansion of the universe, and conveys the excitement in this rapidly evolving area. Prerequisites: 171.101-102 or equivalent.

Staff 3 credits fall

171.411 (N) Geometric and Physical Optics

This course is designed for majors in both physics as well as other science and engineering departments. The course will cover conceptual and experimental topics of importance for scientists and engineers in the practice of their professions. The subjects covered will be drawn from ray optics, optical systems, space optics, photometry, fiber optics, the atomic basis for reflection and scattering, interference, diffraction, polarization, and lasers. Prerequisite: either 171.102, 171.104, or 171.106.

Staff 3 credits alternate falls

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

171.428 (N) Introduction to Complex Fluids

This course will provide a one-semester survey of the modern concepts for describing the structure, dynamics, and phase behavior of complex fluids from an interdisciplinary perspective. Specific topics will include polymer solution statistics and thermodynamics, properties of liquid crystals, self-assembly and self-organization in soft matter and biomaterials, viscoelasticity, and interfacial phenomena. Experimental exercises coordinated with the lectures will cover measurements of basic material properties using primarily scattering and microscopy techniques.

Staff 3 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 during 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 first semester covers a thorough survey of analog and digital electronics with a strong emphasis on integrated-circuit technology. During the second semester, experiments are carried out on cosmic rays, X-ray scattering Mössbauer effect, atomic beams, and optical spectroscopy.

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

171.615 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; measurements of distance within the galaxy; stellar kinematics; stellar populations; chemical evolution.

Staff 3 hours alternate falls

171.618 Observational Astronomy

Astronomical coordinate systems and time-keeping. Geometrical optics and telescope design. General detector theory (noise sources, DQE, signal-to-noise considerations). Common optical detectors (CCD's, photomultipliers, image intensifiers, photographic plates). Photometry and photometric systems (correction of extinction, calibration

techniques). Spectrographs and spectroscopy (prisms, gratings, echelles, interference filters, Fabry-Perot systems, spectrograph design, spectrophotometry). Introduction to radio astronomy and physical optics (antenna theory, signal-to-noise calculations, interferometry). Overview of problems unique to infrared and X-ray 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

171.626 Statistical Methods for Physics and Astronomy

The course gives an overview of modern statistical techniques used in physics and astronomy. Particular emphasis will be placed on Bayesian techniques, spatial statistics, and pattern recognition.

Staff 3 hours spring

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: Undergraduate course in statistical mechanics or approval of instructor.

Staff 3 hours

171.636 Modeling Matter 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 multi-grid 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

171.638 Radio Astronomy and Cosmic Microwave Background

This course provides an introduction to radio sources, radio astronomy observational techniques, and the cosmic microwave background radiation. Topics include filled aperture and interferometric systems, detectors and noise, emission mechanisms, galactic and extragalactic sources, and cosmology.

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 extra-terrestrial life, and NASA's ESP plans.

Staff 3 hours

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

171.710 Lie Groups and Lie Algebras

An introduction to Lie groups, Lie algebras, and their representations. The course emphasizes compact Lie groups and their applications to particle physics.

Staff 3 hours

173.712 Laboratory of Advanced Instrumentations

This course is intended for students who are interested in learning advanced instruments such as scanning electron microscopy, LEED/Auger, X-ray diffraction, magneto-optical Kerr effect, computer simulation and modeling in condensed matter physics. Prerequisites: 173.307-308 or 173.607-608, and permission of instructor. Limit: 20.

Staff 3 hours

171.714 Quantum Field Theory in Curved Space-time

This course will discuss the meaning of the particle concept and particle detectors in curved space-time. Problems in defining the vacuum in such spaces as well as in accelerating frames (Rindler space) will be discussed. Examples of Robertson-Walker and DeSitter space will be given. Other topics will include the physical significance of the stress-energy tensor; quantum black holes, particle creation by a collapsing spherical body, Hawking radiation, and the problem of lost information.

Staff 3 hours

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 gauge 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

171.743-744 Particle Physics and Cosmology

The course will begin with an introduction to gauge theories, grand unification of fundamental interactions, and other recent developments in particle physics. The second half of the course deals with applications of particle physics to modern cosmology as well as a brief review of theory of gravity, stellar evolution, and standard cosmology. Designed for second-year graduate students.

Staff 3 hours spring

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

171.747 Supersymmetry

This course provides an introduction to perturbative and nonperturbative supersymmetric field theories.

Staff 3 hours fall

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 includ-

ing 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, $SU(2) \times U(1)$ 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

172.631-632 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 Starburst Journal Club Seminar

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**110.711-712 Topics in Mathematical Physics**

Staff

270.623 Planetary Atmospheres

Staff 3 hours

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 Chemistry, Earth and Planetary Sciences, 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.

The Faculty

John P. Doering, Professor (Chemistry).

Paul D. Feldman, Professor (Physics and Astronomy).

H. Warren Moos, Professor (Physics and Astronomy).

Darrell F. Strobel, Professor (Earth and Planetary Sciences, Physics and Astronomy).

Graduate Program

Background Requirements

Because planetary science is the application of basic principles from the parent sciences of chemistry, geology, and physics to the study of solar system objects, 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 a chemist, geologist, 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.

The research program in planetary science is closely coordinated with the programs in astrochemistry and astrophysics. Students are encouraged to take courses in astrophysics, chemistry, geology, 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 and comets utilizes the Hubble Space Telescope and the Far Ultraviolet Spectroscopic Explorer. Currently, an in-depth study of the Saturnian system is being conducted with the Cassini spacecraft.

Future spacecraft data are anticipated from the Rosetta Mission, the Lunar Reconnaissance Orbiter (launch end of 2008), and the New Horizons Pluto Kuiper-Belt Mission (arrival at Pluto in July 2015). A broad range of fundamental problems in atmospheric chemistry, dynamics, and radiation pertinent to the atmospheres of the giant planets and their satellites and cometary comas are being pursued observationally, theoretically, and in the laboratory.

Political Science

The programs of the Political Science Department are designed to help students attain a deeper understanding of politics in its various dimensions. The department encourages students to become sophisticated theoretically and to study politics in global and comparative perspective. Students can focus on American politics, law and politics, comparative politics, international relations, and political theory. 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. Courses are also taught by adjunct and visiting professors. In addition to taking courses, students can do independent research under the guidance of individual faculty members. A wide variety of courses in comparative and international politics is also given at the Paul H. Nitze School of Advanced International Studies (SAIS), a branch of Johns Hopkins University located in Washington, D.C. Exchange programs with universities in Europe and China are in place or under development. Studying in Baltimore provides an opportunity to understand today's political and public policy challenges, and the university's location so close to Washington offers a wide variety of internship possibilities for interested students. Many students also participate in the Aitchison Public Service Undergraduate Fellowship Program at the Johns Hopkins Washington Center.

The Faculty

Jane Bennett, Professor and Chair: political theory and american political thought.

Mark M. Blyth, Associate Professor: comparative political economy, institutional and ideational theory, advanced industrial states.

Erin Chung, Assistant Professor: 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, Assistant Professor: political theory, jurisprudence; law and society, rhetorical theory and theories of interpretation.

Steven R. David, Professor and Special Assistant to the Dean for Undergraduate Programs: international relations, security studies, comparative politics.

Daniel H. Deudney, Associate Professor: international relations, political theory.

Richard E. Flathman, 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, Professor: comparative politics, Latin American politics, comparative racial politics, transnational political movements.

Waleed Hazbun, Assistant Professor: international political economy, Middle East 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, Assistant Professor: American politics, comparative politics.

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

Kellee S. Tsai, Associate Professor: comparative politics, political economy of development, chinese politics, international political economy.

Lecturers and Adjunct Faculty

Wayne Smith: Politics of Cuba.

Thomas Thornton: Politics of India.

Facilities

In addition to the Milton S. Eisenhower Library, students may use a variety of research libraries and data collections in Baltimore, Annapolis, and Washington, D.C., including the Library of Congress and the National Archives. The Homewood Academic Computing Center, supplemented by the computing, word processing, and related equipment maintained by the department itself, provides data processing facilities and access to national and international data banks.

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 International Studies

The department offers a separate 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 229).

Major in Political Science

The major in political science described below is designed for students interested in intensive study of the institutions and problems of modern government.

Requirements for the B.A. Degree

(See also General Requirements for Departmental Majors, page 47.)

Students who wish to major in political science should take a program in the first two years that will provide a command of written and spoken English; some general, specific, and cultural background; and an adequate foundation in history and the social sciences.

The student must also take a broad range of courses in political science. Course work may include independent reading or field work in the Baltimore urban area. Each student should take advanced courses and seminars whenever this is appropriate.

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 or CG), 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 semester 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.

Seniors also have the opportunity to write a senior research thesis. To be eligible to write this thesis, seniors must enroll in the Senior Seminar in Political Science and International Studies (190.471, three credits) during the fall semester, and have the topic approved by the seminar leader and a faculty thesis supervisor. This seminar will assist in formulating an appropriate topic, researching the relevant literature, and writing and editing the overall thesis. In the spring semester, seniors sign up for senior thesis (190.499).

Honors Program in Political Science

To be eligible for departmental honors at graduation, students must achieve a GPA of 3.7 or better in all courses required for the major, as well as satisfactorily completing the senior seminar and thesis or submitting a substantial research paper certified as honors quality work by a faculty sponsor.

Graduate Programs

The graduate program in political science reflects the distinctive strengths of The 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, the Humanities Center, History, Philosophy, Sociology, Economics, and Public Policy. 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 con-

nections 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 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 \$13,000. Assuming satisfactory progress toward the Ph.D., students can normally expect to receive financial aid for four years. Increasingly, fifth year funding is available. 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. All students are strongly encouraged to satisfy the department-wide foreign language requirement by the end of their first year of graduate study. Students with exceptionally good prior preparation sometimes take their comprehensive examinations in May of their second year, but most students sit for these examinations during their third year in the program. In planning their programs, students should remember that the probability of receiving financial aid from the department itself diminishes somewhat beginning in the fifth year of study.

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 subdisci-

plinary fields into which work in the department is divided.

All candidates for the Ph.D. must satisfy the following requirements:

M.A. Requirements

The master of arts degree is offered only as a step toward the Ph.D. degree. 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. In the case of students who have taken an M.A. in political science or a closely related field at another university, or a degree in law or other professional school, the department will, on request, determine to what extent that work satisfies the Johns Hopkins requirements.

Course Requirements

Complete a minimum of 14 semester courses at the 300- or 600-level with a grade of B or better. The seven courses taken toward the M.A. count toward satisfying this requirement.

Comprehensive Examinations

Pass 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. Students may, if they wish, take an optional second minor examination in one of these fields, in one of the two other fields that the department offers exclusively as minors, or outside 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 adviser and faculty from other departments.
- Complete with a grade of B or better a minimum of three courses at the 300- or 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

Complete a doctoral 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

Pass a final examination. The final examination will take the form of a defense of the doctoral dissertation and will be 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 Government and Politics
- Comparative Government and Politics
- International Relations
- Political Theory
- Law and Politics

Two fields in which the department offers work are available as minors only:

- Philosophy of Political Inquiry
- Quantitative Research Methods

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 advisers and with the faculty in their major and minor fields in constructing and pursuing their programs.

American Government and Politics

Each student taking a major in this field is expected to pass examinations in two of the following subfields:

- President and Congress
- Urban Politics and Intergovernmental Relations
- Parties and Elections

Thus, in each case that American Government and Politics is taken as a major field, and however the faculty conducting the examination chooses to organize it, the comprehensive examination will consist of questions and topics drawn from the two choices that the student sitting for the examination has elected. Seminars and other course work to prepare these fields must be arranged in consultation with relevant faculty.

Each student taking a major field in American Government and Politics is required to take a one-semester course in statistical research methods, 190.602 (Introduction to Quantitative Political Science) or its equivalent.

Students taking a minor field in American Government and Politics will take a comprehensive examination covering at least one of the subfields listed above.

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
- 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.

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:

- National Security Studies
- International Relations Theory
- American Foreign Policy
- International Political Economy

Students majoring in International Relations will also take at least one minor field from among the following:

- American Government and Politics
- Comparative Politics
- 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 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.

Political Theory

Students majoring in Political Theory will take a comprehensive examination covering the following two subfields:

- Contemporary Political Theory
- History of Political Thought

Preparation for these examinations will be arranged in consultation with relevant faculty. Students will also take at least one minor field from among the following:

- American Government and Politics
- Comparative Politics
- International Relations
- Law and Politics

They may choose a second minor field from within or from outside the Department of Political Science.

Students minoring in Political Theory will take a comprehensive examination covering one of the two theory subfields designated above. Preparation for this examination will be arranged in consultation with relevant faculty.

Law and Politics

Students majoring in Law and Politics are required to achieve competency in two of three fields:

- American Constitutional Law and Judicial Process
- Law and Society
- Comparative Constitutional Law

Students majoring in Law and Politics will take at least one minor field from among the following:

- American Government and Politics
- Comparative Politics
- International Relations
- Political Theory

They may choose a second minor field from within or from outside the Department of Political Science. It is recommended that students majoring in Law and Politics take 190.602 (Introduction to Quantitative Political Science) or its equivalent.

Students minoring in Law and Politics will take a comprehensive examination covering one or two of the law and politics subfields designated above. Preparation for this examination will be arranged in consultation with relevant faculty. Students minoring in Law and Politics are expected to take at least three courses in the field.

Philosophy of Political Inquiry

Students offering this minor field will take a minimum of three relevant seminars, such as 190.653-654 (Language and Politics), and seminars in the study of political thought. A seminar in historiography, quantitative methods, the philosophy of science, or anthropological methods could also serve as appropriate preparation for the comprehensive examination in this field.

Quantitative Research Methods

Students offering this minor field will take the following courses or the equivalent:

- 190.603 (Political Data Analysis)
- At least one additional quantitative methods course from a cognate department such as Applied Mathematics and Statistics, Economics, Psychological and Brain Sciences, or Sociology.
- At least one seminar dealing with the philosophy or history of science or with a nonstatistical mode of inquiry such as 190.653-654 (Language and Politics), or a seminar in historiography.

Undergraduate Courses

The designation after a course name indicates the field within which it falls: American Politics (AP), Comparative Politics (CP), Political Theory (PT), International Relations (IR), Law and Politics (LP).

190.101 (S) 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 (S) 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, Tsai 3 credits

190.120 (S) American Parties and Politics (AP)

An inquiry into interest groups, political parties, and elections, and their roles in the political system of the United States.

Staff 3 credits

190.203 Writing in Political Science

Students create a variety of texts to advance their writing and research skills in political science. Subfields covered will vary from year to year.

Staff 3 credits

190.209 (S) 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

190.211 (S) Introduction to Political Economy (CP)

This historically oriented course examines the politics of “the economy” through an examination of the major contributions to the “political” study of the economy from the 17th century to the present.

Blyth 3 credits

190.212 (S) Introduction to Political Economy II (IR, CP)

Course introduces the student to the fields of domestic, comparative, and international political economy. Topics covered include economic growth and decline, competitiveness, and the political effects of globalization.

Blyth 3 credits

190.265 (S) Comparative Political Behavior (CP)

An introduction to the study of political behavior, emphasizing electoral behavior in democratic countries.

Katz 3 credits

190.280 (S,H) Classics of Political Thought (PT)

A study of four classic theorists: Augustine, Rousseau, Tocqueville, and Nietzsche, and examining their conceptions of self, politics, nature, and freedom.

Connolly 3 credits

190.304 (S) Introduction to Public Policy (AP, CP)

Seminar designed to introduce students to the study of public policy and institutional variation in both the United States and advanced industrial nations. Topics will include rationalist approaches, policy network analysis, agenda formation, and policy implementation. Limited to upper-level undergraduates and graduate students.

Sheingate 3 credits

190.308 (S) Topics in Foreign Policy (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

190.311 (S) Middle East Politics (IR, CP)

A study of the dynamics of state building, identity construction, and regional order across the Middle East. Topics include the politics of nationalism, the rise and decline of oil wealth, the challenge of political Islam, and the evolution of regional geopolitics and U.S. foreign policy in the region.

Hazbun 3 credits

190.316 An Introduction to Globalization (IR)

Explores the expansion of transnational flows of capital, commodities, people, and ideas and their impact on patterns of economic, political, and cultural change across the globe. Surveys the academic literature as well as the discourses of international institutions, popular media, and social protest movements.

Hazbun 3 credits

190.323 (S) 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

190.326 (S) 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 3 credits

190.328 (S) 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 (S) 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

190.333-334 (S) 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 each

190.335 (S) Themes in Comparative Politics (CP)

This course introduces the student to the main themes and theories that characterize the subfield of comparative politics. The course will be organized around five key themes: development, democracy, identity, agency, and globalization.

Blyth 3 credits

190.336 (S,W) Chinese Foreign Policy (IR, CP)

This seminar analyzes the foreign policy of the People's Republic of China since 1949. In addition to understanding the historical basis of Chinese nationalism and perceptions of the world, we will also critically consider the "China Threat" debate in the U.S., contested territories (esp. Taiwan), foreign economic relations, human rights concerns, and the PRC's post-Cold War role in the global community.

Tsai 3 credits

190.338 (S) 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 alternative and less formal dispute processing forums. It will also examine the role of courts in the criminal justice system.

Grossman 3 credits

190.343 International Tourism and Politics (IR)

An examination of the political, economic, and cultural forces behind the development of the international tourism industry. Also explores the role of tourism in shaping patterns of economic development, nation building, and the construction of cultural difference.

Hazbun 3 credits

190.344 (S) Anti-Semitism (AP)

For centuries, struggles between Jews and their antagonists have played an important role in the politics of Europe and the Middle East. Over the past 150 years, episodes of anti-Semitism have manifested themselves in the United States, as well. This seminar examines the origins, character, and political significance of attacks on Jews. Every student will be asked to write and present a major seminar paper. Limit: 15, with preference given to juniors and seniors.

Ginsberg 3 credits

190.347 (S) 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 (S) 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 (S) 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

190.356 (S,W) The Social Contract and Its Discontents (PT)

This seminar will engage selected articulations and criticisms of "social contract" theory in Europe from the mid-17th century to the early 20th. It will attend in particular to differences between the three "classic" expressions of consent theory—Hobbes, Locke, and Rousseau—as well as to differences between a variety of significant challenges to these earlier notions of a social contract. The latter may include writings by Hume, Burke, Wollstonecraft, Marx, and Freud, among others.

Culbert 3 credits

190.357-358 (S) B.A./M.A. Seminar (IR)

(See International Studies, page 229.)

Staff 3 credits

190.360 (S,H) Theories of Freedom (PT)

An examination of leading issues in the theory of freedom. Theorists considered include Hobbes, Rousseau, Hegel, Constant, Mill, and recent writers such as Berlin, Taylor, Rawls, Frankfurt, and Goffmann. Lectures and discussion.

Flathman 3 credits

190.363 (S,W) Politics of International Development (IR, CP)

This seminar integrates theoretical and practical perspectives on international development. We will trace the implications of how the notion of development has evolved from a near-exclusive focus on enhancing economic growth in "Third World" countries during the 1950s and 1960s, to a broader notion of development in the 1990s that includes non-economic indicators of human well-being.

Tsai 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

190.366 (S) Topics in World Politics (IR)

This course aims to examine thoroughly a different theme in world politics each semester. Previous themes include Norms and Force in International Relations, Cosmopolitanism and Transnationalism, and Globalization in IR Theory.

Grovogui 3 credits

190.368 (S) 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

190.377 (S,H) Concepts of Political Philosophy: Justice (PT)

An examination of theories of justice from Plato to Rawls.

Flathman 3 credits

190.379 (S) Broadcasting 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, LP)

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

190.383 (S) Urban Society and Politics (AP)

An analysis of the social bases of urban politics, concentrating on the concept of community, the urban social class hierarchy, the role of ethnic groups in city politics, and the impact of the urban economy on the urban political system.

Crenson 3 credits

190.384 (S) 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.

Crenson 3 credits

190.389 (S,W) 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 (S) Introduction to Latin American Politics (CP)

A survey of political institutions and processes in modern Latin America.

Keck 3 credits

190.394 (S) 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 insti-

tutional behavior and the changing role of Congress in the constitutional order.

Cooper 3 credits spring

190.395 (S) Citizenship and Politics (AP)

An examination of the contested meanings of citizenship as legal status, normative ideal, and a form of social or political activity. The course considers how the meanings of the term are created, realized, or distorted in the institutions that make political decisions for communities and societies.

Crenson 3 credits

190.402 Washington Internship Program in Political Science (AP)

Corequisite: 190.403. Prerequisite: permission of instructor.

Ginsberg 3 credits spring

190.403 (S) Washington Seminar: Politics and Policy in Contemporary America (AP)

Economists believe that policy can be analyzed through the application of cost-benefit analysis. Philosophers believe that policy can be analyzed through the application of ethical principles. Political scientists know that policy can only be understood in political terms, that is, in terms of underlying struggles among important groups and forces. The winners of these struggles generally invent the appropriate ethical principles and cost-benefit studies needed to justify the policies they want. This seminar examines the relationship between political struggles and public policies in contemporary America. Every student will be asked to prepare a seminar paper dealing with an important current policy issue.

Ginsberg 3 credits

190.409 (S,W) 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 (S) 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.

Crenson 3 credits

190.411 (S,W) 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

190.414 (S,W) Topics in U.S. Foreign Policy I: The Cold War—Origins, Trends, and Effects (IR)

This is a topical course in American foreign policy. It analyzes the origins of the Cold War, its implications for U.S. foreign policy, and its impact on the policy choices of

various administrations in regard to postwar reconstruction in Europe and U.S. involvement in the Third World. Special emphasis will be placed on the effects of the competition between the United States and the Soviet Union in the determination of America's global objectives, in particular its options in Europe, the Korean Peninsula, Vietnam, and Latin America.

Grovogui 3 credits

190.415 (S,W) Topics in U.S. Foreign Policy II: U.S. Policy toward Southern Africa (IR)

This course analyzes and assesses American foreign policy toward Africa during the Cold War. While this course will examine U.S.-African policy in general, special emphasis will be placed on American objectives in Southern Africa. For practical reasons, the region extends from Zaire (the Congo) to South Africa and includes, principally, Angola, Mozambique, Zimbabwe (Southern Rhodesia), and Namibia.

Grovogui 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

190.422 (S) 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 (S,W) 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

190.471 (S,W) 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

190.499 (S) Senior Thesis: Political Science and International Studies

Prerequisite: 190.471.

Staff 3 credits spring

190.501 Political Science Internship I**190.505-506 International Studies Internship Program****190.531 Summer Independent Study for Undergraduates**

Limited to Political Science students.

190.532 Summer Internship Program

Not part of the Washington Internship Program. Prerequisite: permission of the professor sought as sponsor. Limited to Political Science students.

190.534 Intersession 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****190.543-544 Independent Research in Political Science****190.553 Political Science Internship II****190.598 Independent Study in Political Science****Interdepartmental****360.112 (H,S) The City: A Multidisciplinary Perspective (AP)**

In this course, students are systematically exposed to the many ways that different disciplines have of thinking about historical and contemporary cities.

Kargon, Crenson 3 credits

Cross-Listed**130.306 (H,S) The Origins of Diplomacy**

Westbrook 3 credits

195.477-478 Introduction to Urban Policy: Seminar and Internship (195.477: AP)

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 but will only receive credit for the course component in the political science requirements for graduation.

Newman 3 credits (seminar) 3 credits (internship)

Graduate Courses**190.602 Introduction to Quantitative Political Science (Q)**

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 (Q)

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 (LP)

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 (CP)

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 (LP)

Seminar focusing on the constitutions and constitutional law of selected countries.

Grossman 2 hours

190.611 The Constitution and the International System (IR, LP)

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 credits

190.614 Seminar: Constitutional Theory (LP)

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 (AP)

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 (CP, IR)

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

190.623 Seminar on the Rise and Decline of the Welfare State (CP, IR)

Examines the construction, consolidation, and current retrenchment of the welfare state as a particular institutional form of capitalism in comparative and theoretical perspectives.

Blyth 2 hours

190.625 Theories of Comparative Politics (CP)

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 (AP)

Seminar will focus on core readings in American politics with emphasis on the president and Congress.

Cooper 2 hours fall

190.632 Organized Interests and the State (AP)

A study of interest groups, in both the United States and other countries, their role in electoral competition (including campaign finance), and their relationship to institutions of public authority. The course will also survey various approaches to the study of interest groups.

Sheingate 3 hours

190.635 The Institutes and Conventions of Human Rights (IR, PT)

This course is 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

190.649 Sovereignty: (1492–1600)

To explore 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

190.651 Skepticism, Ethics, and Politics (PT)

An examination of issues in ethics and metaethics and their bearing on the standing of argumentation in normative and justificatory political philosophy. Writers considered include Sextus Empiricus, Montaigne, Hume, J.S. Mill, Sidgwick, Moore, Ayer, Stevenson, Hare, Foot, Geach, Searle, and Lovibond.

Flathman 2 hours

190.653-654 Language and Politics (PT)

Examination of leading issues and positions in the philosophy of language and their implications for, and connections with, the philosophy and methodology of political and social science. Writers examined include Locke, Mill, Durkheim, Wittgenstein, Winch, de Man, Cavell.

Flathman 2 hours (alternate years)

190.659 Oakeshott, Arendt and a Little Bit of Foucault (PT)

A comparative examination of the thought of Oakeshott and Arendt with emphasis on their theories of individuality, action, and politics.

Flathman 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 (PT)

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

190.666 Political Economy of Development (CP)

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 sub-national level, including fiscal decentralization, collective action problems, and the informal sector.

Tsai 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 Judgment in Politics and Law (PT, LP)

A study of theories of judgment and public life. Theorists will include Plato, Aristotle, Hume, Kant, and Arendt.

Culbert 2 hours

190.673 Seminar on Institutional Analysis (AP)

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

190.679 International Political Economy and Globalization (IR)

This seminar explores the politics of transnational economic flows, the globalization of production, and the relationship between power and wealth in the governance of the global economy. Surveys the historical development of the global economy and contending theoretical perspectives in international political economy.

Hazbun 3 credits

190.680 Issues in and around Liberalism (PT)

Thinkers considered include Constant, Mill, Berlin, Rawls, and Dworkin. Consideration of the possibility of augmenting liberal theory by recourse to ideas from voluntarist thinkers such as Ockham, Hobbes, Nietzsche, and William James.

Flathman 2 hours

190.683-684 Research Seminar on Political Parties (AP, CP)

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

190.800 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, Associate Professor: cognitive neuroscience, working memory, attention, and functional neuro-imaging.

Howard Egeth, Professor: perception, memory, cognition, psychology and law.

Lisa Feigenson, Assistant Professor: cognitive development, numerical cognition.

Eric Fortune, Assistant Professor: neural mechanisms of behavior, sensory processing, neuroethology.

Michela Gallagher, Professor (Chair): learning and memory, neurobiology of aging.

Justin Halberda, Assistant Professor: cognitive development, reasoning, language acquisition.

Peter Holland, Professor: learning, memory, motivation, behavioral ecology.

Amy Shelton, Assistant Professor: cognitive neuroscience, spatial cognition, learning, memory, and development.

Craig Stark, Assistant Professor: cognitive neuroscience, learning and memory, functional neuroimaging and neural network modeling.

Veit Stuphorn, Assistant Professor: neurophysiological studies of decision making.

Steven Yantis, Professor: visual perception, attention, and functional neuroimaging.

Associate Faculty

Richard Allen, Assistant Professor: (Neurology).

Stephen Drigotas, Senior Lecturer, Undergraduate Adviser: social psychology.

David H. Edwin, Associate Professor (Medical Psychology): clinical and medical psychology.

Douglas Fogel, Lecturer (Johns Hopkins University Counseling Center): behavior modification.

Linda Gorman, Senior Lecturer: psychopharmacology.

Jennifer Haythornthwaite, Associate Professor (Psychiatry and Behavioral Sciences): behavioral medicine.

Paul J. Hofer, Senior Lecturer (U.S. Sentencing Commission, Washington, D.C.): law and psychology.

Chris Kraft, Lecturer (Johns Hopkins Center for Marital and Sexual Health).

John J. McComb, Adjunct Assistant Professor (Clinical Practice): mental health care and counseling.

Aaron R. Noonberg, Adjunct Assistant Professor (Clinical Practice): forensic psychology, neuropsychology, and behavioral medicine.

Rachel Piferi, Lecturer, behavior modification, theories of personality.

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.

Joint Faculty

Charles Connor, Assistant Professor (Mind/Brain Institute): neurophysiology of visual perception and object recognition.

Stewart Hendry, Professor (Mind/Brain Institute): primate functional neuroanatomy.

Steven Hsiao, Associate Professor (Mind/Brain Institute): neurophysiology of tactile shape and texture perception.

Alfredo Kirkwood, Associate Professor (Mind/Brain Institute).

Barbara Landau, Dick and Lydia Todd Faculty Development Professor (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).

Brenda Rapp, Professor (Cognitive Science): cognitive neuropsychology, attention, reading and writing.

Emeritus Appointments

Bert F. Green Jr., Professor Emeritus: psychological measurement, quantitative methods, and computer methods.

Stewart H. Hulse, Professor Emeritus: comparative cognition, animal learning and behavior, auditory perception.

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 1.5T and 3.0T 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: 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 semester 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 Education 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 three 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. The David Olton Award is given for outstanding achievement in independent research by an undergraduate in the Psychological and Brain Sciences Department.

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 adviser, chooses a research project that will provide extended research experience. Normally, the student designs a study as a larger ongoing project. A project proposal/progress report 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 adviser 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. These are usually performed at the rate of one per semester beginning the first semester of the first year. 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 see www.jhu.edu/~as1/researchlink.html.

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

Fellowships and assistantships are available to all doctoral students, with stipends that are competitive with those of other universities. In addition, tuition remission is provided to all students holding fellowships and assistantships. Summer research assistantships are available in the department.

For further information on graduate study in psychology, contact the academic program coordinator, 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.

Eggeth 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.

Eggeth 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

200.209 (S) Personality Theory

An overview of the major theories of personality, with their empirical bases and applications.

Piferi 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

200.205 (S) Behavior Modification

This course will help students to increase their efficacy in creating behavior change, for both themselves and others, through the understanding and utilization of empirically tested psychological principles. In addition, it will provide an overview of modern-day behavior therapies and their approaches to treating psychological disorders.

Fogel 3 credits

200.206 (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.

Staff 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

200.309 (S) Evolutionary Mechanisms of Human Behavior

This course examines the evolution of human adaptive behaviors. In particular it examines evolutionary contri-

butions to behaviors concerned with problems of survival, such as mating strategies, parenting, and group living.

Staff 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

200.325 (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

200.328 (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

200.339 (S,W) Issues in Counseling and Mental Health Care

This course examines important mental health issues in the context of contemporary clinical practice. It explores major theories of counseling and psychotherapy through readings, case narratives, accounts of clinical processes, and research studies of clinical effectiveness.

McComb 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

200.357 (N,S,W) The Cognitive Neuroscience of Memory

This seminar-style course takes an integrative approach to understanding the neural basis of memory. Multiple approaches to the study of memory (e.g., cellular/molecular, neuropsychology, animal models, computational models, and neuroimaging) will be covered in an attempt to gain a more complete answer to the question, How does memory work? Prerequisite: 080.203 or 200.109 or permission of instructor.

Stark 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

200.372 (S,N) Psychology of Aging

Covers both the biological and behavioral aspects of aging. Psychological functions are examined, particularly as related to changes in the biological systems.

Gallagher 3 credits

200.374 (S,N) Behavioral Medicine

The course deals with the investigation of biomedical and behavioral knowledge relevant to health promotion and medical treatment. Topics include heart disease, cancer, compliance, smoking, exercise, biofeedback, stress, pain.

Piferi 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

200.378 (N,W) Evolution of Behavior

A fundamental challenge of evolutionary theory has been the complex processes underlying the emergence of new behaviors. The processes by which heritable changes in nervous systems lead to new, adaptive behaviors remain one of the most fascinating areas of research in behavioral neuroscience. This course has three objectives. The course will first describe evolutionary processes and their relation to animal behavior. Second, the course will explore the structure of the nervous system in relation to the evolutionary history of vertebrates and the life histories of particular species. Finally, the course will review the evolution of several well-understood behavioral systems. Suggested prerequisite: Animal Behavior, an introductory neuroscience course, any evolution. No freshmen.

Fortune 3 credits

200.383 Mental Models, Mental Logic

An advanced seminar where we try to discern what are the *formats* of mental representations (concepts). Is the concept TREE an *image* in the head, or is it a set of *sentences* about trees? Students read and discuss multiple journal articles each week.

Halberda 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

200.501-502 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 staff members, 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 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, Halberda, Shelton, Stark,

Yantis 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 the staff. 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

200.608 Mathematical Models of Perception and Cognition

Advanced seminar on models of information processing, emphasizing mathematical characterizations of perceptual and cognitive processes. Prerequisite: elementary probability theory.

Yantis 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

Stark 2 hours

200.622 Neurobiology of Learning and Memory

Advanced study of neurobiological mechanisms of cognitive processes in animals.

Gallagher, Holland 2 hours

200.625 Birds and Words: Comparative Approaches to Vocal Learning and Perception

This class examines the developmental course of bird-song learning and the learning of the sound structure of human language. Both behavioral and neural mechanisms mediating these forms of vocal learning are compared and discussed.

Ball 2 hours

200.634 Biological Rhythms and Behavior

Advanced study of biological rhythms as they pertain to seasonal reproductive behavior.

Staff 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

200.661-662 Professional Psychology

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

200.670 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 advisers. 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

200.849 Teaching Practicum

All candidates are required to obtain special experience in various aspects of undergraduate teaching.

Staff

Public Health Studies

Public Health combines a prevention orientation with a population perspective in pursuit of better health for all members of society. While physicians treat individual patients, public health professionals deal with big, urgent, and critically important issues such as access to health care, response to bioterrorism, or controlling outbreaks of epidemic disease.

The Public Health Studies Program offers undergraduates a major that links undergraduates to the world of public health through core courses taken on the Homewood campus, as well as electives taken in East Baltimore at the Johns Hopkins Bloomberg School of Public Health. Students select an emphasis in either natural sciences or social sciences to coordinate with their academic interests and future goals.

Core course work at Homewood includes Fundamentals of Epidemiology, Environment and Health, Fundamentals of Health Policy and Management, Biostatistics, as well as Calculus I, and two semesters each of English, and biology. Students choosing a natural science focus take the core of science and math courses required for eligibility to medical school. Students emphasizing the social sciences will formulate their own coherent academic program that includes a minimum of eight upper-level courses from departments such as Anthropology, Economics, Political Science, Sociology, or History of Science and Technology.

The Bloomberg School of Public Health of The Johns Hopkins University is the oldest and largest school of public health in the world. Although its primary function is to serve as a graduate school, seniors majoring in public health studies will take a semester worth of courses there in fulfilling their B.A. degree requirements.

Course work at the Bloomberg School of Public Health (BSPH) 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 hygiene, nutrition, occupational medicine/health protection and practice, population studies, toxicology, and tropical medicine.

An honors option is available to public health studies majors with a minimum GPA of 3.3 in core course requirements at the end of the junior year. Students will arrange to work in a research, independent study, or field practicum capacity under the supervision of a faculty member who is affiliated with JHU, and the guidance of the director of the Public Health Studies program. Students will

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 before the start of the senior year.

The Public Health Studies office is located in the Greenhouse, Room 104 on the Homewood campus and may be consulted about the various courses, careers, and graduate programs in public health. Information can also be obtained by e-mailing phstudies@jhu.edu.

B.A./M.H.S.

Undergraduate students currently enrolled in the Johns Hopkins University Krieger School of Arts and Sciences program in public health have a unique opportunity to receive both bachelor's and master's degrees. The Johns Hopkins Bloomberg School of Public Health, departments of Environmental Health Sciences and Mental Health offer early graduate school admission to public health studies majors. One-half of the School of Public Health course credits earned toward the B.A. also apply toward the M.H.S. In addition, students in this program will receive co-advising from both schools to optimize their academic experience.

Applications for the B.A./M.H.S. degree are due in spring of the junior year. Public health majors may apply to any of the BSPH departments during their senior year, but credit requirements for the M.H.S. will be the same as for other students entering the M.H.S. program. Please note that admitted students must complete the B.A. degree before formally enrolling in the Bloomberg School.

Program Directors

Kelly Gebo, Director.

James D. Goodyear, Associate Director.

Requirements for the B.A. Degree

All requirements must be taken as graded credits.

Required Courses at Homewood

AS 060. __/220. __	Two semesters of English	6
AS 110.106/108	Calculus I	4
EN 570.303	The Environment and Your Health	3
AS 280.340	Intro to 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 9
 AS 020.306/316 Cell Biology + lab

**Elective Concentration at Homewood
choose A or B:****A. Natural Science Emphasis**

- 030.101 Introductory Chemistry + lab 4
 030.102 Introductory Chemistry II + lab 4
 171.101/103 General Physics I + lab 5
 171.102/104 General Physics II + lab 5
 110.107/109 Calculus II 4
 030.205 Intro Organic Chemistry I 4
 030.206 Intro Organic Chemistry II 4
 030.225 Organic Chemistry Lab 3

Nine credits of 100- or 200-level social science courses. These must include two courses from the following departments: Anthropology, Economics, Sociology, or History of Science and Technology.

12 credits of 300- or higher of social science (S) credits.

B. Social Science Emphasis

15 credits of 100- or 200-level social science courses.

Eight 300-level courses, three from one department in group A; three from one department in group B; plus two electives from other social science departments; 24 credits minimum.

- | | |
|------------------|-----------------------|
| (a) Anthropology | (b) Economics |
| History | Geography/ |
| Psychology | Environmental Science |
| Sociology | History of Science |
| | Political Science |

Requirements at BSPH

Twelve Homewood credits of courses taken at the Bloomberg School of Public Health. This is equivalent to 18 BSPH units. These courses may be taken in any department but exclude independent research/study. These courses may only be taken in the fourth year or upon completion of the required courses at Homewood.

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 3 credits spring

280.156 (H,S) Invention of Tropical Disease

This course is an undergraduate seminar intended for freshmen and sophomores. 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.

Goodyear 3 credits fall

280.213 (S) Epidemiology of Violence: The Case of Latin America

An interpretation of post-Columbian Latin America from a public health perspective. Focusing on the role of violence—political, socio-economic, interpersonal—in the roots of underdevelopment.

Goodyear 3 credits spring

280.340 (S) Fundamentals of Health Policy and Management

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 3 credits spring

280.345 (S,Q) Biostatistics in Public Health

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: 3 years of high school mathematics.

Johnson 4 credits fall

280.350 (S) Fundamentals of 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.

Feinleib 3 credits spring

280.375 (S) Cultural Factors in Public Health

LaVeist 3 credits spring

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.

Goodyear, Bone 3 credits fall

280.495 (S,W) Honors in Public Health Seminar

Using lectures, group projects, 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.

3 credits fall

280.498-499 Honors in Public Health Studies

Restricted to public health studies majors. Consult public health adviser for procedure. Prerequisite: 280.495.

280.501-502 Internship in Public Health

Restricted to public health studies majors. Consult the public health studies adviser for procedure.

280.507-508 Independent Study in Public Health

Restricted to public health studies majors. Consult the public health adviser for procedure.

280.511-512 Research in Public Health

Restricted to public health studies majors. Consult the public health adviser for procedure.

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.

Africana Studies

362.385 (S,W) Community Health Promotion

Furr-Holden 3 credits

Anthropology

070.311 (H,S) Intro Medical Anthropology

Staff 3 credits

070.315 (H,S) Advanced Topics in Medical Anthropology

Das 3 credits

070.327 (H,S,W) Poverty's Life: Anthropologies of Health and Economy

Han 3 credits

Economics

180.252 Economics of Discrimination

Morgan 3 credits

180.280 (S) Population Economics

Slade 3 credits

180.289 (S) Economics of Health

Salkever 3 credits

Environmental Sciences

570.239 (E,N) Current/Emerging Environmental Issues

Roberts 3 credits

570.303 (E,N) The Environment and Your Health

Required for all public health majors.

Staff 3 credits

570.406 (H,S) Environmental History

Schoenberger 3 credits

570.427 (S) Natural Resources, Society, and Environment

Schoenberger 3 credits

570.498 (E) Engineering Aspects of Public Health Crisis

Roberts 3 credits

History

100.333 (H,S,W) Global Public Health Since WWII

Galambos 3 credits

History of Science and Technology

140.106 (H,S) History of Medicine: 18th–20th Centuries

Fissell, Marks 3 credits

140.336 (H,S) Health, Risk, and History

Mooney 3 credits

140.382 (H,S) Sickness and Health in Early Modern Europe

Fissell 3 credits

Philosophy

150.219 (H) Introduction to Bioethics
Bok 3 credits

150.474 (H) Justice and Health
Bok 3 credits

Political Science

190.354 (S,W) Politics of Health Policy
Sheingate 3 credits

190.405 (S) Food Politics
Sheingate 3 credits

195.477 (S) Introduction to Urban Policy
Newman 3 credits

195.478 Urban Policy Internship
Newman 3 credits

Psychological and Brain Sciences

200.132 (S) Introduction to Developmental Psychology

200.133 (S) Introduction to Social Psychology

200.214 (N,S) Brain Myths and Folk Psychology

200.330 (S) Psychology of Gender

200.339 (S) Issues in Counseling and Mental Health Care

Sociology

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

230.305 (S) Poverty and Welfare Policy
Cherlin 3 credits

230.313 (S) Space, Place, Poverty, and Race
DeLuca 3 credits

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

230.341 (S) Medical Sociology
Eaton 3 credits

Interdepartmental

360.258 (H,S) Women's Health and the Life Course
Staff 3 credits

Public Policy

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

Alan Abramson, Senior Lecturer; Director, Nonprofit Sector and Philanthropy Program, The Aspen Institute.

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.

Burt S. Barnow, Associate Director for Research; Principal Research Scientist; Adjunct Professor (Economics): labor economics, employment and training programs, applied microeconomics and econometrics, program evaluation, child support programs, welfare programs.

Peter Berns, Senior Lecturer; Executive Director, Maryland Association of Nonprofit Organizations: nonprofit management

Sen. Benjamin Cardin D-MD, Distinguished Lecturer; Maryland: the legislative process, domestic social policy.

Keenan Dworak-Fisher, Senior Lecturer: statistics

Nancy Hall, Senior Lecturer; Senior Adviser, Maryland Association of Nonprofit Organizations: nonprofit management

Joseph Harkness, Associate Research Scientist: housing policy, urban and regional development, and social policy.

Tama Leventhal, Associate Research Scientist: social policy, children, youth, and families, low-income families with children.

Sandra J. Newman, Director; Professor of Public Policy (Sociology and Health Policy and Management): housing policy, policy analysis, urban and social welfare policy.

Demetra Nightingale, Principal Research Scientist: social policy, employment, welfare, and poverty.

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.

Ellen Roche, Senior Lecturer; former Chief Economist, National Association of Realtors: microeconomics

Michelle Sager, Senior Lecturer.

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.

Joseph Sterne, Senior Fellow: media and public policy, civil rights.

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, especially 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 English as a Foreign Language (TOEFL), and have the results submitted directly to the university. Hopkins requires a minimum score of 600 (paper-based), 250 (computer-based), and 100 (Internet-based). A minimum score of 560 on the test, and 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 and Data Analysis for Policymaking
- 195.607 The Policy Process
- 195.608 Policy Tools
- 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

These courses, taken primarily during the first year, emphasize the acquisition of a set of core analytical skills, an appreciation of the ethical dimensions of policy choice, an awareness of the role of public, nonprofit, and private sectors in public problem solving, and a recognition of the global dimensions of policy choices.

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 five 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 International 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 advisers.

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. Assistant-

ship 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 \$13-15 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

190.610 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.

Staff

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

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.

Crews Cutts, Roche

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.

Dworak-Fisher

Policy Research Seminar

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.

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.

Staff

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

195.611 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.

Barnow

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

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.

Barnow

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

195.650 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.

Staff

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.

Nightingale

195.652 Social Policy: Special Topics Seminar

Nightingale

195.683 Applied Evaluation Seminar

Barnow, Nightingale

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.

Arndt

195.633 Ethics and Accountability in the Nonprofit Sector

Nonprofit organizations operate in an environment that calls for strong ethics and high ideals as the cornerstone for the many benefits and privileges these organizations receive. This course will focus on ethics and accountability efforts in nonprofit organizations around the country. Students will explore watchdog groups, self-regulatory efforts of nonprofits, and public perceptions of the nonprofit sector.

Berns

195.686 Nonprofits in a Three-Sector World

Course description: How do we address social policy issues in the U.S.? The answer necessarily involves the public, nonprofit, and private sectors (and even newer hybrids). The first quarter of the course focuses on each of the three sectors, using the nonprofit sector as the point of reference. The remainder of the course focuses on cross-sector collaboration, case studies, and current debates in the field.

Abramson

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

195.680 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.

Sterne

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 adviser.

Staff

Sociology

The Department of Sociology at Johns Hopkins University concentrates on two broad areas, at both the graduate and undergraduate levels. One is cross-national, comparative research and the study of long-term, world-scale social change. The other is social inequality and the major institutions of this and other societies that directly affect individuals' stratification prospects and outcomes, namely, family, education, and work, as well as, more generally, class, race, and gender.

Faculty and student research is devoted to addressing important theoretical issues with rigorous empirical study. Results from these studies help advance general knowledge of society and contribute to the solution of social problems. Teaching is oriented to bringing to students the latest knowledge in the various subfields of the discipline and training them in rigorous analysis of social processes and issues. Examples of recent faculty research include a comparative study of social class, job conditions, and personality in Poland, Ukraine, and China; a Baltimore-based study of high school dropouts and the early adult transition; a study of the effects of welfare reform on children and families; a study of world-historical patterns of labor unrest; a study of cross-class relations among African-American women and of downward residential mobility among black mothers; a study of the impact of immigration on social mobility for both natives and immigrants and social inequality of the host society; a study of global inequalities and East Asian regional development; the contentious merger of old and new elites during the communist era in China; changing labor relations in Chinese factories between 1949 and the present; and a study of informal workers' movements in India. Additional programs of research consider the timing of educational transitions, vocational education, the impacts of neighborhoods and housing on the educational and economic outcomes of families and young people.

More detailed information can be found on our Web site: www.soc.jhu.edu.

The Faculty

Rina Agarwala, Assistant Professor: 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: class, education and social reproduction, political sociology, social movements.

Giovanni Arrighi, Professor: economic sociology, historical sociology, world systems analysis, social theory, and comparative national development.

Pamela R. Bennett, Assistant Professor: stratification/mobility, education, and demography.

Andrew J. Cherlin, Benjamin H. Griswold III Professor of Public Policy: sociology of the family, demography, social policy.

Stefanie A. DeLuca, Assistant 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.

Robert A. Gordon, Research Professor: small-group leadership, social deviance and policy, criminology, sociology of intelligence.

Lingxin Hao, Professor: sociology of the family, immigration, social policy, quantitative methodology.

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, class, and gender, the African-American population, psychosocial health.

Stephen B. Plank, Assistant Professor: education, quantitative methods, stratification.

Beverly J. Silver, Professor: historical sociology, world-systems analysis, labor and social movements, political sociology, international development.

Emeritus

John L. Holland, Professor Emeritus: psychology and sociology of vocational decision making and careers, evaluation of vocational interventions.

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.

Nettie E. Legters, Adjunct Associate Professor (Center for Social Organization of Schools): education, organizations—formal/complex.

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.

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.

Laura L. Morlock, Professor: economic and social change, sociological theory, medical demography.

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 47.)

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 Introduction to Social Theory, and either 230.322 Quantitative Research Practicum or 230.323 Qualitative 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 (CSID) 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 (SI) 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).
- One semester of research experience in the form of Independent Research (230.506) or an equivalent research assistantship in the Department of Sociology, sponsored by Sociology faculty.

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 adviser 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 (kmc-don@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 advisers. 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 and Data Collection (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 and Selected Topics (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 in the Social Sciences (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. Graduate-level courses in the department (i.e., those numbered 300-level and above) may be taken as electives without prior approval, as may substantive graduate-level courses in any of the other social science departments (social science departments are those that carry "S" credits at the undergraduate level, including the Department of History) and must be passed with a grade of B- or higher. Methods/technical courses (e.g., statistics, computer science) outside the department and substantive courses in non-social science departments require prior written approval of the student's faculty adviser. Training in foundational skills at the introductory level (e.g., calculus, linear algebra) and foreign language study in general may *not* be counted as electives. Elective courses taken at divisions of the university that follow a quarter calendar system (e.g., the Bloomberg School of Public Health) are credited at a ratio of two quarter courses to one semester course.

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.

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

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 in 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

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 (a list of department courses approved as electives for the PSI is maintained in the departmental office).

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 adviser 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 adviser 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 com-

puter 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 and Information Centers, page 526.)

Financial Aid

The department strives to provide five years of financial aid for all students who are in good aca-

ademic 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 introduces students to basic sociological concepts and perspectives, and applies them to a variety of topics including family, work, and the dynamics of class, gender, and racial/ethnic inequalities in the United States and globally.

Staff 3 credits

230.106 (S,W) Freshman Seminar: Education in the Media

Several weeks will be spent systematically collecting major newspapers' coverage of schools for analysis of the contents of these articles using sociological tools and perspectives.

Plank 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) 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. We begin by studying the landmark Supreme Court case *Brown v. Board of Education*, and related school segregation, desegregation, and resegregation issues. Through lectures, discussions, and films, students will become familiar with the various sociological lens through which the educational issues facing Blacks, Asians, Latinos, and American Indians are analyzed.

Bennett 3 credits

230.150 (S) Issues in International Development

This course introduces students to problems of inequality in wealth and welfare from a global, comparative, and historical perspective. The causes and consequences of inequalities among countries, as well as gender, class, ethnic, and regional stratification, are examined. Major theoretical perspectives on international development and global social change are studied and applied to an analysis of contemporary social issues. Freshmen and sophomores 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) Research Methods for the Social Sciences

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. The major topics covered include (1) scientific inquiry and the role of theory in research, (2) causation, (3) conceptualization and operationalization, (4) research design—including experiments, survey research, field research, and comparative research.

Hao 3 credits

230.203 (S) Introduction to Latin American Societies

An introduction to Latin American societies for beginners, this course gives an overview of Latin America, discussing its historical, economic, social, political, and cultural dimensions.

von der Heydt 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

230.208 (S) Contemporary Perspectives in Race Relations

This course surveys various current approaches to questions of American race, racism, and race relations. Its central objective is to provide an overview of the historical, political, economic, and cultural factors which have contributed to the race relations climate observed in the present day. The course also addresses sociological theorizing and research on racial issues.

McDonald 3 credits

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

The goal of this course is to explore issues of race and ethnic minorities, such as school and residential segregation, academic tracking, language isolation, and peer group influences to understand their effects on learning opportunities. Students will be asked to think about the ways in which disadvantages faced by racial and ethnic minorities are alleviated or reproduced in schools.

Bennett 3 credits

230.213 (S,W) Social Theory

This course provides an introduction to classical sociological theories (with an emphasis on Marx, Weber, and Durkheim). Contemporary theoretical perspectives on social inequality, conflict, and social change are also explored. Emphasis is placed on understanding the theoretical constructs as well as on applying them in the analysis of current social issues.

Andreas 3 credits

230.300 (S) Contemporary Economic Sociology of Latin America

This course will analyze the economic and social structures of Latin America from WWII onward, giving emphasis to the actual problems of globalization. This course will offer a structural approach to the most recent stages of development, taking into account the internal and external factors. It will encompass the era of populism, military dictatorships, the period of democratization, and the present era of globalization.

von der Heydt 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

230.305 (S) Poverty and Welfare Policy

Examines the scope, character, and causes of poverty, the major policies to address it, and the movement toward welfare reform. The roles of migration, race/ethnicity, and gender are considered.

Cherlin 3 credits

230.306 (S) Economic Sociology

Classical and contemporary theories of the interaction between economy and society. Hierarchies, market segmentation, embeddedness. Formal and informal economies in advanced and developing societies.

Arrighi 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.

von der Heydt 3 credits

230.309 (S) Introduction to Demography and Residential Segregation

This course will introduce students to the basic concepts of demography, such as population processes and structure. The course will also undertake an in-depth examination of a particular social problem—the separation of race and ethnic groups in residential space—about which demography intersects with sociology. Students will explore the history of racial and ethnic segregation in the U.S., its patterns, causes (social class, discrimination, etc.), and consequences.

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

230.312 (S,W) Education and Society

This course examines how educational institutions affect students' skills, values, and social mobility across generations. Research is reviewed that compares educational institutions according to their formal and interpersonal structures.

Alexander 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

230.316 (S,W) 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

230.317 (S,W) Sociology of Immigration

This course surveys sociological theories and research on immigration to the U.S. Theoretical approaches include theories of international migration, economic sociology, immigration, and assimilation. Research topics include the impact of U.S. immigration laws and policies on immigrant inflows and stocks, self-selection of immigrants, the impact of immigration on the native-born population and the U.S. labor market and economy, and the adaptation of the first and second generations. The course focuses on immigration since 1965 and its related controversies and debates.

Hao 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 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

230.322 (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 (230.301).

Staff 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).

McDonald 3 credits

230.324 (S) Gender and International 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

230.328 (S,W) Sociology of Human Development

A survey of sociological research and theory on life cycle stages from infancy through adulthood with emphasis on continuity and change. Topics will include sociology of birth and infancy, childhood and adolescence as a transition period for young adulthood, and the various stages of adulthood into old age. Major themes are life-course issues, especially the role of education.

Staff 3 credits

230.329 (S,W) Seminar in Work and Personality

An intensive examination of the research literature on the relationship between work and personality, emphasizing such issues as the causal directionality of the relationships, conceptualization of job structure and of personality, processes by which job conditions affect off-the-job psychological functioning, the relationship between people's positions in the class structure and stratification hierarchy and their job conditions, and modification of job conditions.

Kohn 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

230.335 (S) Political Sociology

Analyzes the relations of the state to society and economy in several nations which occupy distinctive positions in the world system, with special attention to the effects of different class structures and patterns of regional inequality on political protest, mobilization, and change.

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

230.342 (S) Gender and International 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 the globalization, class and work, political participation, and social movements.

Agarwala 3 credits

230.349 (S) Globalization and Social Movements

An examination of major waves of social protest in the 20th century (including antiwar, feminist, labor, and national liberation movements). The implications of world-historical patterns for understanding current dynamics will also be discussed.

Silver 3 credits

230.351 (S) The Historical Sociology of East Asia

The East Asian region in pre-modern and early modern times. East Asian and European dynamics compared. Connections between "the rise of the West" and "the demise of the East." Origins of the Chinese Diaspora. Rebellions, wars, and revolutions. The reorganization of the region under U.S. hegemony. Japanese and Chinese business networks. The East Asian economic renaissance and the current crisis in world-historical perspective.

Arrighi 3 credits

230.388 (S) Sociology of the Family

A survey of the transformation of the social institution of the family in the U.S. and the world over the past half-century. Topics include family history, gender roles, variations by social class and by racial and ethnic groups, cohabitation, marriage, divorce, domestic violence, stepfamilies, aging, and public policy and the family.

Cherlin 3 credits

230.389 (S) The Family in Comparative Perspective

This course is designed to give students a broad familiarity with the area of the family in comparative perspective. Various societies are selected from European and Asian countries, in comparison with the United States. Specific topics include: (1) theories of family sociology and principles of the comparative perspective; (2) family structure, family formation, family dissolution, childbearing, childrearing, and old age support; (3) relationship between the family and work, focusing on women's labor force participation; and (4) relationship between the family and the state, focusing on family policies.

Hao 3 credits

230.390 (S) Theories of Social Change and Evolution

This is a course on the historical development of human societies. Systematic comparisons are made between societies and intersocietal networks with emphasis on changes in the logic of social development. The course surveys general theories of social evolution and historical economic systems. The dynamics of political centralization/decentralization in the rise and fall of chiefdoms, states, empires, and modern hegemonies are also compared.

Staff 3 credits

230.391 (S) Theories of International Development

Theories of political, economic, and social development. National development and the development of international systems. Although contemporary development and underdevelopment are emphasized, patterns of change in recent centuries are also examined in order to provide a comparative background for understanding recent developmental processes.

Silver, Arrighi 3 credits

230.407 (S) Comparative Labor Movements Research Seminar

Research-oriented course on the dynamics of labor and social movements from a global and comparative-historical perspective.

Silver 3 credits

230.410 (S) Cross-National Research on Social Structure and Personality

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 3 credits

230.450 (S) Macro-Comparative Research Methods

This course covers basic methods of studying long-run, large-scale social change. Both qualitative and quantitative methods are covered.

Staff 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

All research involves making strategic decisions. Often these decisions are implicit, but they ought to be explicit and well thought out, for they will have a major impact on the validity of the conclusions one can draw from the research. The decisions made in planning a study invariably involve tradeoffs, which in turn require a careful assessment of what are the central issues one wishes to address, and what issues can be left aside for future research. This course will introduce students to some of the critical choices one faces in designing research, so that the students are better equipped to understand and to evaluate the research they encounter and, in time, to plan their own research.

DeLuca

230.602 Social Theory: Theories of Society

Intensive readings from classical theorists (Marx, Weber, and Durkheim) form the core of this course. Emphasis is placed on exploring the utility of social theory for formulating important sociological questions and conceptualizing social research.

Arrighi

230.603 Contemporary Social Theory

Contemporary theories of social interaction. Functionalism: Parsons and Merton. Critical sociology and conflict theory: Mills, Habermas, and Bourdieu. Symbolic interactionism: Mead, Blumer, and Goffman. Theories of rational choice: Homans, Blau, and Coleman. Ethnomethodology, standpoint theory, and postmodernism: Garfinkel, Smith, Foucault. Alternative solutions to the micro-macro "bridging problem."

Andreas

230.604 Regression Analysis

A seminar in multiple regression (least squares and logistic) with an introduction to computer applications. Limited to graduate students with a solid statistics background. Prerequisite: 230.205 or the equivalent.

Plank

230.605 Categorical Data Analysis and Selected Topics

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 Issues in Economic Sociology

In-depth reading and discussion of classical and contemporary works in economic sociology. Typical issues examined include capitalism as historical social system; capital and markets as social structures; social networks, commodity chains, and product cycles; sociological perspectives on economic development.

Arrighi

230.607 Labor in the World System

A research seminar on the comparative-historical sociology of labor movements. The interrelationships between transformations in the labor process, labor markets, and patterns of working class formation and protest are examined; spatial and temporal convergences/divergences are analyzed.

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 in 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.

Arrighi, 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

230.615 Seminar on Panel Data Analysis

The course covers advanced methods for panel data analysis, including discrete time models for continuous vs. categorical dependent variables, random vs. fixed effects, and static vs. dynamic processes. Applications of these models to sociological research will be illustrated.

Hao

230.616 Researching Race, Class, and Gender

This advanced graduate seminar reviews the major sociological works on race, class, and gender. It is designed to assist dissertation-level students to flesh out specific points and counterpoints feeding debates among scholars in the field.

McDonald

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

230.620 Seminar on Women and Work

A graduate seminar designed as a collective research experience to investigate the interdependent nature of gender, work, and family. Specifically, the course will examine market and nonmarket forces that affect women's employment trends and employment life trajectories; structural inequality in the society and its consequences for the workplace; how organizational settings affect the behavior of men and women at work; historical racial and ethnic differences in the meaning of work and participation in the paid and non-paid labor force; and the connectedness of women's employment to marriage and childbearing. Open to advanced undergraduates with permission of instructor.

McDonald

230.622 Seminar on Limited Dependent Variable Models

This course introduces students to techniques for the analysis of event histories and categorical data such as logistic regression, hazard models, and other censored and truncated regression models. Students will do exercises using sample data and statistical software.

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

230.627 Research on Structural Globalization

This course focuses on studies of cycles, trends, and structural changes in the modern world-system. The literature on globalization is reviewed and studies of the causes and consequences of changing structural features of the whole world-system are examined.

Arrighi

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

230.643 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 in the Social Sciences

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

230.655 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

230.656 Theoretical Perspectives on Education and Society

Students are introduced to current theory and research regarding the role of schooling in modern society. Topics are selected to enable students to understand and extend or revise current perspectives and measurements of the antecedents and nature of effects of education. Topics include classical theories on the functions of education (e.g., Durkheim, Weber, Waller, Dewey, and Marx), education and nation-building, education and the division of labor, differentiation and stratification in schools, and education and cultural and social reproduction.

Plank

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/Assistantship

Staff

230.811 Teaching Assistantship

Staff

Theatre Arts and Studies Program

The program offers a comprehensive approach to the arts of acting, directing and playwriting along with the fundamentals of technical direction, play production, play analysis, theatre management and theatre history.

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 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
production and management.

The Faculty

Margaret (Peg) Denithorne, Instructor: Acting,
directing, theatre history.

James Glossman, Instructor: Directing, acting,
theatre management, theatre history.

John T. Irwin, Decker Professor in the Humanities,
Writing Seminars: criticism and poetry in the theatre.

Marc Lapadula, Visiting Assistant Professor, Writing
Seminars: playwriting.

Richard A. Macksey, Professor, The Humanities
Center, History of Science and Technology:
Theatre history and criticism.

William J. Miller, Instructor: Acting.

Michael Quattrone, Instructor: Acting, theatre
history.

William Roche, Instructor: technical direction,
theatre crafts, theatre management.

Krista Smith, Instructor: Acting, directing.

Ronald Walters, Professor, History, American
cultural and social history.

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 adviser 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

Workshop IV (Prerequisite Workshop III) is 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.

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

225.312 (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

225.314 (H,W) 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

225.322 (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

225.344 (H) Voice and Movement for the Stage

Development of vocal and physical awareness and expression through fundamental exercises for voice and body. In addition, technique will be developed using poetry, Shakespeare sonnets, and monologues.

Staff 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.

Various 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

300.116 (H,W) Forms of Comedy: Theory and Practice

A comparative survey of comic forms in drama and narrative from classical antiquity to the present. Texts will be read with representative theoretical statements.

Macksey 3 credits

300.118 (H,W) The Uses of Comedy: Theory and Practice

A comparative study of writing and theory with special attention to the devices of satire, irony, and parody.

Macksey 2 credits

300.308 (H,W) Comic Relief: Comedy and Catharsis

Versions of comic theory from Aristotle to Freud, Bergson, and Koestler, with an emphasis on psychological explanations of comic design and response. Illustrations will be drawn from examples in literature, film, and the graphic arts.

Macksey 3 credits

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, Sex and Society, 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

Veena Das, Krieger-Eisenhower Professor

(Department of Anthropology and Humanities)

Hent de Vries, Professor (Humanities and Philosophy)

Frances Ferguson, Mary Elizabeth Garrett Professor (English and Humanities)

Aaron Goodfellow, Associate Director, Program for the Study of Women, Gender, and Sexuality

Lori Leonard, Professor (Health, Behavior and Society, Bloomberg School of Public Health)

Paola Marrati, Professor (Humanities and Philosophy)

Katrin Pahl, Assistant Professor (German and Romance Languages and Literatures)

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, minors are required to take two of the four core courses. In the recent past, the core courses have been Feminist and Queer Theory, Gender and Health, Sex and Society, 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
- 070.360 Negotiating the Everyday: The Situation of Children in Baltimore
- 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

- 040.315 Family, Gender, and Sexuality in Ancient Greece

Economics

- 180.252 Economics of Discrimination
- 180.289 Economics of Health

English

- 060.223 Marriage Problems
- 060.313 The Body in Early Modernity
- 060.384 Interracial Intimacy and the American Novel
- 060.354 Marriage and Literature
- 060.704 Queer Times: Narrative, Sequence, Sexuality

Film and Media

- 061.331 America Since Brando
- 061.335 Monster Films

German and Romance Languages and Literatures

- 212.302 Love, Death, and the Supernatural
- 213.335 Technology and Sexuality

- 213.337 Mermaids and Water Sprites
- 212.408 Love, Poetry, Eroticism
- 213.648 The Multilingual Culture of Weimar Era Berlin

History

- 100.219 The Chinese Cultural Revolution
- 100.247 Remaking Gender in 20th-Century America
- 100.359 Women's Labor Migration
- 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

- 140.124 Women and Medicine
- 140.324 Electronic Identities in Japan
- 140.373 The Body and Health Care in Japan

Humanities

- 300.303 Early Modern Women Writers: Poetry of the European Renaissance
- 300.326 Comparative Sensibilities: East and West
- 300.335 Science Fiction and the Avant-Garde
- 300.336 Proust and Philosophy
- 300.363 Reading Judith Shakespeare: Women Playwrights of Early Modern England
- 300.383 What Makes Us Desire
- 300.672 Thomas Hardy

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

- 103.331 Sex, Drugs, and Rock and Roll in Ancient Egypt
- 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 International Development
- 230.614 Seminar on the Family
- 230.616 Researching Race, Class, and Gender

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.

Tristan Davies, Senior Lecturer: fiction.

John T. Irwin, Decker Professor in the Humanities: criticism and poetry.

Brad Leithauser, Professor: fiction.

Alice McDermott, Richard A. Macksey Professorship for Distinguished Teaching in the Humanities: fiction.

Jean McGarry, Professor: fiction.

Mary Jo Salter, Professor: poetry.

Dave Smith, Elliott Coleman Professor of Poetry (Chair): 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.

Joint Appointments

Richard A. Macksey, Professor (The Humanities Center, History of Science and Technology): film studies.

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

(See also General Requirements for Departmental Majors, page 47.)

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.

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).
- Demonstrated competence in a foreign language through the intermediate level.
- Eight advanced semesters beyond IFP in The Writing Seminars.

Requirements for an Undergraduate Writing Seminars Minor

A minor in The Writing Seminars is available to selected undergraduate students 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 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, and Brad Leithauser. 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 six 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. McGarry 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. McGarry and Teaching Fellows 3 credits

220.146 (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 sci-

ence is useful but not essential. Limit: 15. Permission not required.

Finkbeiner 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 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

220.205 (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

220.206 (H) 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) Seminar: 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

220.322 (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.

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

220.325 (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: 14.

Davies, McGarry 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, 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

220.338 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

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

220.342 (H) Introduction to Dramatic Writing: Film

An examination of the screenplay as a literary text and blueprint 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

220.347 (H) 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

220.377 (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

220.388 (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

220.397 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 readings 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

220.400 (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.

McDermott, McGarry 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*, *Cleanmess*, *Pearl*, *Gawain and the Green Knight*, and *Piers Plowman*. Limit: 15.

Irwin 3 credits

220.406 (H,W) 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

220.412 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.

McGarry 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.

Senior Faculty

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

220.611 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

220.613-614 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.

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 American Poetry

A study of American poetry written after 1945 with discussion of aesthetic movements, events, 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

220.637 Techniques of Fiction: Workshop in Formative Genres

An examination of the formative genres in prose fiction and their hybridized descendants in Defoe, Flaubert, Stevenson, Camus, Barnes, Dixon, and others. Written work will focus on conscious borrowing from alternative genres.

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 isolate 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 of 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: 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 the M.S., M.S.E., and Ph.D. 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 Web sites, throughout 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 advisers, 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

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.

Alan J. Goldman, Professor Emeritus: operations research, game theory, optimization, graph theory, facility location.

Shih-Ping Han, Professor: optimization, numerical analysis, operations research.

Daniel Q. Naiman, Professor (Chair): statistics, computational probability, bioinformatics.

Carey E. Priebe, Professor: statistics, image analysis, pattern recognition.

Edward R. Scheinerman, Professor: discrete mathematics, partially ordered sets, random methods, graph theory.

Fred Torcaso, Lecturer: stochastic processes, asymptotics and partial differential equations.

John C. Wierman, Professor and Director of the Center for Leadership Education: probability, statistics, random graphs, stochastic processes.

Laurent Younes, Professor: mathematical imaging, shape theory and applied differential geometry, computational probability, statistics.

Joint, Part-Time, and Visiting Appointments

Shiyi Chen, Professor (Mechanical Engineering): turbulence, computational fluid dynamics, lattice Boltzmann applications, molecular dynamics, flow in porous media.

Gregory Chirikjian, Professor (Mechanical Engineering).

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.

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 adviser. 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 adviser, each student constructs an individualized program meeting the requirements below. A written copy of the program should be on file with the faculty adviser, 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, page 47, and Writing Requirement, page 43.)

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, 110.108-109, or 110.111-112 can be used to satisfy the Calculus I and II requirements. The courses 110.202 or 110.211-212 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, 550.281, 550.385, or 550.386 is acceptable. (Other courses may be substituted with adviser'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 adviser's approval. One course in real analysis (110.405 or higher), abstract algebra (110.401), or differential equations (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 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.

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 (e.g., C, FORTRAN, Pascal, or Java in the courses 550.281, 550.385, 550.386, 600.107, 600.109, or 500.200), 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.
- 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 con-

cepts, practices, and skills necessary for effective leadership as managers and entrepreneurs in the public and private sectors.

Course descriptions of entrepreneurship and management courses offered by the Center for Leadership Education are provided on page 528.

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 recommendation 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

Students may work toward either the master of arts (M.A.) degree or the master of science in engineering (M.S.E.) degree. Both degrees 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 adviser. All 600- and 700-level courses are satisfactory for this requirement. Most 400-level courses are also acceptable. All courses must be completed with grades of B- or higher.
- 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 adviser.
- Demonstrate a working knowledge of the utilization of computers in the mathematical sciences.

In consultation with the faculty adviser, 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 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 advisers. 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 adviser.
- 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 Web site.

Course Program

The most common way for students to gain the knowledge and skills to succeed in the Ph.D. pro-

gram is through course work. In consultation with his or her adviser, each student will develop a program of proposed coursework. 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 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 Web site, but a student with different goals is free to propose an appropriate program meeting the approval of the research adviser.

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 adviser 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 Abel Wolman Fellowship, awarded by the Whiting School in honor of a pioneering engineering school faculty member.
- 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.

550.103 (Q, S) 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, Torcaso 4 credits

550.112 (Q,E) Statistical Analysis II

Second semester of a general survey of statistical methodology. Topics include least squares and regression analysis, correlation, further nonparametric methods, chi-square tests, the likelihood concept, decision theory, Bayesian inference, time series, simultaneous equations, sample survey design. Prerequisite: 550.111. Students who may wish to undertake more than two semesters of probability and statistics should consider 550.420-430.

Fishkind, 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

550.171 (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.

Fishkind, Scheinerman, Torcaso 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 spring

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

550.281 (Q,E) Computing in Applied Mathematics

Overview of some of the more common computational platforms in which to do applied mathematics. The course will cover computing in at least three general areas: numerical linear algebra using Matlab, symbolic mathematics using Maple, and statistics using R. Students will be presented with applications, basic mathematics that underlies the problems to be solved, and computational approaches to their solution. Prerequisite: Calculus I.

Naiman 4 credits

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, 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.

Fishkind, Geman, Younes 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.

Fishkind, Geman, Younes 4 credits

550.331 (Q,E) Introduction to Mathematical Finance

The principal aim of this course is to provide the mathematical ideas leading up to the now famous Black-Scholes formula for options pricing. Topics to be covered will include basic probability, normal random variables, Brownian motion, interest rates, the arbitrage theorem, pricing of various types of options. Prerequisites: Calculus I, II and III.

Naiman 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, Goldman 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 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 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, Goldman, 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, Priebe, Torcaso, Wierman 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) 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.

Fill, Torcaso, Wierman 4 credits spring

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.

Marchette, Naiman, Priebe 4 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

Applications of numerical analysis to statistics. Linear least squares; random number generation; Monte Carlo techniques; analysis of variance; time series computa-

tions; numerical integration. Emphasis on computational aspects relevant to practical statistical problems. Prerequisites: 550.430, computing experience.

Naiman 3 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 datasets. Prerequisite: 550.310 or equivalent. Recommended prerequisite: 550.413.

Staff 4 credits

550.437 (Q,E) Information, Statistics, and Perception

Statistical inference, inductive learning and information theory together provide a cohesive framework for machine perception. Various problems in image analysis and computational biology will be analyzed in this context in both theory and practice (working algorithms). Examples include visual tracking, object recognition,

texture modeling, neural decoding and gene expression. 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.

Torcaso 3 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. Mathematics 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.

Staff 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.

Staff 4 credits spring

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.

Staff 4 credits fall

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.

Goldman 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.

Goldman 3 credits

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 nonlinear 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

550.475 (Q,E) Computational Algebra

Commutative algebra approached from a computational point of view. The theory and application of Groebner bases and related algorithms (e.g., Buchberger’s algorithm) for solving many standard problems related to polynomials in several variables. Many elementary and important ideas from algebra will be covered, including elimination theory, implicitization, ideals, Hilbert’s Nullstellensatz, and an introduction to elementary algebraic geometry. A key focus of the course is on the algorithmic treatment of classical algebraic problems as well as problems from robotics and automatic theorem proving. Computer algebra packages will be demonstrated and used by the students. Prerequisites: Linear Algebra (550.291 or 110.201), Discrete Math (550.171) or equivalent.

Naiman 4 credits

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

550.486 (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, perturbation 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 par-

tial 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

This course introduces a series of mathematical concepts for low level image processing and the numerical algorithms that are derived from them. These include linear and non-linear smoothing and enhancement, PDE-based isotropic and anisotropic filters, variational energy-minimization methods, data analysis and decomposition methods allowing low-level image understanding: standard image transforms (Fourier, cosine, wavelets), techniques of principal and independent component analysis. Prerequisites: elementary calculus (110.108-109 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.

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.

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.

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, 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, 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 T^2 ; multivariate linear models; regression, ANOVA; inference 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 selected papers (research articles, tutorials, etc.) in bioinformatics and computational biology. The major objective is to prepare students to comfortably read the literature and to understand the nature of research in this field. The common theme is learning from data, for instance inferring phenotype from genotype, or modeling regulatory networks, based on gene or protein expression data. By and large, the papers will be presented by the students. In addition, these expositions will be supplemented by lectures on various aspects of statistical learning, predictive inference and pattern recognition (e.g., class discovery and prediction, feature selection, p-values and permutation analyses, overfitting, the bias/variance dilemma and cross-validation). Prerequisites: A course in statistics is required; previous exposure to machine learning or pattern recognition is recommended. Course is recommended for prepared seniors through postdocs and faculty.

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

550.661 (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.

Goldman, Han 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.

Goldman, Han 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 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 1.5 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.

Eyink, Han 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, Han 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

550.700 Master's Research

Reading, research, or project work for master's-level students. Arranged individually between students and faculty. Offered each semester.

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

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

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

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

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

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

550.735 Topics in Statistical Pattern Recognition

This course will cover topics in classifier design and dimensionality reduction from a statistical perspective.
Priebe

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.
Goldman

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.
Goldman, Han

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 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.
Staff 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 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.
Han 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

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

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, Han

550.800 Dissertation Research

Reading, research, or project work for advanced graduate students. Arranged individually between students and faculty. Offered each semester.

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

550.230 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

550.432 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 Information, Statistics, and Perception
 550.438 Statistical Methods for Computer Intrusion Detection
 550.439 Time Series Analysis
 550.440 Stochastic Calculus
 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

- 550.251 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

- 550.281 Computing in Applied Mathematics and Statistics
 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
 550.491 Applied Analysis for Engineers and Scientists
 550.475 Computational Algebra
 550.480 Shape and Geometry
 550.486 Asymptotic Methods
 550.491 Applied Analysis for Engineers and Scientists
 550.493 Mathematical Image Analysis
 550.681 Numerical Analysis
 550.692 Matrix Analysis and Linear Algebra
 550.693 Turbulence Theory
 550.790 Topics in Applied Mathematics

Combined Areas, Research, and General

- 550.103 Mathematics and Politics
 550.331 Introduction to Mathematical Finance
 550.400-401 Mathematical Modeling and Consulting
 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
 550.500 Undergraduate Research
 550.501 Senior Thesis
 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

The usefulness of the methods of engineering science for solving biological and medical problems has become increasingly evident in recent years. The application of engineering to these problems is known as biomedical engineering. 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 neurobiology, theoretical and computational biology, cell and tissue engineering, and nanobiotechnology.

The Faculty

Angelo Homayoun All, Research Associate: surgical assist devices.

Robert H. Allen, Associate Research Professor: design, education, birth mechanics.

Joel Bader, Assistant Professor: bioinformatics and computational biology.

Michael A. Beer, Assistant Professor: genomics and computational molecular biology.

Henry Colecraft, Assistant Professor: molecular biology and physiology of voltage-gated calcium channels, viral gene delivery, gene therapy, animal models of cardiovascular and neurological diseases.

Jennifer H. Elisseeff, Associate Professor: tissue engineering, biomaterials, cartilage regeneration.

Harry R. Goldberg, Assistant Professor, Assistant Dean School of Medicine: interactive simulations, virtual classrooms.

Eileen Haase, Instructor: Models for Life, Physiological Foundations Laboratory, Cellular and Tissue Engineering Laboratory: molecules and cells.

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.

Andre Levchenko, Assistant Professor: intracellular signal transduction, cell engineering, cancer research.

Michael I. Miller, Professor: image understanding, computer vision, medical imaging, computational linguistics, computational neuroscience.

Baohan Pan, Research Associate: nerve regeneration, spinal cord injury, spinal cord regeneration.

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, Professor (Chair): auditory neurophysiology and psychophysics.

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.

Artin A. Shoukas, Professor: systems analysis of circulatory systems, systems physiology.

Alexander A. Spector, Research Professor: biosolid mechanics, cell mechanics and biophysics, molecular motors, mathematical and computational modeling.

Nitish V. Thakor, Professor: medical instrumentation, medical micro and nanotechnologies, neurological instrumentation, signal processing, and neural prosthesis.

Natalia Trayanova, Professor: computational cardiac electrophysiology, mechanisms of arrhythmogenesis and cardiac anti-arrhythmia therapies, development of models of cardiac tissue structure from various imaging modalities, mechano-electric feedback in the heart.

Leslie Tung, Associate Professor: functional electrophysiology of cultured cardiac cell networks, cardiac arrhythmias, analysis of multicellular structure.

Rene Vidal, Assistant Professor: 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).

Xiaoqin Wang, Professor: neurophysiology of the auditory cortex, neural mechanisms of speech perception and learning, computational neuroscience.

Raimond L. Winslow, Professor: applied statistical learning, computational cell biology, cardiac electrophysiology, grid-based computing and data sharing for collaborative science.

Kevin J. Yarema, Assistant Professor: metabolic engineering of oligosaccharide biosynthetic pathways, analysis of the effects of unnatural metabolites on gene expression, glycobiology.

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

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, Associate Professor (Anesthesiology 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.

Charles C. Della Santina, Assistant Professor (Otolaryngology–Head & Neck Surgery): electrical stimulation of the inner ear for restoring balance function, neurophysiology, vestibular function testing.

Andrew S. Douglas, Associate Dean 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.

Donald Geman, Professor (Applied Mathematics and Statistics): statistical learning, visual recognition, computational genomics.

John Goutsias, Professor (Electrical and Computer Engineering): digital processing, image processing and analysis.

Edith D. Gurewitsch, Assistant Professor (Gynecology and Obstetrics): birth simulation, human subjects testing.

Henry R. Halperin, Professor (Medicine): cardiovascular medicine, MR compatible devices.

Justin Hanes, Associate Professor (Primary: Chemical and Biomolecular Engineering; Secondary: Oncology, The Sidney Kimmel Comprehensive Cancer Center): synthesis of new biodegradable polymers, targeted drug and gene delivery via the blood and lungs, particle transport and trafficking in biological barriers, cancer.

Kalina Hristova, Assistant Professor (Materials Science and Engineering): biomolecular materials, biomembranes, biosensor development.

Steven S. Hsiao, Associate 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 Jedynek, Assistant Research Professor (Applied Mathematics and Statistics): statistical models in image processing, language processing, genomics and neuroscience.

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

Konstantinos Konstantopoulos, Professor (Chemical and Biomolecular Engineering): cell and fluid mechanics in medical applications, cancer metastasis, thrombosis, inflammation/bacterial infection.

Hai-Quan Mao, Assistant Professor (Materials Science and Engineering): non-viral gene delivery, cell-materials interaction, polymeric scaffolds, design and synthesis of biodegradable polymeric materials.

Eduardo Marban, Professor (Cardiology): molecular and cellular biology of the heart in health and disease.

W. Lowell Maughan, Professor (Medicine): left ventricular function.

Elliot McVeigh, Associate Professor (NIH): magnetic resonance imaging.

Richard A. Meyer, Professor (Applied Physics Laboratory): neural mechanisms of pain, applications of technology to neuroscience problems.

Americo A. Migliaccio, Assistant Professor (Otolaryngology–Head and Neck Surgery): effect of galvanic stimulation on the vestibular ocular reflex, neurophysiology, vestibular function testing.

Robert E. Miller, Associate Professor (Pathology Informatics): clinical laboratory instrumentation, laboratory information systems.

Lloyd B. Minor, Professor (Otolaryngology–Head and Neck Surgery): vestibular neurophysiology.

Vincent L. Pisacane, Associate Professor (United States Naval Academy): space technology, technology management.

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.

Mark J. Shelhamer, Associate Professor (Otolaryngology): sensorimotor adaptation, nonlinear dynamics, vestibular and oculomotor modeling, space flight adaptation.

Kathleen J. Stebe, Professor (Chemical and Biomolecular Engineering): surfactants, interfaces far from equilibrium, self-assembly.

Robert H. Stiefel, Instructor (Johns Hopkins Hospital): clinical engineering.

Sean Sun, Assistant Professor (Mechanical Engineering): biological force generation, molecular motors, cell motility, statistical mechanics of soft condensed materials.

Tza-Huei (Jeff) Wang, Assistant Professor (Mechanical Engineering): micro/nanoscience and technology, BioMEMS, single molecule manipulation and detection.

Ursula Wesselmann, Associate Professor (Neurology): pathophysiological mechanisms of pelvic and urogenital pain, pain modulation during pregnancy and labor, gender differences in pain perception.

Thomas B. Wolf, Professor (Physiology): molecular dynamics calculations, membrane biophysics, computational neurosciences.

Laurent Younes, Associate Professor (Applied Mathematics and Statistics): statistical properties of Markov random fields, image analysis, deformation analysis—shape recognition.

Program Directors

The members of the Committee on Biomedical Engineering, which directs the Ph.D. degree program, are Professor Winslow (chair and director of the doctoral program), Professor Fuchs, Professor Johns, Professor Johnson, Professor Sachs, Professor Schramm, and Assistant Professor Mori. The director of the master's degree program is Professor Yarema. The director of the undergraduate program is Professor Tung.

Facilities

The center of gravity for the Department of Biomedical Engineering is the Traylor and Ross 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. In June 2001 Clark Hall opened its doors on the Homewood campus to house the Whitaker Biomedical Engineering Institute. The Whitaker Institute has been 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 will provide 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 library, a student instrumentation laboratory, a fully staffed mechanical shop and a supercomputing facility.

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. For instance, there are three laboratories completely equipped for cardiovascular systems experimentation, including state-of-the-art equipment for measuring regional blood flows and pressures. At least four laboratories are equipped for the recording of activity from single and multiple neurons and for delivering complex, computer-generated, sensory stimuli to a variety of preparations. Four laboratories use computer controlled systems to study muscle biophysics. Several laboratories collaborate with those of the Department of Materials Science and Engineering to provide complete instrumentation for both conventional and nondestructive testing and evaluation of biomaterials.

The profoundly interdivisional nature of biomedical engineering education at Johns Hopkins provides students with a wide range of general university facilities. These include 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 130 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 math-

ematics, 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 objective of the undergraduate program is to educate students majoring in biomedical engineering who:

- prepare to enter graduate (M.S. or Ph.D. degree programs) or professional schools (Medical, Veterinarian, Business, Public Health, and Law).
- prepare students to enter industrial careers in biomedical engineering or related engineering field.

Each student plans a curriculum suited to his/her goals, with the assistance of a faculty adviser. Upon completion of the B.S. in biomedical engineering, students will demonstrate the ability to:

- apply fundamental knowledge of mathematics, physical sciences, biology, physiology and engineering for the solution of problems at the interface of engineering and biology; the ability to make measurements on and interpret data from living systems, addressing the problems associated with the interaction between living and non-living materials and systems.
- use effective communication skills, work within multidisciplinary teams and have an awareness of professional and ethical responsibilities to have a positive impact on the global society
- recognize the importance of lifelong learning in order to expand knowledge
- participate in creative, synthetic, integrative activities of design courses and independent projects.

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.

Bachelor of Science in Biomedical Engineering

Students seeking the B.S. degree are encouraged to focus their studies on one of four subspecialties that incorporates traditional engineering disciplines and biomedical application. If a student's program is sufficiently focused, a notation will be placed on the transcript stating an area of concentration within biomedical engineering. See the Biomedical Engineering Undergraduate Advising Manual for specifics on areas of concentration, 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 47.)

The B.S. degree in biomedical engineering requires 130 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 43).

Biomedical Core Knowledge (33 credits):

- Molecular and cellular biology
580.221 Molecules and Cells
- 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
- Creating, analyzing, and simulating a linear or non-linear system model from knowledge of the real biological system

– Analysis of systems described by linear and non-linear ordinary differential equations

580.222 Biological Systems and Control

– Analysis of biological control systems

580.223 Biological Models and Simulations

- Fundamental thermodynamic principles in biology
580.321 Statistical Mechanics and Thermodynamics
- What do biomedical engineers do?
580.111 Biomedical Modeling and Design
580.202 BME in the Real World

Focus Area

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:

Biological Systems Engineering—"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 and Tissue Engineering—"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?"

Courses in a focus must be taken, for a total of 27 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 will be active participants in shaping the undergraduate curriculum.

Modern Biology Electives

The student must choose at least one course appropriate to his/her interests and approved by the Biomedical Engineering adviser. 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 47.)

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 (21 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

- 580.221 Molecules and Cells
- 580.222 Biological Systems and Control
- 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
- Six credits of biomedical engineering (580.4XX) courses, not to include research or independent study.

Electives:

At least 30 credits of courses coded (E) must be included. At least one semester of an engineering laboratory beyond 580.423-424 is recommended. A course in which the use of computers is emphasized is strongly recommended (e.g., 600.109 or 500.200).

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.

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.

Application for admission must be received by January 10.

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 580.421-422 Systems Bioengineering and other advanced engineering courses. Students will also fulfill a minor teaching requirement by providing support to one of three lab-based undergraduate courses and two core lecture courses. Additionally, each student 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. Application for admission should be made no later than the spring semester of the junior year, and the 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 or internship.

The Whiting School of Engineering awards partial tuition fellowships to outstanding undergraduate students in support of the graduate component of their studies.

Ph.D. in Biomedical Engineering

The purpose of the biomedical engineering doctoral program is to provide the fields of medicine and biology with a group of scientists having advanced training in the engineering sciences, physical sciences, and mathematics coupled with a thorough understanding of the basic biological sciences. This is accomplished by a combined curriculum that includes courses in the schools of Arts and Sciences and Engineering and in the School of Medicine. Students are accepted with a variety of educational backgrounds and research objectives. The primary emphasis of the program is the application of the basic analytical tools of engineering science to fundamental research problems in biology (particularly mammalian physiology) and medicine.

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. Many research opportunities are available within the department, located in the School of Medicine, but to keep the available research opportunities broad and varied, students may work in the laboratories of investigators located throughout the schools of Medicine, Arts and Sciences, or Engineering. To emphasize the interdisciplinary nature of the program, it is supervised by a committee composed of faculty members from both the Medical School and the Whiting School of Engineering.

Admission

Because many universities do not offer an undergraduate program in biomedical engineering, students planning graduate studies in this field should arrange a schedule to include courses beyond the elementary level in biology, mathematics, and the engineering sciences. However, it is recognized that many students discover their interest in biomedical engineering too late in their undergraduate career to complete such a program. Therefore, inquiries are invited from interested students who are prepared in any of the fields of engineering, physical sciences, or life sciences. The program accepts candidates only for the degree of doctor of philosophy.

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 January 10. Notification of awards is made no later than April 1, and recipients are expected to signify their acceptance no later than April 15. Requests for applications or information should be addressed to the Director of the Biomedical Engineering Training Program, 606 Traylor Research Building, 720 Rutland Avenue, Baltimore, Maryland 21205.

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 advisers. Each student is assigned a panel of three advisers 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 Medi-

chine. 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.

Undergraduate Courses

580.111 (E,N) BME Modeling and Design

(formerly BME Design Group)

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

580.202 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 580.111-112. Permission of course directors required.

Allen, Shoukas 3 credits per semester

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.

Colecraft, 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) Biological 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 non-linear 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 a team leader and a group of BME freshmen and sophomores, to solve open-ended problems in biomedical engineering. Upperclassmen are expected to apply their general knowledge and experience, and their knowledge in their concentration area, to teach lowerclassmen and to generate the solution to practical prob-

lems encountered in biomedical engineering. Permission of course director required.

Allen, Shoukas 3 credits per semester

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 3 credits fall

580.402 (E) Neuroengineering

See description for 580.702.

Thakor 3 credits spring

580.411-412 (E) Design Team—Senior

Senior-level version of 580.311-312. Permission of course directors required.

Allen, Shoukas 3 credits per semester

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, Shoukas 4 credits per semester

580.421 (E,N) Physiological Foundations I

(formerly *Physiological Foundations 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.

Yue Staff 4 credits fall

580.422 (E,N) Systems Bioengineering II

(formerly *Physiological Foundations 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, 580.421. Corequisite: 580.424.

Shadmehr, Staff 3 credits spring

580.423-424 Laboratory in Systems Bioengineering I, II

(formerly *Laboratory in Physiological Foundations I and 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

580.427 (E,N) Calcium Signals in Biological Systems

Calcium is a universal and versatile messenger that directly regulates diverse biological processes including muscle contraction, neurotransmission, and hormonal secretion. The course develops a quantitative treatment of mechanisms generating distinct calcium signals, and the transduction of such signals into biological responses. Examples will be drawn extensively from heart cells and neurons, as well as non-excitabile cells. Topics include: experimental approaches to measuring intracellular calcium dynamics, physical basis and mathematical modeling of calcium dynamics and homeostasis, mechanism of decoding calcium signals and clinical implications of calcium dysregulation. Prerequisites: 580.421-422 or equivalent. Recommended: 110.302 or 580.222.

Colecraft 3 credits spring/even 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 spring

580.435 (E,N) 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 the passive and active behavior of cell membranes, volume conductor models of cells and tissues, the bidomain model, bioelectric and biomagnetic measurements, electric and magnetic stimulation, and impedance plethysmography and tomography. Prerequisites: 520.219, 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

580.440 Cellular and Tissue Engineering

Lectures provide an overview of molecular biology fundamentals, an extensive review on extracellular matrix and basics of receptors, followed by topics on cell-cell and cell-matrix interactions at both the theoretical and experimental levels. Subsequent lectures will cover the effects of physical (shear, stress, strain), chemical (cytokins, growth factors), and electrical stimuli on cell function, emphasizing topics on gene regulation and signal transduction processes. Material on cell-cycle, apoptosis, metabolic engineering and gene therapy will also be incorporated into the course. Prerequisites: senior and graduate students; others by permission.

Elisseff, Yarema 3 credits fall

580.448 (E,N) Biomechanics of Cells and Organisms

Mechanical aspects of the cell are introduced using the concepts in continuum mechanics. We will discuss the role of proteins, membranes and cytoskeleton in cellular function and how to describe them using simple mathematical models. Prerequisites: 171.101-102, 110.108-109, 110.202. (Co-listed as 530.410)

Sun, Spector 3 credits spring

580.450 (E,N) Mechanics of Living Tissues

Review of continuum mechanics for large, finite deformations. Overview of constitutive properties of tissues, including viscoelasticity. Methods of mechanically testing tissues. The finite element method as applied to physiological problems. Mechanics of specific tissues and organs, e.g., heart, lung, bone. Prerequisites: 110.201 Linear Algebra, 560.206 Engineering Mechanics of Solids, 530.405 Mechanics of Solids and Structures, or equivalent.

Spector, Douglas 3 credits spring/even years

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, microfluidics, gene 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: 560.201 Statics, 110.302.

Allen 3 credits spring/odd years

580.460 (E) Physiological Fluid Mechanics

Basic concepts and problems of fluid and solid mechanics and rheology are introduced and applied to the analysis of blood flow in the macro- and microcirculation, and to other physiological flows. Analysis of mathematical models is combined with discussions of physiological mechanisms. Prerequisite: 110.302.

Popel 3 credits spring/odd years

580.461 (E) Biological Transport

Basic principles and mechanisms of mass transport in multicomponent systems with application to biological phenomena. Examples of physiological mass and heat transfer. Mathematical models of pharmacokinetics and membrane transport. Students will carry out a modeling project of biological transport systems. Prerequisite: 110.302.

Popel 3 credits fall/odd years

580.464 (E) 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 segmentation, 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. Prerequisites: 110, 202 and 600.461 or instructor's permission. (Co-listed as 600.462)

Vidal 3 credits spring

580.466 (E,Q) Statistical Methods in Imaging

Denosing, 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

580.470 (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. (Co-listed as 520.432.)

Prince 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.

Van Zijl, Pekar 3 credits fall/even years

580.482 (E,N) Computational Modeling of the Cardiac Myocyte

See description for 580.682.

Winslow 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

580.495 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. 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

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 intercession. 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 intercession

580.580 (E) Biomedical Engineering Senior Design Project

Independent or team design project to design and evaluate a system. The design should demonstrate creative thinking 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 Horizons in Systems Bioengineering I and II

Open to doctoral students in BME. Advanced papers and topics in systems bioengineering will be surveyed in a three-semester sequence. Topics are thematically related to those covered in the Systems Bioengineering course. Topics, as they relate to the ongoing research in the Whitaker Biomedical Engineering Institute, will be introduced by WBMEI faculty. Students are required to present an original research proposal based on one of the topics covered in the course.

Staff 2 hours

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 networks). Prerequisite: working knowledge of elementary probability and statistics. (Co-listed as 520.610)

Goutsias 2 hours spring

580.616 Introduction to Linear Dynamical Systems

A beginning graduate course in linear, time-invariant systems. Topics include state-equation representations, input-output representations, response properties, controllability, observability, realization theory, stability, and linear feedback. Prerequisites: undergraduate courses in control systems and linear algebra. Permission required for undergraduates.

Cowan, Vidal 3 hours spring

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
offered in alternate years, beginning fall of even-numbered 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, Shadmehr 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 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

580.633 Calcium Signals in Biological Systems

See 580.427 for description. Advanced homework problems, paper presentations, and exam questions are added to the core curriculum.

Colecraft 3 hours spring/even years

580.634 Bioelectricity

See 580.434. Paper presentations and advanced assignments are added to the core curriculum. Prerequisite: 580.421. Recommended 520.213.

Tung 3 hours spring

580.635 Project in Bioelectromagnetic Phenomena

See 580.435 for description. Paper presentations and advanced assignments are added to the core curriculum.

Tung 3 hours fall/even 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

580.639 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

580.640 Cellular and Tissue Engineering

Graduate version of 580.440.

Elisseff, Yarema 3 hours fall

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

580.670 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

580.682 Computational Models of the Myocyte

The cardiac myocyte is one of the most extensively studied cells in biology. As such, it serves as a critically important example of how to develop quantitative, dynamic computational models of cell function. This graduate-level course will present a comprehensive review of all aspects of modeling of the cardiac myocyte. Topics include a) experimental and theoretical approaches to the modeling of cardiac cell membrane ion channels and currents; b) models of voltage- and ion-dependent membrane transport systems, and cellular homeostatic mechanisms; c) intracellular calcium dynamics; d) force generation in cardiac myocytes; e) historical and modern integrative models of the cardiac myocyte; and f) models of disease processes in cardiac myocytes. The course will also cover emerging areas of modeling activity including a) mapping and modeling of signal transduction pathways in the cardiac myocyte; b) mechanisms by which such pathways modulate cell function. Prerequisites: Physiological Foundations of Biomedical Engineering or equivalent, differential equations or linear algebra/differential equations, and a semester-long college-level course in a programming language such as C, C++, or Fortran.
Winslow 3 credits spring

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. (Co-listed with 530.688.) Foundations of Computational Biology and Bioinformatics I is not a prerequisite for this course.
Karchin 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 Learning Theory II: 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 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

580.725 Medical Microsystems

Fundamental and advanced fabrication processes for integrating diverse materials (including silicon) into microstructures and microdevices. Micropatterning, moulding, sensing, and actuation technologies. Research concepts and applications of microsystems at the molecular, cellular, and medical systems level. Applications such as DNA microarrays, drug and gene delivery, microsensors and actuators for research, microstructures for implants, and microdevices for prostheses. Prerequisites: 580.471 or 580.495. Undergraduates by permission.

Andreas, Thakor 3 hours fall

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

580.748 Magnetic Resonance in Medicine

(formerly 580.473)

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 graduate students who wish to pursue research in magnetic resonance. Prerequisite: 520.214 Signals and Systems. Undergraduates by permission.

Osman 3 hours spring/even year

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

580.801-802 Research in Biomedical Engineering

Staff credit varies

Cross-Listed

510.420 Topics in Biomaterials

Staff 3 credits

530.410 Biomechanics of the Cell

Sun 3 credits

540.433 Engineering Aspects of Drug Delivery

Hanes 3 credits

600.439 Principles of Computational Biology

Staff 3 credits

600.445-446 Computer-Integrated Surgery I, II

Staff 3 credits

540.633 Engineering Aspects of Drug Delivery

Hanes 3 credits

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 nanoparticles depend upon their dimensions; by making particles in the nanometer size range, materials with new optical, electrical, and magnetic properties can be created. The ability to fabricate these particles and assemble them into ordered structures 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 can spontaneously assemble in ordered structures with nanometer length scales are ripe for exploitation to create new materials. In this concentration, students are trained in the fundamental scientific underpinnings of this emerging discipline.

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 lecture and laboratory courses in Cell Biology in order to fulfill advanced science requirements and 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 of the Chemical and Biomolecular Engineering undergraduate program is to provide students with the knowledge and skills required to pursue a professional career or to continue their studies towards an advanced degree. Recent graduates of the Chemical and Biomolecular Engineering program will:

- Become practicing engineers in industries related to chemistry and the life sciences, and/or pursue additional graduate or professional education.
- Solve challenging and diverse problems in the workplace, using their mastery of chemical and biomolecular engineering skills.
- Work effectively independently and in diverse multidisciplinary teams using good communication skills and while adhering to the highest ethical standards.
- Seek out professional challenges and opportunities that demonstrate leadership and a commitment to excellence in all professional endeavors.

The department also offers graduate programs leading to the master of science and Ph.D. degrees. These programs emphasize research leading to 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, Associate Professor: hydration phenomena & 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.

Marc D. Donohue, Professor (Associate Dean for Research, Whiting School of Engineering): 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.

Sharon Gerecht, Assistant Professor: embryonic and adult stem cells, vascular regeneration, micro/nano fabrication, biomaterials, tissue engineering

David Gracias, Assistant Professor: micro/nanofabrication, self-assembly, hybrid microelectronics, thin films, polymer and biomaterial surfaces, non-linear optical spectroscopy, probe microscopy.

Jeffrey Gray, Assistant Professor: biomolecular modeling, protein assembly and function, therapeutic antibodies, proteomics, nanoscale structure formation.

Justin Hanes, Associate Professor: biomaterials synthesis, nanosystems for targeted drug/gene delivery, extra- and intracellular barriers to targeted drug/gene delivery, cancer therapeutics, pulmonary drug delivery

Michael J. Karweit, Research Professor: numerical analysis, statistics, fluid mechanics, acoustics.

Joseph L. Katz, Professor: 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, Associate Professor: 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.

Michael E. Paulaitis, Research Professor: high-pressure phase equilibria, supercritical fluids, hydration phenomena, thermodynamic and transport properties of polymeric materials and proteins.

Kathleen J. Stebe, Professor (Chair): transport phenomena at interfaces, Marangoni effects, dynamic surface tension, fluid particle behavior, adsorption of surfactants and proteins, electroporation, vesicle mechanics.

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

Jeffrey Bulte, Professor (Radiology): immune and stem cell therapies, MRI cell tracking, cell encapsulation therapy.

Jonah Erlebacher, Associate Professor (Materials Science and Engineering): 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.

Jennifer H. Elisseeff, Associate Professor (Biomedical Engineering, Orthopedic Surgery): tissue engineering, biomaterials, cartilage regeneration.

Samuel Denmeade, Associate Professor (Oncology; Pharmacology and Molecular Sciences): prostate cancer biology, prodrug/prototoxin development, cancer proteases as therapeutic targets, cancer stromal targets, protease inhibitors, animal models, clinical trials (prostate, kidney, bladder cancer).

Jan Hoh, Associate Professor (Physiology): cellular and molecular biophysics, forces that organize cytoskeleton, molecular mechanisms of cell mechanics, micropatterned substrates for cell biology, cell matrix interactions, atomic force microscopy.

John Isaacs, Professor (SOM-Oncology): chemical therapeutics, structural modeling, small molecule inhibitors, enzyme activated prodrugs, steroidal and non-steroid androgen antagonists, natural products chemistry.

Ben Ho Park, Assistant Professor (Oncology): somatic cell engineering, drug screening, genetics, breast cancer, drug resistance.

Aleksander S. Popel, Professor (Biomedical Engineering): computational biology and medicine, systems biology, angiogenesis, microcirculation, cell mechanics and molecular transport.

Sean Sun, Assistant Professor (Mechanical Engineering): molecular biophysics, cell biomechanics, soft condensed matter theory, cell motility, nonequilibrium statistical mechanics, stochastic methods, pattern formation and computer simulations.

Michael (Seungju) Yu, Assistant Professor (Materials Science and Engineering): design, synthesis and application of protein-based materials, polymer chemistry, bio-inspired nanostructures, biosynthesis of artificial proteins, biomaterials for tissue engineering and drug delivery, piezoelectric polymers, liquid crystals, collagen engineering.

Facilities

The offices and state-of-the-art laboratories of Chemical and Biomolecular Engineering are located in the New Engineering Building, Maryland Hall, and Krieger 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 the Accreditation Board for Engineering and Technology (ABET) and by the American Institute of Chemical Engineers. 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 Web site at www.jhu.edu/chbe.

Requirements for the B.S. Degree

(See also General Requirements for Departmental Majors, page 47.)

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. 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, 540.303, 540.301, 540.490, 540.304, 540.306, 540.311 (or 540.313), 540.314, and 540.409. 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 41 credits of chemical and biomolecular engineering core courses, students are required to take at least seven 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: 020.205, 030.205, and 030.307. Students are required to take five additional credits (usually two courses) beyond these two required courses. Students who are concentrating in Molecular and Cellular Bioengineering or Interfaces and Nanotechnology have additional and/or alternate requirements (see below).
- *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 three subject areas. In addition students are required to take at least one concentration consisting of two or more courses in at least one area of humanities or social sciences. See the Chemical and Biomolecular Engineering Undergraduate Advising Manual for more details.
- *Writing Courses.* Three writing intensive or 'W' courses are required. One of the courses must be one of the following: 060.113, 060.114, 220.146, 661.110, 661.310, 661.330 and 661.411. 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, advanced chemistry electives, computing requirement, 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 Biomol. Eng. in Workplace	1
H/S Elective	<u>3</u>
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	<u>3</u>
Total	15

Sophomore Year/Fall

540.202 Intro. Chemical & 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	<u>4</u>
Total	17

Sophomore Year/Spring

540.203 Engineering Thermo	3
540.303 Transport I	4
110.302 Differential Equations with Applications	4
Advanced Chemistry Elective	<u>4</u>
Total	15

Junior Year/Fall

540.204 Applied Physical Chem.	3
540.304 Transport II	4
030.307 Physical Chemistry Instrumentation Lab III	3
Engineering Elective	3
H/S Elective	<u>3</u>
Total	16

Junior Year/Spring

540.301 Kinetic Processes	4
540.306 Chemical & Biological Separations	4
Advanced Chemistry Elective	3
Undesignated Elective	3
H/S Elective	<u>3</u>
Total	17

Senior Year/Fall

540.311 Chemical Engineering Lab	6
540.409 Modeling Dynamics & Control for Chemical and Biological Systems	3
H/S Elective	3
Undesignated Electives	<u>3</u>
Total	15

Senior Year/Spring

540.314 Chemical and Biomolecular Product Design	4
Engineering Elective	3
H/S Elective	3
Undesignated Electives	<u>6</u>
Total	15

Concentrations

Students pursuing 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 transcript. These concentrations have additional and/or alternate requirements, as described.

Molecular and Cellular Bioengineering (MCB) Concentration

Students must fulfill the following requirements:

- 020.306 Cell Biology is required and satisfies four credits of the advanced chemistry/biology electives.
- The requirement for 030.307 Physical Chemistry Instrumentation Lab III is replaced with a requirement for both 020.315 Biochemistry Lab and 020.316 Cell Biology Lab.
- Six credits of bioengineering electives are required.
- Students take 540.313 Chemical and Biomolecular Engineering Lab instead of 540.311 Chemical Engineering Lab.

Note that the four credits from Cell Biology and the one extra credit arising from taking 020.315 and 020.316 instead of 030.307 satisfy the requirement for five credits of advanced chemistry and biology electives.

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 Biomol. Eng. in Workplace	1
H/S Elective	<u>3</u>
Total	16

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	<u>3</u>
Total	15

Sophomore Year/Fall

540.202 Intro. Chemical & 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	<u>4</u>
Total	17

Sophomore Year/Spring

540.203 Engineering Thermo	3
540.303 Transport I	4
110.302 Differential Equations with Applications	4
020.306 Cell Biology	<u>4</u>
Total	15

Junior Year/Fall

540.204 Applied Physical Chem.	3
540.304 Transport II	4
020.315 Biochemistry Lab Bioengineering Elective	3
H/S Elective	<u>3</u>
Total	15

Junior Year/Spring

540.301 Kinetic Processes	4
540.306 Chemical & Biological Separations	4
Undesignated Elective	3
020.316 Cell Biology Lab	2
H/S Elective	<u>3</u>
Total	16

Senior Year/Fall

540.313 Biomolecular Engineering Lab	6
540.409 Modeling Dynamics & Control for Chemical and Biological Systems	3
H/S Elective	3
Undesignated Electives	<u>3</u>
Total	15

Senior Year/Spring

540.314 Chemical and Biomolecular Product Design	4
Bioengineering Elective	3
H/S Elective	3
Undesignated Electives	<u>8</u>
Total	18

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 Biomol. Eng. in Workplace	1
H/S Elective	<u>3</u>
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	<u>3</u>
Total	15

Sophomore Year/Fall

540.202 Intro. Chemical & 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	<u>4</u>
Total	17

Sophomore Year/Spring

540.203 Engineering Thermo	3
540.303 Transport I	4
110.302 Differential Equations with Applications	4
Advanced Chemistry Elective	<u>3</u>
Total	14

Junior Year/Fall

540.204 Applied Physical Chem.	3
540.304 Transport II	4
030.307 Physical Chemistry Instrumentation Lab III	3
030.452 Materials and Surface Characterization	3
H/S Elective	<u>3</u>
Total	16

Junior Year/Spring

540.301 Kinetic Processes	4
540.306 Chemical & Biological Separations	4
Undesignated Elective	6
H/S Elective	<u>3</u>
Total	17

Senior Year/Fall

540.311 Chemical Engineering Lab	6
540.409 Modeling Dynamics & Control for Chemical and Biological Systems	3
H/S Elective	3
Engineering Elective	<u>3</u>
Total	15

Senior Year/Spring

540.316 Chemical and Biomolecular Product Design	4
Engineering Elective	3
H/S Elective	3
Undesignated Electives	<u>7</u>
Total	17

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 25 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

There are two formal requirements for this degree. The student must take six graduate-level courses, and is expected to attend seminars throughout his or her years in residence in the program. The student must 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. There are four required core courses: Thermodynamics and Statistical Mechanics for Chemical and Biomolecular Systems, Fundamentals of Biotransport Phenomena, Cellular and Molecular Biotechnology of Mammalian Systems, and Interfacial Science with Applications in Colloidal and Biological Systems. The student selects additional engineering or science courses with the help of the graduate adviser to design a curriculum appropriate for the student's engineering interest. Students must maintain a B average in course work and satisfactory progress in research. In addition all first-year students must enroll in 540.490 Chemical and Biomolecular Engineering Safety during their first semester. Each year thereafter students must attend a departmental safety refresher course.

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 adviser and at least one more faculty member from the Department of Chemical and Biomolecular Engineering.

Doctor of Philosophy

The Ph.D. degree is awarded for original research performed under the guidance of a thesis advisor. There are five formal requirements for this degree.

The student must take six graduate-level courses, and is expected to attend seminars throughout his or her years in residence in the program. The student must enroll in graduate seminars (540.600/601) throughout his or her tenure in the Department of Chemical and Biomolecular Engineering at Johns Hopkins University. There are four required core courses: Thermodynamics and Statistical Mechanics for Chemical and Biomolecular Systems, Fundamentals of Biotransport Phenomena, Cellular and Molecular Biotechnology of Mammalian Systems, and Interfacial Phenomena in Nanostructured Materials. The student selects additional engineering or science courses with the help of the graduate advisor to design a curriculum appropriate for the student's engineering interest. Students must maintain a B average in coursework and satisfactory progress in research. In addition all first year students must enroll in 540.490 Chemical and Biomolecular Engineering Safety during their first semester. Each year thereafter students must attend a departmental safety refresher course.

The student must serve as a teaching assistant (TA) for two semesters during the first two and a half years of study. The two and a half year time frame may be extended if TA positions are not available. The typical workload for a TA is 10 hours per week.

The student must pass a departmental candidacy exam for the Ph.D. program. This oral exam focuses on material covered in an undergraduate chemical engineering curriculum, including transport phenomena, thermodynamics, and reaction kinetics. Graduate students normally take this exam during the first year of graduate study.

The student must also pass the university's Graduate Board Oral (GBO) exam. This exam is administered by a committee of five faculty members consisting of the research adviser, another member of the Department of Chemical and Biomolecular Engineering, and three faculty members from other science or engineering departments. The GBO is a comprehensive examination in the candidate's field of specialization and requires proficiency on the graduate level in areas outside the major field. The exam is usually taken by the fifth semester.

The student must write a thesis based on original research and defend it before three faculty members (at least two of whom are from the Department of Chemical and Biomolecular Engineering).

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 details on the graduate program are listed in the Graduate Student Handbook available from the department.

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.

1 credit

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.

Staff 4 credits

540.203 (E) Engineering Thermodynamics

Development of classical thermodynamic relationships and constitutive equations for one and two component systems. 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 3 credits

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

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.

Hanes 4 credits

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 4 credits

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 (Bernoulli'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.

Drazer 4 credits

540.306 (E) Chemical and Biological Separations

This course covers staged and continuous-contacting separations processes critical to the chemical and biochemical industries. Processes considered include distillation, liquid-liquid extraction, gas absorption, leaching chromatography, crystallization, precipitation, filtration, and drying. 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 4 credits

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 of the following four projects: distillation, gas absorption, liquid-liquid extraction and chemical kinetics in a tubular flow reactor and also 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.

Katz 6 credits

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 three biomolecular engineering projects 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 effectively in groups. Prerequisites: 540.301, 540.304, 540.306, 540.490.

Ostermeier 6 credits

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 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.

Katz 4 credits

540.402 (E) Cellular and Molecular Biotechnology of Mammalian Systems

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-translational 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

540.404 (E) Therapeutic and Diagnostic Colloids

The inefficient or inappropriate transport of particles in complex biological fluids in the body currently limits

the effectiveness of nanoparticle-based strategies aimed at providing a variety of breakthroughs in medicine, from highly targeted drug and gene delivery systems to improved particles for advanced imaging and diagnostics. Many bodily fluids serve as barriers to particle transport to desired locations, and some are microporous, highly viscous and/or elastic in nature. This course seeks to provide a fundamental understanding of the phenomena, including fluid micro-, meso- and macrorheology, that governs nano- and microparticle transport in important biological fluids, including the blood, airways, mucus, and living cells. A comparison of macroscopic and microscopic particle transport behavior, including comparisons of ensemble-average transport behavior to that of individual particle behavior, is a common thread that runs throughout the course. The importance of particle physicochemical properties in achieving desired particle transport through biological barriers to desired sites of action will be addressed. The course will include a case study involving the design criteria of efficient synthetic systems for gene delivery in the lung airways.

Hanes, Wirtz 3 credits

540.409 (E,Q) Modeling, Dynamics, and Control for Chemical and Biological Systems

Introduction to process modeling and simulation. Steady state and unsteady state analysis of chemical process, biomolecular, and cellular control systems. State-space, Laplace transform techniques, block diagram algebra, and transfer functions. Control theory applied to chemical and biological processes including feedback and feedforward control. Frequency response, stability analysis, and introduction to nonlinear dynamics. Corequisites: 110.302 or a differential equations course, 540.203, 540.301, 540.303, 020.305 and 020.306 or equivalent is recommended but not required.

Gray 3 credits

540.412 (E) Interfacial Phenomena in Nanostructure Materials

All materials properties of materials change when encountered or fabricated with nanoscale structure. In this class, we will examine how the properties of nanostructured materials differ from their macroscopic behavior, primarily due to the presence of large interfacial areas relative to the characteristic volume scale. General topics include the structure of nanostructured materials (characterization and microscopy), thermodynamics (effects of high curvatures and surface elasticity), kinetics and phase transformations (diffusion and morphological stability), and electronic properties (quantum confinement and effects of dimensionality).

Frechette, Erlebacher 3 credits

540.432 (E) Metabolic Engineering

An overview on the latest advances to modulate intracellular pathways using recombinant DNA and other manipulation techniques for biotechnological, medical, environmental, energy, and other applications. Specific application areas include improved cellular performance for production of biopharmaceuticals, degradation of

toxins, generation of novel drugs and cell therapies, production of biologicals in plants, and energy generation from microbial sources. Specific pathways considered include intracellular metabolism, glycosylation, apoptosis, and cell cycle. Techniques to be covered include both experimental and mathematical methods to manipulate and interpret changes in cellular behavior and the analysis of specific biochemical reaction pathways within cells and organisms.

Betenbaugh 3 credits

540.433 (E) Engineering Aspects of Controlled Drug Delivery

This course addresses the fundamental engineering behind the development and understanding of controlled drug delivery systems. Focus is placed on the encapsulation and delivery of therapeutic proteins and genes from polymeric devices due to their increasing prevalence and importance in pharmaceutical products. Routes of drug delivery to be covered include oral, transdermal, pulmonary, injection, and surgical implantation. Topics include biological barriers to drug delivery, drug pharmacokinetics, particle targeting via receptor-ligand interactions, intracellular transport of colloidal particles and synthetic gene delivery vectors. Prerequisites: Transport Phenomena course (such as 540.303 or 580.461) and Kinetic Processes course (such as 540.301). Otherwise, permission may be given in special cases by instructor.

Hanes 3 credits

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). 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

540.442 (E) Advanced Topics in Bio/Chemical Kinetic Processes

Survey of kinetic/reactor phenomena of high relevance to industry and cutting-edge biomolecular engineering research. Topics to be covered include reactions with phase changes for the microelectronics industry, computational modeling of complex multiple reaction systems, enzyme kinetics (including inhibition, allostery and cooperativity), pharmacokinetics, cell bioreactors, and intracellular kinetics relevant to metabolic engineering.

Betenbaugh, Hanes, Ostermeier 3 credits

540.460 (E, N) Computational and Experimental Design of Biomolecules

This course reviews current research problems in biomolecular design both from computational and experimental approaches. Current methods in structure prediction (folding, docking, and design) will illustrate fundamen-

tal concepts in protein structure, biophysics, and optimization. Current research problems in evolution-based biomolecular engineering will illustrate principles in the design of biomolecules (i.e., protein engineering, RNA/DNA engineering), metabolic pathways, signaling pathways, genetic circuits, and complex biological systems including cells. Prerequisites: 020.305

Gray, Ostermeier 3 credits

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. In addition once per year a three-hour refresher seminar must be taken by all students involved in laboratory research.

Staff 1 credit

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

540.600-601 Chemical and Biomolecular Engineering Seminar

Lectures are presented on current subjects relevant to chemical engineering.

1 credit

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

500.111 (E,N) Energy and the Environment

Katz 3 credits

500.150 (H,E) Ethical and Societal Issues in Engineering

Donohue 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

Graduate Courses

540.602 Cellular and Molecular Biotechnology of Mammalian Systems

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.
Bettenbaugh, Konstantopoulos

540.606 Molecular Simulations and Multiscale Modeling

This course provides an introduction to modern numerical methods for calculating thermodynamics, transport and structural properties of complex systems in chemical and biomolecular engineering. The first part of the course will focus on molecular level simulations, from ab initio methods to molecular dynamics and Monte Carlo simulations, their applications and limitations. The second part of the course will emphasize the need of multiscale models to address the multiplicity of length and time scales present in complex systems. Mesoscopic models will be investigated as a first step into multiscale models. Then, current methods to bridge the gap between atomistic simulations and macroscopic methods will be presented in case studies.
Drazer, Gray

540.612 (E) Interfacial Phenomena in Nanostructure Materials

All properties of materials change when encountered or fabricated with nanoscale structure. In this class, we will examine how the properties of nanostructured materials differ from their macroscopic behavior, primarily due to the presence of large interfacial areas relative to the characteristic volume scale. General topics include the structure of nanostructured materials (characterization & microscopy), thermodynamics (effects of high curvatures and surface elasticity), kinetics and phase transformations (diffusion and morphological stability), and electronic properties (quantum confinement and effects of dimensionality).

Frchette, Erlebacher

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, towards the end we will devote couple of lectures to modern developments in statistical mechanics that connect non-equilibrium work to equilibrium free energies.
Asthagiri

540.633 Engineering Aspects of Controlled Drug Delivery

(For description see 540.433)
Hanes

540.640 Micro to Nanotechnology

(For description see 540.440)
Gracias

540.642 Advanced Topics in Bio/Chemical Kinetic Processes

(For description see 540.442)
Bettenbaugh, Hanes, Ostermeier

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 con-

siders how these concepts can be used to understand the behavior of a deformable cell near planar surfaces. Stebe, Konstantopoulos, Drazer

540.660 Computational and Experimental Design of Biomolecules

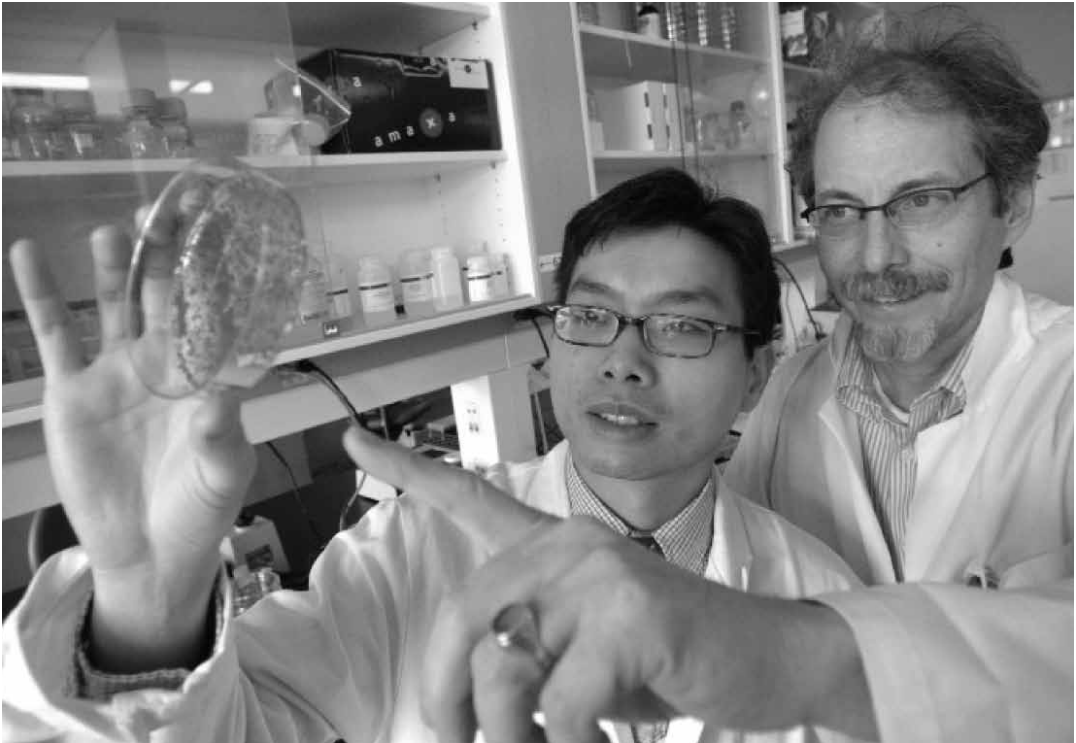
This course reviews current research problems in biomolecular design both from computational and experimental approaches. Current methods in structure prediction (folding, docking and design) will illustrate fundamental concepts in protein structure, biophysics, and optimi-

zation. Current research problems in evolution-based biomolecular engineering will illustrate principles in the design of biomolecules (i.e., protein engineering, RNA/DNA engineering), metabolic pathways, signaling pathways, genetic circuits and complex biological systems including cells. Prerequisite: 020.305.

Gray, Ostermeier

540.801-810 Graduate Research

1-12 hours spring



Civil Engineering

Civil engineers apply sophisticated analysis and design techniques to advance the needs of society for shelter, infrastructure, and a safe environment. Graduates pursue not only the traditional fields of structural analysis and design, soil mechanics and foundation design, environmental engineering and policy, or coastal and ocean engineering, but increasingly are taking on important 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 the logical thinking useful in pursuing careers in other professional fields, such as law, business, or medicine.

The Department of Civil Engineering offers programs at the undergraduate, graduate, and post-doctoral levels. Civil Engineering at Hopkins offers a unique balance among mechanics fundamentals, state-of-the-art tools, experimental techniques, and research, with an emphasis on hands-on experimentation as well as integration of computer use into courses as appropriate. 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, aeroelastic forces on modern long-span cable-supported bridges, and coastal and ocean engineering to name a few. Two five-year bachelor's/master's degree programs are 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.

J. Hugh Ellis, Professor (Chair): structural health engineering, environmental systems.

Lori Graham-Brady, Associate Professor: probabilistic mechanics, finite elements, stochastic modeling of materials.

James K. Guest, Assistant Professor: structural analysis and optimal design, material design, computational mechanics.

Reagan Herman, Senior Lecturer and Assistant Research Professor: design and behavior of steel

structures, bridge design, field monitoring of bridges.

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.

Narutoshi Nakata, Assistant Professor: structural dynamics, experimental method, smart structures technology, earthquake engineering.

Benjamin Schafer, Associate Professor: structural stability, computational mechanics, experimental methods.

Lian Shen, Assistant 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.

Grant Garven, Professor (Earth and Planetary Sciences): groundwater, flow in permeable media.

Charles R. O'Melia, Professor Emeritus (DOGEE): environmental engineering, aquatic chemistry.

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

Sanjay R. Arwade, Visiting Assistant Professor: structural mechanics, stochastic methods, multi-scale material models.

Kirk Mettam, Lecturer: structural engineering and architecture.

Charles Russo, Lecturer: structural design.

Niklas W. Vigener, Lecturer: investigation and evaluation of structures.

Facilities

The teaching and research facilities of the Department of Civil Engineering are located primarily in Latrobe Hall. Additionally, the Coastal Engineering Laboratory is located in the Stieff Building. The department has a library and conference room, and a lounge. Each graduate student is assigned individual study space and a computer.

Teaching laboratories include the undergraduate and graduate soil mechanics laboratories, and the structural testing laboratories. The facilities of the Latrobe shop, are available for laboratory courses and research work.

The department sponsors a weekly seminar series, as well as the Richard J. Carroll endowed lectureship; both are designed to bring prominent civil engineers to campus to speak with students and faculty.

Financial Aid

Undergraduate scholarships and other sources of financial aid have been described earlier (see page 23).

Financial assistance to graduate students is available on a competitive basis in the form of partial or complete tuition remission, teaching assistantships, research assistantships, and fellowships. In addition to university-wide fellowships, graduate students in civil engineering are also eligible for fellowships from the Abel Wolman Graduate Fellowship, 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 would be 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. More detailed information can be found in the Civil Engineering undergraduate advising manual, available online at www.jhu.ce.edu. Each student is assigned an adviser 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. Furthermore, technical electives may be taken satisfactory/unsatisfactory only with the approval of the adviser. 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 I

270.220 The Dynamic Earth: An Introduction to Geology or 030.205 Introductory to Organic Chemistry I or another natural science course

Mathematics (16 credits):

110.108 Calculus I
110.109 Calculus II
110.202 Calculus III
550.291 Linear Algebra & Differential Equations

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 H and S elective requirements must total at least 24 credits and may include any course labeled as H and/or S.
- 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 (Practical Composition I) or 220.105/106 (Introduction to Fiction and Poetry Writing I and II)—These should be taken early in the student's program (they must be taken for a letter grade and passed with a grade of C or better). The second writing course of at least 3 credits must be taken from the Krieger School of Arts and Sciences.
- Courses used for the S elective requirements must total at least 9 credits, must include one of the following: 180.102 Microeconomics or 570.493 Economic Foundations, and may include 500.150 Ethical Questions in Engineering.

Unspecified Electives (7 credits):

Common Engineering (48 credits):

560.141 Perspectives on the Evolution of Structures
560.201 Statics & Mechanics of Materials
560.202 Dynamics
510.201 Introduction to Engineering Materials
560.206 Solid Mechanics & Theory of Structures
560.305 Soil Mechanics
560.330 Foundation Design
560.351 Introduction to Fluid Mechanics
560.380 Introduction to Ocean & Wind Engineering

570.301 Environmental Engineering I: Fundamentals
570.302 Environmental Engineering II: Water & Wastewater Treatment
560.320 Steel Structures
560.435 Probability & Statistics in Civil Engineering
560.349 Design & Synthesis I
560.350 Design & Synthesis II

Technical Electives (16 credits):

Technical electives are courses in mathematics (Q), basic sciences (N) or engineering (E) and are to be selected by students in consultation with their advisor. The course used to satisfy the computer programming requirement may be counted as a technical elective. Other than this programming course and courses specifically listed in Technical Courses, courses below the 200-level cannot be counted as technical electives except with the approval of the adviser. Civil Engineering Seminars (560.491-494) count as technical electives.

- 500.200 Introduction to Computing for Engineers and Scientists, 600.109 Introduction to Programming in C or 600.107 Introduction to Programming in Java, 530.106 Computing in Mechanical Engineering. Students who can demonstrate a working knowledge of a scientific programming language (FORTRAN, PASCAL, C, etc.) need not take one of these courses, but may take another technical elective instead.
- Students are expected to select either Structural/Geotechnical Engineering or Environmental Engineering as areas of concentration. Students selecting the Structural/Geotechnical Engineering concentration must take 560.325 Concrete Structures and students selecting Environmental Engineering concentration must take 570.305 Environmental Engineering Systems Design.
- 560.491 CE Seminar Junior Fall and 560.492 CE Seminar Junior Spring.

Sample B.S. Program

The online Civil Engineering undergraduate advising manual 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 with respect to technical and nontechnical electives and design credits.

Minor in Principles of Civil Engineering

This program is available to non-departmental majors only, who would like an overview of the prin-

ciples of civil engineering. The following courses are required:

- 560.141 Perspectives on the Evolution of Structures
- 560.201 Statics and Mechanics
- 560.206 Solid Mechanics and Theory of Structures

- A two-course sequence in civil engineering selected in consultation with a civil engineering faculty member.

Bachelor's/Master's Honors Programs

The Department of Civil Engineering has two honors programs for the combined bachelor's/master's degrees. Formal application is required, whereupon students may be admitted as early as the second semester of the sophomore year. The honors programs take five or six years, depending on the options selected, and carry a tuition fellowship of 50 percent after the first eight semesters of undergraduate work.

One program combines a B.S. in civil engineering with either a master of science in engineering in civil engineering (M.S.E.) or a master of civil engineering (M.C.E.). The other program leads directly from the B.S. in civil engineering to the M.S.E. in environmental engineering through the Department of Geography and Environmental Engineering.

Graduate Programs

The Department of Civil Engineering offers a graduate program that is based primarily in structural engineering/structural mechanics, geotechnical engineering/geomechanics, probabilistic methods/hazards management, and coastal/ocean engineering. To be admitted to the program, students are expected to have graduated with an outstanding record in an appropriate undergraduate program.

Structural, geotechnical, and coastal and ocean engineering today are dynamic, complex, and technologically sophisticated fields. Powerful computational methods and high-strength materials have offered new opportunities and new challenges. 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

Obtaining the master of science in engineering degree in civil engineering normally takes three to four semesters of full-time study. It is also possible

to satisfy the requirements on a part-time basis. The option for those receiving a terminal M.S.E. degree consists of a minimum of eight courses and a master's thesis. The option for those going on to the Ph.D. consists of 10 courses and passing the department qualifying examination and the Graduate Board oral examination. Transfer credit for work completed at another institution is generally not counted toward the M.S.E. degree.

There is no set curriculum for graduate study. Students are expected to design a program that offers them depth in structural engineering/structural mechanics, geotechnical engineering/geomechanics, or probabilistic methods/hazards management, or coastal and ocean engineering as well as a degree of breadth in related disciplines. All programs must be approved by the department.

Requirements for the M.C.E. Degree

The master of civil engineering degree requires 10 courses and emphasizes four focus areas: structural engineering, geotechnical engineering, bridge engineering, and coastal and ocean engineering. Oriented toward professional practice, this degree program is not normally selected by those students planning to go on for the Ph.D. Courses are scheduled so that it is possible to earn the M.C.E. degree on a part-time basis, taking all courses in the late afternoon and evening. Students normally take some courses listed in this catalog and some listed in the catalog for Engineering Programs for Professionals. Information regarding this program, including admission, is available from the Office of Engineering Programs for Professionals Web site at www.epp.jhu.edu.

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, friction, centroids and centers of gravity, and moments of inertia. Includes laboratory experience. No freshmen without permission of instructor.

Brady 4 credits

560.202 (E,N) 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. Prerequisites: 560.201, 110.109 Calculus II, 171.101 General Physics I.

Dalrymple 4 credits

560.206 (E) Solid Mechanics and Theory of Structures

Application of the principles of structural analysis for statically determinant and indeterminate structures (trusses, cables, beams, arches, and frameworks). 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 solutions. Prerequisite: 560.201

Herman 4 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. Co-requisite: 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.

Schafer, Herman 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 the elastic methods of analysis are used. Prerequisite: 560.206.

Herman 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) Design and Synthesis 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) Design and Synthesis II

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.

Mettam 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/flood loads, wind field and wind loads, 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. Prerequisite: 110.109 Calculus II.

Igusa 3 credits

560.445 (E) Advanced Structural Analysis

Matrix methods for the analysis of statically indeterminate framed structures such as beams, plane trusses, space trusses, plane frames, grids and space frames. Stiffness and flexibility methods. Prerequisite: 560.206.

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

560.691-692 Graduate Seminar

Graduate students are expected to register for this course each semester. Both internal and outside speakers are included.

Staff

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

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.

Brady, Anandarajah 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 for Engineers

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

560.741 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

560.745 Retaining Structures and Slope Stability

Earth pressure theories. Design and behavior of rigid, flexible, braced, tied-back, slurry, and reinforced soil structures. Stability of excavation, cut, and natural slopes. Methods of slope stability analysis, effects of water forces, shear strength

selection for analysis. Stability and seepage in embankment dams. Prerequisite: 560.305 or equivalent.

Staff 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.

Schafer 3 hours

560.754 Wind Engineering

Climatology and meteorology of the Earth's boundary layer. Basic aerodynamics, structural dynamics, and principles of stochastic loadings applicable to the wind engineering of structures. Wind tunnel modeling of buildings and bridges. Aeroelastic and other special problems. Corequisite: 560.752.

Staff 3 hours

560.756 Earthquake Engineering

Plate tectonics and seismicity of the Earth. Engineering seismology-quantification and classification of earthquake ground motions. Dynamics of structures subjected to earthquake loads. Design spectra. Building code provisions. Design concepts and detailing. Soil-structure interaction. Response of special structures. Corequisite: 560.752.

Staff 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 multi-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

560.777 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-Lagrangian 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.

Staff 3 hours

560.787 Structural Optimization

Introduction to structural optimization with focus on topology optimization using finite element methods. Applications to design of structural and mechanical systems and use of inverse homogenization to design material microstructures that yield extreme/prescribed properties.

Guest 3 hours

560.835-836 Graduate Research in Civil Engineering

Prerequisite: permission of instructor.

Staff

Graduate Courses

Engineering Programs for Professionals (EPP)

565.475 (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

565.605 Advanced Reinforced Concrete Design

This intensive course covers reinforced concrete materials and specifications and includes the following topics: conception, analysis, and design of continuous beams and frames; building; bridges and shells; elements theory, with emphasis on the ultimate strength method; precast and prestressed concrete; and special topics. Prerequisite: 565.126 Structural Design II or 560.325 Concrete Structures.

Staff 3 hours

565.620 Advanced Steel Design

This course examines advanced design of structural steel buildings using the load and resistance factor design approach. Topics include member design and analysis and overall structural system concepts. Prerequisites: 565.125 Structural Design I or 560.320 Steel Structures.

Staff 3 hours

565.625 Advanced Foundation Design

This course covers performance requirements and review of soil mechanics; laboratory testing, subsurface investigation and in situ testing; bearing capacity and settlements of shallow foundations; design of spread footings and mat foundations; axial capacity of deep foundations; settlements of deep foundations; lateral capacity of deep foundations; weak, compressible, and expansible soils; earth pressure theories; cantilever and sheet-pile retaining structures. Prerequisites: 560.330 Foundation Design and 560.475 Advanced Soil Mechanics.

Stello 3 hours

565.630 Prestressed Concrete Design

Topics for discussion include prestressed concrete materials, prestressing systems, and loss of prestress; analysis and design of sections for flexure, shear, torsion, and compression; consideration of partial prestress, composite sections, and slabs. Prerequisite: 560.325.

Staff 3 hours

565.635 Ground Improvement Methods

The course addresses the selection cost, design, construction, and monitoring of ground improvement methods for problematic soils and rock. Ground improvement methods covered include wick drains, micropiles, light-weight fill materials, soil nailing, mechanically stabilized slopes and walls, grouting, stone columns, dynamic compaction, and soil mixing. Prerequisites: 560.330, 560.475.

DiMaggio 3 hours

565.645 Marine Geotechnical Engineering

This course introduces students to soil mechanics in the marine environment. Topics covered include the nature of marine sediments, soil behavior due to cyclic loading, marine geotechnical investigations, shallow foundations and dead-weight anchors, pile foundations and anchors, penetration and breakout of objects on the seafloor, marine slope stability, soft ground improvement, marine dredging, and project planning. Prerequisite: 565.121 Soil Mechanics or 560.305 Soil Mechanics.

Staff 3 hours

565.650 Port and Harbor Engineering

Planning and engineering of ports and harbors has received renewed worldwide interest as the newest super-large cargo ships push the envelope for channel depth and berth space. This course covers planning of marine terminals and small-craft harbors, ship berthing and maneuvering considerations, port navigation, marine structures, inland navigation, marine construction planning, sediment management, and port economics. A field trip to the Port of Baltimore provides practical application of course material and shows students firsthand the unique challenges of engineering on the waterfront.

Staff 3 hours

565.665 Ocean Engineering Mechanics

Students examine linear, nonlinear, and random theories of wave mechanics; wave-induced loadings on fixed structures; wave-structure-soil interactions in both deterministic and random seas; wave-induced motions of floating structures; and sea floor mechanics. Although the course stresses analytical methods, experimental techniques will be introduced where appropriate.

Staff 3 hours

565.670 Coastal Structures

Over half of the U.S. population lives in coastal areas, and this percentage has been steadily increasing. Civil engineering of structures at the coastline is important to infrastructure development and community protection. This course covers the practical design and analysis of coastal structures such as seawalls, breakwaters, groins, and jetties. Topics include wave forces, sediment transport, and

coastal zone planning. Prerequisite: 560.780 Coastal Engineering or 560.781 Introduction to Water Waves.

Staff 3 hours

565.675 Hydrodynamics of Estuaries

The Chesapeake Bay is the largest of the nation's 130 estuaries, covering over 4,000 square miles with over 11,000 miles of shoreline. This course provides a general introduction to estuary dynamics, including tides, shallow water waves, dispersion, sedimentation, salinity stratification and mixing, pollution, and flushing. Concepts are specifically applied to the Chesapeake Bay, including a field trip on the Bay in late spring to make field measurements. Prerequisite: 535.119 Fluid Mechanics or equivalent.

Staff 3 hours

565.745 Retaining Structures and Slope Stability

Earth pressure theories. Design and behavior of rigid, flexible, braced, tied-back, slurry, and reinforced soil structures. Stability of excavation, cut, and natural slopes. Methods of slope stability analysis, effects of water forces, shear strength selection for analysis. Stability and seepage in embankment dams. Prerequisite: 560.305 or equivalent.

Staff 3 hours

565.784 Bridge Design

History, aesthetics, and classification of bridges. Design and engineering of modern steel and concrete highway bridges.

Staff 3 hours



Computer Science

The field of computer science is pervasive. The availability of relatively inexpensive high performance computing capabilities, ever increasing memory capacities, high speed and wireless networking have created a technology-driven restructuring of the way much of society and almost all professions now operate. Information, and its associated processing and transport, is the commodity upon which corporations are built and fortunes made. At the center of this revolution, making it happen, are those who study computer science.

Because computer science is a highly diverse and broadly applied field, studying it can proceed in many different directions. Accordingly, the undergraduate and graduate programs in the Department of Computer Science at Johns Hopkins are designed to accommodate a wide range of student interests. Programs are not only academically rigorous, but also sufficiently flexible so that students can create a computer science program to satisfy their own needs. Whether the ultimate goal is a mainstream career in computer science or a desire to be empowered by computer science in conjunction 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.

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. Details on this program 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 either a bachelor of science or bachelor of arts in computer engineering. This field of study includes course work in computer science, as well as electrical and computer engineering. Students may be advised by specific program faculty in either of those departments. 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.

The Department of Computer Science focuses its teaching and research programs in three major areas: analysis, systems, and applications. The faculty offers theoretically and/or experimentally oriented courses in these areas at the undergraduate and graduate levels. Three interdisciplinary research centers in the university have direct relationships with faculty associated with the Department of Computer Science: the Information Security Institute, the NSF Engineering Research Center for Computer-Integrated Surgical Systems, and the Center for Language and Speech Processing. All faculty members in the Department of Computer Science have research laboratories in which individual projects are available for undergraduate and graduate students. Examples of these research laboratories include networks, distributed systems, wireless and sensor systems, graphics, vision, robotics, computer-integrated surgical systems, security, storage systems, programming languages, and natural language processing. An important component of the educational process in the Department of Computer Science at Johns Hopkins is the opportunity for student participation in the research programs of the faculty. Particularly in the graduate program, original research in close association with individual faculty members is emphasized.

For additional information regarding the academic programs available, and the facilities provided, please consult the sections which follow, or the departmental Web site www.cs.jhu.edu or the department office, 224 New Engineering Bldg, Baltimore, MD 21218-2694.

The Faculty

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, on-line and distributed computing.

Randal Burns, Assistant 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, Lecturer: programming languages, software engineering, systems software.

Gregory D. Hager, Professor: vision, robotics, human-machine systems, computer-assisted surgery.

Susan Hohenberger, Assistant Professor: cryptography, computer security, algorithms, and complexity theory

Joanne Houlahan, Senior Lecturer and Director of Undergraduate Studies: CS education, communication networks, graph 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.

Fabian Monrose, Associate Professor: computer and network security, biometrics and user authentication.

Aviel Rubin, Professor (Technical Director, Information Security Institute): system and networking security, computer privacy, applied cryptography.

Jonathan Shapiro, Assistant Professor: secure operating systems, development tools, software assurance, software verification.

Scott F. Smith, Professor (Chair): programming languages, type systems, security in language design, component programming languages.

Russell H. Taylor, Professor (Director, CISST ERC): medical robotics, computer assisted surgery.

Andreas Terzis, Assistant 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

Andreas Andreou, Professor (Electrical and Computer Engineering): electron devices, sensors, analog VLSI, physics of computation.

Joel Bader, Assistant Professor (Biomedical Engineering): bioinformatics and computational biology.

Gregory Chirikjian, Professor (Mechanical Engineering): robotics, kinematics, dynamics, control, motion planning.

Noah Cowan, Assistant Professor (Mechanical Engineering): sensor-based control of locomotion and manipulation, machine learning, and biologically inspired robotics.

Ralph Etienne-Cummings, Associate 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.

Frederick Jelinek, Professor (Electrical and Computer Engineering) (Director, Center for Language and Speech Processing): speech recognition, statistical methods of natural language processing, and information theory.

Rachel Karchin, Assistant Professor (Biomedical Engineering): computational molecular biology, bioinformatics, genetic variation.

Sanjeev Khudanpur, Assistant Professor (Electrical and Computer Engineering): information theory, statistical language modeling for speech recognition and machine translation.

Michael I. Miller, Professor (Biomedical Engineering): image understanding, computer vision, medical imaging, computational anatomy.

Allison M. Okamura, Associate Professor (Mechanical Engineering): robotic fingers, virtual environments, remote and computer assisted surgery.

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.

Edward R. Scheinerman, Professor (Applied Mathematics and Statistics): graph theory, partially ordered sets and random graphs.

Alexander Szalay, Professor (Physics and Astronomy): theoretical astrophysics, galaxy formation.

Rene Vidal, Assistant 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, large-scale scientific computation, visualization and nonlinear dynamical systems theory.

Adjunct, Research, and Visiting Faculty

Amihood Amir: algorithms design and analysis, multidimensional pattern matching, knowledge discovery algorithms, real time systems algorithms, computational molecular biology.

Joseph Bates: experimental computing systems.

Philippe Burlina: computer vision, visual analysis and communications, multi-modality image exploitation, enterprise software systems for content and e-process management.

Jonathan D. Cohen: computer graphics, geometric modeling, virtual environments.

Robert Cole: data networking performance and evaluation and related protocol enhancements to improve overall system performance and reliability.

Christos Davatzikos: medical image processing and analysis, image guided surgery.

Bharat Doshi: routing, information security.

Gabor Fichtinger: applied surgical robotics, surgical CAD/CAM systems, percutaneous therapies, stereotactic radiosurgery.

John Griffin: storage systems, secure systems.

Keith Hall: dependency parsing of inflected languages, machine translation, syntactic language modeling, game theoretic models.

Peter Kazanzides: medical robotics.

James Mayfield: information retrieval, cross-language retrieval, information extraction, natural language processing.

Christine Piatko: computational geometry, information visualization, information retrieval.

Christian Scheideler: distributed algorithms and data structures, randomized algorithms and stochastic processes, theory of network communication, (in particular peer-to-peer systems, mobile ad-hoc networks and sensor networks), combinatorics and discrete mathematics.

John Sheppard: artificial intelligence, machine learning, data mining.

Adam Stubblefield: computer security and cryptography.

Jonathan Trostle: network and operating system security, cryptography, network security management.

I-Jeng Wang: wireless networking, Bayesian networks, probabilistic models.

Lawrence B. Wolff: computer vision, computational sensors for vision/robotics, computer graphics

Part-Time Lecturers

Sheela Kosaraju: computer ethics.

Harold Lehmann: medical informatics.

Current Research Activities

Computer science research activities include the following areas: 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, internet computing, cryptography and information security, secure and robust systems, storage systems, fault-tolerant computing, networks and distributed systems, robotics, and computer-integrated surgical systems.

Facilities

The computing facilities includes over 70 workstations and servers; a large undergraduate laboratory comprised of 24 Unix workstations, 12 Windows stations, a remotely accessible Unix compute server, and a separate collaboration room allowing students to work in a team-based environment; a Masters' Students Office area consisting of Unix Workstations; assigned locations and computers for PhD students; multiple high-speed network laser printers, a networked copier, and a color PostScript laser printer.

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, and more.

The facilities are tied together by our own LAN, and access to specialized hardware in other departments and institutions is available via the university intranet and the Internet. Modem access is available to many of the systems in the department. In addition, the university provides wireless access to the JHU intranet and the Internet, as well as server systems that provide e-mail accounts for all students.

Undergraduate Programs

(See also General Requirements for Departmental Majors)

All undergraduate students majoring or minoring in computer science must have a faculty adviser in the department. They will be assigned an adviser as entering freshmen or upon deciding on the major/minor. Interested undergraduates (including minors) should see the Computer Science director of undergraduate studies (224 NEB) to declare a major or minor and be assigned a computer science adviser.

The objectives of our undergraduate 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 in other majors may pursue a minor in computer science or a minor in computer integrated surgery. Additional information regarding undergraduate programs can be found in the department's undergraduate advising manual or on the Web site at www.cs.jhu.edu. Some students majoring in computer science may be eligible for a concurrent bachelor's/master's degree program. Every major must follow a program approved by his/her faculty adviser.

Requirements for the B.S. Degree

The bachelor of science degree in computer science provides for the acquisition of the following knowledge base and skill set:

- An understanding of basic computer science principles and practices.
- The ability to design and implement a system or component to meet specifications using modern computing tools.
- The ability to evaluate and compare the efficiencies of alternate problem solutions.
- An understanding of the concepts and analytical approaches used in science and mathematics.
- The ability to contribute to a team project, including effective written and oral communication skills.

- The ability to work and learn independently, as well as an awareness of the need for continuing education.
- An exposure to humanities and social sciences that provides breadth and a societal context.
- An understanding of what constitutes ethical and professional behavior.

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 or applied mathematics and statistics, 16 credits in basic sciences, and 18 credits in humanities/social sciences. 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. 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.

Freshman majors must take 600.105 M&Ms (optional for transfers into the major). This is a 1-credit S/U course that may only be counted as an elective.

Computer Science (42 credits):

- The following foundational courses in computer science must be included in a student's program:

Only one of:

AP Computer Science credit (4 or 5 on AB, or 5 on A)

600.107 Intro to Programming in Java

Each of:

600.104 Computer Ethics

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, 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 Web site.

- Students must take at least one of the following courses which contain oral communication components: 600.321/421, 600.324/424, 600.392, 600.466.
- With the adviser'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.
- 600.101 Computer Fluency cannot be counted toward this requirement, nor toward the 126 credit total.
- 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 and Applied Mathematics and Statistics (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, and must include coverage of both probability and statistics. Other highly recommended math electives are Calculus III, Linear Algebra, and Differential Equations. Note that students will need at least six courses to fulfill the credit requirement. Entrepreneurship courses (551.xxx or 660.xxx) are not acceptable.

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 Web site, which includes most 'N' designated courses, 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 be used to satisfy this requirement.

Writing Requirement:

All B.S. candidates in Computer Science 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. 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 or applied mathematics and statistics, 12 credits in basic sciences, 18 credits in humanities/social sciences, and 6 credits in foreign languages. 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 adviser. 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.

Freshman majors must take 600.105 M&Ms (optional for transfers into the major). This is a 1-credit S/U course that may only be counted as an elective.

Computer Science (30 credits):

- The computer science courses should include the following:
Only one of:
AP Computer Science credit (4 or 5 on AB, or 5 on A)
600.107 Intro to Programming in Java
Each of:
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 adviser's permission, up to 6 of the 30 required credits may be taken in the Department of Electrical and Computer Engineering.
- 600.101 Computer Fluency cannot be counted toward this requirement. However, it can be counted toward the 120 total credits needed

for the degree. No more than 3 credits of short courses or 3 credits of independent study 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 towards 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 and Applied Mathematics and Statistics (18 credits):

- The following courses must be included:

110.108 Calculus I

110.109 Calculus II

550.171 Discrete Mathematics

- 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. Entrepreneurship courses (551.xxx or 660.xxx) are not acceptable.

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 Web site, which includes most 'N' designated courses, 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 advisers. 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.

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

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.

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 (43):

- One programming course—choose from:
AP Computer Science
600.107 Intro to Programming in Java
- 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 adviser, 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 adviser. 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 Web site.

Short courses cannot be used toward the minor requirements.

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 adviser from the National Science Foundation-funded Engineering Research Center (ERC) in Computer Integrated Surgical Systems and Technology (CISST). Current faculty available as advisers include Professors Russell Taylor (CS), Greg Hager (CS), Jerry Prince (ECE), Ralph Etienne-Cummings (ECE), and Allison Okamura (ME).

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 adviser

Required Fundamental Mathematics Courses

110.106 or 110.108 Calculus I

110.107 or 110.109 Calculus II

110.202 or 100.211-212 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 adviser in the CIS minor.

- One course in imaging, chosen from the following:
600.461 Computer Vision
520.414 Image Processing and Analysis I
520.432 or 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 adviser 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:
580.470 Biomedical Sensors
600.461 Computer Vision
530.651 Haptics 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

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 adviser in the department. In order to declare a first or second major in computer science, students should see the Director of undergraduate studies in NEB 224 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 and no later than the beginning of their senior 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 students with significant advanced placement credits or students who have elected to carry somewhat heavier course loads each semester have finished the program in considerably less time. Applicants are judged on the basis of their performance in courses and their letters of recommendation. If accepted, they must take at least one course per semester toward fulfilling the requirements of each degree (undergraduate and graduate). No course may be counted for both the undergraduate degree and the graduate degree. Upon admission to the program students will be assigned a graduate faculty adviser 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 adviser in the department. The adviser assigned to a student may change, subject to the acceptance of the new adviser.

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. Students may be able to complete the program in as little as one year. 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 adviser 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 Web site. 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 adviser 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, which may be bound and submitted to the Milton S. Eisenhower Library.

By satisfying the Ph.D. qualifying course and project 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 should regularly attend the department seminars, and are required to enroll in and maintain satisfactory attendance in Computer Science Seminar 600.601-602 for at least two semesters. Although seminar attendance is required, the seminar may not be counted toward the 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 adviser 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 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 Web site. 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 adviser 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 towards 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 adviser, 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 adviser/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 and qualifying project requirements, 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 adviser 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 adviser, a second faculty member in the Department of Computer Science (who must have a primary tenure-track appointment in the Department if the adviser 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 advisers 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 adviser 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 sti-

pend 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

600.101 (E) Computer Fluency

Students will become fluent with information technology through coverage of basic underlying concepts and use of common applications. Concepts will include the building blocks of computer systems and software, as well as historical perspectives and social implications. Students will learn basic and selected advanced skills with MS Office (word processing, spreadsheets, presentations, databases), as well as webpage design in HTML, with programming in JavaScript, and Unix operating system basics. The goal is to empower students so that they remain skilled computer users and will have confidence and success learning and applying new technologies on their own in the future. Prerequisite: none. *Note:* This course is for non-CS majors only. [General]

Houlahan 4 credits fall, spring

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]

Fröhlich 4 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.

Staff 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 three 4-week blocks of meetings with different computer science professors, focused on a central theme. Active participation is required. Satisfactory/Unsatisfactory only. [General]

Houlahan 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 the fundamental programming concepts and techniques in Java and is intended for all who plan to use computer programming in their studies and careers. Topics covered include control structures, arrays, functions, recursion, dynamic memory allocation, simple data structures, files, and structured program design. Elements of object-oriented design and programming are also introduced. Prerequisite: familiarity with computers. [General]

Houlahan 3 credits fall, 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 novice 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. Co-requisite: 600.107. Satisfactory/Unsatisfactory only. [General]

Houlahan 1 credit

600.120 (E) Intermediate Programming

This course covers intermediate to advanced object-oriented programming in both C and C++. The focus of the course is on programming techniques, class design, and the use of class libraries. Topics to be covered include polymorphism, overloading, inheritance, pointers, dynamic memory allocation, templates, collections, exceptions, and others as time permits. Students are expected to learn syntax and low-level language features independently. Course work involves significant programming projects in both languages. Prerequisite: 600.107 or AP CS. [General]

Staff 4 credits fall, spring

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

600.161 (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.

1 credit intersession

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: 600.107. [General]

Staff 3 credits fall, spring

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, push-down 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. Prerequisite: none. [General]

Kosaraju 3 credits fall, summer

600.315 (E) Database Systems

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]

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]

Shapiro 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]

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]

Monrose 3 credits fall

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 a special case of satisfiability, integer programming, rational pattern transduction, Bayesian network inference, or weighted logic programming. For each of these 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 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, 600.271, Calc II. [Analysis]

Eisner 3 credits spring

600.328 (E) Compilers

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 [Systems]

Masson 4 credits fall, summer

600.335 (E) Artificial Intelligence

Artificial Intelligence (AI) is introduced by studying knowledge representation mechanisms, automated reasoning, automatic problem solvers and planners, production systems, game playing, and machine learning. 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. Prerequisite: 600.226, 550.171; linear algebra, prob/stat recommended. [Applications]

Hager, Sheppard 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; 600.211 recommended. [Systems]

Amir 3 credits fall, even years

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 intrasystem 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]
Masson, Terzis 3 credits spring

600.348 (E,Q) Theory of Network Communication

The course covers current topics in the area of communication in distributed systems. This includes an introduction to parallel computational models and important routing parameters and networks, as well as the presentation and analysis of strategies for broadcasting, unicasting, and multicasting in static and dynamic networks, load balancing, and distributed data management. Weekly assignments. Some knowledge of probability theory is helpful. Prerequisite: 600.344/444 or permission. [Analysis]
Scheideler 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

600.359 (E) Projects in Graphics and Multimedia

Students in this course collaborate to work on a large scale project in the area of computer graphics and multimedia. From initial brainstorming to investigation of existing systems to the development of a full-scale system, students shape a project into something that may be useful to either the research community or the general public. Prerequisites: Students should have a background in computer science or in films. CS students must have completed Data Structures (600.226) and at least one 300-level course with a semester programming project (or comparable experience). Film students should provide an appropriate faculty reference to the instructor. Both CS and film students must get approval of the instructor for registration. [Applications]
Cohen 3 credits

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]
Awerbuch 3 credits fall

600.371 (E,Q) Modern Complexity Theory

Topics covered will be polynomial complexity classes and beyond, complexity of logic and arithmetics, cryptography and complexity, interactive proof systems and probabilistically checkable proofs, inapproximability, and new directions including Quantum computing and complexity of evolutionary systems. Weekly assignments. Prerequisites: 600.271 or permission. [Analysis]
Scheideler 3 credits

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

Computers and information technology have become major forces in transforming American medicine. We shall discuss some of the new entities—the computer-based patient record, clinical practice guidelines, and digital libraries—and their underlying technologies: networks, databases, controlled vocabularies, and decision analysis. Prerequisite: none. Short course.
Lehmann 1 credit

600.403 (E) Computational Genomics: Sequence Modeling

This short course will cover probabilistic methods for modeling biological sequences (e.g., DNA and protein sequences). Topics include inferring relationships between and among sequences and evolutionary trees over sequences. Prerequisites: knowledge of algorithms, probability and programming. Short course.
1 credit

600.408 (E, Q) Empirical Research Methods in CS

Computer programs are real-world processes that, like complex physical and biological systems, can be studied in controlled experiments and analyzed statistically. This course gives a rigorous grounding in empirical methods for students interested in any area of applied computer science. Topics: experimental design, probabilistic model-

ing, exploratory data analysis, hypothesis testing, and system tuning. Prerequisites: 600.120 and 600.226, or equivalent knowledge. Short course.

1 credit

600.411 (E) Conversational Interfaces

This course looks at the application of natural language processing technology systems for human-computer interaction, in particular text-based conversational interfaces. The course begins with background on computational approaches to discourse and dialogue, and then reviews recent work in information extraction and question answering. There will be one final project which explores a novel use of nlp for text-based human computer interaction. Prerequisite: 600.465 or 600.466. Short course.

1 credit

600.415 (E) Database Systems

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]

Burns 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]

Shapiro 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]

Burns 3 credits fall

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]

Monrose 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, 600.271, Calc II. [Analysis]

Eisner 3 credits spring

600.426 (E) 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

600.433 (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 4 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, prob/stat recommended. [Applications]

Hager, Sheppard 3 credits spring

600.436 (E) High-Assurance Systems

This course focuses on the design and implementation of high assurance (i.e., certifiably secure) systems. It examines the history of high assurance standards and system building, the state of current standards, and the motivations behind them. It discusses the objectives of high-assurance software construction and the methods by which high-assurance is achieved, and tests these methods against an actual high-assurance software system. In the process, it challenges the assumptions that underlie high assurance software processes, and investigates how these assumptions and methods may need to change in the face of open source and/or collaborative software development. Finally, it looks at research topics in high assurance systems. Prerequisite: 600.318/418. [Applications]

Shapiro 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 Topics in Operating Systems

Topics will vary from year to year, usually in the areas of operating system security, security assurance, resource management, high-performance microkernels, and similarly advanced subjects. Emphasis in this course is on understanding not just concepts but their implications for the whole of the resulting system design. A significant project may be included. Prerequisite: 600.318/418. [Systems]

Shapiro 3 credits

600.439 Microkernel Architecture and Design

This course examines operating system internals by using an existing, high-performance microkernel as a guide. We start from the moment the machine is powered on and look at each action that the microkernel takes as it starts up. We follow this path until we have worked our way through the first interprocess communication, and then look at how drivers and system structure is initialized. As we work our way through the microkernel's initialization and startup, we examine what is happening at each step, what options exist for the design at that point, and why the particular choice of the actual implementation was made. We will also look at architectural tradeoffs in the design of the operating system. Prereq: Thorough knowledge of C and UNIX, 600.333/433 & 600.318/418. [Systems]

Shapiro 3 credits

600.442 (E,Q) Cryptography and Network Security

This course focuses on algorithms and protocols for secure network communication. Topics include cryptographic algorithms (DES, Diffie-Hellman, RSA), authentication, key management, secure networking, certification, trust management, and secure electronic commerce. Prerequisites: 600.271 and 550.171 or equiv, 600.226 and a 300-level or above systems course. [Analysis]

Ateniese 3 credits fall

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]

3 credits

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 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

600.448 (E,Q) Theory of Network Communication

Similar material to 600.348, but in more depth, intended for upper-level undergraduates and graduate students. Students may receive credit for 600.348 or 600.448, but not both. Weekly assignments. Some knowledge of probability theory is helpful. Prerequisite: 600.344/444 or permission. [Analysis]

Scheideler 3 credits

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 engi-

neering 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

600.452 (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

600.457 (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

600.460 (E) Interactive Graphics and Games

This course studies a variety of techniques for creating interactive graphics applications. Students collaborate in small groups to design and implement their own 3D games. Prerequisite: 600.356/456 or 600.357/457 or significant graphics experience and permission. [Applications]
Cohen 3 credits

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. Prerequisites: 600.226. [Applications]
Hager 3 credits fall

600.462 (E) Advanced Topics in Computer Vision

(Cross-listed as 580.464)

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 segmentation, 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 and linear algebra or permission. [Applications]
Vidal 3 credits spring

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]
Awerbuch 3 credits fall

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 spring

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

600.471 (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 probabi-

listically checkable proofs. Prerequisite: 600.271 or permission. [Analysis]

Hohenberger 3 credits

600.475 (E) Machine Learning

This course covers current topics in machine learning research. After a brief historical review, the class focuses on a series of different learning models, including memory-based learning, genetic algorithms, and neural net learning algorithms. The class considers the design and methodology of experiments used to test and compare different machine learning systems. Although the main focus is on experimental work, the course also examines theoretical work on distribution-free learning models. Students in the course design their own machine learning system as a final project. Prerequisite: 600.335/435 or permission of instructor. [Applications]

Sheppard 3 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.

3 credits

600.493 (E) Robocup I

This course allows students to participate in the development of a robot soccer team. Students will work with a development team to improve some aspect of the team infrastructure, sensing, world modeling, or strategy components. Prerequisites: 600.226, calculus, probability and statistics; co-requisite: 600.336 when offered.

Hager 1 credit spring

600.494 (E) Robocup II

This course is for students who wish to manage a development team for robot soccer. Students will create and manage software projects related to robot soccer. Prerequisites: 600.493 or permission.

Hager 1 credit spring

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

600.501-502 Independent Study

Individual guided study 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 either term by freshmen or sophomores.

600.503-504 Independent Study

Individual guided study 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 either term by juniors or seniors.

600.507-508, 574, 595 Independent Research

Independent research 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 and credit assigned 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. P/F 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.

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 adviser 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 writeup 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 adviser's research group. Students will be expected to establish

a research plan and schedule and may be required by their adviser 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)

600.576 Intersession Independent Study

Similar to 600.501-504, except taken during winter intersession.

600.597 Summer Independent Study

Similar to 600.501-504, except taken during summer session.

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 e-mail 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

600.619 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

600.624 Advanced Topics in Network Security

This course focuses on advanced research topics in communications security. The course is structured as a research seminar where students present research papers to the class. Topics include protocol analysis, security in inter-domain routing, broadcast authentication protocols, covert channels and anonymous communication, key management, advanced traceback schemes, attack propagation modeling, among others. A course project is required. Prerequisite: 600.324/424, 600.344/444 or instructor permission. [Systems]

Monrose 3 hours

600.625 Computer and Network Forensics

The course exposes students to a myriad of fundamental concepts and techniques for recovering and inferring information in computer systems and networks. Topics include (but are not limited too) file system forensics, kernel-level rootkits and associated challenges, reconstructing malware evolution and dynamics, analysis of anonymization and privacy preserving techniques, advanced network traceback, traffic classification, biometrics and digital evidence, data integrity and audit trails, secure remote logging, and system call introspection. A semester-long course project is required. Students will also be responsible for presenting and discussing selected research papers on topics pertinent to the course. Some familiarity with low-level system programming is assumed. Prerequisite: 600.324/424 and 600.318/418 or instructor permission. [Applications]

Monrose 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

600.641 Special Topics in Theoretical Cryptography

In this seminar, we will explore the foundations of modern cryptography. We will study how to formalize the security guarantee of a protocol and cover techniques for proving that a protocol meets a claimed guarantee. Some included topics will be zero-knowledge proofs, multiparty computation, program obfuscation, and anonymous authentication. An emphasis will be placed on major past results, recent progress and current open problems. The workload will include a final research project. Prerequisite: a prior course in cryptography or security, or permission of the instructor. [Analysis]

Hohenberger 3 hours

600.642 Advanced Cryptographic Protocols

This course will focus on advanced cryptographic protocols with an emphasis on open research problems. Prerequisite: 600.442 or 600.443 or permission of the instructor. [Applications]

Ateniese 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 protec-

tion, 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

600.644 Advanced Computer Networks

This is a graduate-level course on computer networking. The course involves both a reading/lecture/discussion component and a project component. We will read about 50 research papers on various aspects of computer networking: LAN/WAN technologies, congestion/flow control, traffic analysis, routing, internetworking, multicast, security, and quality of service. Students are expected to read papers before the class, submit a one page summary for each paper, and participate in the discussion during the class. The class projects can be either of the following types: design/implementation, measurement, and simulation. The lecture will be conducted in an interactive fashion. The instructor will lead the discussion, but we expect everyone to participate. You will be graded for both the paper summaries and class discussion. Prerequisite: 600.344/444 or instructor permission. [Systems]
Terzis 3 hours

600.646 Advanced Computer-Integrated Surgery II

(See description under 600.446.)
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 3 credits

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. [Applications]
Okamura 3 hours

600.652 Advanced Computer-Integrated Surgery Seminar

(See description under 600.452.)
Prerequisite: 600.445 or permission of instructor. [Applications]
Taylor 1 hour spring

600.658 Seminar on Shape Analysis and Retrieval

This course is motivated by the recent proliferation of 3D models on the World Wide Web and will focus on methods for designing systems that allow users to retrieve desired models from large repositories of 3D shapes. The course will review a number of existing shape representations designed to assist in the task of whole-object and partial-object retrieval. Some of the subjects discussed in this course will include, signal processing, alignment, compression, skeletonization, and shape descriptors. Students will be expected to present one or two papers throughout the course of the semester and will also need to complete a final project in the area. Prerequisite: any 600.4xx course in computer graphics and linear algebra; or permission of instructor. [Applications]
Kazhdan 3 hours

600.659 Seminar on 3D Model Reconstruction

This seminar will survey a variety of classical and recent techniques for the reconstruction of 3D models. The course will be decomposed into three separate parts: (1) reconstruction of models using computational-geometry-based techniques, (2) reconstruction of models using surface fitting approaches, and (3) reconstruction of models using implicit function fitting. Students will be expected to present two or three papers throughout the semester and will also need to complete two projects. The first project will be an implementation project, focused on exposing students to some of the technical challenges of reconstruction by having them implement an existing method. The second project will be a research project, motivating students to think about new methods for surface reconstruction. Prerequisites: any 600.4xx course in computer graphics and linear algebra; or permission of instructor. [Applications or Analysis]
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

600.664 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 spring

600.665 Statistical Language Learning

This course focuses on past and present research that has attempted, with mixed success, to induce the structure of language from raw data such as text. Lectures will be intermixed with reading and discussion of the primary literature. Students will critique the readings, answer open-ended homework questions, and undertake a final project. Prerequisite: 600.465 or permission required. [Applications]

Eisner 3 hours

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

This course is focused on the state of the art in distributed systems research, networks, and the Internet. The course is managed as a discussion group where the professor and students present recent research topics, as well as design and implement useful semester-long projects. 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

600.726 Seminar 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 Seminar 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

600.743 Seminar 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 Computer Integrated Surgery

This weekly seminar will focus on research issues in computer integrated surgery, including subjects such as medical image analysis, statistical modeling, visualization, vision/sensing, surgical planning, 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.

Fitchtinger 1 hour

600.746 Medical Image Analysis Seminar

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/Hager 1 hour

600.757 Seminar in Computer Graphics

This seminar course reviews current research in computer graphics. Prerequisite: permission of instructor.

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

600.765 Seminar 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: permission of instructor.

Eisner 1 hour

600.771 Seminar in Theory

This seminar course reviews current research in theoretical computer science. Students will read, present, and discuss papers in weekly meetings. Prerequisite: permission of instructor.

Scheideler 1 hour

600.801-802 Dissertation Research

600.803-804, 895 Graduate Research

Independent research for master's or pre-dissertation Ph.D. students.

600.809-810, 891 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 adviser.

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

600.462 Advanced Topics in Computer Vision

600.630 Computer Vision Seminar

600.646 Advanced Computer-Integrated Surgery II

600.652 Advanced Computer-Integrated Surgery Seminar

Electrical and Computer Engineering

520.353 Control Systems

520.454 Control Systems Design

520.614 Linear System Theory

520.615 Linear Control Theory

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

530.645 Kinematics

530.646 Introduction to Robotics

530.647 Adaptive Systems

530.649 Robot Motion Planning

530.651 Haptics 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 adviser.

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
050.330 Psycholinguistics
050.630 Topics in Language Processing

Computer Science

600.465 Introduction to Natural Language Processing
600.466 Information Retrieval and Web Agents
600.665 Statistical Language Learning
600.765 Seminar in Natural Language Processing

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
520.644 Pattern Theory: From Representation to Inference
520.666 Information Extraction from Speech and Text
520.674 Information Theoretic Methods in Statistics
520.735 Sensory Information Processing
520.774 Kernel Machine Learning



Electrical and Computer Engineering

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) computer engineering; (2) systems, communications, and signal processing; and (3) solid state and quantum electronics.

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, nanoelectronics, life science microsystems, natural and synthetic sensory systems, neural computation.

William R. Brody, Professor (President, The Johns Hopkins University): medical imaging, magnetic resonance imaging.

Frederic M. Davidson, Professor: quantum optics, optical coherence, optical communications.

Ralph R. Etienne-Cummings, Associate Professor, Director of Computer Engineering Program: mixed-signal VLSI, computational sensors, robotics, neuromorphic engineering.

John Goutsias, Professor: signal and image processing, modeling and computational analysis of cellular processes, bioinformatics.

Pablo A. Iglesias, Professor: robust control, systems biology, mathematical modeling of biological systems.

Frederick Jelinek, Julian Sinclair Smith Professor of Electrical and Computer Engineering (Director, Center for Language and Speech Processing): speech recognition, statistical methods of natural language processing, and information theory.

Jin U. Kang, Associate Professor: opto-electronics, nonlinear optics, fiber optics and lasers.

Alexander E. Kaplan, Professor: "extreme" nonlinear optics: super-powerful laser interactions with matter.

Sanjeev P. Khudanpur, Assistant Professor: information theory, statistical language modeling.

Jacob B. Khurgin, Professor: quantum electronics, nonlinear optics.

Gerard G. L. Meyer, Professor (Chair): parallel computing, computational methods, fault tolerant computing.

Jerry L. Prince, William B. Kouwenhoven Professor: image processing and computer vision with application to medical imaging.

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.

William J. Byrne, Associate Research Professor: large vocabulary continuous speech recognition.

Gregory Chirikjian, Professor (Mechanical Engineering): robotics, computational biology, statistics of biological macromolecules.

A. Brinton Cooper III, Associate Research Professor: Error control coding, coded wireless and optical communication.

Christopher Diehl, Assistant Research Professor (Senior Professional Staff APL): machine learning, computer vision, sensor networks.

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

Gregory Hager, Professor (Computer Science): robotics, vision-based interaction, and visual tracking.

Roger Hammons, Assistant Research Professor and Senior Professional Staff APL: communication and radar systems, channel coding and applications, nonbinary families of CDMA signature sequences and associated channel codes.

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.

Mark N. Martin, Assistant Research Professor and Senior Professional Staff APL: low power VLSI, CMOS device physics, radiations effects.

Michael I. Miller, Hershel L. Seder Professor of Biomedical Engineering (Director, Center for Imaging Science): image understanding and computer vision, medical imagining and computational anatomy.

Nael Osman, Associate Professor (Radiology): image and multi-dimensional signal processing, medical imaging.

C. Harvey Palmer Jr., Professor Emeritus

Louis J. Podrazik, Lecturer: parallel computer architectures and algorithms, fault tolerant design.

Theodore O. Poehler, Research Professor (Vice Provost for Research): quantum electronics, solid state physics.

Philippe Pouliquen, Assistant Research Scientist: optoelectronic, mixed signal, low power VLSI, CAD tools for VLSI.

Wilson J. Rugh, Edward J. Schaefer Professor Emeritus

Raymond Sova, Assistant Research Professor (Principal Professional Staff APL): laser communications, R-F photonics.

Kim Strohhahn, Assistant Research Professor (Principal Professional Staff APL): radiation hardened electronics.

Matthias Stuber, Associate Research Professor, (Radiology): high resolution coronary MRI, MR myocardial tagging, high field MRI.

Nitish Thakor, Professor (Biomedical Engineering): biomedical instrumentation sensors and VLSI systems, neuroengineering.

Michael E. Thomas, Research Professor (Principal Professional Staff APL): propagation of light, applied spectroscopy and lasers.

Benjamin Tsui, Professor (Radiology): image reconstruction, quantitative SPECT and PET imaging, structural X-ray analysis.

Rene Vidal, Professor (Biomedical Engineering): biomedical imaging, computer vision, hybrid systems, machine learning.

James West, Research Professor: electroacoustics, physical acoustics, and architectural acoustics.

Raimond Winslow, Professor (Biomedical Engineering): systems biology and bioinformatics.

Current Research Activities

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.

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, and H-infinity control theory. 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.

Solid State and Quantum Electronics

Current research activities include work in the 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.

Facilities

The department maintains extensive facilities for teaching and research in Barton Hall and the Stieff Building. 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 control systems design 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 who, after graduation, will be successful engineers in indus-

try, government laboratories and other organizations, or advanced students in the best graduate programs. 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 in an economical and efficient manner.
- contribute to society as broadly educated, articulate, and ethical citizens who are at ease in multidisciplinary teams.
- strive to continually update and renew their knowledge throughout their careers in order to meet the needs of a rapidly changing world.

Students graduating with a B.S. in electrical engineering will have demonstrated the ability to:

- understand advanced 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, taking into account cost, safety, environmental and socio-political constraints.
- 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 the recognition of the need for life-long learning and the ability to pursue it.

Each student and faculty adviser 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 adviser. The faculty adviser 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 six (6) credits of advanced laboratory, design intensive, or senior design project courses from those given in the attached advising check-list. 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.)

- *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 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 and 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 Java (600.107) or Introduction to Programming in C/C++ (600.109).
- *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	<u>6</u>
	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
600.109 Intro Programming in C/C++	3
Non-ECE Engineering Elective	3
H/S Electives	<u>6</u>
Total	34

Junior Year (32 credits)

110.302 Differential Equations	4
550.310 Probability and Statistics	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	<u>6</u>
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	<u>6</u>
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' long-standing 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 adviser to enable graduates of the program to educate students who, after graduation, will be successful engineers in industry, government laboratories and other organizations, or advanced students in the best graduate programs. 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 in an economical and efficient manner.
- contribute to society as broadly educated, articulate, and ethical citizens who are at ease in multidisciplinary teams.
- strive to continually update and renew their knowledge throughout their careers in order to meet the needs of a rapidly changing world.

Students graduating with a B.S. in computer engineering will have demonstrated the ability to

- understand advanced 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, taking into account cost, safety, environmental and socio-political constraints.
- 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 the recognition of the need for lifelong learning and the ability to pursue it.

Each student and faculty adviser 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 adviser. The faculty adviser must be a member of the program committee that supervises the Computer Engineering Program. The current faculty members in the program committee are:

Department of Electrical and Computer Engineering

Andreas G. Andreou, Professor and Director of
Computer Engineering Program
Ralph Etienne-Cummings, Associate Professor
Gerard Meyer, Professor (Chair)

Department of Computer Science

Yair Amir, Associate Professor
Gerald Masson, Professor
Lawrence Wolff, Professor

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 Introduction to Programming in JAVA (600.107) or Introduction to Programming in C/C++ (600.109), 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 attached advising 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 pre-calculus 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.

This program fulfills the general distribution requirements of the university. The remaining credits are electives to be selected by the student in consultation with and approval by the faculty adviser. It should be noted that there is a university rule stating that no more than eighteen (18) D or D+ credits can be counted toward the total credit requirements for a degree.

The 42 credits of computer engineering courses must include the following:

- 18 credits in Electrical and Computer Engineering
- 18 credits in Computer Science
- 6 additional credits of either ECE or CS

The program must also contain a substantial advanced laboratory and design experience appropriate to the student's interests. This requirement can be met by either twelve (12) credits of advanced laboratory or design intensive courses or six (6) credits of advanced laboratory or design intensive courses and one year of a Senior Design Project (520.498-499).

A GPA of at least 2.0 must be maintained in Computer Engineering courses.

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
600.109 Introduction to C/C++	3
H/S Elective	<u>3</u>
	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
600.118 Intermediate Programming C/C++	4
H/S Elective	<u>3</u>
	35

Junior Year (32 credits)

550.171 Discrete Math	4
600.318 Operating Systems	4
600.334 Computer System Architecture	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	<u>6</u>
	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
520.490 Digital VLSI	3
520.495 Microfabrication Lab	3
520.424 FPGA Synthesis Lab	3
Non-ECE/ECE/MathSci Engineering Electives	6
H/S Elective	<u>6</u>
	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).*

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 adviser in the department. The adviser assigned to the student upon admission may be changed, subject to the approval of the new adviser. 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 adviser.
- 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 50). 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

520.213 (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

520.218 Introduction to Optics and Photonics

This is an introductory course in optics and photonics with laboratory experiments that parallel the lecture notes. Basic concepts in optics and photonics are covered that include geometric optics, interferometry, diffraction, radiometry, spectroscopy, dielectric media, non-linear optics, fiber-optics and lasers. We will apply these concepts to understanding how optical systems work in the areas of bio-photonics, laser remote sensing and optical communications. Prerequisites: 171.101-102.

Sova 3 credits fall

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. Co-requisite: 110.202.

Staff 3 credits

520.345 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 Microprocessor Laboratory

This course introduces the student to the programming of computers at the machine level. General concepts relevant to microcontrollers are presented, including memory access, numerical representations, programming models, and coding techniques. Prerequisites: 520.142 or equivalent and programming competence in a high-level language such as BASIC or PASCAL.

Glaser 3 credits fall

520.353 (E,Q) Control Systems

Modeling, analysis, and an introduction to design for feedback control systems. Topics include state equation and transfer function representations, stability, performance measures, root locus methods, and frequency response methods (Nyquist, Bode). Prerequisites: 520.214 and 110.201 or 550.291.

Staff 3 credits fall

520.372 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 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. Prerequisite: 520.214.

Davidson 3 credits

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

520.413 (E) Introduction to Photonics

This course is an introduction-level course for students interested in opto-electronics. It covers the basics behind the optical devices used in communication, information storage, and display. The course begins with the in-depth review of principles of geometrical optics and imaging including the cameras, microscopes, and telescopes. The physical optical phenomena of interference, diffraction, and polarization of light are then studied, as well as the theory of the light propagation in optical waveguides. Based on this background various devices for modulation, switching, scanning, and demultiplexing of light are then described. Prerequisites: 520.219-220 or equivalent.

Khurgin 3 credits

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 morphological image processing and analysis, image representation and description, image recognition and interpretation. Laboratory exercises demonstrate key aspects of the course. 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

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 20,000 gate FPGA devices. 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 computer 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

520.426 (E) Parallel Processing Systems

An introduction to parallel hardware/software computing structures. Pipelining and vector machines, structures and algorithms for array processors, multiprocessor architectures and control, data flow machines, and VLSI parallel computing structures.

Jenkins 3 credits spring

520.428 (E,Q) Introduction to Algorithms for Parallel Computers

An introduction to the design and analysis of algorithms for implementation on advanced multiple computer architectures. Efficient techniques for vector, shared memory, and distributed memory machines. Classical parallel algorithms studied include parallel prefix, sorting, and message routing on specific architectures using MPI. Numerical linear algebra primitives: solution of structured linear systems, including bidiagonal, tridiagonal, triangular systems; LU, QR, FFT factorizations. Algorithm/ architecture mappings and tradeoffs. Prerequisites: basic computer architecture and a course in computer programming.

Podrazik 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

520.430 Parallel Optimization

Optimization problems and their analysis including primal and dual formulations. Optimality conditions and their relationship to algorithm synthesis. Survey of both uncon-

strained and constrained optimization algorithms in the context of developing algorithms suitable for implementation on parallel computers. Unconstrained techniques include gradient descent, conjugate-gradient, Quasi-Newton and Newton's Method, their parallel implementations and algorithm variants. A survey of parallel algorithms for constrained optimization will be presented, including feasible set, projection and interior point methods. Various applications will be studied throughout the class to supplement the theory. Prerequisite: a course in advanced calculus and a course in linear algebra (a previous course in optimization or parallel processing is not required).

Podrazik 3 credits fall

520.432 (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. Co-listed as 580.472.

Prince 3 credits spring

520.433 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, segmentation, 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

520.435 (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 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

520.447 (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.

Jelinek 3 credits fall

520.448 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 Advanced Microprocessor Laboratory

The course covers the interfacing of microprocessors to memory and peripherals. Topics include input/output ports, timer operations, interrupt handling, serial communication, digital to analog and analog to digital conversions, and EEPROM programming. Student work is primarily software with some hardware hookup. Prerequisites: 520.349 or programming competence in 8080 or Z-80 assembly language and an understanding of logic gates.

Glaser 3 credits spring

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

520.460 (E) Error Control Coding

Designs of error control codes and their decoders for digital communication systems are presented. A self-contained algebraic framework is developed to lead to the study of BCH and Reed-Solomon codes and their decoders. Probabilistic coding schemes will include convolutional codes with Viterbi and MAP decoding. Capacity-approaching codes will be examined, focusing on turbo and LDPC codes, iterative decoders, and message passing algorithms. Prerequisites: Probability 550.420 or equivalent and linear algebra.

Cooper 3 credits fall

520.465 Digital Communications I

The basic tools of modern digital communications, random signal theory, basic detection theory, and spectral representation are presented. Memoryless modulation and demodulation schemes are thoroughly studied for the Gaussian channel, and measures of performance are developed. Topics in wireless communication and intersymbol interference are introduced. Prerequisites: 520.401 and 550.420 or equivalent.

Cooper 3 credits spring

520.466 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.

Cooper 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

520.484 (E) Optoelectronics Lab

This laboratory course involves designing and building optoelectronic circuits. Namely, laser diode drivers (CW and pulsed), oscillators, low-noise amplifier circuits, photodetector biasing circuits, and active filters will be designed, built, and tested. Prerequisites: 520.345 and permission of instructor.

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 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 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 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 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 depo-

sition, 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

520.601 Introduction to Linear Dynamical Systems

A beginning graduate course in linear, time-invariant systems. Topics include state-equation representations, input-output representations, response properties, controllability, observability, realization theory, stability, and linear feedback. Prerequisites: undergraduate courses in control systems and linear algebra.

Rugh 3 hours

520.603 Electromagnetic Waves and Radiating Systems

Representation of the electromagnetic field: Maxwell's equations, potentials, boundary conditions, stress and energy, harmonic waves. Radiation, the antenna boundary value problems. Cavity resonators, theory of waveguides, refraction. Scattering by objects without edges, diffraction by obstacles with edges. Special topics.

Joseph 3 hours

520.605-606 Introduction to Solid State Physics

An introduction to solid state physics for advanced undergraduate and graduates 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. Prerequisite: quantum mechanics or permission of instructor.

Khurgin 3 hours

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. Synthetic aperture radar and X-ray computed tomography serve as motivating examples throughout the course, and specific details for reconstruction and restoration within these applications are covered. Prerequisite: 520.651.

Prince 3 hours spring

520.610 Computational Functional Genomics

This class 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. This has become feasible with the development of DNA microarray technology, which allows the simultaneous measurement of gene expression levels of thousand of genes. Several topics will be covered in this class. These 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

520.614 Linear System Theory

A second course in state-variable representations for linear systems, with emphasis on multi-input, multi-output, nonstationary systems. Topics include solution properties, periodic systems, stability concepts, controllability, observability, and realization theory.

Staff 3 hours

520.615 Linear Control Theory

A continuation of 520.614, with emphasis on basic properties of linear control problems. Topics include polynomial and rational fraction descriptions, stabilization, characterization of stabilizing controllers, and geometric approaches. Prerequisite: 520.614.

Staff 3 hours

520.617 Sampled Data Control

This course deals with multivariable, linear continuous-time plants connected to a discrete-time controller through ideal sample and hold circuitry. Topics include effects of sampling, intersample behavior, input-output stability, lifting and fast discretization. Prerequisite: undergraduate work on discrete-time control.

Iglesias 3 hours

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

520.623 Optical Propagation, Backgrounds, and Sensing

This course presents a unified perspective on optical propagation in linear media. A basic background is established using electromagnetic theory, spectroscopy, and quantum theory. Properties of the optical field and propagation media gases, liquids, and solids and their interaction are developed. Basic formulas on absorption line-strength and shape and Rayleigh scattering are developed and applied to atmospheric transmission, seawater propagation, optical windows, optical fibers, and remote sensing. A survey of experimental techniques and hardware is presented. Computer codes are discussed and demonstrated. Prerequisites: A course on electromagnetic theory and elementary quantum mechanics.

Thomas 3 hours fall

520.630 Introduction to the Calculus of Variations and Optimal Control

An introduction to standard results of variational calculus in the context of minimization problems in n -dimensional Euclidean space. The application of convexity concepts to such problems. Classical minimization problems and the Euler-Lagrange equations. The last part of the course introduces optimal control problems and the Pontryagin principle. Prerequisite: 110.405.

Staff 3 hours

520.633 Introduction to Robust Control

An introduction to the robust analysis and control of linear systems. Topics include time and frequency response; norm characterizations of robustness and performance; deterministic and stochastic noise models; robust stability and performance; and optimal control.

Iglesias 3 hours fall

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

520.644 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, we examine Gaussian random fields, second order representation theory, and random processes in space time, as well as random processes of geometric shape through Gaussian fields on manifolds. Numerous

examples will be examined in image understanding and image analysis. Co-listed as 580.744.

Miller 3 hours spring

520.645 Adaptive Filtering

An introduction to the basic principles, mathematical theory, algorithmic design, and practical implementation of linear adaptive filters. Topics include adaptive least-mean square and recursive-least-square algorithms, adaptive lattice structures, fast finite-precision implementations, and behavioral analysis. Prerequisite: 520.435.

Tran 3 hours fall/alternate years

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

520.651 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

520.653 Fundamental Non-linear Optics

Kaplan 3 hours

520.655 Foundations of Digital Communications

This course presents the theory of modulation and detection in digital communications. The optimum receiver for the Gaussian channel is presented. Classes of modulation schemes are studied, and the performance of each is compared with theoretical limits. How to deal with signal distortion caused by frequency selectivity is examined, and receivers for signals experiencing amplitude fading due to receiver and transmitter motion are discussed. Prerequisite: 520.651.

Cooper 3 hours

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/Jelinek 3 hours spring

520.667 Engineering Modeling and Analysis of Biological Systems

This course will provide an introduction to multiscale models and simulations with an emphasis on surveying engineering methods for describing the behavior of biological systems and networks from cells and organs. The goal of the course is to familiarize students with the wide array of quantitative approaches that can be applied to biological computations within the context of multiscale modeling and analysis. Co-listed with 540.667. Iglesias

520.673 Magnetic Resonance in Medicine

The course is an introduction to the field of magnetic resonance imaging. All of the basic principles of magnetic resonance imaging that are necessary to understand current literature are covered. Topics include Bloch equations, imaging principles, excitation, image contrast mechanisms, and instrumentation. Prerequisites: 520.214 or 580.222. Co-listed with 580.673. Staff 3 hours

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

520.691 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

520.725 Medical Microsystems

This multidisciplinary interdepartmental course on microsystem science and technology for medicine and biology. Lecturers from different departments and disciplines will present basic material micro and nano fabrication, low power interface electronics, sensors and effectors, MEMS and microfluidics as well as system integration and appli-

cations. Permission of instructor required. Co-listed as 580.725.

Andreou/Thakor 3 hours

520.727-728 Quantum Electronics

Interaction or radiation with free and bound electrons, perturbation theory, density operator, and quantum statistics. An introduction to laser theory and nonlinear optics. Prerequisite: a 400 level course in Schroedinger wave equation quantum mechanics.

Kaplan 3 hours

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

520.745 Solid State Electronics

An introduction to the physical principles and operational characteristics of semiconductor devices. Topics will include semiconductor physics, junctions devices, MOS devices, surface effects, and defect models.

Staff 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 Seminar on 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

520.760 Seminar on Geometric Control Theory

Topics include local/global decompositions of nonlinear control systems using smooth distributions on a manifold, the control Lie algebra, controlled invariant distributions, applications to disturbance decoupling and noninteracting control, and feedback linearization techniques. Prerequisites: 520.614, elementary background in differential topology or differential geometry, or permission of instructor.

Rugh 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 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 bio-inspired 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, microelectromechanical 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

520.774 Advanced Topics in Digital VLSI

Weekly seminar in contemporary research issues in digital integrated circuit design. Readings will be drawn from influential papers in the past and from current research. Topics include circuit design for skew-tolerance, pre-charge vs. self-resetting logic, ultra-low-power techniques, charge-recycling logic, transistor leakage management, fault tolerance, technology trends, and novel microar-

chitectures. Case of microsystem integration and functional complexity. Prerequisite: permission of instructor required.

Andreou

520.777 RF & Wireless Circuits and Systems

Research project oriented seminar with topics from the modern RF, microwave and wireless literature approached from both circuit and systems perspectives. Project topics will include integrated RF circuits design, testing and evaluation as well as architectural, communicational and mathematical issues. Students are expected to study and present assigned material in the class meetings, do their research-oriented projects under close supervision of the instructor with the goal of deriving original results and prepare a final report written in IEEE paper format. Permission of instructor is required.

Staff 3 hours fall

520.778 Advanced Topics on Circuit Information

Processing and Dynamics (Seminar)

There is vast number of important and challenging problems in modeling, optimizing, and designing circuits and complex circuit systems, that involve an extensive use of information, communication, optimization, control, and systems dynamics theory. The seminar intends to expose the students to the beauty of such interdisciplinary problems. Participating students are expected to have a fair graduate-level background in circuits and applied mathematics. Permission of instructor is required.

Sotiradis 3 hours

520.779 Advanced Topics in Spoken Language Systems

Research seminar devoted to the analysis of spoken language systems. Participants will discuss speech processing and language modeling themes in current language engineering literature. Laboratory projects of mutual interest to instructor and students may be undertaken. Registration by permission only.

Staff 1-3 hours fall

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.

The W. P. Carey Minor in Entrepreneurship and Management

The minor in entrepreneurship and management focuses on business and management from a multidisciplinary viewpoint, with a quantitative emphasis. The program, part of the Center for Leadership Education (page 528), 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.

The primary goal of the program is to provide Hopkins students with the knowledge and skills to become effective leaders. 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, analyze and correct problems in the firm's operations, and understand the dynamics of the marketplace.

The minor is purposely designed to serve several types of students. The program will help prepare students for entrance to law school, an MBA program, or other graduate school. Other students will start working in engineering or technical positions, then later move into management or start their own business. A third group of students is primarily interested in gaining knowledge to follow their interests in investments and personal finance.

Courses that may be used to satisfy requirements for the minor are grouped into five categories: Calculus and Statistics, Business and Finance, Leadership and Organizational Behavior, Operations, and International Trade. Lists of acceptable courses are regularly updated and may be obtained at the Center for Leadership Education office or on the center's Web site: <http://web.jhu.edu/leadership>.

Director

John C. Wierman, Professor: Applied Mathematics and Statistics.

Assistant Director

Marybeth Camerer

Senior Lecturers

Lawrence Aronhime: accounting, finance, management, entrepreneurship, technology commercialization.

Mark Franceschini: business law, business ethics, Internet law.

Judy Goldenberg: business law, business ethics.

Leslie Kendrick: marketing .

Jack L. Powell: accounting, finance.

Douglas Sandhaus: business law, Internet law.

Lecturers

Joan Davenport: intellectual property, business law.

David Fisher: business law.

Philip Friesen: leadership.

Lynn Kingsley: accounting.

Annette Leps: accounting, management.

Russell Morris: corporate finance, financial institutions.

Charles Morton: intellectual property.

Vasilos Peros: intellectual property, business law.

Maria Petrovici: management.

Bryan Rakes: business law.

Joshua J. Reiter: operations management, information technology management.

Stuart Ritter: personal finance.

William Smedick: leadership.

Judy Smylie: business law, business ethics.

Andrea Wills: marketing and sales.

Facilities

The CLE office is located in 104 Whitehead Hall. Updated office space provides a comfortable environment for informal discussions among faculty and students. Faculty and teaching assistants' office hours are held in the main office.

Courses

660.100 Invitation to Entrepreneurship

This one-week intercession course invites students to consider the issues and challenges involved in starting a business through a series of informative talks by successful entrepreneurs, business professionals, alumni, and trustees. Guest speakers will share with the class their experiences in building and managing companies as well as their individual success stories. Speakers will also cover such topics as financing a start-up, marketing, intellectual property, writing business plans, and managing a small business. Students will be assigned homework daily and there will be a packet of reading materials.

Staff 1 credit

660.102 Personal Finance

Wondering how to make your money work while you're out working for your money? This interactive course introduces students to the real-world personal financial decisions they will face throughout life. Working together, students will evaluate various solutions and determine the best way to meet their own financial goals. Topics include prioritizing spending, purchasing a car and home, credit, developing and implementing an investment strategy, insurance options, deciphering taxes, and retirement planning.

Ritter, Leps, Powell 3 credits fall and spring

660.105 (S,W) Introduction to Business

This survey course provides an overview of the various functions of business in a global market economy. After completing the course students will be able to identify, discuss and understand the nature of business and importance of profit motive; the forms of business ownership and when they are appropriate and advantageous; the functions and responsibility of management; the functional division of business into operations and production management, marketing, finance, labor relations and human resource management, R&D, and strategy; the types of financial institutions and their role in the economy; the functions of venture capital and the stock market; the evaluation of the financial health and potential of a company using the business plan or annual report.

Aronhime 4 credits fall and spring

660.203 Financial Accounting

A first course in financial accounting, focusing on production of financial statements for for-profit business entities required by Generally Accepted Accounting Principles (GAAP). Fundamental understanding of components of the statements and maintenance of accounts during the accounting cycle. Students are confronted with various theoretical constructs in the context of a problem-solving learning environment.

Powell, Aronhime, Leps, Kingsley 3 credits fall and spring

660.204 Managerial Accounting

Introduces managerial accounting principles. Coverage includes accounting liabilities, shareholder accounting,

and preparation of the Statement of Cash Flows. Preparation of financial statements for manufacturing entities and cost analysis. Presented in problem-solving learning environment. Prerequisite: 660.203 Financial Accounting.

Powell, Aronhime, Kingsley 3 credits

660.205 (S) Business Law I

This course is designed for the student who is interested in either (a) a broad knowledge of law as it relates to modern business, or (b) a survey of many business related aspects of law with a view to further legal studies. The course will involve reviewing and analyzing statutory and case law covering a variety of substantive subject areas including civil procedure, personal and subject matter jurisdiction, intentional torts, negligence, criminal law, contract law, consumer law and parts of the Uniform Commercial Code. This course, together with Business Law II, will provide a complete, self-contained, well-rounded, study of business law, or will provide a foundation for further legal study.

Goldenberg, Franceschini, Sandhaus, Fisher, Smylie, Rakes, Peros, Davenport, Morton
3 credits fall and spring

660.206 (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 property, personal property, bailments, bankruptcy, secured transactions, employment discrimination, business financing, investor protection, antitrust and environmental law.

Prerequisite: 660.205 Business Law I.

Goldenberg, Fisher 3 credits fall and spring

660.220 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. Recommended prerequisite: 660.105 Introduction to Business.

Aronhime, Petrovici 3 credits fall and spring

660.231 (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.

Goldenberg, Franceschini, Smylie 3 credits
fall and spring

660.241 Information Technology Management

This course surveys the fundamentals of information technology from a management point of view. It provides the foundation for follow-up courses in legal and ethical issues, and 660.341 Business Process and Quality Management. Major topic areas include systems concepts and value in the global economy, data and technology management, systems analysis and design, telecommunications, and societal and legal issues. The student will gain an understanding of information technology and an appreciation for information technology as a process enabler and strategic facilitator in the Internet age. Cases on business and legal aspects of technology are used throughout to focus on real-world issues. Recommended prerequisite: Introduction to Business 660.105.

Reiter 3 credits

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 3 credits fall and spring

660.302 (S) Corporate Finance

This course is designed to familiarize the student with the basic concepts and techniques of financial management practice. The course begins with a foundational discussion of time value of money and moves on to time value application in the areas of financial asset valuation, cost of capital calculation, and capital budgeting. Students also receive basic instruction in financial statement analysis, risk and portfolio theory, capital structure and working capital management. The course wraps up with an overview of derivatives. Prerequisites: 660.203 Financial Accounting. Recommended: Macroeconomics, Microeconomics.

Morris, Powell 3 credits fall and spring

660.305 (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: 660.205 Business Law.

Morton, Peros, Davenport 3 credits

660.306 (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, patents, trademarks, copyright, licenses, privacy, defamation, obscenity, the application of traditional concepts of tort liability to an Internet context, computer crime, information security, antitrust (Microsoft case), taxation, international considerations, and an analysis of other recent litigation and/or statutes. Prerequisite: 660.205 Business Law I.

Franceschini, Sandhaus 3 credits fall and spring

660.326 Organizational Development

The purpose of this course is to help future entrepreneurs and future entrepreneurs and managers learn methodologies for improving their organization's effectiveness and performance. It is also intended to help the individual develop his/her potential to make maximum contributions toward the successful growth of the organization. This course is based on studies from the discipline of applied behavioral science. The stages of the OD Process Model will be utilized as the foundation for this course. It will apply both conceptual and experiential approaches toward organizational development. It is designed to help develop interpersonal skills by allowing students to participate in individual and team exercises that require the application of chapter content to specific organizational situations. The approach is to focus on "learning by doing."

Staff 3 credits

660.330 Leadership Dynamics

The course explores theories and personal experiences that illustrate the nature of leadership in formal organizational settings. Topics covered include leadership traits and behaviors, power, influencing, decision-making, charisma, followership and bad leadership. The format for the class is a mixture of presentations (by the instructor,

students), exposure to local leaders, experiential exercises and self-assessments (intended to help awareness of style and skills) and case analysis (biographical analysis and personal cases). Recommended prerequisite: 660.105 Introduction to Business, 660.220 Principles of Management.

Friesen 3 credits fall and spring

660.332 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 Principles of Management 660.220.

Smedick 3 credits

660.335 Negotiation and Conflict Management

The focus of this class is the nature and practice of conflict resolution and negotiation within and between organizations. The primary format for learning in this class will be structured experimental exercises designed to expose students to different aspects of negotiation and to build tangible skills through interpersonal exchange. While some class time will be 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, salary, 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 and spring

660.341 (E) 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 or 660.241 IT Management.

Reiter 3 credits

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

660.351 Sales Management

This course will introduce students to key concepts in business-to-business selling, and build upon key skills developed in Principles of Marketing. Using a blend of didactic and interactive class sessions, students will learn how to identify ethical and legal issues in selling, what the buying process is, and how to adapt the selling process in order to build relationships. Students will be exposed to core management concepts, including managing a sales force. In addition to analyzing cases individually, each student will be part of a team that sells a product or service during the latter half of the semester, by developing a sales presentation and executing to the class. Prerequisite: Principles of Marketing 660.250.

Wills 3 credits

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. Recommended: 660.250 Principles of Marketing.

Kendrick 3 credits fall

660.360 Small Business Management

Provides tools students will need to successfully launch and manage a small business in a competitive, global environment. Examines the challenges of entrepreneurs, the business plan, marketing and financial issues, hiring, and managing people. Recommended prerequisite: 660.105 Introduction to Business, 660.220 Principles of Management.

Leps, Petrovici 3 credits

660.402 (S) Financial Institutions and Capital Markets

This course is a broad survey of the flow of funds through capital markets and financial institutions, with emphasis on the U.S. markets. Topics will include the roles of money and capital markets, intermediation and the role of financial institutions, the role of the Federal Reserve, interest rate determination, the nature and purposes of financial institution regulation, the nature of risk confronted by financial institutions, and strategies for mitigating those risks. Prerequisites: 660.302 Corporate Finance and at least one economics course.

Morris 3 credits

660.430 Creativity and Innovation

Students will learn techniques for improving the flexibility and originality of their thinking and will explore approaches used by managers and organizations to create and sustain high levels of innovation. Topics covered include everyday creativity, creative thinking techniques, idea selection approaches, group techniques for creativity, conditions that promote creativity, empathic design and disruptive technologies. Recommended prerequisite: at least two courses in the Entrepreneurship and Management program, junior or senior standing.

Staff 3 credits

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. Recommended prerequisite: 660.203 Financial Accounting and 660.250 Principles of Marketing, junior or senior standing.

Aronhime 3 credits

660.465 (W) Technology Commercialization

This course utilizes lectures, case analyses, and team projects to provide a strategy framework for determining the commercial value of new technologies and the best path for realizing that value. Student teams work on specific new technologies by reviewing applicable literature, defining fields of use, analyzing the strength of the provisional patent, identifying technology and market gaps, gauging the interest of potential customers and licensees, projecting the potential returns to licensees, evaluating spin-off possibilities, and determining the value the technology from the perspective of its owner(s). They hold extensive discussions with inventors, university technology transfer directors, intellectual property attorneys, independent experts, outside investors, and potential licensees and customers. Recommended prerequisite: 660.203 Financial Accounting and 660.250 Principles of Marketing, junior or senior standing.

Aronhime 3 credits

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.

Wierman 1 credit

660.501 Practicum in Entrepreneurship

Students work on existing business plans under the close supervision of an Entrepreneurship and Management faculty member. Students must complete an application, available in 104 Whitehead Hall, which must include a resume, transcript, and essay describing the business concept. 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.

Aronhime variable credit

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

Marc Donohue, Professor (Chemical and Biomolecular Engineering) and Associate Dean for Research

Andrew Douglas, Professor (Mechanical Engineering) and Associate Dean for Academic Affairs. Primary Adviser to the General Engineering Program and Chair of the General Engineering Faculty Oversight Committee

Kalina Hristova*, Assistant Professor (Materials Science and Engineering)

Mike Karweit, Research Professor (Chemical and Biomolecular Engineering)

Joseph L. Katz, Professor (Chemical and Biomolecular Engineering)

Daniel Naiman*, Professor (Applied Mathematics and Statistics)

Erica Schoenberger*, Professor (Geography and Environmental Engineering)

Ben Schafer*, Associate Professor (Civil 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 which 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 a number of free electives.
- *Flexibility.* This program is designed to allow students, in consultation with their adviser, the flexibility to choose a program of study which 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 adviser. 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 some knowledge of the international dimensions of engineering. They can do this by studying abroad or by taking a combination of language and other classes which 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 adviser. Candidates must fulfill the overall requirements for the B.A. degree as described in this catalog (see page 47). These include the university writing requirement, distribution requirement and 120 credit minimum. Details of these requirements are also provided in the 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 very 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 four 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.

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 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 can 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 can 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) which 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; Introduction to Programming in C/C++; Computing for Engineers and Scientists; and Computing in Mechanical Engineering.

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) which 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 adviser.

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 adviser. 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

500.101 (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, conservation, 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

500.303 (E,Q) Applied Mathematics I

Course topics include ordinary differential equations, complex variables, Fourier transforms (discrete and continuous), Laplace transforms, “elements” of partial differential equations, and numerical methods. Prerequisite: 550.291 or equivalent.

Staff 4 credits

500.304 (E,Q) Applied Mathematics II

Partial differential equations, special functions, calculus of variations, eigenfunction expansions, integral equations, asymptotic expansions, and complex analysis with numerical methods treated throughout the course. Prerequisite: 500.303 or equivalent.

Staff 3 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 Course

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 help fulfill a degree requirement in some way (e.g., serves as a course applied to the degree, satisfies a computer proficiency requirement, contributes to the master's essay or doctoral thesis). Before the practicum is begun, the sponsoring faculty member and the student's faculty adviser (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 helps to fulfill a degree requirement. 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 follow 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, Program Chair, Graduate Part-Time Program in Environmental Engineering and Science: environmental engineering, hazardous waste management, solid waste management.

William P. Ball, Professor: environmental engineering, contaminant fate and transport.

John J. Boland, Professor Emeritus: environmental economics and policy.

Edward J. Bouwer, Professor (Chair): environmental engineering, environmental microbiology, waste treatment.

Grace S. Brush, Professor: ecology, plant geography.

J. Hugh Ellis, Professor: environmental systems.

Steve H. Hanke, Professor: applied micro- and macroeconomics and finance.

Markus Hilpert, Assistant Professor: environmental flow and transport processes.

Benjamin F. Hobbs, Professor: energy and environmental systems, engineering and economics.

Charles R. O'Melia, Professor Emeritus: environmental engineering, aquatic chemistry.

Marc B. Parlange, Professor: hydrology, environmental fluid mechanics, engineering.

A. Lynn Roberts, Professor: environmental chemistry.

Erica J. Schoenberger, Professor: economic geography, regional development.

Eugene D. Shchukin, Research Professor: colloid and surface science.

Alan T. Stone, Professor: environmental and aquatic chemistry.

Mandy J. Ward, Assistant Professor: environmental gene expression profiling, bacterial chemotaxis.

Peter R. Wilcock, Professor: mechanics of earth surface processes, applied geomorphology.

Justin C. Williams, Associate Research Professor: environmental and urban systems.

M. Gordon Wolman, Professor: geomorphology, water resources.

Joint, Part-Time, and Visiting Appointments

Rolf Halden, Assistant Professor (Environmental Health Engineering, Bloomberg School of Public Health): bioremediation, water quality, biotransformation, exposure assessment.

Joseph Katz, Professor (Mechanical Engineering): experimental fluid mechanics, development of advanced diagnostics techniques.

Charles Meneveau, Professor (Mechanical Engineering): environmental fluid mechanics, engineering, turbulence.

Andrea Prosperetti, Professor (Mechanical Engineering): fluid mechanics, bubble mechanics, numerical simulations.

Kellogg Schwab, Assistant 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 advisers 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 relation between geography and environmental, social, and literary theory (with special concerns for class, race, and gender issues) while seeking applications of theoretical insights gained from such studies to a diversity of subject matter. 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 philosophical, economic, and broad-based cultural back-

grounds 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 although partial tuition fellowships are offered to qualified master's students.

Two fellowships may be of particular interest to Ph.D. applicants. The Wolman Fellowship, administered by the Whiting School of Engineering, honors the memory of alumnus and department chair Abel Wolman and his lifelong dedication to environmental engineering and graduate education; Ph.D. applicants are nominated by the department for consideration for this fellowship. The department often can offer one or more departmental fellowships to fully support the most qualified Ph.D. applicants for the first year of study.

Furthermore, many students within the department have been awarded graduate research fellow-

ships 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 adviser, 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 course in probability and statistics (The Department of Applied Mathematics and Statistics offers 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 Intro Chemistry Lab I
- 030.106 Intro Chemistry Lab 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 for Ecology or General Biology

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 (each of at least 3 credits) in Humanities or Social Sciences (catalog code H or S) with at least two courses at the 300-level or higher. Note that 570.334 Engineering Microeconomics can be counted toward these 18 credits. There is also a university writing requirement of at least two courses (6 credits). Note also that most medical schools require a year of English literature and/or composition.

Required course:

- 570.334 Engineering Microeconomics

Additional elective examples:

- 570.456 Seminar on the Geography of Multinational Corporations
- 570.465 Water Resource Development: History and Principles
- 360.349 Cities Under Stress: The Baltimore Case

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)
- 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 (13 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 adviser. Any changes in courses must be approved by the adviser. These courses will include numerous open-ended problems.

- Environmental Management and Economics

570.496 Mathematical Models for Managing Urban and Environmental Systems	
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	
183.639 Food and Water Borne Diseases	
187.610 Principles of Toxicology	
340.601 Principles of Epidemiology	

Technical Electives (minimum of 12 credits)

(selected in consultation with an adviser)

At least three (E), (Q), or (N) courses at or above the 300-level 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., 570.509 Independent Study or 570.499 Senior Thesis). Note earlier comments for premed 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).

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	
<i>Fall</i>	
110.108 Calculus I (Physical Sciences and Eng)	4
570.107 Intro to Geography (H/S elective I)	3
030.101 Intro Chemistry I	3
030.105 Intro Chemistry Lab I	1
570.108 Intro to Environmental Eng	<u>3</u>
Subtotal	14
<i>Spring</i>	
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	<u>3</u>
Subtotal	14
	(Annual 28)
• Year 2	
<i>Fall</i>	
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	<u>4</u>
Subtotal	16
<i>Spring</i>	
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	
<i>Fall</i>	
570.305 Environmental Engineering Systems Designs	4
570.334 Engineering Microeconomics	3
570.301 Environmental Engineering I: Fundamentals	3
570.351 Intro Fluid Mechanics	3
570.422 Math Models for Managing Environ Systems	3
540.203 Engineering Thermodynamics	<u>3</u>
Subtotal	19

<i>Spring</i>	
570.302 Environmental Engineering II	3
570.304 Environmental Engineering and Science Lab	2
360.349 Cities Under Stress: The Baltimore Case	3
570.328 Geography and Ecology of Plants	3
Probability/Statistics course	<u>3</u>
Subtotal	14
	(Annual 33)

• **Year 4**

<i>Fall</i>	
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

<i>Spring</i>	
570.421 Environmental Eng Design II	3
570.432 Sediment Transport and River Mechanics	3
530.328 Fluid Mechanics II	3
570.491 Hazardous Waste Engineering and Management	3
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 adviser 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 adviser approval.

	credits
110.108 Calculus I	4
110.109 Calculus II	4
110.202 Calculus III	4
550.291 Linear Algebra and Differential Equations	4
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 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, and disinfection. Prerequisite: 570.301 Environmental Engineering I: Fundamentals.

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. Co- 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 Eng
- 570.205 Ecology
- 570.239 Current and Emerging
Environmental Issues
- 570.317 Paleoecology
- 570.328 Plant Ecology and Geography
- 020.151 General Biology I
- 270.220 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

570.444 Colloid Chemistry

 570.445 Physical/Chemical Processes in
Environmental Eng I

 570.465 Water Resources Development:
History and Principles

 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 Intro to Geochemistry

270.410 Global Climate Change: Intro

540.301 Kinetic Processes

540.303 Transport Phenomena I

550.310 Probability and Statistics

560.435 Probability and Statistics in Civil Eng

*Substitution for one required course may be possible under special circumstances, with explicit approval of the environmental engineering minor adviser.

**Additional course electives are possible but require approval of the environmental engineering minor adviser.

For further information, contact Dr. William P. Ball, coordinator, 308 Ames Hall (DOGEE), 410-516-5434, bball@jhu.edu.

To arrange an initial advising appointment, please call Christine Kavanagh, academic program coordinator, 313 Ames Hall (DOGEE), 410-516-5533, dogee@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
- 171.112 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 Intro to Environmental Science
- 570.205 Ecology
- 570.239 Current and Emerging Environmental Issues
- 270.110 Habitats, Extinction, and Biodiversity 3
- 270.220 The Dynamic Earth
- 270.221 The Dynamic Earth Lab

- **Upper-Level Courses (9 credits)**

- 570.239 Current and Emerging Environmental Issues
- 570.301 Environmental Eng I
- 570.302 Environmental Eng II
- 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
- 570.444 Colloid Chemistry
- 570.445 Physical and Chemical Processes in Environmental Eng I
- 570.446 Biological Processes for Water and Wastewater Treatment
- 570.465 Water Resource Development: History and Principles
- 570.491 Hazardous Waste Engineering and Management
- 570.495 Mathematical Foundations for Public Decision Making
- 270.302 Aqueous Geochemistry
- 270.321 Intro Oceanography
- 270.350 Sedimentary Environments
- 270.311 Geobiology
- 270.313 The Ecology of a Changing Planet
- 270.314 Field Course in Soil Formation
- 270.369 Intro Geochemistry
- 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 wastewater 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 adviser 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 advisers 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.

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, page 47, and Writing Requirement, page 43.)

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 adviser 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 550.413 Applied Statistics and Data Analysis (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 adviser, 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 multinational corporations and international competitiveness combined with parallel economics courses on international development and international trade. 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 Mathematical Foundations for Public Decision Making and 570.493 Economic Foundations for Public Decision Making.

Graduate Programs

(See also Admissions and Finances, page 21.)

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- 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 advisers

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 chosen 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 1 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 adviser.

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 semi-

nar. 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 adviser. 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 typically 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.

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
- 570.644 Dynamic Environmental Systems Simulation and Decision Analysis
- 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:

- 270.375 Ground Water
- 570.353 Hydrology
- 570.465 Water Resource Development: History and Principles
- 570.686 Multiscale Flow and Transport in Porous Media

Recommended electives include:

- At least one course in Systems Analysis and Economics
- 570.431 Open-Channel Hydraulics
- 570.432 Sediment Transport and River Mechanics
- 570.445 Physical and Chemical Processes in Environmental Engineering I

Prerequisites for the M.S. and M.S.E. programs include mathematics through differential equations and computing skills. Contaminant Fate and Transport, Environmental Process Engineering, Environmental Management and Economics, and Water Resources Engineering require one course in applied mathematics, e.g., 570.495, numerical analysis, or engineering mathematics. 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 Mathematical Foundations for Public Decision Making
- 570.608 Modeling and Optimization of Environmental and Civil Systems *or*
- 570.644 Dynamic Environmental Systems Simulation and Decision Analysis *or*
- 570.496 Mathematical Models for Managing Urban and Environmental Systems
- 570.659 Environmental Policy Analysis

Recommended electives include:

- At least one course in physical, chemical, or biological processes
- 570.609 Facility Location Systems Analysis
- 570.612 Public Utility Economics

570.618 Multiobjective Programming and Planning

570.676 Stochastic Programming

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 undergraduate 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 adviser.

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 Mathematical Foundations for Public Decision Making

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.

Wolman, 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.

Ellis, Alavi 3 credits fall/summer

570.110 (N) Introduction to Environmental Science

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

570.205 (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, simulation, 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.

O'Melia 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. Prerequisite: 570.301 or permission of instructor.

Ball 3 credits spring

570.303 (E) The Environment and Your Health

This course surveys 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). Evaluation is by written examination. No prerequisites.

Kensler 3 credits fall

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 measurement and control of disinfection by-products. Pre- or corequisites: 570.301-302.

Staff 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

570.309 (N) Microbiology

This course will provide an introduction to microbiology, with an emphasis on prokaryotic microorganisms and their roles in environmentally and medically important issues. Aspects of microbial growth and nutrition, diversity, ecology, genetics, and genomics will be covered. Prerequisite: Biochemistry.

Ward 3 credits spring

570.317 (N) Paleocology

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.

Hobbs, Boland 3 credits fall

570.343 (S) Controversies in Applied Economics

This course addresses fundamental controversies in applied economics and includes selected topics in public choice economics (democracy, the Constitution, and bureaucracy); Austrian economics (the socialist calculation debate, markets vs. governments, alternative currency regimes, and entrepreneurship, competition, and monopoly); the economics of property rights (marginal cost controversy, the social cost controversy, nature of the firm, environmentalism, and privatization); and monetarism, Keynesianism, and supply-side economics. (All

topics not covered every semester.) Prerequisites: 180.101-102 Elements of Macroeconomics/Microeconomics.
Hanke 3 credits

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.*

Parlange, 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

570.367 (S) The Economics of Financial and Foreign Exchange Markets

A theoretical and empirical analysis of how spot, futures, and options markets function and how they affect resource allocation. Markets covered include financials (debt instruments, interest rate options, and stock indexes) and foreign currencies. Prerequisites: 180.101-102 or permission of instructor.

Hanke 3 credits

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) 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

570.406 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 hours spring

570.409 (E,Q) Facility Siting Models

In the past two decades, mathematical methods have been developed to site facilities both in urban areas and larger regions. The course considers methods to determine the optimal location of emergency services such as ambulances and fire equipment, industrial plant and warehouse location, retail facility siting, and the siting of ordinary facilities such as hospitals, clinics, and libraries. Focus is on applying linear programming in a creative way to develop solution methods.

Staff 3 credits fall

570.411 Environmental 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.

Ward/Bouwer 4 credits fall

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.

Staff 1 credit 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; ground-water 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 environmental 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.

Staff 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)

Wolman 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

570.427 (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

570.429 (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, in dependence upon surrounding media and other environmental conditions. Prerequisites: 570.444 or general physics and chemistry.

Shchukin 3 credits fall

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. Emphasis on coagulation, sedimentation, filtration, membranes

systems, and advanced oxidation processes. Prerequisite: 570.445 or permission of instructor.

O'Melia, Ball 3 credits spring

570.450 (E,N) Molecular Biology for Engineering Applications

This course will introduce molecular techniques to engineers. Topics covered will include nucleic acids and their isolation from environmental samples, gene cloning and sequencing, DNA transfer, hybridization analysis, the polymerase chain reaction and T-RFLP, and DNA microarray technology. Applications include bioremediation, wastewater treatment, and public health microbiology. Some laboratory classes will be included. Prerequisite: Engineering Microbiology.

Ward 4 credits fall

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

570.456 (S) Seminar on the Geography of Multinational Corporations

This course explores the origins of the multinational firm and the factors shaping its strategies of competition, production and location. Particular industries (e.g., electronics, automobiles) are analyzed in some detail. The impact of multinational direct investment on home and host countries are also investigated.

Schoenberger 3 credits fall

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

570.465 (H,S) Water Resource Development: History and Principles

An attempt to review utilization and development of water in diverse environments beginning with early irrigation systems revealed by archaeology including those in the Middle East, Asia, and Latin America. Inquiry directed

toward environmental and social factors influencing methods and complexity of development with emphasis upon comparisons between regions and past and present eras. Prerequisite: permission of instructor.

Wolman 3 credits fall

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; characterization 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.

Bouwer, Alavi 3 credits spring

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.

Boland, Hobbs 3 credits fall

70.495 (E,Q) Mathematical Foundations for Public Decision Making

A collection of systems analytic techniques which are frequently used in the study of public decision making is presented. Emphasis is on mathematical programming techniques. Primarily linear programming, integer and mixed-integer 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 Environmental Engineering Systems Design (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 3 credits spring

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

570.509 Independent Study: Geography and Environmental Engineering

Staff 1-3 credits fall/spring

Interdepartmental

360.311 (H,S) History of the American Automobile

Leslie, Schoenberger 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**

360.528-529 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. Prerequisites: Permission of instructor. Satisfactory/Unsatisfactory.

Hanke 3 credits spring/fall/intersession/summer

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

570.600 (E) Engineering Aspects of Public Health Crises

This course addresses strategies for stopping and preventing waterborne disease outbreaks both in the U.S. and settings without piped water supplies, with special emphasis on refugee populations.

L. Roberts 3 credits fall

570.603 Water Resources Systems Engineering

The course considers descriptive and optimization-oriented water quantity models. Topics include modeling stream flow by synthetic hydrology, sizing and operation of single reservoir; operation and sizing of reservoirs in series and parallel; multi-reservoir-multi-purpose systems. Prerequisites: 570.495 or knowledge of linear programming and some background in probability; permission of instructor.

Staff spring

570.605 Systems Analysis in Water Quality Management

Relations of water quality indicators such as biochemical oxygen demand; dissolved oxygen and nitrogenous oxygen demand are described via differential and differ-

ence equation models. The models are then incorporated into optimization modes. Least-cost pollution abatement models, equity models, regional location models and cost-sharing procedures are examined. Prerequisites: mathematical programming and differential equations or permission of instructor.

Staff 3 hours on demand

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 Modeling and Optimization of Environmental and Civil Systems

Students will implement advanced applications of optimization to the management of solid waste, water resources, pollution, and renewable and nonrenewable resources development. Advanced optimization and modeling methods are reviewed. Prerequisite: 570.495 or equivalent.

Hobbs 3 hours alternate years

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 addresses selected issues of theory and policy in the economics of public utilities. Topics include both the traditional issues of rate-of-return regulation and the more recent subjects of marginal cost-based peak load pricing, capacity planning models, etc., as they apply to water,

energy, and telecommunications utilities. While most attention is given to economic issues, the political, legal, institutional context in which these issues arise is also evaluated. Prerequisites: 180.301 Microeconomic Theory or 570.493, and 110.202 Calculus III, or equivalents.

Boland fall

570.613 Seminar in Geomorphology: Soils and Plants

Analysis and discussion of current research in the field. Wilcock, Brush, Wolman 2 hours

570.614 Advanced Topics in Facility Location Systems Analysis

This course considers models on the frontiers of location research as well as location modeling areas where research contributions are still needed. Format is a mixture of lectures by the professor and student reports. Offered on demand.

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 spring

570.620 Seminar on Industrial Restructuring

Reading seminar on the dynamics and implications of post-war economic restructuring in the advanced industrial nations.

Schoenberger fall

570.622 Topics in Human Geography

Advanced reading seminar considering major contributions in the contemporary geography literature. Prerequisite: permission of instructor.

Schoenberger 2 hours

570.626 Urban Water Demand Management and Planning

This course will discuss the importance of the urban water sector and the need for more effective management. It will address a range of demand-side issues, mostly in the context of the U.S. and from the perspective of economic analysis. Issues will include the determinants of the urban water demand, water use forecasting, tariff design, water conservation planning and evaluation, drought management, and integrated management. Prerequisites: Intermediate Microeconomic Theory, Calculus III.

Boland 3 hours spring

570.637 Aquasols

Physical and chemical aspects of the behavior of small particles in aquatic systems. Surface chemistry, adsorption, and colloidal stability. Hydrodynamics of particle transport and deposition. Applications in natural aquatic systems. Prerequisite: 570.443 or permission of instructor.

Staff spring alternate years

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

570.641 Department Seminar

Visiting speakers, faculty, and students. Reports and research on topics of current interest.

Staff 2 hours

570.644 Dynamic Environmental Systems Simulation and Decision Analysis

The first half of this course introduces numerical methods and object-oriented software for simulating the behavior over time of environmental systems described by ODEs and PDEs. Examples include food web models, pollutant transport, economic growth, and batch treatment processes. The second half introduces the principles of dynamic decision analysis for system planning and control. Bayesian analysis and stochastic dynamic programming are introduced.

Hobbs 3 hours fall/alternate years

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.

Boland 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

570.668 Advanced Topics in Project Evaluation

An overview of techniques and extensions of benefit cost analysis. Special attention is given to methods for dealing with non-monetized and non-quantified impacts, and valuation problems in soft money economies.

Boland 2 hours

570.673 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

570.675 Micrometeorology and the Atmospheric Boundary Layer

This course examines the atmospheric boundary layer under convective and nocturnal conditions, energy budget at the land surface with emphasis on regional and local evaporation, similarity theory and boundary layer scaling, statistical description of turbulence, spectral analysis, and conditional sampling. Prerequisites: differential equations, fluid mechanics.

Parlange 3 hours spring/alternate years

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

570.681 Environmental Engineering Seminar

Broad coverage of environmental engineering and science problems. Guest speakers, assigned reading, and critical analysis of journal articles.

Ball, Bower, Roberts, Stone

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 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.
Ball, Bouwer, Roberts, Stone

Cross-Listed

270.676 Numerical Methods in Hydrogeology

Staff 3 hours

Interdepartmental

360.617 Engineering Nature

A graduate seminar (open by permission to advanced undergraduates) exploring how the products and processes of modern industry have altered the environment on a local, regional, and global scale.
Schoenberger

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 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 25 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.

JHUISSI and CS MSECS—Dual Master's Program

The Johns Hopkins University Information Security Institute (JHUISSI) 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 JHUISSI 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 JHUISSI 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 JHUISSI 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 adviser(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 adviser in JHUISSI 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 adviser affiliated with JHUISSI and an MSECS adviser 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 JHUISSI affiliations. In the more common cases where two advisers are involved, the advisers 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 adviser(s)) can be double counted so as to be usable in satisfying of course requirements of the MSSSI 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 MSSSI 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 MSSSI 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 MSSSI 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 advisers and the CS graduate coordinator and the JHUISI graduate coordinator.

Dual Master's Program with the Department of Applied Math and Statistics in the WSE

A similar DMP has been initiated regarding the JHUISI MSSSI 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 MSSSI/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 MSSSI and the Master of Health Sciences (MHS) program in the Bloomberg School of Public Health (BSPH). The details of this MSSSI/MHS DMP are similar in principle to those for the MSSSI/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 Web site www.jhuisi.jhu.edu or the Information Security Institute Office at 3400 North Charles, Wyman Park Building, Room 407, 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.

Guisepppe 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.

Milad Doueihi (Communication in Contemporary Society): digital security, privacy and civil liberties.

Ruth Faden, Philip Franklin Wagley Professor of Biomedical Ethics; Executive Director, The Phoebe R. Berman Bioethics Institute; Professor (Medicine): ethical issues in public health; history of bioethics in the U.S. and its effects on health policy; ethical, psychological, and social issues in health policy; risk perception and protective behavior; social and psychological determinants of health behaviors.

James G. Hodge Jr., JD, Assistant Scientist (Health Policy and Management); Director, Center for Law and Public Health: international human rights and health, public health law and ethics, constitutional law, genetics law and policy, health information privacy.

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, Senior Fellow, 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, Information Security Senior Manager: information security, management, and infrastructure protection.

Darren Lacey JD, Chief Information Security Officer, Johns Hopkins University.

Michael Lavine, Lecturer, Information Security Institute, Towson University, Assistant Professor of Computer and Information Sciences; 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.

David Marchette, Lecturer, Fellow by Courtesy (Applied Mathematics and Statistics): intrusion detection, nonparametric and semi-parametric density estimation, pattern recognition, aided target recognition, image analysis, medical imaging, exploratory data analysis.

Fabian Monrose, Associate Professor (Computer Science): network security, user authentication, electronic commerce, biometrics, network operating systems, Internet platforms for supporting next-generation computing.

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; Assistant Research Scientist (Health Policy and Management): political philosophy, constitutional law, justice and health, ethical and legal issues in human stem cell research.

Adam Stubblefield, Assistant Research Professor (Computer Science): applied cryptography, network security, RFID security, applications of virtualization to security.

Andreas Terzis, Assistant Professor (Computer Science): network security, malware detection and containment, wireless sensor networks, computer networks.

JHUISI COURSES

Core Technology Courses

- 650.412 Java Security
- 650.441 Designing Security Systems
- 600.443 Security and Privacy in Computing
- 600.424 Network Security
- 600.442 Cryptography and Network Security
- 650.471 Cryptography and Coding
- 600.624 Advanced Topics in Network Security
- 600.642 Advanced Cryptographic Protocols
- 600.643 Advanced Topics in Computer Security
- 600.471 Theory of Computation
- 600.641 Special Topics in Theoretical Cryptography
- 550.438 Statistical Methods in Computer Intrusion Protection
- 650.425 Computer and Network Forensics
- 650.457 Computer Forensics

Elective Technology Courses

- 650.737/738 Information Security Project
- 650.433 Embedded Computer Systems
- 600.422 Security Informatics Fundamentals
- 600.456 Protocols and Systems for Internet and Web Security
- 600.488 Algorithms for Information Security
- 600.648 Secure Software Engineering
- 550.438 Statistical Methods for Computer Intrusion Detection
- 605.434 WWW Security
- 605.731 Network Security
- 605.732 Cryptology

Core Policy Courses

- 650.414 Rights in the Digital Age
- 650.417 Theory and Practice of Computer Ethics
- 650.430 Moral and Legal Foundations of Privacy
- 650.733 New Public Policy for the Information Revolution

Elective Policy Courses

- 680.711 Data Privacy and International Public Policy
- 680.751 International Governance of New Technologies
- 480.628 Digital Rights Management: American and European Perspectives

Core Health Courses

- 650.651 Health Information, Privacy, Law and Policy
- 650.418 Informatics in Public Health

- 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

Foundational Courses

- 600.418 Operating Systems
- 600.421 Object Oriented Systems
- 600.433 Computer Systems Fundamentals
- 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 adviser 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 information technology 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.

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 web site 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 2008 is July 15, 2008. The deadline for Spring 2009 is December 15, 2008.
- The MSSI deadline for international students for Fall 2008 is March 15, 2008. The deadline for Spring 2009 is November 1, 2008.

Please mail your supporting documents to:

Deborah Higgins
 Graduate Coordinator
 Johns Hopkins University
 Information Security Institute
 3400 N. Charles Street
 Wyman Park Building Room 407
 Baltimore, Maryland 21211-2895

or

If sending by express carrier other than US Postal Express, send to:

Deborah Higgins
 Graduate Coordinator
 Johns Hopkins University
 Information Security Institute
 3100 Wyman Park Drive, 4th floor
 Baltimore, MD 21211-2895

Course Requirements for the MSSSI

Upon admission to the master of science in security informatics, a student is assigned a graduate adviser from the Information Security Institute who must approve the courses to be applied to the MSSSI.

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 adviser to take the project for credit as your 10 course or you may take an elective as your 10 course and complete the project as a non-credit course.

All courses supporting the MSSSI are categorized as one of four types: (i) Technology; (ii) Policy; (iii) Health; (iv) Management. All MSSSI 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.
- 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 MSSSI 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 advisers. 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 MSSSI 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 MSSSI 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 adviser 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 towards one area requirement. The MSECs coursework program must be approved by the CS assigned MSECs adviser and the department/center.

Concurrent Bachelor's/Master's degree Program in Conjunction with the MSSSI

A concurrent bachelor's/master's degree program including the MSSSI 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 MSSSI 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 MSSSI degree. Usually with one additional year of study, the student can simultaneously satisfy both sets of degree requirements.

Tuition Support

Students applying for the MSSSI 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 MSSSI 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 MSSSI

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.

Wilson 3 credits

650.441 Designing Security Systems

This course concentrates on how security systems are broken in the real world. The bulk of the course will focus on real-life case studies; specifically, we will be interested in how attacks have been used to break deployed systems and what lessons security engineers can learn from each failure. Topics include software flaws and reverse-engineering, protocol analysis and the misuse of cryptography, side channel attacks, and attacks on physical security measures such as locks and tamper-resistant devices.

Masson 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.

Lavine 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.

Scheinerman 3 credits

600.424 Network Security

Software and hardware perspectives to attacks on computer systems utilizing network infrastructures are considered. Approaches such as stack smashing attacks and exploitations of protocol flaws are examined from both theoretical and practical viewpoints. Virtual private net-

works (VPNs) and firewalls are discussed. User and client authentication methodologies are studied.

Monrose 3 credits

650.442 Cryptography and Network Security

This course focuses on formal analysis and design of algorithms and protocols for the support of secure network communication. Topics include cryptographic algorithms (DES, Diffie-Hellman, RSA), authentication, key management, secure networking, certification, trust management, and secure electronic commerce.

Ateniese 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

600.642 Advanced Cryptographic Protocols

This course will focus on advanced cryptographic protocols with an emphasis on open research problems. Prerequisite: 600.442 or 600.443 or permission of the instructor.

Ateniese 3 credits

600.643 (E) Advanced Topics in Network Security

Topics may vary but focus mainly on network perimeter protection, host-level protection, authentication technologies, intellectual property protection, formal analysis techniques, intrusion detection and similarly advanced topics. Prerequisite: 400 level course in security, including 600.442/443/424, or permission.

Rubin 3 credits

550.438 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.

Marchette 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

600.422 (E) Security Informatics Fundamentals

Principles of information security are addressed. Topics covered include identification and authentication, access control, security models, and issues related to operating system integrity. Practical aspects of security and assurance are addressed relative to Unix, Windows NT, and approaches to security evaluation. Distributed systems security is considered from the perspective of the World Wide Web and the Internet in terms of TCP/IP security. Multi-level security in databases relative to concurrency control and object-oriented systems is explored.

Masson 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

600.648 Secure Software Engineering

This course examines best practices for designing secure systems, with particular emphasize on software engineering. We review various criteria for designing secure sys-

tems and apply those principles to real systems. Students will be exposed to various techniques for analyzing system properties and for verifying program correctness, and will be expected to use that knowledge in examining existing protocols. Topics to be covered include the limits of techniques for software protection, such as code obfuscation, tamper-proofing and water-marking, analysis of software based attacks (and defenses), timing attacks and leakage of information, type safety, and capability systems. A course project is required.

Monrose 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, espe-

cially 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.

Lacey 3 credits

Elective Policy Courses

680.711 Data Privacy and International Public Policy in the Internet Age

In the Internet age, data information flows have changed dramatically, and existing public policies toward personal data privacy have been rendered, if not obsolete, certainly insufficient. This course examines the issues of government versus self-regulation of data privacy, as well as the global governance issues. The course examines the global initiatives that liberal democracies have taken to deal with the consequences of the Internet revolution in transborder data flows, as well as the regional ones, like the European Union Data Privacy Directive. Finally, the course explores the economic costs of these new personal data privacy initiatives, and to what extent they advance or retard development of an e-economy.

Staff 3 credits

680.751 International Governance of New Technologies

This course will focus primarily on information technology and biotechnology as areas of rapid technological change that pose challenges to existing international governance institutions. It will establish a conceptual basis for under-

standing problems of international regulation (e.g., when formal mechanisms are required and when private sector self-regulation is preferable). It will also pay special attention to institutional design questions for new governance mechanisms in areas like Internet domain name allocation and safety testing for agricultural and human biotechnology.
Fukuyama 3 credits

480.627 Digital Security, Privacy, and Civil Liberties

This course focuses on digital security and the legal and social concerns raised by the efforts to combat them. Issues addressed include the need to maintain a balance for security in a networked world with the desire to protect the privacy of individuals. Consideration is given the new laws drafted to protect against digital threats in terms of whether such laws deliver effective countermeasures or is it necessary to rethink the ways in which the legal system tries to adapt to emerging technologies? The course also examines some of the most important digital threats and tools for ensuring privacy as well as the laws associated with them.
Doueihi 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 is 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

650.651 Health Information Privacy, Law, and Policy

This course pertains to issues relating to protecting health information privacy in the modern era. Theoretical and ethical discussions underlying health information privacy are covered. The primary focus of the course is to provide

a modern context through which privacy protections are debated, constructed, implemented, and enforced. The course attempts to instruct students on the legal, policy, and practical issues surrounding the protection of health information privacy. The major federal and state privacy laws and policies and how these laws and policies are implemented in the public and private sectors is considered.
Hodge 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 Act 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

306.655 Ethical Issues in Public Health

Lectures and small group discussions focus on ethical theory and current ethical issues in health policy, including informed consent; resource allocation, and the right to health; lifestyle and health; and control of health hazards. Student evaluation based on class participation and a paper evaluating ethical issues in the student's area of public health specialization.

Faden 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

Additional Policy Courses

480.628 Digital Rights Management: American and European Perspectives

This seminar will focus on Digital Right management strategies and technologies (Watermarking, Encryption, XrML, etc.) and the legal structures that are designed to support them. We will especially focus on the differences in the legal perspectives between the European Commission’s drafts and the proposed or existing American laws pertaining to the protection of digital copyright.
Doueih 3 credits

680.747 The Economic and Policy Implications of Global Electronic Commerce

Considers policymakers’ increasing use of the Internet and electronic commerce as tools for helping business to raise national competitiveness, and for improving overall economic well-being, and asks how these goals can be advanced by policy reforms. Discusses area where it is clear what should be done, and areas where policy directions are murky. Uses frameworks from economics to analyze these and other important policy questions.
Staff 3 credits

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 than 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 covered, 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 microprogramming, 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

600.444 Computer Networks

This course considers intrasystem communications issues in more depth than 600.333. 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. Prerequisite: 600.333 or general knowledge of computer architecture.

Monrose 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

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 between 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 Engineer-

ing 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 is 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 fun-

damental interdisciplinary principles of materials science including physics and chemistry, and also to expose students to the forefront 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 (Chair): 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.

Jonah Erlebacher, Associate 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.

Robert E. Green Jr., Theophilus Halley Smoot Professor of Engineering: 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.

Kalina Hristova, Associate Professor: biomolecular materials, mimetics of cellular membranes, 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: 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; spin effects in organic materials; 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, thermodynamics and kinetics of phase transformations, atomic level structures and polymorphs in metallic glasses, mechanical properties of amorphous and nanocrystalline metals, structural materials for microelectromechanical systems, thin films and surface modification.

Hai-Quan Mao, Assistant Professor: polymeric materials for tissue engineering, polymeric scaffolds for adult stem cell expansion, liver tissue engineering, polymeric materials for drug and gene delivery, liver targeted gene delivery, complex coacervation; microencapsulation, synthesis and characterization of biodegradable polymers, polyphosphoesters.

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 (Vice Provost for Research): quantum electronics, solid state physics, polymers and conducting organic compounds.

Robert B. Pond Sr., Professor Emeritus: physical metallurgy, materials science, solidification, superplasticity, solid mechanics.

Peter C. Searson, Professor: synthesis and characterization of nonmaterial; electrochemistry; applications for nanotechnology in biology and medicine.

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: self-propagating exothermic reactions 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.

Michael (Seungju) Yu, Associate Professor: polymer chemistry, synthesis and application of protein-based materials, 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)

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)

D. Howard Fairbrother, Associate Professor (Chemistry): surface chemistry-synthesis, characterization and properties of amorphous carbonaceous thin films, atom reactions with organized thin film assemblies, environmental health and safety of carbon based 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.

Emanuel Horowitz, Professor (part-time): materials science, biomaterials, biocompatibility, metallo-organic compounds, polymers.

Joseph L. Katz, Professor (Chemical and Biomolecular Engineering): nucleation processes, formation of ceramic powders in flames, inhibiting scale formation, new proteomics tools.

Lynne Jones, Associate Professor (Orthopedic 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.

Edward P. Mueller, Lecturer (part-time); Consultant: biomaterials, surgical implants, anti-microbial materials.

Glenn Rahmoeller, Lecturer (part-time): applied ethics, use of utilitarian and deontological theories to analyze and solve controversial ethical issues confronting engineers.

Kathleen J. Stebe, Professor (Chemical and Biomolecular Engineering): surfactants, self-assembly, interfacial flows, dynamic surface tension, non-equilibrium interfaces.

David R. Veblen, Professor (Earth and Planetary Sciences): crystallography, transmission electron microscopy, X-ray diffraction, mineralogy.

Denis Wirtz, Professor (Chemical and Biomolecular Engineering): cell adhesion and migration, cell mechanics, cytoskeleton 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, whose impact on the scientific and engineering community 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. As our graduates develop their paths forward, it is our intent that they will:

- Recognize, understand, and further the evolving role that materials science and engineering plays in society.
- Pursue careers in materials science and engineering, or in fields that require an understanding of materials, using a broad, fundamental view of materials as well as a solid foundation in science and engineering.

- Engage in materials research and apply research methods in advancing a wide range of established and emerging technologies.
- Pursue graduate studies in materials and in related engineering fields or enter professional fields such as medicine or law.
- Communicate effectively in a range of technical and non-technical forums and engage productively in team-based efforts.
- Provide leadership and standards of ethical behavior in their professional roles that serve the scientific community, the engineering profession as well as broader segments of our society.

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. degree program in Materials Science and Engineering is accredited by the Accreditation Board for Engineering and Technology, Inc. (ABET). 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 adviser.

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 adviser. 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 or mathematical sciences, 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. On completion of the undergraduate studies, students majoring in materials science and engineering will:

- Be 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.
- Have acquired 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.
- Utilize modern scientific, engineering and computer tools to analyze problems in materials science and engineering.
- Identify important scientific and engineering problems related to materials, and then design systems and processes as well as perform relevant experiments and interpret data to aid the solution of these problems.
- Learn to work both independently and in teams.
- Have obtained 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.

- Be 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 with regard to contemporary issues.

Three B.S. degree tracks are offered by the Department of Materials Science and Engineering.

Traditional Track. The Traditional 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. The Biomaterials Track is intended for those students with a focused interest in biomaterials. To receive commendation for completion of the Biomaterials Track, the student must complete the following courses with grade of C or higher.

- 580.221 Molecules and Cells
- 510.407 Biomaterials II
- 510.431 Biocompatibility of Materials

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 to their department advisers. Students intending to follow the Biomaterials Track must complete a biomaterials-related senior design project.

Nanotechnology Track. The Nanotechnology Track is intended for those students with a focused interest in nanomaterials. To satisfy the requirements of the Nanotechnology Track, students must successfully:

- Complete a nanotechnology-related senior design project
- Complete 510.440 Micro- and Nanostructured Materials and Devices (or equivalent) with a grade of B or higher
- Complete two advanced materials electives with a grade of C or higher selected from the following list:
 - 510.457 Materials Science of Thin Films
 - 540.440 Chemical Engineering for Micro and Nanotechnology
 - 540.438 Interfacial Phenomena in Nanostructured Materials
 - 530.487 Introduction to Microelectromechanical Systems (MEMS)
 - 530.495 Microfabrication Laboratory

f. 171.405 Introduction to Condensed Matter Physics

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 to their department advisers.

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).

Biomaterials Track

Biomaterials is an exciting and rapidly developing field at the multidisciplinary interface of materials science, engineering, biology, chemistry and medicine. Our unique biomaterials program is designed to provide a broad educational basis with emphasis on principles and applications of biomaterials. 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.

Biomaterials is 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, and 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. 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.

Nanotechnology Track

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 engi-

neering, 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 isn't just 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.

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, a curriculum designed to train students in the fundamental interdisciplinary principles of materials science including physics and chemistry, and also to expose students to cutting edge nanomaterials research, both in elective classes and in research laboratories. Students in the Nanotechnology Track will be well-prepared for successful careers in materials engineering across a wide range of disciplines.

Successful completion of the Nanotechnology Track will be noted on the student's transcript.

Detailed description of the B.S. program (course credits in parenthesis)

Materials Science (42 credits)

• Ten core courses:

- 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

- (3 ea., 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 adviser). 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 (25 credits)

- 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)
- 030.105-106 Intro Chemistry Lab (1 ea.)
- 030.102 Intro Chemistry II (3)
- 030.205 Organic Chemistry I
- 030.225 Organic Chemistry Lab (3)

* Students may take 510.101 Introduction to Materials Chemistry or 030.101 Introductory Chemistry I to fulfill the Intro. Chem. I. requirement.

Mathematics or Mathematical Sciences (20 credits)

- 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):

- 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.

Students must complete one of the following courses (3):

- 600.107 Intro to Programming in Java
- 600.109 Intro to Programming in C/C++
- 600.120 Intermediate Programming
- 500.200 Computing for Engineers and Scientists
- 530.106 Computing in Mechanical Engineering

Humanities and Social Sciences (18 credits)

- 18 credits of (H) or (S) electives

Science and Engineering Electives (6 credits)

- One course of upper-level engineering, natural sciences or mathematics
- One course of unrestricted engineering, natural sciences or mathematics
- Upper level is 300 or higher

Unrestricted Electives (6 credits)

- 6 credits of electives

Sample Undergraduate Programs for Materials Science and Engineering: Traditional 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	<u>3</u>
Total	16

Spring

030.102 Intro. Chem. II	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	<u>3</u>
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	<u>4</u>
Total	18

Spring

510.313 Mechanical Properties of Materials	3
510.314 Electronic Properties of Materials	3
110.201 Linear Algebra	4
600.109 Intro. to Programming in C/C++	3
H/SS elective	<u>3</u>
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
530.201 Statics and Mechanics of Materials	4
H/SS elective	<u>3</u>
Total	16

Spring

510.315 Physical Chemistry of Materials. II: Kinetics and Phase Transformations	3
510.429 Materials Science Lab II	3
110.302 Differential Equations	4
H/SS Elective	3
Math/Sci/Eng elective	<u>3</u>
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/SS Elective	<u>3</u>
Total	15

Spring

510.434 Senior Design II	3
510.4xx MSE elective	3
510.4xx MSE elective	3
H/SS elective	3
H/SS elective	<u>3</u>
Total	<u>15</u>

Grand Total**128**

* Students may take 510.101 Introduction to Materials Chemistry or 030.101 Introductory Chemistry I to fulfill the Intro. Chem. I 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	<u>1</u>
Unrestricted Elective	
Total	16

Spring

030.102 Intro. Chem. II	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
510.104 Introductory Lectures in Biomaterials	<u>3</u>
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/SS Elective	<u>3</u>
Total	17

Spring

510.313 Mechanical Properties of Materials	3
510.314 Electronic Properties of Materials	3
110.201 Linear Algebra	4
600.109 Intro. to Programming in C/C++	3
H/SS elective	<u>3</u>
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/SS elective	<u>3</u>
Total	16

Spring

510.315 Physical Chemistry of Materials II: Kinetics and Phase Transformations	3
510.429 Materials Science Lab II	3
510.407 Biomaterials II	3
110.302 Differential Equations	4
H/SS Elective	<u>3</u>
Total	16

• **Year 4**

Fall

510.433 Senior Design I	3
510.4xx MSE elective	3
510.4xx MSE elective	3
H/SS Elective	3
530.201 Statics and Mechanics of Materials	<u>4</u>
Total	16

Spring

510.434 Senior Design II	3
510.431 Biocompatibility of Materials	3
Math/Sci/Eng elective	3
H/SS elective	3
Unrestricted Elective	<u>3</u>
Total	<u>15</u>

Grand Total 128

* Students may take 510.101 Introduction to Materials Chemistry or 030.101 Introductory Chemistry I to fulfill the Intro. Chem. I 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 employ 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 a thesis, 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 advisers 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 Engineering and Applied Science Program for Professionals (EPP) 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 EPP Office, (410) 516-8728 or www.epp.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 encour-

aged 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 adviser, 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 advisers. 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 adviser. Students who are entering the Ph.D. program will be advised by their research adviser. Students with a research adviser in another department will be assigned an academic adviser from among the full-time faculty in the department. Student progress will be assessed regularly by the faculty adviser(s) and the Graduate Program Committee. Students are expected to remain in regular communication with their faculty adviser(s).

Each student's progress will be reviewed annually by the Graduate Program Committee, in consultation with the student's adviser(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 adviser(s) and filed with the Graduate Program Committee each year. The department must be satisfied 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 thesis (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 adviser 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 EPP program.
 - Up to two of the elective courses can be business courses.
 - Any elective taken from outside the department (including EPP 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.
- A grade of C or better must be achieved in each course to obtain credit.
- An overall grade point average of 3.0 or higher 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 Department of Materials Science and Engineering Seminar.
- A master's essay or journal publication is required. For the journal publication a student must submit to the Graduate Program Committee an article describing his or her 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 adviser 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 EPP program.
 - Up to two of the elective courses can be business courses.
 - 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.
 - Any elective taken from outside the department (including EPP 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.
- An overall grade point average of 3.0 or higher 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 Department of Materials Science and Engineering Seminar.

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

The degree of doctor of philosophy (Ph.D.) is awarded subject to the recommendation of the student's adviser and departmental approval, based on satisfactory completion of the following requirements:

- Six core courses in materials science and engineering:
 - 510.601 Structures of Materials
 - 510.602 Thermodynamics of Materials
 - 510.603 Phase Transformations in Materials
 - 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 (600-level or higher) courses in materials science and engineering or related fields.
- Students who have completed other graduate-level course work may petition the graduate program committee to waive up to two core courses (510.601-606) and up to two elective courses. Written requests for such waivers must be received by the graduate committee by the end of the first semester of matriculation. This request must include a description of the course, a course syllabus, and documentation of the grade received.
- In some cases, an adviser may require a student to complete additional course work.
- A comprehensive oral exam covering the areas of structure, thermodynamics, and phase transformations of materials, and the student's choice of one of the following areas: chemical and biological properties of materials; mechanical properties of materials; electrical, optical, and magnetic properties of materials. This exam is offered semiannually and may be taken prior to

or during the student's second year. The examining committee will be composed of three tenured and/or tenure track departmental faculty members. The student will have two opportunities to pass within a one year period. Failure to pass the exam upon two attempts will ordinarily result in dismissal from the program.

- An oral presentation of a dissertation proposal at a department seminar held before the end of the student's third year. A written version of the dissertation proposal must be presented to a three-member faculty committee two weeks prior to the oral presentation. One member of the committee shall be the faculty adviser; the other two members shall be selected in consultation with the faculty adviser. A brief closed discussion session between the student, adviser, and the other members of the faculty committee shall follow the presentation; additional private discussions may be required by one or more of the committee members.
- The completion of an original research project. Candidates must write a dissertation describing their work in detail. A public defense of the thesis before a committee of five faculty members (chosen by the Graduate Program Committee, with at least three members being from outside the department) is required, and will be followed by a closed final graduate board examination with the committee. Approval of the thesis will be by majority vote of the committee. The thesis

defense/oral examination must be scheduled for a date two months prior to any personal or university deadline for graduation (e.g. the start date for a job). A complete draft of the dissertation must be presented to all of the committee members no later than two weeks before the defense. The dissertation in its final form must be read and signed by two members of the committee (the adviser and one other member).

- Only courses for which the student has received a grade of B- or better will be counted towards completion of course requirements. If a grade of C+ or lower is received, the student must repeat the course and achieve a grade of B- or better. Receipt of a letter grade of C+ or lower in two courses will normally be cause for dismissal from the program.

An overall grade point average of 3.0 must be maintained. Failure to maintain a 3.0 GPA will normally result in dismissal from the program.

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).

Katz 3 credits fall

510.104 (E,N) Introductory Lectures in Biomaterials

This course provides an introductory overview of the selection and use of materials in biological systems. During the first hour of each class period, a guest lecturer will discuss his area of expertise in the field of biomaterials.

The lectures are of an introductory nature suitable for the nonspecialist and are open to freshmen. Topics to be included are selected from the areas of design of special materials for use in biological systems, the use of materials in biological systems, and the study of the properties of natural biological materials. The second hour is used for open discussion with the guest lecturer and the instructor on the specific topic for the day.

Horowitz, Mueller 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 many 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 electronic paper, 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.

Spicer 3 credits spring

510.204 (S, W) Engineering Ethics

The course is built around actual case studies, supplemented by materials dealing with engineering professionalism, codes of ethics, and ethics philosophy. Students will learn professional responsibility, and how to design ethical responses within an organizational structure where one must balance career needs, legal and regulatory concerns, financial demands, and ambiguous and incomplete information. Case studies will be chosen to illustrate different kinds of ethical problems within different branches of engineering and different kinds of circumstances. These studies will be used to compare and contrast issues such as the choices and constraints faced by decision makers.

Rahmoeller 3 credits spring

Intermediate

The six course series, 510.311-316, 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.

Hristova 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.

Mao 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.

Hufnagel 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.

Ma 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.

Cammarata 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.

Yu 3 credits fall

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.

Spicer 3 credits

510.405 (E,N) Materials Physics

An overview of the principles of solid-state physics as they apply to engineering materials with an emphasis on nano-materials. Topics include a study of physical phenomena in solids (such as thermal and electrical conductivity, thermal expansion, and elasticity) and their anisotropy in crystalline solids. Also covered are the fundamentals of quantum mechanics for an understanding of the properties of nanometer-scale electronic and optoelectronic materials structures.

Spicer 3 credits

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

510.422 (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.

Erlebacher 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

510.428 (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 electron 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.

Weihls 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 techniques. 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.

Katz 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.

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.

Horowitz 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 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.

Hristova 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 research results. Prerequisites: 510.311-312, 510.428-429, 510.433.

Hristova 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

360.404/644 (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.

Hufnagel 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 multi-component 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.

Cammarata 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, coarsening, glass transition. Prerequisites: 510.601 and 510.602 or permission of instructor.

Erlebacher 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.

Weihls 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 processes. 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.

Spicer 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.

Yu 3 hours fall

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

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

510.617 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

510.619 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 Amorphous and Nanocrystalline Metals

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

510.624 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

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

510.622 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

510.650 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

510.653 Advanced Statistical Thermodynamics

This course covers the advanced topics beyond those in the conventional thermodynamics and statistical thermodynamics. Topics include field theory, renormalization group, dynamic scaling, finite size effects, and non-equilibrium thermodynamics. Computation and its role in these topics are also covered. The applications of various theoretical methods and ideas in materials science and engineering are explored.

Staff 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.

Weihls 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 reaction rates and thermodynamics of irreversible processes developed generally and applied

to the chemical kinetics and diffusion, theory of nucleation (Volmer-Weber, Becker-Düring, Fisher-Turnbull), theory of growth (including instabilities during growth), Johnson-Mehl-Avrami kinetics of phase transformations, Lifshitz-Slyozov-Wagner kinetics of coarsening, spinodal decomposition. Prerequisite: 510.312 or 510.602 (or similar course covering thermodynamics).

Cammarata 3 hours

510.703 Great Papers in Materials Science

Classic papers in different disciplines of materials science are critically read with a goal of tracing intellectual and scientific progress, and relating such progress to modern developments. Students are required to read papers and develop presentations based on the paper's content.

Erlebacher, Cammarata 1 hour

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 2 hours

510.739-740 Research Group Seminar

Topics in advanced areas of interest to particular research groups. The seminar covers various topics in these fields, including a review of the current literature. Prerequisite: permission of instructor.

Searson 1 hour

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. Both programs are accredited by ABET, the Accreditation Board for Engineering and Technology. 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 three main stems of the undergraduate curriculum—thermal and fluid systems, mechanics and materials, and robotics and control systems. 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, etc., 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 potentials. 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

Ilene Busch-Vishniac, Professor: new materials for electromechanical sensors and actuators, noise control, and microautomation engineering education.

Shiyi Chen, Professor: computational fluid dynamics, statistical theory and computation of fluid turbulence, mesoscopic physics and lattice Boltzmann computational methods, multiphase flows and boiling.

Gregory S. Chirikjian, Professor (Chair): design, kinematics, motion planning dynamics and control of mechanisms, and robots, computational aspects of nanotechnology and conformational analysis of biological macromolecules.

Noah J. Cowan, Assistant Professor: sensor-based control in robotics and biological systems, biomechanics of locomotion, biologically-inspired robotics.

Andrew S. Douglas, Professor (Associate Dean for Academic Affairs, Whiting School of Engineering): dynamic fracture of ductile materials, mechanics of active materials, mechanics of soft tissue.

Kevin J. Hemker, Professor (Chair): understanding and predicting mechanical performance by correlating microsample tensile testing with transmission electron microscopy in order to identify the fundamental processes controlling deformation in advanced structural materials, thermal barrier coatings, MEMS, and nanocrystalline materials. Employing high resolution and analytical electron microscopy to characterize and study nanostructured materials and dislocation core geometries.

Cila Herman, Professor: experimental heat transfer and fluid mechanics, optical measurement techniques (holographic interferometry) applied to heat transfer measurements, heat transfer enhancement, boiling in microgravity and under the influence of electric fields, cooling of electronic equipment, thermoacoustic refrigeration, MEMS, heat transfer in oscillating flows, heat exchangers. Experimental visualization of temperature fields and study of heat transfer enhancement in oscillatory flow in a grooved channel.

Joseph Katz, Professor, Whiting School Mechanical Engineering Chaired Professor: experimental fluid mechanics, quantitative visualization of complex flows, turbomachines, breaking waves, bubbly and cavitating flows, stratified shear flows and oceanographic flows, development of advanced diagnostic techniques, PIV, holography for laboratory and field application. Statistical geometry of subgrid-scale stresses determined

from holographic particle image velocimetry measurements.

Omar M. Knio, Professor: computational fluid mechanics, reacting shear flows, physical acoustics, atmospheric and oceanic flows, energetic materials, microfluids, uncertainty quantification.

Charles Meneveau, Professor, Louis M. Sardella Chair in Mechanical Engineering: experimental, numerical, and theoretical studies in turbulence; subgrid scale modeling and large-eddy simulation; fractals; application of novel data analysis techniques to shed new light on the longstanding turbulence problem; development of improved models for engineering applications.

Allison M. Okamura, Associate Professor: virtual and teleoperated environments: haptic interfaces, tactile and force feedback, virtual fixtures, medical robotics, surgical simulation, educational applications. Robotic fingers and hands: dexterous manipulation, tactile sensing, haptic exploration, object modeling.

Andrea Prosperetti, Professor, Charles A. Miller Jr. Chair in Mechanical Engineering: theoretical and computational fluid mechanics and acoustics; multiphase flow; gas and vapor bubble acoustics; microfluidic systems.

K. T. Ramesh, Professor: Director of Center for Advanced Metallic and Ceramic Systems: nanostructured materials, nanomechanics, high strain rate behavior and dynamic failure of materials, impact problems, fragmentation, instabilities in materials, planetary impact problems; impact injury biomechanics, tissue dynamics, mechanics of transcription.

William N. Sharpe Jr., Professor, Alonzo Decker Chair in Mechanical Engineering: experimental solid mechanics; testing of small specimens; mechanical properties of MEMS materials.

Lester K. Su, Assistant Professor: experimental fluid mechanics, turbulent mixing and combustion, combustion systems, laser diagnostics, interaction of experiments and simulations, spray and droplet dynamics.

Sean Sun, Assistant Professor: theoretical biophysics, mechanics of molecular motors, statistical mechanics of liquids, quantum dynamics in complex systems.

Jeff Tza-Huei Wang, Assistant Professor: BioMEMS; microfluidics; micro total analysis system (μ -TAS); nanofabrication and microfabrication; experimental molecular dynamics; single molecule manipulation and detection; ultrasensitive molecular sensing basing on

confocal microscopy, fluorescence resonance energy transfer (FRET), and fluorescence correlation spectroscopy (FCS).

Louis L. Whitcomb, Professor: nonlinear dynamical systems, design, and model-based control of mechanical systems. Focus areas of robot control: underwater robotics vehicles, robot arms, and medical robotics; adaptive force control of position/velocity controlled robots: theory and experiment. Adaptive identification of dynamically positioned underwater robotic vehicles.

Joint, Part-Time, and Research Appointments

Juan I. Arvelo Jr., Assistant Research Professor (Applied Physics Laboratory).

Stephen Belkoff, Associate Professor (Orthopedic Surgery): biomechanics or orthopaedic implant, fracture fixation in osteoporotic bone, mechanism of injury, vertebroplasty.

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, nonindentation testing, stresses in thin films, novel electrochemical deposition methods, computer simulations.

Andrew F. Conn, Senior Lecturer (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.

Edwin Fitzgerald, Doctor of the University.

Gregory D. Hager, Professor (Computer Science): vision, robotics, human-machine systems, computer-assisted surgery.

Robert Ivester, Adjunct Associate Professor.

Robert H. Kraichnan, Homewood Professor (Los Alamos National Laboratories).

Hasan N. Oguz, Associate Research Professor: fluid mechanics.

Thomas Osborn, Professor (Earth and Planetary Sciences): physical oceanography.

- Marc B. Parlange**, Professor (Geography and Environmental Engineering): hydrology, environmental fluid mechanics, engineering.
- Aleksander S. Popel**, Professor (Biomedical Engineering): physiological flows and transport, microcirculation, cell mechanics.
- Yue-Hong Qian**, Adjunct Associate Professor, Mechanical Engineering (Princeton University).
- Mark Robbins**, Professor (Physics and Astronomy): nanomechanics, molecular origins of macroscopic mechanical behavior, especially friction, adhesion, and yield.
- Jack C. Roberts**, Research Professor (Applied Physics Laboratory): advanced composite materials.
- Kathleen Stebe**, Professor (Chemical and Biomolecular Engineering): transport phenomena at interfaces, Marangoni effects, dynamic surface tension, fluid particle behavior, adsorption of surfactants and proteins, electroporation, vesicle mechanics.
- Daniel J. Stilwell**, Adjunct Assistant Professor (Virginia Polytechnic Institute and State University): autonomous robotic systems, nonlinear control theory.
- Daniel Stoianovici**, Associate Professor (Brady Urological Institute): medical robotics.
- Russell H. Taylor**, Professor (Computer Science): medical robotics, computer-assisted surgery.
- Natish V. Thakor**, Professor (Biomedical Engineering): medical instrumentation and medical micro and nanotechnologies, neurological instrumentation, signal processing, computer applications .
- Rene Vidal**, Assistant 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).
- Liming Voo**, Associate Research Professor (Applied Physics Laboratory).
- Timothy Weihs**, Associate Professor (Materials Science and Engineering): 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.
- Dennis Wickenden**, Research Professor (Applied Physics Laboratory).
- Thomas Wright**, Adjunct Research Professor: theoretical solid mechanics, wave propagation, dynamic failure, adiabatic shear localization, instabilities.
- Shujia Zhou**, Associate Adjunct Professor.

Facilities

Most teaching and research facilities of the department, as well as the departmental office, are located in Latrobe Hall. 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 microscale up to the macroscale. A large hydrodynamics laboratory is the home of several laser-based flow visualization setups, 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 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 haptic exploration laboratory is equipped with teleoperated robots, robotic manipulators, and haptic (force and tactile feedback) devices for research in the areas of medical robotics, virtual environments, rehabilitation, and prosthetics. 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 supplementary teaching assistantships. Applications for graduate study received by December 15 are given preference in financial aid decisions.

Research assistantships are available to 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 programs, including updated scheduling and course offerings, please consult the undergraduate advising manuals which are available from the department office in Latrobe Hall and on the departmental Web site at www.me.jhu.edu. For details and an explanation of ABET requirements, see their Web site at www.abet.org.

Requirements for the Bachelor's Degree

See also General Requirements for Departmental Majors, page 47; Writing Requirement, page 43; 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 competence 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 adviser. 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, and robotics. The choice of concentration is decided in the junior year after consultation with the student's faculty adviser.

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. In these endeavors, they will:

- Apply and cultivate their understanding and mastery of the fundamental scientific, engineering, and professional principles at the foundation of mechanical engineering.
- Apply advanced mathematical, computational and experimental techniques to respond to demands of advanced technology, economy, and efficiency that put an ever-increasing premium on the quantitative aspects of engineering.
- Contribute to society as broadly educated, articulate, and ethical citizens, who are at ease in multidisciplinary teams.
- Strive to continually update and renew their knowledge throughout their careers, to excel in a rapidly changing world.

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 or D+ not accepted)

- 110.108 Calculus I
- 110.109 Calculus II
- 110.202 Calculus III (or 110.211 Honors Multivariable Calculus and Linear Algebra or 110.201 Linear Algebra [Fall Semester])
- 550.291 Linear Algebra/Differential Equations (or 110.212 Honors Multivariable Calculus and Linear Algebra or 110.302 Differential Equations [Spring Semester])
- 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 or D+ 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 (21 credits)

Seven humanities and/or social science electives (designated H or S in this catalog); of which one must specifically teach writing (either 500.211

Technical Communications, 060.113 Expository Writing, 220.105 Introduction to Fiction and Poetry Writing, or another course as approved by the student's adviser) and one must be in economics. To obtain coherence and depth in these humanities and social science electives, at least six credits must be at the 300-level or higher. For examples of areas of concentration and more details, see the academic advising manual and the website at www.me.jhu.edu.

Required Engineering Courses (47 credits; grades of D or D+ 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 (which can be used as a Technical Elective) 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
- 530.454 Manufacturing Engineering
- 530.461 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 or D+ not accepted)

- 530.403/404 Engineering Design Project I/II

Mechanical Engineering Electives (9 credits; grades of D or D+ not accepted)

Three courses (300-level or higher) in mechanical engineering

Technical Electives (9 credits; grades of D or D+ 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 adviser. 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 adviser.

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 ME 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 Concentration 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):

- 530.418 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 this concentration include:

- 171.118 Stars and the Universe
- 520.214 Signals and Systems
- 530.328 Fluid Mechanics II
- 520.401 Basic Communications
- 525.445 Modern Navigation Systems

Students may not use the satisfactory/unsatisfactory option for required courses, including (H) and (S), unless approved by their faculty adviser. Further, the Department of Mechanical Engineering required that grades of C- or better be obtained in all required Engineering, Mathematics, and Science courses (i.e. grades of D or D+ will not be accepted). The department will accept D grades only up to a maximum of 10 credit hours except where indicated.

Sample Program:

• Year 1

<i>Fall</i>	
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 MechE Freshman Lab I	1
H/S Elective	<u>3</u>
Subtotal	15
<i>Spring</i>	
110.109 Calculus II	4
530.102 Freshman Experiences in Mechanical Engineering II	2
530.104 Intro to Mechanics II	2
530.106 MechE Freshman Lab II	1
H/S Elective: Microeconomics or Macroeconomics	3
H/S Elective	<u>3</u>
Subtotal	15

• Year 2

<i>Fall</i>	
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	<u>1</u>
Subtotal	17
<i>Spring</i>	
550.291 Linear Algebra/Differential Equations	4
530.202 Dynamics	3+1
530.215 Mechanics-Based Design	3+1
530.241 Electronics and Instrumentation	<u>3+1</u>
Subtotal	16

• Year 3

<i>Fall</i>	
530.327 Intro Fluid Mechanics	3+1
530.352 Materials Selection	3+1
H/S Writing Elective	3
H/S Elective	3
Statistics Elective	<u>3</u>
Subtotal	17

<i>Spring</i>	
530.334 Heat Transfer	3+1
530.343 Design and Analysis of Dynamic Systems	3+1
Mechanical Engineering Elective	3
Technical Elective	<u>3</u>
Subtotal	14
• Year 4	
<i>Fall</i>	
530.403 Engineering Design Project I	4
530.454 Manufacturing Engineering	3
530.461 Engineering Business and Management	3
Technical Elective	3
H/S Elective	<u>3</u>
Subtotal	16
<i>Spring</i>	
530.404 Engineering Design Project II	4
Mechanical Engineering Elective	3
Mechanical Engineering Elective	3
Technical Elective	3
H/S Elective	<u>3</u>
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. In these endeavors, they will:

- Apply and cultivate their understanding and mastery of the fundamental scientific, engineering,

and professional principles at the foundation of mechanics,

- Apply advanced mathematical, computational and experimental techniques to respond to demands of advanced technology, economy, and efficiency that put an ever-increasing premium on the quantitative aspects of engineering,
- Contribute to society as broadly educated, articulate, and ethical citizens, who are at ease in cross-disciplinary and multidisciplinary teams, and
- Strive to continually update and renew their knowledge throughout their careers, to excel in a rapidly changing world.

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 adviser.

**Mathematics with a focus on applications
(23 credits; grades of D or D+ not accepted)**

- 110.108 Calculus I
- 110.109 Calculus II
- 110.202 Calculus III, (or 110.211 Honors Multivariable Calculus and Linear Algebra, or 110.201 Linear Algebra [semester one])
- 550.291 Linear Algebra/Differential Equations, (or 110.212 Honors Multivariable Calculus and Linear Algebra, 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)

**Mathematics with a focus on fundamentals
(23 credits; grades of D or D+ not accepted)**

- 110.108 Calculus I
- 110.109 Calculus II
- 110.211-212 Honors Multivariable Calculus and Linear Algebra
- 110.302 Differential Equations with Applications
- 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 or D+ not accepted)

- 530.103/104 Introduction to Mechanics I/II and 530.105/106 Mechanical Engineering Freshmen Laboratory 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 500.211 Technical Communications, 060.113 Expository Writing, 220.105 Introduction to Fiction and Poetry Writing, or another course as approved by the student's advisor) and one must be in economics. 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 or D+ not accepted)

Introductory course(s) in computing: 530.101/102 Freshman Experiences in Mechanical Engineering I and II and 530.105/106 Mechanical Engineering Freshmen Laboratory I/II (recommended), or another computing course if a different introductory engineering course is taken.

Introductory course for freshmen: students must choose one of the following (*=strongly recommended, **=recommended):

- 530.101/102 Freshman Experiences in Mechanical Engineering I and II (combines introductory course in computing and an overview of Mechanical Engineering)*
- 510.102 Materials and their Influence on Technology*
- 520.137 Introduction to Electrical and Computer Engineering
- 500.101 Introduction to Engineering**
- 570.108 Introduction to Environmental Engineering
- 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 or D+ not accepted)

- 530.403/404 Engineering Design Project I/II

Engineering Science Electives (12 credits; grades of D or D+ 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 or D+ 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 or D+ not accepted))

A minimum of four (E), (Q), or (N) courses at or above the 300-level, chosen in consultation with the student's adviser 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 adviser. 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
- 570.301 Environmental Engineering I:
Fundamentals
- 580.460 Physiological Fluid Mechanics
- 580.461 Biological Transport

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
- 530.416 Advanced Design
- 530.730 Finite Element Methods
- 560.301 Theory of Structures
- 560.302 Structural Analysis and Design
- 560.455 Structural Mechanics
- 580.450 Mechanics of Living Tissue

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 adviser. The department will accept 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 adviser.

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 adviser, 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 adviser.

Example bio-oriented courses which can be applied to the above three categories include (but are not limited to):

020.386 Macromolecular Machines	
250.353 Biomolecular Dynamics and Ensembles	
510.420 Topics in Biomaterials Science	
530.440 Computational Mechanics of Biological Macromolecules	
530.445 Introductory Biomechanics	
530.495 Microfabrication Laboratory	
540.409 Modeling Dynamics and Control for Chemical and Biological Systems	
550.435 Bioinformatics and Statistical Genetics	
580.455 Introduction to Orthopaedic Biomechanics	
580.460 Physiological Fluid Mechanics	
600.439 Principles of Computational Biology	
530.571 Statistical Mechanics in Biological Systems	

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 towards this end.

Sample Program:

• Year 1

<i>Fall</i>	
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	<u>3</u>
Subtotal	16
<i>Spring</i>	
110.109 Calculus II	4
Intro to Computing Elective or Intro to Engineering Elective and Lab II	3
H/S Elective (2): Microeconomics or Macroeconomics	3
H/S Elective (3) (writing)	<u>3</u>
Subtotal	13

• Year 2

<i>Fall</i>	
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	<u>1</u>
Subtotal	17
<i>Spring</i>	
550.291 Linear Algebra/Differential Equations	4
530.202 Dynamics	3+1
530.215 Mechanics-Based Design	3+1
Technical Elective (1)	<u>4</u>
Subtotal	16

• Year 3

<i>Fall</i>	
530.327 Intro Fluid Mechanics	3+1
Engineering Mechanics elective (solids)	3+1
Technical Elective (2)	4
Statistics Elective	<u>3</u>
Subtotal	15
<i>Spring</i>	
Engineering Mechanics elective (fluids)	3+1
Engineering Mechanics elective (solids/fluids)	3+1
Technical Elective	3
Mathematics Elective	3
H/S Elective (4)	<u>3</u>
Subtotal	17

• Year 4

<i>Fall</i>	
530.403 Engineering Design Project I	4
Engineering Mechanics elective	3
Engineering Mechanics elective (materials/dynamics)	3
H/S Elective (5)	<u>3</u>
Subtotal	16
<i>Spring</i>	
530.404 Engineering Design Project II	4
Technical Elective (4)	4
Technical Elective (5)	4
H/S Elective (6)	<u>3</u>
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. While the department still strongly prefers applications to be received by the end of the fall semester of the junior year, the department will consider applications received later.

To apply for admission, the student must submit an application. In addition, the student will need to present a statement of purpose and college transcripts.

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 have a good chance of obtaining the advanced degree in a reasonable time. No academic degree is required, but the applicant should have at least two years of good 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 adviser to help him/her to map out 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 adviser. The adviser 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 adviser in successive years. After serious research for a dissertation has begun, the research supervisor will automatically function as adviser.

Requirements for the M.S.E. Degree

For the master of science in engineering degree at least eight one-semester courses are required. At least half of them should be selected among those listed as *graduate courses* in this catalog. 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 adviser.

A non-thesis 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. 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 adviser.

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 an 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 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 adviser.

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 pass a final oral examination which is essentially a defense of the dissertation.

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. Co-requisites 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. Co-requisites are 530.101/102 and 530.105/106 (laboratory). Okamura 2 credits each semester/offered yearly

530.105/106 (E) Mechanical Engineering Freshman Laboratory I and II

Hands-on laboratory complementing 530.101/102 and 530.103/104, 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. Co-requisites are 530.101/102 and 530.103/104. Okamura 1 credit each semester/offered yearly

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 permission of instructor.

Staff 4 credits (3 hours lecture, 1 hour lab) fall

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.

Ramesh 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. Prerequisites: 110.109, 171.102.

Meneveau or 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 and II, Linear Algebra, Differential Equations.

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 560.202.

Su 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

Conduction in one, two, and three dimensions. External and internal forced convection, convection with change in phase. Performance and design of heat exchangers. Black-body radiation, Stefan-Boltzmann law. Computational modeling and experimental study of selected topics in conduction, convection, and radiation. Prerequisites: 530.231, 530.327.

Herman 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.

Staff 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.

Staff 8 credits academic year

530.405 (E) Mechanics of Solids and Structures

Continuum mechanics provides a rigorous basis to the study of deformable solids and fluids. Review of vector calculus and tensor analysis. Kinematics of a body. Stress. Conservation laws. Constitutive equations for solids and fluids. Linear elasticity. Energy methods and foundations of the finite element method. Prerequisites: 110.201, 550.291 or 110.212, 530.215 or 560.206 or permission of the instructor.

Staff 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. Preferably linear algebra also.

Sun 3 credits

530.414 (E) Computer-Aided Design

This course attempts to integrate the concepts developed in 530.215 with the use of the computer as a design tool. The topics covered include the design of mechanical systems. Extensive use is made of computer-aided design software, including object modeling, system assembly, and mechanism solution procedures. Computer-aided drafting and dimensioning. Prerequisite: 530.215.

Stoianovici 3 credits

530.416 (E) Advanced Mechanical Design

A continuation of 530.215 expanding on topics such as fatigue, fracture, and various mechanical components and including linkage systems and cams. Student teams will be assigned different experimental or computational projects. Three lectures per week initially and then two per week during project work. Prerequisite: 530.215.

Sharpe 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, 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

Mechatronics is the synergistic integration of mechanism, electronics, and computer control to achieve a functional system. This interdisciplinary course includes lectures, lab assignments and projects that teach the student to design and build mechatronic devices, building upon the themes of 530.420 Robot Sensors and Actuators. We expand on the topics of mechanism design, motors and sensors, interfacing and programming microprocessors, mechanics prototyping, and creativity in the design process. Course labs and projects are performed in small student groups. Each group develops a microprocessor-controlled electro-mechanical device, such as a mobile robot or art-making machine. Project topics vary from year to year. 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.

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 3 credits spring/odd years

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/odd 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

530.445 (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

530.449 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. Assignments will include laboratory and field measurements of acoustic phenomena.

Staff 3 credits

530.461 (E) Engineering Business and Management

An introduction to the business and management aspects of the engineering profession. The course will focus on the process of product definition and development, the structure and functioning of engineering organizations, project management, intellectual property protection, and the management of project teams.

Staff 3 credits fall

530.467 (E) Thermal Design Issues for Aerospace Systems

This course deals with processes, systems, instruments and equipment for aerospace systems. Issues of energy conver-

sion 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 of 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.

Guzman 3 credits spring

530.487 (E,N) Introduction to Microelectromechanical Systems (MEMS)

For engineering and science majors. 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. Prerequisite: senior or graduate standing or permission of instructor.

Staff 3 credits spring/odd years

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 adviser 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

530.601 Continuum Mechanics

An introduction to the foundations of continuum mechanics. Vectors and tensors; properties and basic operations. Kinematics of deformation; Eulerian and Lagrangian descriptions of motion. Stress in a continuum. Conservation laws; mass and momentum balance. Thermodynamics; energy balance and entropy. Constitutive equations; invariance under a change of observer and material symmetry. Fluids and solids; viscous and elastic response. The Navier-Stokes equations. Finite elasticity. Linear elasticity.

Staff 3 hours fall

530.602 Mechanics of Solids

An introduction to elasticity, plasticity, viscoelasticity, and fracture, using the mathematical tools developed in 530.601 Continuum Mechanics. Stress and equilibrium. Kinematics. Principle of virtual work. Constitutive relations: linear elasticity, plasticity, and viscoelasticity. Illustrative boundary value problems. Linear elastic fracture mechanics. Micromechanics of inelastic deformations. Prerequisite: 530.601 or permission of instructor.

Staff 3 hours spring

530.612 Computational Solid Mechanics

More than an introduction to the use of numerical methods in solid mechanics problems, this is a hands-on course where students will develop their own portfolio of finite element techniques. Topics covered include meshing techniques, error estimation and convergence, adaptive strategies, contact and friction, time integration, elastic and inelastic solids. Graduate students only.

Staff 3 hours spring

530.616 Introduction to Linear Systems

Prerequisite: undergrad courses in control systems and linear algebra. Permission of instructor required for undergrads. A beginning graduate course in linear, time-invariant systems. Topics include state-equation representations, input-output representations, response properties, controllability, observability, realization theory, stability, and linear feedback. Co-listed as 580.616.

Cowan, Vidal 4 hours spring.

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. Compressible flows. Introduction to non-Newtonian fluids.

Meneveau, Knio, Katz 3 hours fall/spring

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 differential equations are discussed. Heat transfer with a phase change, and contemporary conduction problems are discussed. In the second part of the course radiative properties 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 phenomenological basis of the constitutive models for energy and mass flux. Then, using the transport theorem, general conservation 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

530.634 Heat Transfer Processes in Living Tissue

The course introduces the fundamentals of bioheat transfer. Topics covered include mechanisms of heat transfer, conduction, convection and radiation; bioheat equation, analytical and numerical solutions; thermal therapies and cryopreservation; experimental methods; infrared thermometry; micro and nanoscale phenomena in bioheat transfer. Project. Background in heat transfer is necessary.

Herman 3 hours

530.635 Mixing and Combustion

Mixing of fluids, covering ideas from dynamical systems and mixing in turbulent flows. Combustion of gaseous and liquid fuels; chemistry, kinetics, deflagrations and detonations, premixed and non-premixed flames, effect of turbulence, spray and droplet combustion, combustion systems.

Su 3 hours

530.639 Scientific Computing

An introduction to the foundations of scientific computing. Monte Carlo simulation, molecular dynamics

simulation, fast Fourier transform and applications, optimization, sparse matrices, numerical methods for time dependent PDEs, parallel programming with message passing systems, data parallel programming, parallel libraries for numerical linear algebra, parallel programs for PDE problems, techniques for high performance scientific computation.

Chen 3 hours

530.640 Statistical Mechanics and Molecular Dynamics

This course introduces basic concepts of non-equilibrium statistical mechanics and molecular dynamics for engineers. Topics include Master Equation, Brownian motion, the Boltzmann equation, the hydrodynamic theory from statistical mechanics, the fluctuation and dissipation theorem, path integral, effective action, Monte Carlo method, and molecular dynamics simulation.

Chen 3 hours

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

530.645 Kinematics

A theoretical treatment of the geometry of motion of rigid bodies, mechanisms, and robotic manipulators. Topics include, but are not limited to, (1) parametrization of spherical motion, (2) forward and inverse kinematics of robotic manipulators.

Chirikjian 3 hours fall/even years

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.

Okamura, 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

530.648 Group Theory in Engineering Design

This course is a survey of group theory with an emphasis on applications in mechanical design research. In particular, the representation theory of finite groups, compact Lie groups, and certain noncompact unimodular groups is reviewed, and Fourier analysis on these groups

is applied as a tool in design problems. The concentration is on applications in CAD, discrete and computational geometry, and robotics. Specific applications include modern interpolation, deformation of solid models, and pattern matching.

Chirikjian 3 hours

530.650 Dynamics and Control of Marine Vehicles

Seminar on the dynamics, navigation, and control of marine vehicles. Topics include finite-dimensional approximate dynamical models, navigational techniques, and control methods for surface and underwater vehicles, and historical overview. Emphasis on underwater robotic vehicles.

Whitcomb 3 hours

530.651 Haptics for Teleoperation and Virtual Reality

Open to undergraduates with permission. Graduate-level introduction to the field of haptics, focusing on virtual environments that are displayed through the sense of touch. Topics covered include human haptic sensing and control, types of haptic interfaces (tactile and force), haptic rendering and modeling of virtual environments, and medical applications such as tele-surgery and surgical simulation. Course work includes homework, reading and discussion of research papers, presentations, and a final project. Appropriate for students in any engineering discipline with interest in virtual reality or computer integrated surgical systems.

Okamura 3 credits fall/even years

530.652 Bridging Length Scales in Materials Behavior

Addresses the tools needed to bridge the macroscopic, continuum, mesoscopic, microscopic, and atomic length scales that currently bound the physical theories and models that have been developed to describe materials behavior.

Hemker 3 hours

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, Lagrange, 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.

Staff 3 hours

530.659 Computational Methods of Engineering Mathematics

This graduate course covers the following topics in the context of mechanical engineering problems: linear algebra, systems of linear ordinary differential equations, Fourier analysis, Sturm Liouville Theory and Special Functions, curvilinear coordinate systems, stochastic models of classical mechanical systems, variational calculus.

Chirikjian, Eyink 4 hours fall

530.661 Applied Mathematics 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. Intended for students with the equivalent of four semesters of undergraduate mathematics typical of engineering programs.

Staff 3 hours spring

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 membrane and channels, theory of biological motors, computer simulation 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.

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 Sensor-Based Locomotion and Manipulation

Introduction to the mechanics of locomotion and manipulation. In this context students will learn topics such as Lagrangian and Hamiltonian mechanics, impacts, Poincaré analysis, nonholonomic mechanics, and friction. Prerequisite: graduate course in robotics, controls, or dynamical systems theory; or permission of instructor. Cowan 3 hours

530.687 Foundations of Computational Biology and Bioinformatics

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.

Sun, Bader 3 hours fall

530.688 Foundations of Computational Biology and Bioinformatics II

This course uses statistical mechanics and information theory to develop probabilistic models for biological data, with a primary focus on sequence data and graphical models. Topics will include probability theory, score matrices, hidden Markov models, suffix trees, phylogenetic inference, random graph theory, and network inference. 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 a language of choice, and students will have access to a linux cluster as a computational resource.

Sun, Bader 3 hours spring

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 non-linear optics, birefringence; optical fibers, data transmission, and networking.

Katz 3 hours

530.726 Hydrodynamic Stability

An investigation of the stability of fluid motions. Viscous and inviscid theory of linear stability; superposed fluids, shear flows, boundary layers, parallel flows. Initial-value problem. Absolute and convective instability. Nonlinear

stability theory; energy methods, multiple scales, and numerical investigations.

Prosperetti 3 hours

530.727 Experimental Methods in Fluids

Measurement techniques in fluid mechanics and their applications, limitations and uncertainty are examined. Velocity measurement techniques include 2-D and stereo Particle Image Velocimetry (PIV), holographic PIV with appropriate background in optics, laser, acoustic, and global Doppler Velocimetry, hot wire anemometry, and methods based on molecular tagging. Techniques for measurements of pressure, sound, and shear-stress include piezo-electric, piezo-resistive, and MEMS-based sensors.

Katz 3 hours fall

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.

Hemker, Douglas 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

530.754 Viscoelasticity

The linear theory of viscoelasticity is considered. The basic mathematical tools (e.g., Laplace transforms) are first introduced, and then integrated into a continuum mechanics-oriented description of the response of viscoelastic materials. Stress relaxation and creep phenomena are described; the complex moduli are developed, with specific reference to the physical mechanism associated with the frequency dependence of the properties. Techniques for measurement of linear viscoelastic properties

are discussed. Wave propagation in viscoelastic solids is examined. A number of initial-boundary value problems are solved to illustrate the theory.

Ramesh 3 hours

530.755 Readings at the Mechanics and Materials Interface

Selected articles on the general topic of plasticity and failure will be reviewed and discussed in an open class format. Papers from each discipline will be covered, and a serious attempt will be made to link the mechanics and materials approaches. The interplay between continuum-level mechanics and microstructural-level materials behavior will be explored and emphasized throughout the course. Examples of topics of interest include dislocation mechanisms and the form of plastic constitutive functions, void growth, and shear localization.

Hemker, Ramesh 2 hours

530.756 Advanced Analytical Electron Microscopy

This course will focus on the techniques used to perform analytical electron microscopy. Special emphasis will be placed on the novel experiments and techniques associated with the use of a Gatan Imaging Filter. The lectures will cover both the theory and practical aspects of energy loss spectroscopy and require a strong understanding of the fundamental principles of transmission electron microscopy. Prerequisites: 270.621, 270.622, or equivalent.

Hemker, Veblen 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

530.761 Mathematical Methods of Engineering

This is the first part of a two-semester course (with 530.762) which presents mathematical methods of engineering with a focus on complex analysis and partial differential equations. Specific topics include analytic functions, the theory of residues, contour integrals, series solution of second order ODEs, special functions and their applications, integral transformations.

Staff 3 hours

530.762 Advanced Mathematical Methods of Engineering

A unified view of the classical methods of applied mathematics based on the theory of finite-dimensional and Hilbert spaces. Matrix theory, systems of ordinary differential equations, Fourier series, eigenfunction expansions, Green's functions. Designed to follow either 530.661 or 530.761.

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

530.764 Perturbation Methods

A study of various asymptotic methods for the approximate solution of ordinary and partial differential equations. Representative topics include the regular perturbation method, the method of strained coordinates, the multi-scale method, singular perturbation theory, WKB theory, turning-point problems, etc. Prerequisites: ordinary and partial differential equations.

Prosperetti 3 hours

530.766 Numerical Methods

Elementary introduction to numerical methods for the solution of fundamental problems in engineering. Computer assignments requiring programming.

Knio 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.

Chen, Knio 3 hours spring

530.768 Topics in Low-Mach-Number Flows

Contents vary from year to year. Topics include stratified free-shear flows, buoyancy-induced flows, Rayleigh-Taylor instability, internal gravity waves, zero and low-Mach number combustion, sound generation by vortical flow, flow acoustics interactions. Prerequisite: 530.621.

Knio 3 hours

530.771 Orientational Phenomena

This advanced graduate course covers a diverse set of topics including rotational Brownian motion and diffusion; statistical mechanics of macromolecules; and applications of group-theoretic ideas in mechanics.

Chirikjian 3 hours

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 non-linear oscillations and wave propagation, homogenization, singular perturbations, non-linear 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

530.778 Special Topics

Staff 1-3 hours

530.800 Independent Study

Staff 1-3 hours

530.801-802 Graduate Research

Staff 1-3 hours

530.803-804 Mechanical Engineering Research Seminar

Staff 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

500.601-602 Seminars in Environmental and Applied Fluid Mechanics

520/580.672 Biosensing and BioMEMS

560.201 Statics and Mechanics of Materials

560.202 Dynamics

560.730 Finite Element Methods

580.448 Biomechanics of the Cell and Organisms

580.687-688 Foundations of Computational Biology and Bioinformatics

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
	530.645	Kinematics
	530.646	Introduction to Robotics
	530.651	Haptics for Virtual Reality
	530.676	Sensor-Based Locomotion and Manipulation
Computer Science	600.410	Sensory Engineering
	600.435	Artificial Intelligence
	600.445-6	Computer-Integrated Surgery I and II
	600.452	Computer-Integrated Surgery Seminar
	600.461	Computer Vision
	600.646	Advanced Computer-Integrated Surgery II
	600.652	Advanced Computer-Integrated Surgery Seminar
Electrical/Computer Engineering	520.214	Signals and Systems
	520.454	Control Systems Design
Biomedical Engineering	580.631	Biomechanics and Motor Control

Professional Communication Program

Courses offered by the Professional Communication Program at Hopkins are designed to help students from all disciplines develop strong written and oral communication skills relevant to their educational and professional goals. Professional Communication courses provide students an opportunity to gain skills needed for success in other courses as well as their future careers.

Director:

John C. Wierman, Professor, Applied Mathematics and Statistics

Assistant Director:

Marybeth Camerer

Senior Lecturers:

Nicholas Allocca, technical communication

Kevin Dungey, oral presentations

Andrew Kulanko, oral presentations

Lecturers:

Joanne Cavanaugh-Simpson, business communication

Peter Porosky, business and technical communication, oral presentations

Eric Rice, technical communication, negotiation and conflict management

Pamela Sheff, business and technical communication, research and scientific writing

Stephanie Stone, scientific and research writing

Michael Winett, technical and legal communication

Undergraduate Courses

661.110 (W) Technical Communication

This highly practical course teaches students a variety of technical and business writing theories and practices. Students learn how to meet the challenges of communicating special or technical knowledge to a variety of audiences. They create several different kinds of professional documents, including resumes, application letters, object and process descriptions, instructions, reports and proposals. In addition, students work with computer-based tools to produce professional brochures, manuals and other documents. Oral communication skills are also emphasized and students work on both individual and collaborative assignments. Overall, the course emphasizes real world applications. Students are exposed to the latest research on language and the writing process and develop communication skills which will be immediately valuable to them in their other courses, as well as in future careers.

Sheff, Allocca, Rice, Porosky, Winett 3 credits
fall and spring

661.120 (W) Business Communication

Business Communication provides students with practice in preparing business-style documents. Students focus on developing clear and concise prose by writing business memos and letters, resumes and cover letters, business proposals, and formal reports. Students are expected to present their work orally using business and professional formats, as well as to enhance their presentations with appropriate technology-based media.

Sheff, Cavanaugh-Simpson, Rice, Porosky 3 credits
fall and spring

661.150 (W) Oral Presentations

This course will introduce students to the principles of developing and delivering effective oral presentations,

including getting to the point and staying there; developing clear and audible structure; engaging (and gauging) your audience; using effective delivery techniques; choosing and designing visual aids; and giving presentations using technology (PowerPoint). Students will practice these skills in a variety of contexts, from short impromptu talks to long technical presentations meant for lay audiences. They will create and deliver effective oral presentations and submit written documents (speaking scripts) to accompany them.

Sheff, Dungey, Kulanko, Porosky 3 credits
fall and spring

661.310 (W) Scientific Writing

This course prepares students to write articles for publication in both professional and non-professional journals. Students write original work, critique published articles for content and style, and present work to class. In the short term, it improves any written work that requires synthesis and evaluation. 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.

Sheff, Stone 3 credits fall and spring

661.330 (W) Writing for the Health Professions

This course focuses on real-world professional writing and communication skills in the health professions, with exposure to resources and strategies unique to the fields in order to produce high-quality, professional documents. Focus is placed upon accommodating both expert and

lay audiences. The student will write a variety of papers such as a personal statement, resume, cover letter, and a medical research paper, with an emphasis on style, research skills, and organization. Students will gain an understanding of the composition process and the roles of persuasion, empirical evidence, and analysis in medical writing. This course will be beneficial for the future doctor, as well as anyone in health-related fields. The product of the class will be at least one written document ready for submission.

3 credits

661.340 (W) Legal Communication

This course is for students who have an interest in understanding communication in the legal profession. Emphasis is placed on legal reasoning and professional standards of communication. As the fields of science, engineering, law, and public policy increasingly interact, the need to write documents for audiences concerned with legal issues increases. Students will learn principles of legal reasoning, argumentation, and writing that are common for various audiences. Instruction covers both the effective written presentation of the students' own work and the writing of reports and communication that might generate legal issues from unforeseen audiences.

Winett 3 credits

Graduate Courses

661.610 Research Writing

This course is designed to provide writing and organizational support to graduate students developing journal articles, dissertations, theses, or conference papers. Oral presentation skills are also addressed, as are issues for those speaking English as a second language.

Sheff, Stone

661.650 Oral Presentations

Designed for graduate students, particularly those with little or no experience, this course will train students in the skills needed for giving effective oral presentations

in academic and real-world situations. Students will learn the principles of developing and delivering effective oral presentations, including getting to the point and staying there; developing clear and audible structure; engaging (and gauging) the audience; using effective delivery techniques; dealing with nerves; choosing and designing strong visual aids; and using technology (PowerPoint) effectively. Students will practice these skills in a variety of modes, from short impromptu talks, to technical presentations meant for lay audiences, to professional interview situations. They will speak on topics of their own choosing and live videotaping will be used to help students strengthen their skills. Students will be expected to deliver some form of presentation every class meeting and they will also be asked to submit written speaking scripts for critique.

Sheff, Dungey, Kulanko

661.710 Dissertation Writing Workshop

A continuation of 661.610 Research Writing, the workshop provides additional instruction and mentoring in writing and organization to graduate students presenting research in journal articles, dissertations, theses, or conference papers. Each student is expected to complete articles, dissertation chapters, etc., during the semester. Students may enroll in the workshop in more than one semester. Prerequisite: 661.610 Research Writing.

661.711 Grant and Contract Proposal Writing

This course addresses the writing of advocacy-based documents such as fellowship applications, research grant applications, and proposals for contracts. Graduate students interested in writing, formatting, content development, and budgeting issues associated with successful funding and/or fellowship applications would benefit greatly from this course. This course is appropriate for anyone planning for a career in higher education or research.

Research and Information Centers

Biocalorimetry Center

The Biocalorimetry Center is dedicated to the development and application of new technologies aimed at measuring directly the energetics associated with biological processes and the development of thermodynamic-based algorithms for drug design.

During the last decade, extraordinary advances have been made in the development of technologies for the structure determination of biological macromolecules. The structures of hundreds of protein molecules have been determined at atomic resolution, opening the doors to new developments in our understanding of biological systems. Since the progress or advancement of all biochemical reactions, including the binding of pharmaceutical drugs to their targets, is controlled by their energetics, knowledge and manipulation of the energetics at the atomic level will provide the researcher with an unprecedented degree of control over biological processes. Having access to the overall and atomic-level partitioning of the binding energetics will accelerate 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 energetics of macromolecules at the atomic level and the development of thermodynamic-based strategies for drug design.

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. 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 from the faculty and research staff of the university's departments of Physics and Astronomy and Earth and Planetary Sciences, and from the scientific staff of the Space Telescope Science Institute and the Applied Phys-

ics Lab. At present, the center has over 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. Dr. Arthur Davidsen was the principal investigator.

Presently JHU, with CAS oversight, operates the Far Ultraviolet Spectroscopic Explorer (FUSE), a satellite for high-resolution spectroscopy, launched in the summer of 1999. FUSE observes with much higher sensitivity and spectral resolution than HUT. Its primary scientific goals are 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. Prof. Warren Moos serves as the principal investigator.

The Advanced Camera for Surveys (ACS) was launched aboard the space shuttle Columbia on March 1, 2002. Principal investigator Professor Holland Ford leads a team of scientists to study the evolution of galaxies and clusters of galaxies at high redshift, to study Jupiter and Io, and to search for planets and protoplanetary disks around nearby stars. ACS has 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) is an ongoing NASA mission led by JHU principal investigator Professor Chuck Bennett.

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 (originally discovered by JHU's Professor Adam Riess through observations of distant supernovae). WMAP has ushered in the era of "precision cosmology".

The National Virtual Observatory (NVO), led by principal investigator Professor Alex Szalay will unite the astronomical databases of many earth-bound 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 on line." 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 currently 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.

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. 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.

JHU is an active partner in the Sloan Digital Sky Survey (SDSS). Professor Tim Heckman served as the CEO of the SDSS project during its construction phase, and JHU 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 and is also measuring the properties of Dark Energy through a search for distant Type Ia supernovae.

CAS has recently joined the Pan-STARRS project which will build 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 wide-field 1.8-m telescope in Hawaii. Pan-STARRS will open 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. Professor Adam Riess is a co-leader of the Dark Energy project and Professor Tim Heckman leads the project on Galaxy Evolution. JHU astronomers will play a key role in the development of the massive Pan-STARRS data archive.

CAS's NASA-supported sounding rocket program, one of a small number of such programs, offers students the opportunity to gain "hands-on" experience building payloads for sub-orbital rocket flights at White Sands, New Mexico.

Graduate students at JHU participate in all aspects of research within the center. Students do theoretical research ranging from the physics of water masers in disks around massive black holes to using HST to measure the masses of black holes in galaxy nuclei. Students at JHU, in calibrating optics and detectors for space instruments and then using data from these instruments for their theses, 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 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 revolving around the symbolic interpretation of high-dimensional data. 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 CIS 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 also provides 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 Web site 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 Barton 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 Web site for more information at www.clsp.jhu.edu.

Center for Leadership Education

The Center for Leadership Education (CLE) at Johns Hopkins is comprised of two academic programs as well as numerous other activities, programs, and events. The academic programs, the **W. P. Carey Program in Entrepreneurship & Management (E & M)** and the **Professional Communi-**

cation Program, offer interesting and challenging business-related courses with practical applications. Students in the E & M program may take classes in management, marketing, law, finance, accounting, leadership, operations, or organizational development. Students in Professional Communication may take courses in business or scientific writing, oral communication, or research writing.

The W. P. Carey Program was started in 1996 by Prof. John Wierman, a professor in Applied Mathematics and Statistics, as an opportunity for undergraduate students to learn management and leadership skills. Students may complete a minor in Entrepreneurship & 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 Web site for more information: 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.

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 Depart-

ment 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 middle and high school reform models. 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 projects include the National Network of Partnership Schools that includes schools, districts, and state educational agencies that are working to develop programs of 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 High School Implementation Center, an affiliate of Talent Development High Schools, works with more than 50 schools across the country to implement reforms for large, usually urban, high schools. Talent Development High Schools recently received a grant from the Bill and Melinda Gates Foundation to expand its high school program to at least 15 additional schools during the 2005-2006 school year.

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 will add one grade each year, until it has 600 students in grades 9-12.

The Talent Development Middle Grades reform model is used by about 20 schools in several states. Curriculum developers in the middle grades program continue to develop science, social studies and language/literature materials for use by many schools across the country—not just those using the comprehensive reform model. The teaching guides developed for the social studies series, *A His-*

tory of US will be published by Oxford Press, and the science materials are being considered for publication by the Smithsonian Institution Press.

Research—in which graduate students in the departments of Sociology and Psychology participate—is guided by a university advisory committee and interaction with outside consultants. Audiences for this research include 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.

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 72,000 students annually enroll in the Talent Search, which since 1979 has served over 1,200,000 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, enroll over 7,000 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. Recent intensive efforts have gone forth to diversify CTY's student body by seeking and recruiting students from all neighborhoods and walks of life.

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 105,000 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, CD-ROM 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 biology.

Since its inception, the institute has been interdisciplinary. Ongoing training grants include an NIH predoctoral program (Program in Molecular and Computational Biophysics) and a Burroughs Wellcome Fund pre- and postdoctoral program in computational biology. 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 Institute for Computational Medicine (ICM), established in 2005, is to understand the mechanisms and to improve the diagnosis, prediction and treatment of human disease through applications of mathematics, engineering and computational science. The Institute includes two research centers, the Center for Imaging Science (CIS) and the Center for Cardiovascular Bioinformatics and Modeling (CCBM), as well as other researchers in the Whiting School of Engineering and the School of Medicine.

Basic biological research has been transformed during the past decade. This transformation has been driven by development of new technologies for high throughput data collection which now make it possible to sequence genomes, measure properties of biological networks and perform functional imaging of cells, tissue and organs. The ability to collect such multi-scale biomedical data has the potential to dramatically improve our understanding of human disease. However, doing so requires that we overcome major technological challenges. These challenges include how best to: i) represent, store and query large-scale, heterogeneous biomedical data sets; ii) discover features in these data that support disease risk prediction, diagnosis and treatment for the individual patient; and iii) develop and apply quantitative models to improve our understanding of the cause and treatment of disease. The ICM was created to address these issues.

The Institute in Multiscale Modeling of Biological Interactions

The Institute for Multiscale Modeling of Biological Interactions (IMMBI) at Johns Hopkins, established in 2004, draws on a variety of disciplines in science and engineering to foster studies of biological interactions and to train the next generation of computational biologists.

Computational methods for biological studies have undergone a remarkable transformation over the past 30 years. Today it is possible to perform simulations, modeling, and/or analysis of biological systems that involve many time and length scales, with realistic expectations of gaining new insight and understanding. Combined with the databases of genetic, proteomic, and structural information, multiscale computational approaches will unquestionably guide the integration of biological information to describe the underpinnings of biological function and organization.

The IMMBI is one of three programs sponsored by the U.S. Department of Energy under their computational biology Genomes-to-Life initiative.

Institute for NanoBioTechnology

The Institute for NanoBioTechnology (INBT) is a Johns Hopkins University center for integrated nanobiotechnology research, education, and outreach. INBT was launched in May 2006 with funding from NASA, the National Science Foundation, and the Howard Hughes Medical Institute. Supportive funding has also been provided by the following Johns Hopkins schools: Whiting School of Engineering, the School of Medicine,

the Krieger School of Arts and Sciences, and the Bloomberg School of Public Health. INBT also has an industrial affiliates program 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 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.

INBT headquarters is located in Maryland Hall on the Homewood campus. Facilities and faculty are located at several other Johns Hopkins locations. INBT research is organized into three core research areas: diagnostics and therapeutics, cellular and molecular dynamics, and health and the environment.

- Diagnostics and therapeutics includes the development of devices that can both diagnose and treat disease inside the body.
- Cellular and molecular dynamics includes manipulating cells to investigate biological functions and disease progression.
- Health and the environment includes 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. Key goals include training a new generation of scientists and engineers better able to work between physical sciences/engineering fields and life sciences/medicine fields and creating an entrepreneurial environment for students. INBT currently facilitates two graduate programs in nanobiotechnology, funded by the Howard Hughes Institute and National Science Foundation. An undergraduate minor in nanobiotechnology will be offered beginning fall semester of 2007. Education opportunities in the animation of nanobiotechnology concepts and in science writing are also offered to students.

Visit the INBT website for more information at www.inbt.jhu.edu

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 resolu-

tion, 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, and 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 their home cities and 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, 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, while working in the institute. 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. An advisory committee of JHU faculty also offers guidance to the master of arts in public policy program.

The Integrated Imaging Center

The Integrated Imaging Center was established in 1998 as a Biology Department core facility, located in Mudd Hall on the Johns Hopkins University Homewood campus. The center serves the diverse academic/research interests of the Hopkins community comprising both a light (LM) and electron microscopy (EM) component, and provides our users convenient access to conventional and advanced techniques in LM and EM. The major focus of the center is the utilization of fluorescent and electron dense probes for the purpose of investigating cellular/subcellular structure and function.

As rapid advances have been made in the development of new techniques for cellular imaging, the visualization of proteins at the light and electron microscopic level has become an essential component of any comprehensive study of molecular cell biology. This is because such cutting-edge imaging can provide detailed information on the relative distribution of proteins within the cell 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 (cell fractionation); immunochemical (immunoprecipitation and immunoblotting); and molecular biological methods.

To this end, 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 center offers both undergraduate and graduate courses in microscopy (as well as regular workshops) as a means of providing JHU students training and exposure to the latest, most advanced microscopy techniques, emphasizing the cooperative integration of these techniques with other cell biological research tools.

Maryland Space Grant Consortium

Established in 1989, the National Space Grant College and Fellowship Program consists of 52 partnerships 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 the Maryland Space Grant

Consortium. Its membership of seven institutions includes The Johns Hopkins University and the JHU Applied Physics Laboratory.

The Maryland Space Grant Consortium offers a variety of programs. The Space Science Internship Program for Elementary and Secondary Mathematics and Science Teachers offers an internship consisting of three months of graduate courses on Earth and planetary science, three months of training in the use of direct satellite technology, and one month of research experience. The Outreach Programs include a Women's Science Forum, Physics for Middle School Students, Summer Study in Engineering for Women High School Students, Summertech (computer training for middle school girls), and a tutoring program, "Teach Baltimore," to increase the first-time student pass rate on the Maryland Functional Writing and Mathematics Exams.

Undergraduate scholarships and graduate fellowships are provided from NASA and consortium funds for selected students pursuing studies in the space sciences. 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.

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 intri-

cate 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 magnetoresistance 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.
- 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 by 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 Scholarship. Established in 1988 for undergraduate support for students from Prince Georges County, Maryland.

Arthur and Catherine B. Adel Scholarship. Established in 2002 for the benefit of undergraduate and graduate students majoring in physics and/or astronomy.

A.I.A.C. J. Jay and Hazel M. Pecora Honorary Scholarship No. 1. Established in 1984 for scholarship support for a student of Italian descent in 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, Engr '38.

A.I.A.C. Memorial Scholarship No. 8. Established in 1982, this scholarship supports a senior or last-year graduate student of Italian descent in 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.

Clyde Aitchison Scholarship for Public Service. Established in 1994 to provide scholarships to Krieger School of Arts and Sciences undergraduates participating in the Washington Center internship program in the Study of American Government.

Nathan Albstein and Charles McKenna Memorial Scholarship. Carolyn and Andrew Albstein BA '78 established the Nathan Albstein and Charles McKenna Memorial Scholarship in memory of their late fathers. This need-based scholarship is awarded annually to an academically talented student in the Krieger School of Arts and Sciences. The Albsteins established this scholarship in 2001 to honor their fathers as well as to express their dedication to Hopkins and the Krieger School of Arts and Sciences.

Alumni Association. Established by the Alumni Association in 1996 to support undergraduates in the Krieger School of Arts and Sciences and Whiting School of Engineering.

American Council on Italian Matters of Maryland Scholarship. Established in 1993 by the American Council on Italian Matters of Maryland, this scholarship, based on financial need, is awarded to a young woman of American-Italian heritage, preferably from Maryland, who is pursuing an engineering undergraduate curriculum at Hopkins.

Avery/Miller Scholarship. This scholarship was established in 2006 by Dennis S. Avery to support undergraduate scholarships at the Krieger School of Arts & Sciences by providing up to half the tuition of a needy student per year for four years.

Michael S. Applestein Scholarship Fund. Established in 1967 by bequest of Michael S. Applestein to award annual scholarships to students attending Johns Hopkins and Brandeis universities. Awards are based on academic merit and financial need.

Margareta E. Augustine Scholarship. Established in 1998 by Norman R. and Margareta E. Augustine to provide scholarships for biomedical engineering undergraduates in the Whiting School of Engineering.

Susan J. Baisley Scholarship Fund. Established in 2001 by Susan J. Baisley '80. The fund will provide a yearly need-based scholarship to an academically talented Krieger School of Arts and Sciences undergraduate interested in a career in communications. Students majoring in the Writing Seminars, English, or Film and Media Studies will be eligible for the scholarship. Ms. Baisley, a marketing and communications executive, and a Second Decade Society alumna, established the scholarship in order to provide talented students with the opportunity and benefits of a Hopkins education.

Henry Scott Baker Scholarship Fund. Established in 1984 by Frances R. Baker, Nurs 1924, in memory of her husband, Henry Scott Baker Sr., a Hopkins engineer from the Class of 1917. This scholarship is awarded to students in the Whiting School of Engineering and is based on financial need and academic merit.

Dr. Janet Bassett Baker and Dr. Lawrence H. Baker Memorial Fund. Established for need-based scholarship assistance to a deserving student in the Krieger School of Arts and Sciences, preferably a resident of Baltimore.

Baltimore Orioles Scholarship. Established in 1978 by the Baltimore Orioles Foundation. Preference in awards is given to students who intend to pursue teaching and/or coaching careers and who demonstrate financial need.

William Sherman Bansemer Scholarship. Established in 1945 to support a student who has reached his or her senior year and is unable to proceed further without financial aid.

William Brown Baxley Memorial Fund. Established in 1959 to aid deserving students with financial need from Maryland who are candidates for a degree in the fields of engineering or science in the undergraduate,

graduate, or part-time programs of the university. The fund was established by C. Herbert Baxley, 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 an officer in the American Expeditionary Forces. The fund is supported by Alice B. and Charles Anthony Jr., daughter and son-in-law of Herbert Baxley, and their family.

Becker Family Fund. In November 1995, Dr. George L. Becker Jr., BA '50, established the Becker Family Fund in the Krieger School of Arts and Sciences. This endowed scholarship will be awarded to an undergraduate student majoring in the school's new interdepartmental program in neuroscience.

Gail and Gwen Becker Scholarship Fund. Established by Dr. Larry Becker, A&S '60, on the anniversary of his 40th reunion in memory of Gail and Gwen Becker. Larry Becker was a varsity athlete in lacrosse and basketball 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 will support an undergraduate member or 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, Engr 1964. This scholarship provides financial aid to undergraduate students in 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. This scholarship, established in 1998, may be awarded to a need-based undergraduate freshman in the 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, this undergraduate scholarship is for students in the Krieger School of Arts and Sciences with primary preference given to students participating in the Washington, D.C.-based program.

Beta Theta Pi Scholarship. This scholarship was established in 1989 by various members of Alpha Chi for students who demonstrate 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 scholarship was made possible by a bequest and is used to assist worthy students in the purchase of books and other necessities. The Office of Financial Aid determines the need and designates the borrower. The Office of

Student Loans administers these loans and designates eligibility.

Carl '92 and Rachel Berg Endowed Undergraduate Scholarship Fund. This fund was established in 2005 by Rachel K. and Carl D. Berg to provide support for an undergraduate student, with preference given to a student in the Philosophy Department in the Krieger School of Arts and Sciences.

Kathryn Billman Loan Fund. This is an emergency short-term loan fund issued without interest for students in the Writing Seminars.

W. B. Fund. Established in 1982 by Mr. Warren Bishop, Class of 1961, to honor an undergraduate student athlete who demonstrates financial need.

Frederick Edgar Blaser Scholarship. In 1951 Elizabeth Blaser Robertson gave to the university a sum of money as a memorial to her father, Frederick E. Blaser. Provision is made for an annual grant to the child of a parent who has been employed by the Baltimore and Ohio Railroad or the Chesapeake and Ohio Railroad for at least five years at the time of application.

Arnold S. and Donna R. Blaustein Scholarship Fund. Established in 2004, this scholarship for undergraduate students at the Krieger School of Arts and Sciences is awarded annually based on 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., A&S '43, Med '46. This scholarship will support undergraduates in the Krieger School of Arts and Sciences and the Whiting School of Engineering. Preference in award of the scholarship will be given to highly meritorious students from Pennsylvania.

Blum-Kovler Foundation Scholarship. Established in 1987 to provide scholarship support for an undergraduate student in need of financial assistance.

Stanley E. Blumberg Memorial Scholarships of The Johns Hopkins University. Established in memory of Stan Blumberg who served as the director of Alumni Relations from 1970 to 1983. Approximately 30 awards are given each year to financially needy undergraduate students.

Milton Blumenfeld Scholarship Fund. Established in 1991 to provide scholarships to deserving undergraduates in the Krieger School of Arts and Sciences as determined by the dean of the school.

Robert A. and Irene M. Boenning Scholarship Fund. Established in 2001 by Irene M. and Robert A. Boenning, Engr 1962, to provide need-based scholarships to students in the Department of Electrical and Computer Engineering of the Whiting School of Engineering.

Charles F. Bonilla Scholarship. Established in 1992 by various donors for Whiting School undergraduates in Chemical and Biomolecular Engineering. The scholarship memorializes Dr. Bonilla, a former 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 in 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, Engr 1953, a university trustee emeritus. The scholarship will provide 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. It is awarded annually to a deserving and needy undergraduate student in the Krieger School of Arts and Sciences.

Briddell Family Scholarship. Established in 2006 by W. Kent Briddell, Engr 1969, and his wife, Peggy O'Neill. This scholarship will support undergraduate students in the Whiting School of Engineering.

Charles Harmon Bronner Scholarship. Established in 2007 by an estate bequest of Charles Harmon Bronner, Engr 1925. This scholarship will support students in the Whiting School of Engineering.

Helen K. Browne Scholarship Fund. Established in 1994 by Dr. Stephen J. Browne in honor of his mother, Helen K. Browne, this scholarship offers support to Krieger School of Arts and Sciences undergraduates majoring in economics.

Winston T. and Mamie N. Brundige Scholarship Fund. Established in 1996 by Mr. and Mrs. Winston Brundige to support a student who demonstrates financial need. Mr. Brundige is a member of the Class of 1942.

Alpha Holliman Bush Memorial Scholarship. Established in 1999 by Janice Bush, A&S '76, and her husband, Eric L. Hagestad, in memory of Janice's grandmother. This scholarship will be awarded to a financially needy Krieger School pre-med student who demonstrates an interest and talent in music.

Edwin S. Carr Memorial Scholarship. James G. Rickards, BA '73, MA SAIS '74 and fellow Beta Theta Pi fraternity brothers of Edwin S. Carr established the endowed scholarship in Mr. Carr's memory in 2001. The fund will provide a yearly need-based scholarship to a Krieger School of Arts and Sciences undergraduate who like Mr. Carr was 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 Fund. Established in 1970 in memory of Mr. Casner, A&S '65, this scholarship gives preference to junior or senior students majoring in history, with students in Far Eastern studies given first preference.

Centennial Scholarship. Scholarships to 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 Fund. Sidney Checket and the Checket Family Foundation endowed this fund in 1984 for undergraduate scholarships in the Krieger School of Arts and Sciences. Awards are based on academic merit and financial need.

Karen A. Cheng Scholarship. Established in 2003 by Karen A. Cheng, BA '94, this scholarship provides support to an undergraduate international relations major with a demonstrated extracurricular interest in the visual or performing arts.

Carrie K. and Walter H. Church Scholarship. To support deserving and needy undergraduate students at Johns Hopkins University.

Henry A. Ciccarone Scholarship Fund. Established in 1989 in memory of Henry Ciccarone to provide scholarships for lacrosse players.

Class of 1916 Scholarship Fund. The alumni of the Class of 1916 established this fund to assist financially needy students.

Class of 1925 Scholarship. Established in 1978 to provide scholarships to Arts and Sciences and Engineering undergraduates demonstrating financial need.

Class of 1929 Endowment for Undergraduate Scholarships. On the occasion of their 50th reunion, members of this class made significant contributions and commitments to establish this fund. Undergraduates in the schools of Arts and Sciences and Engineering are eligible.

Class of 1930 Need Scholarship. Established in 1990 to provide scholarships for undergraduates who demonstrate need.

Class of 1930 Scholarship Fund. This scholarship, established by the Class of 1930 upon the occasion of their 50th reunion, is awarded on the basis of academic excellence to undergraduate students.

Class of 1934 Scholarship Fund. To provide scholarships for Homewood undergraduate students.

Class of 1935 Scholarship. Established in 1991 by members of the Class of 1935 to provide undergraduate support to need-based students in the schools of Arts and Sciences and Engineering.

Class of 1940 Scholarship Fund. Established in 1987, this fund benefits financially needy undergraduate students at the schools of Arts and Sciences and Engineering.

Class of 1941 Scholarship. Established in 1991 by members of the Class of 1941, this scholarship provides need-based undergraduate support to students in the schools of Arts and Sciences and Engineering.

Class of 1942 Scholarship. Established in 1992 to provide scholarships to undergraduates who demonstrate need.

Class of 1943 Scholarship. Established in 1943 to provide need-based scholarships for undergraduate students.

Class of 1949 Scholarship Fund. Established in 1996 to provide scholarships to worthy students in need of financial aid or tuition assistance.

Class of 1950 Scholarship Fund. Established in 1990 to provide scholarships to undergraduates who demonstrate need.

Class of 1951 Scholarship. Established in 1991 by members of the Class of 1951, this scholarship provides need-based undergraduate support to students in the schools of Arts and Sciences and Engineering.

Class of 1952 Scholarship. Established in 1992 to provide scholarships to undergraduates who demonstrate need.

Class of 1953 Scholarship. Established in 1993 to provide annual scholarships to undergraduate students demonstrating financial need.

Class of 1954 Memorial Scholarship. Established in 1986 to provide scholarships for worthy students based on academic achievement.

Class of 1956 Scholarship. Established in 1990 to provide scholarships for undergraduates who demonstrate need.

Class of 1957 Endowment. Established in 1992, this endowment provides general undergraduate support.

Class of 1958 Scholarship. Established in 1993 to provide annual scholarships to undergraduate students demonstrating financial need.

Class of 1959 Scholarship Fund. To provide financial aid to need-based undergraduates in the schools of Arts and Sciences and Engineering.

Class of 1963 Scholarship. Established in 1993 to provide annual scholarships to undergraduate students demonstrating financial need.

Class of 1968 Scholarship. Established in 1993 to provide need-based scholarships for undergraduate students.

Class of 1971 Scholarship. Established in 1991 to provide need-based undergraduate scholarships to students, with preference given to the sons and/or daughters of members of the Class of '71 who matriculated at JHU.

Class of 1977 Scholarship. Income from this fund is awarded annually to a financially needy undergraduate.

Class of 1979 Memorial Scholarship. Established in 1980 by the class in memory of Ana de Castillo, David Budzik, and Daniel Yin, three deceased class members. This scholarship is awarded to a student of strong moral character and community dedication who is entering the senior year.

Edward W. and Madelyn S. Clautice Scholarship Fund. Created in 1999 by Edward W. Clautice, Engr '38, in memory of his wife, Madelyn Clautice, to whom he was married for 53 years. The Clautice Fund will support 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 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.

Andrew Paul Cox Scholarship Fund. Established in 1990 by A. Paul Cox Jr., Engr 1959, 1970 (M.S.), and his wife, Gertrude A. Cox, in honor of his father, to provide scholarships for Whiting School students in Electrical Engineering. Based upon merit, with financial need a consideration.

Gordon Croft Scholarship and the Russell Gordon Croft Endowed Scholarship. Established in 1987, and 2006, respectively, by L. Gordon Croft, Engr '56. These scholarships are awarded to students in the Whiting School of Engineering who reside in Charles County, Maryland, and who are graduates of Charles County, Maryland public schools.

Wm. Cullimore III Memorial Scholarship. Established in 1988 by Emily Rodney Cullimore in memory of Mr. Cullimore, Engr '22, this fund provides undergraduate scholarships to students in the Whiting School of Engineering who are graduates of Polytechnic Institute in Baltimore.

Roger Dalsheimer Scholarship in the Humanities. Established in 1996 to provide undergraduate support to students majoring in the humanities in the Krieger School of Arts and Sciences.

Jack Davis Memorial Scholarship. Established in 1989, in memory of Mr. Davis, to provide scholarships to undergraduates in the Krieger School of Arts and Sciences.

Day Family Scholarship. Established in 1997 to provide scholarships to any deserving student in Arts and Sciences or Engineering. Preference will be given to students from the state of Colorado.

Daniel and Conor Denhahan Scholarship Fund. Established in 2002, the income from this fund will support an undergraduate scholarship for a member or members of the men's varsity lacrosse team.

The Leroy and Nola Dickson Endowed Scholarship Fund. Established in 1999 by LeRoy Dickson, Engr 1960 1962 (M.S.) 1968 (Ph.D.) and his wife, Nola Dickson to provide scholarships to undergraduate students who are enrolled, and remain enrolled through attainment of their undergraduate diploma, in the full-time program of the Whiting School of Engineering.

The Charles C. Diggs Scholarship Fund. Established in 1996 by Mr. Diggs, Engr '40, '61, to provide need-based scholarships to undergraduates in the Whiting School of Engineering

Nancy G. and B. Boro Djordjevic Scholarship Fund. Established in 1998 by B. Boro Djordjevic, Engr '78 (M.S.) '80 (Ph.D.), and his wife, Nancy G. Djordjevic to provide scholarships for undergraduate students in the Whiting School of Engineering in the areas of nondestructive evaluation, materials engineering, and/or mechanical engineering.

The Dorsey Scholarship Endowment. Established in 1999 by Herbert Dorsey, Engr '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 Fund. Established in 1977 by Mr. Doub's sister, Mrs. Frances Doub North, and his son, Richard M. Doub, to support electrical engineering students in the Whiting School of Engineering. Awards are based on merit and financial need. Cyrus L. Doub was a graduate of the School of Engineering in 1919.

Ina and Howard Drew Scholarship Fund. Ina and Howard Drew, both BA '78 established the Ina and Howard Drew Endowed Scholarship Fund in 2001. The need-based scholarship 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. The Drews live in New Jersey with their son, Alex, and daughter, Sarah. Howard is a periodontist and Ina is a managing director of JP Morgan Chase and trustee of Johns Hopkins University.

Hugh L. Dryden Memorial Scholarship. A perpetual memorial was established in 1973 by Mrs. Dryden to honor her husband, a graduate of The Johns Hopkins University. The fund is used for scholarship aid in the Krieger School of Arts and Sciences.

Edwin C. Duncan Scholarship. Established in 2000 by Robert R. Duncan, A&S '71, in honor of his father, a lifelong sportsman and longtime supporter of Hopkins lacrosse. Robert Duncan is a former varsity lacrosse player who played on two national championship teams coached by Bob Scott. This scholarship will support a member or members of the men's varsity lacrosse team who has(have) demonstrated academic and athletic integrity.

Robert and Bonnie Dymowski Scholarship Fund. Established in 1994 to assist deserving 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 Fund. Established by John Howard Eager in 1957 to provide need-based scholarships in the schools of Arts and Sciences and Engineering.

Earl Family Scholarship. Established in 2002 by Matthew A. Earl '94. This undergraduate scholarship will provide support for a junior or senior in 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.

The William Eichengreen Scholarship. This scholarship was established in 2005 at the request of the late William Eichengreen, 1937 alumnus of the Zanvyl Krieger School of Arts & Sciences. This scholarship is for undergraduate students in the Krieger School of Arts and Sciences.

Otto and Hilda Einolf Scholarship. Established in 1982 for students in the Whiting School of Engineering by Charles W. Einolf, Engr '56, and his wife, Dorothy Einolf, to support full- or part-time students. The scholarship memorializes Mr. Einolf's parents.

Helen Eakin Eisenhower Scholarship Fund. 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 undergraduates.

Dr. Milton S. Eisenhower Scholarship Fund. To provide financial aid to need-based undergraduates in the Krieger School of Arts and Sciences.

Christopher B. Elser Scholarship. This scholarship was established in 2004. In his time at Johns Hopkins, Christopher Elser dedicated himself to his friends, soccer, his studies, and the community around him. To celebrate Chris's life and to carry forward what he lived for, Chris's family and friends have established this scholarship. The scholarship will be awarded annually to a bright and talented student who shares Chris's passion for athletics and dedication to community. Chris's family hopes that this scholarship will be awarded to an upperclassman already attending Johns Hopkins. In turn, the student receiving this needed financial support will keep Chris's vibrant spirit alive on the campus of Johns Hopkins and beyond.

John Engalitcheff Jr. Scholarship Fund. Established in 1989 by associates of the late Mr. Engalitcheff, Engr '30, and the Baltimore AirCoil Company to provide scholarships for full-time or part-time students in the Whiting School of Engineering.

Engineering Emeriti Professors' Student Aid Fund. Established in 1958 by Johns Hopkins engineers to honor professors of engineering who have reached the

age of retirement. Its purpose is to aid deserving students pursuing studies in engineering. Awards are based on academic merit and financial need.

Jeffrey M. Epstein and Ronit Adler Scholarship. Established in 2003 by Jeffrey Epstein, BA '73, and his wife, Ronit Adler, this scholarship supports an undergraduate student in the Krieger School 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.

Edgar F. Felder Jr. Memorial Scholarship. This scholarship was established in 2006 by Mark H. Felder and Beth Ann Felder to support an undergraduate student in the Krieger School of Arts and Sciences.

Fenzel Family Scholarship Fund. This fund was established in 2006 by John Fenzel Jr. to provide support for an undergraduate student in the Krieger School of Arts and Sciences.

Dale Fike Memorial Scholarship. This scholarship was established in 2006 by various alumni from the classes of 1982, 1983, and 1984 in memory of Dale Fike, a 1983 alumnus of the Krieger School of Arts & Sciences. This scholarship is to support undergraduates in the Krieger School of Arts and Sciences.

Finston/Robertson Scholarship Fund. Established in 2000, this scholarship will be awarded to a financially needy undergraduate student of the Krieger School with a diagnosed learning disability (also referred to as a learning-style difference).

Louise R. Firestone Scholarship. Established in 2003 by Louise Firestone, BA '78, to support an undergraduate student in the Krieger School of Arts and Sciences.

First Generational Scholarship Fund. Established anonymously in 2000 by an alumnus to provide need-based support to a Krieger School of Arts and Sciences undergraduate who is the first in his/her family to attend college, or who otherwise demonstrates need.

William Fox Jr. Scholarship at the Whiting School of Engineering. This was established in 2005 by the William Fox Jr. Foundation to provide financial aid to undergraduate engineering students at the Whiting School of Engineering, with a preference for United States citizens.

Frances Howard Flatau Scholarship Fund. Established in 2001 by William H. B. Howard, M.D., A&S '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 in the Whiting School of Engineering. Preference is given to Biomedical Engineering students.

William Fox Jr. Scholarship at the Whiting School of Engineering. Established in 2004 by JoAnn W. Fox-Weingarten, Engr '71, and Susan Fox Rosellini in memory of their father, William Fox Jr. The scholarship provides

financial aid to undergraduate engineering students in the Whiting School of Engineering.

Fox/Jeffrey Undergraduate Scholarship Fund. Established in 2000, this scholarship will be awarded to an undergraduate in the Krieger School of Arts and Sciences. Preference for the need-based scholarship will be given to students focusing their academic interests in the social sciences and/or the humanities.

France-Merrick Foundations. Provides scholarships for Homewood undergraduate students engaging in community activities.

Myer A. L. Frank Scholarship. Under the will of the late Mrs. Martha Frank Lauer, a sum of money was bequeathed to the university in 1989 for a scholarship in memory of her brother. The Myer A. L. Frank Scholarship is awarded by the university to a graduate of the Baltimore City College.

Charles Carroll Fulton Memorial Fund. This fund was established in 1927 by Dollie Glovins Fulton in memory of her father, Charles Carroll Fulton, for scholarship assistance to needy undergraduate students.

Christina Funke Scholarship Fund. With the bequest of Walter A. O. Funke, this scholarship was established in 1964 to be used for talented students who demonstrate financial need.

Lillian Gavurin Memorial Scholarship. Established in 2003 by Stuart Gavurin, BA 1983, and his wife, Andrea, this scholarship is awarded to a Krieger School undergraduate who has demonstrated social responsibility and tolerance of diversity through ongoing involvement in non-religious community service. The scholarship is awarded during the freshman or sophomore year and granted to the same student each year until achievement of degree.

Elisabeth Gilman Memorial Fund. A memorial to Miss Elisabeth Gilman, whose father was the first president of The Johns Hopkins University, was established by Robert W. Nelson for scholarship purposes. 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.

Bernard Glatt Memorial Scholarship Fund. This fund was established by Jeanne L. Fink and Henry J. Fink in 1978 in memory of Bernard Glatt, an educator and former student at Johns Hopkins university. Awards are based on academic merit and financial need.

Morris Goldseker Scholarship Fund. Established at the university in 1976, this fund provides scholarships for needy and deserving undergraduate students from the state of Maryland.

Aurora G. Granofsky Scholarship. Established in 2001 to provide scholarship support for deserving 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.

The Greenberg Family Scholarship. Established in 2003 by William S. Greenberg, Class of 1964, 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.

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 an undergraduate on the Homewood campus in the schools of Arts and Sciences or Engineering.

Grey Lady Scholarship Fund. Established in 1996 by an alumnus on the occasion of his 40th reunion. The scholarship is to be used for a student in the Krieger School of Arts and Sciences who demonstrates need. Preference will be given to a qualified student who resides in Nantucket.

The Charles G. Groh Scholarship Fund. Established in 2000 by Charles G. Groh, Class of 1953. 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 in the Krieger School of Arts and Sciences. The scholarship will be awarded based upon financial need.

I. Cyrus Gutman Scholarship. Established in 1986, this endowed scholarship supports financially needy students.

Lillian and Willard Hackerman Loan Fund. Established in 1985 by Lillian and Willard Hackerman and Mrs. Whiting, this is an interest-free loan fund for students majoring in engineering. To be eligible, students must have demonstrated need; recipients are selected by the Office of Student Financial Services. The amount a student may borrow cannot exceed one-half the annual tuition.

A. Z. Hartman Memorial Scholarship Fund. This memorial was 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. Awards are based on academic merit and financial need.

William H. Hazlehurst Scholarship. Established in 1999 by William Hazlehurst, A&S '49. The permanent endowment at The Johns Hopkins University was established for the benefit of undergraduate students with financial need.

Jeremy W. Head Scholarship. This scholarship will support an outstanding student who demonstrates financial need.

Michael Heinel Scholarship. Established in 2003 by Michael Heinel, BA '72, this scholarship supports an undergraduate student in the 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 Fund. Established in 1988 through the estate of Samuel Helfrich to support deserving students in the Krieger School of Arts and Sciences.

The Carroll D. Hennick Memorial Scholarship. Established in 2002 to provide financial aid to non-medical undergraduate and graduate students in the Whiting School of Engineering and the Krieger School of Arts and Sciences.

Robert E. Hess Memorial Scholarship Fund. In 1984 the estate of Alice R. Hess provided for the establishment of this scholarship in memory of her son. Awards are based on financial need and academic merit.

Sylvia Mattin Heusch Scholarship Fund. Established in 2000 to support undergraduate students studying the humanities in the Krieger School of Arts and Sciences with first preference given to history of art students.

Richard and Carol Hochman Endowment Fund. Established in 1987, this fund provides support to middle-income liberal arts students from public schools in the New York metropolitan area. Awards are based on academic merit and financial need.

Hodson-Gilliam Success Endowment. This endowment was established in 2005 by the Hodson Trust to provide partial tuition support for minority undergraduate students.

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.

Hollander Memorial Fund. This fund was established in 1991 in honor of the late Dr. Jacob Hollander to provide scholarships in the field of political economy.

Homewood Campus Music Scholarship. Established in 1996 by Dr. Sung Oh to support a Krieger School undergraduate.

Richard and Joan Howell Undergraduate Scholarship. Established in 2004 by Richard, Engr 1955 and Joan Howell to provide financial aid to undergraduate students at the Whiting School of Engineering. Primary preference is given to recently graduated students of Dundalk High School. Secondary preference is given to recently graduated students of Catonsville High School.

George J. Hudgins Jr. Scholarship Fund. Established in 1994 by Mr. Hudgins, Engr 1958, to provide scholarships in the Whiting School of Engineering for deserving graduates of the Baltimore Polytechnic Institute.

Family Scholarship Fund in Memory of Allan S. and Elsie C. Huston. Established in 2006 by Allan S. Huston Jr., Engr 1966, and his wife, Jane M. Huston, in memory of his parents. The scholarship provides assistance to students of the Whiting School of Engineering, with preference given to students who have an interest in athletics.

Albert D. Hutzler Jr. Memorial Fund. Established in 1986 to support undergraduate students who demonstrate financial need.

Stanley Gene Jacobson Memorial Scholarship Fund. Established in 1986 to assist financially needy students in the Krieger School of Arts and Sciences.

Jochebed Scholarship Fund. Established in 2000 by Heather Hay Murren, BA '88. The scholarship will support a Krieger School undergraduate. 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 in the Homewood Schools.

Christian A. Johnson Scholarship Fund. The Christian A. Johnson Endeavor Foundation established this award in 1984 for deserving undergraduate students who demonstrate financial need.

Paul J. and Susan D. Kadri Family Scholarship. Established in 2006 by Paul J. Kadri, Engr 1987, and his wife, Susan Kadri. The scholarship will support an undergraduate student from the Krieger School of Arts and Sciences or the Whiting School of Engineering. Preference will be given to students who have graduated from certain high schools in which Mr. Kadri has served as administrator. Currently these schools include the New Jersey school districts of Newark, Trenton, and Moorestown Township.

Leonidas P. Kaouris Memorial Scholarship. This fund was 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, based on need, will be awarded to an undergraduate student of the Krieger School of Arts and Sciences, who demonstrates academic promise and financial need.

Z. Morton Katz Memorial Scholarship. Friends of Z. Morton Katz of Baltimore, a former student at Johns Hopkins University who lost his life in the Battle of Montfaucon in France, established in 1919 a memorial scholarship to be awarded annually to a member of the graduating class of the Baltimore City College on the basis of superior character and scholarship.

Stan and Stephanie Katz Scholarship. This scholarship was 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 Endowment Fund. This memorial was 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. Awards are based on academic merit and financial need.

Marci and Larry Kenney Scholarship Fund. This fund established by Marci Kenney, BA 1978, MA 1979 (SAIS), and her husband, Larry Kenney Jr., 1978 Engr, will support an undergraduate student from the Krieger School of Arts and Sciences and/or the Whiting School of Engineering. Preference for the need-based scholarship will be given to an academically talented student.

William L. Kepper Memorial Endowed Scholarship. Established in 2001 by his children Kimberlee, BA '78, MA '79, SAIS, Eileen, Will, and Heidi Kepper. The need-based scholarship, awarded to a 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, Engr 1982, 1989 (M.S.), to provide undergraduate need-based scholarships in the Whiting School of Engineering.

Benjamin and Fortuna Iseman Klotz Memorial Scholarships. Established in 1985 by the estate of Mrs. Fortuna Klotz, a Baltimore sculptor, painter, music lover, and amateur championship golfer. Her husband, Ben Klotz, A&S 1922, a urologist and surgeon, died in 1990.

Carl A. Knierim Scholarship Fund for Chemistry. This scholarship, which provides financial assistance for undergraduate students majoring in chemistry, was set up by Dora Will Knierim in 1981 in memory of her husband, Carl Adam Knierim, B.S. 1924. Awards are based on academic merit and financial need.

Arthur R. and Rena A. Knipp Scholarship Fund. This fund was 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 needy students, preferably in the fields of physics or mathematics.

Kohli Scholarship. This was established in 2005 by Anil and Deepa Kohli for Women's Lacrosse.

Bertram Koslin Scholarship. Established in 2001 to support an undergraduate in the Whiting School of Engineering, with a 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, BA '32, to aid a needy student of the Krieger School 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.

Kurz Family Scholarship. This scholarship was established in 2005 by Donald A. Kurz. This scholarship is for undergraduate students in the Krieger School of Arts and Sciences.

KSAS 9/11 Alumni Memorial Scholarship. Established in 2001 in honor of the sudden loss of five alums of the 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.

Eli M. Lamb Memorial Scholarship. In 1916 the Alumni Association of the Friends School of Baltimore established the Eli M. Lamb Memorial Scholarship to assist financially needy students, with preferences given to Friends alumni.

Land Scholarship. Established in 1991 by Dr. W. Everett Land '28, Ph.D. '33, and Mrs. Land, these scholarships provide support for undergraduate or graduate students in the departments of Chemistry or Chemical and Biomolecular Engineering.

Donald R. Lang and Varley H. Lang Memorial Scholarships. Established in 1998 in memory of two brothers, Donald R. Lang, Engr '28, and Varley H. Lang, A&S B.A. '36, Ph.D. '38, whose love of learning was surpassed only by the joy of sharing that knowledge with others. These scholarships are to be awarded to undergraduates in the Whiting School of Engineering and the Krieger School of Arts and Sciences, on the basis of academic merit and financial need.

The W. Jeffrey Lawrence Scholarship. Established in 2000 by W. Jeffrey Lawrence, BA '77, SAIS '78. This endowed scholarship will support Krieger School undergraduate students in the BA/MA program.

Nevin O. Lawyer Scholarship Fund. To provide need-based scholarships to Homewood undergraduates whose permanent residence prior to entering college was the state of Maryland.

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 Krieger School of Arts and Sciences in 1934 and from the School of Medicine in 1938.

Robert H. Levi Scholarship Fund. Established in 1990 by his children to provide scholarships for undergraduates in the Krieger School of Arts and Sciences.

David and Marcia Levy Scholarship. Established to provide assistance to undergraduate students in the School of Arts and Sciences who demonstrate need. Preference given to Writing Seminars majors.

Sweetser Linthicum Esquire Scholarship Fund. Established in 1997 to provide scholarships to deserving students majoring in the fields of history and/or political science.

Donald Ho Yu Liu, M.D. and Emilie Chua Liu, M.D., Scholarship. This scholarship was established in 2005 by Diana C. Liu to provide support to a Krieger School undergraduate student with financial need who also plans on a career in medicine.

Vernon Lynch Scholarship. In 1925 Mr. Edmund Lynch of New York established an endowment fund in memory of his brother, Vernon Lynch, who died while engaged in service during World War I. The fund has since been augmented, and two grants are open to graduates of the Baltimore City College who are accepted for admission to The Johns Hopkins University.

Edward MacNichol Scholarship. Established in 2004 by the estate of Edward MacNichol, A&S '52 (Ph.D.), this scholarship supports undergraduate students in the Krieger School of Arts and Sciences.

Helen and Sam Mandel and Anita and Julian Mandel Educational Scholarship Fund. This fund established by Howard Mandel, BA '77, and his wife, Susan, in honor of Howie's parents and grandparents' commitment to education, will support an undergraduate in the Krieger School of Arts and Sciences. Preference for the need-based scholarship will be given to an incoming freshman from Brooklyn, New York; Queens, New York; Stuyvesant High School in New York; or Los Angeles.

Brenda I. Mardis Scholarship. Established in 2001 by Brenda Mardis, this scholarship is awarded to a member of the Blue Jays Women's Lacrosse team.

Jerome and Helen Margulies Scholarship. This scholarship was established by Frederic Margulies, A&S '69, in memory of his parents. The scholarship is need-based and will be awarded to an undergraduate student of 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 Endowed Scholarship Fund. This scholarship was established in 2006 by the Maryland Section of the American Society of Civil Engineers to support a civil engineering student bearing the name of The Maryland Section of the American Society of Civil Engineers Endowed Scholarship Fund. The Department of Civil Engineering at the Whiting School of Engineering in conjunction with the Office of Student Financial Services will be responsible for the selection of the scholarship recipient. Recipients will be 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 Honorary Scholarship. Established in 1990 to provide scholarship support to a Whiting School senior who is a resident of the state of Maryland and demonstrates financial need.

James E. McClaine Scholarship Fund. Established in 1999 by James E. McClaine, Engr 1963, and his wife, Kay E. McClaine, Nurs 1964, to support undergraduate students in an engineering discipline.

Gail J. McGovern Endowed Scholarship. Established in 1999 by Gail J. McGovern, A&S '74 and a trustee of the university. This scholarship will provide need-based assistance for students studying mathematics or science in the Krieger School of Arts and Sciences. First preference will be given to female students who attended an urban public high school prior to attending the university.

William E. and Elda M. Meiers Scholarship Fund. Established in 1999 by William E. Meiers, Engr 1952, and his wife, Elda M. Meiers, to support deserving undergraduate students majoring in an engineering discipline.

Melissaratos Family Scholarship Fund. Established in 1999 by Mr. Aristides Melissaratos, Engr 1966, to provide scholarship support to deserving undergraduate students majoring in an engineering discipline. Preference is given to engineering students who are from city of Baltimore.

Jay Menon, M.D. Memorial Scholarship. The Jay Menon Memorial Scholarship was established in 2000 by his wife, Shama, daughter, Seema, and son, Sanjay. 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 to 1977. In addition to Dr. Menon's many professional accomplishments, the greatest legacy he leaves behind is the improved quality of life of his many grateful patients. He was a wonderful husband and father who will be remembered for his generosity, kindness, and joy for life. The Jay Menon Memorial Scholarship is a loving tribute to the memory of an extraordinary physician and caring individual.

Joseph Meyerhoff Scholarship Fund. Established in 1979 by Joseph Meyerhoff who had attended the University in 1918. The scholarship is to provide support to deserving students in the Whiting School of Engineering who major in civil engineering at the undergraduate or graduate level.

Miller Scholarships. Established in 1993 by Charles D. Miller, A&S '49, to provide scholarships in the Krieger School of Arts and Sciences for undergraduates who previously participated in the CTY program.

Jan M. Minkowski Scholarship. Established in 2002 in memory of Jan M. Minkowski, 1963 (Ph.D.), a Whiting School electrical and computer engineering professor emeritus. This scholarship will support deserving undergraduate students majoring in electrical and computer engineering, computer science, or mathematical sciences.

John G. Monteabaro Foundation Endowed Scholarship Fund. This fund was 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 Krieger School of Arts and Sciences.

Patricia Biggs Morrison Scholarship. Established in 1998 by William F. Morrison, Class of '49, in honor of his wife and to provide financial assistance for American undergraduates in the Krieger School of Arts and Sciences.

Tobia H. and Morton M. Mower Scholarship Fund. This fund provides scholarships for undergraduate students in the Krieger School of Arts and Sciences who demonstrate financial need.

Sylvia Friedberg Nachlas Scholarship. Established in 1988 by Sylvia F. Nachlas to support needy and deserving students in the Krieger School of Arts and Sciences.

Ruth Nagle Watkins Scholarship Fund. This fund was established in 2006 at the request of the late Ruth Nagle Watkins to provide scholarships for students majoring in art history.

James H. Nelson Scholarship. James Nelson, A&S '75, an attorney from Boulder, Colorado, established this scholarship in 1998. This scholarship is to be awarded to a financially needy 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 Fund. This fund was established in 2006 by Chris and Elizabeth Nguyen to provide support for an undergraduate student who is a rising junior or senior in the Zanvyl Krieger School of Arts and Sciences, with preference given to a student whose focus is pre-medical education with an interest in children's health.

Ronald M. Nordmann '63 and Jodi E. Nordmann '93 Undergraduate Scholarship. This scholarship was established in 1999 by Mr. Nordmann, a member of the Class of 1963, to support undergraduate students in the Krieger School of Arts and Sciences with demonstrated financial need. Mr. Nordmann and his daughter, Dr.

Jodi Nordmann '93, wanted to help students who might otherwise be unable to attend Johns Hopkins.

Dr. W. Luther Norem Scholarship Fund. Established in 1994 to provide financial aid for deserving students.

Ralph S. O'Connor Scholarship. Established in 1993 to provide scholarships to undergraduates in the 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 will provide financial support for undergraduate scholar-athletes in the Krieger School of Arts and Sciences.

Alan T. Ossermann Sr. Scholarship Fund. 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. To provide undergraduate scholarships for a member of the men's lacrosse team.

Palmisano Endowed Scholarship. Established in 2000 by Samuel J. Palmisano, BA 1973, to provide financial assistance to undergraduates majoring in the sciences.

Mr. and Mrs. Samuel F. Palmisano Scholarship. Established in 2002 by Mr. and Mrs. Samuel F. Palmisano to provide support for well-rounded undergraduates in the Whiting School of engineering who are studying computer science.

Kumud A. and Arvind V. Patel Scholarship. Established by Rajul Patel '94 in honor of his parents, to award scholarships to undergraduate students based on financial need or adversity.

Joseph B. and Frances T. Payne Scholarship Fund. To support deserving and needy undergraduate students at Johns Hopkins University.

George A. Petrossian, M.D., Fund. This fund was established in 2005 by George A. Petrossian, M.D., for undergraduate students at the Krieger School of Arts and Sciences.

Phi Ep Buddy Fund. Various members of the Phi Epsilon Pi fraternity have established this scholarship to provide undergraduate support in the Krieger School of Arts and Sciences.

Phi Gamma Delta Scholarship. Awarded each semester to a fraternity member of Phi Gamma Delta who is not an officer and who best exemplifies the ideals of community-mindedness.

Pikoos Memorial Scholarship. Established in 1989 by Mindelle Weinberg in memory of her late father, Abraham Pikoos, Engr 1921, to assist students majoring in mathematics, physics, and engineering.

James F. Pitts Scholarship. Established in 2004 by James F. Pitts, Engr 1973, 1978 (M.S.), 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. Friends and colleagues of Lynn D. Poole, director of public relations at The Johns Hopkins University from 1946 to 1966, created a memorial scholarship fund in his honor in 1969. The scholarship is awarded annually to a financially needy and scholarly student studying humanities in the Krieger School of Arts and Sciences.

Timothy J. Popko Memorial Scholarship. This fund was established by Ethan Leder, BA '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 an 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 undergraduates in the field of political economy.

Guy T. Railey Memorial Scholarship Fund. Established in 2004 by Mrs. Beverly Railey, this scholarship honors Guy Railey, A&S '58, a longtime teacher and coach at Hopkins. The scholarship supports a lacrosse student.

Dr. and Mrs. William F. Railing Scholarship Fund. This scholarship was established on the occasion of Dr. Railing's 50th reunion. This scholarship will provide assistance to a third- or fourth-year undergraduate student in the Krieger School of Arts and Sciences, majoring in economics, who maintains a 3.0 grade point average and 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 will be awarded based on financial need, and preference will be given to students who are graduates of Baltimore City College.

Quest Systems Inc. Scholarship. This scholarship established in 1995 is awarded each semester to one senior majoring in computer science who is in the upper 20 percent of their class and selected by the department chair.

Anna Rappa Memorial Fund. This scholarship was established in 1984 by the family and friends of Mrs. Rappa to assist undergraduates in the 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 Fund. Established in 2000 by Howard J. Read, A&S '66. Mr. Read is a partner in the law firm of Read and Laniado in Albany, New York. This scholarship will support undergraduates in the Krieger School of Arts and Sciences.

Charles C. Charretton Reeder Scholarship Fund. Established in 1992 in memory of Mr. Reeder, Engr 1930, to provide scholarship support for undergraduate students in the Whiting School of Engineering.

Edward F. Reese, M.D., Memorial Scholarship. Established in 1991 by Ralph H. Reese in memory of his father, this scholarship is designated to support 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., Engr 1989, this scholarship will provide support to an undergraduate student in the Whiting School of Engineering who demonstrates financial need, and who intends to attend medical school.

George L. Rogosa Undergraduate Scholarship. Established in 2000, the scholarship shall be awarded to an undergraduate in the Krieger School of Arts and Sciences with financial need and strong academic promise.

Martha O. Roseman Scholarship. Established in 2000, this scholarship will be awarded to a need-based undergraduate in the Krieger School of Arts and Sciences. First preference will be given to an undergraduate with a diagnosed learning disability.

Roger and Bobbi Rosenberger Endowed Scholarship. Established in 1999 by Roger Rosenberger, Engr 1965 and his wife, Bobbi Rosenberger, to provide undergraduate scholarships for students in the Whiting School of Engineering.

Ben and Esther Rosenbloom Scholarship Fund. Created in 1990 to provide scholarships for undergraduate students.

John W. and Mary Lou Ross Scholarship Fund. Established in 2000 by John W. and Mary Lou Ross. This scholarship will support deserving undergraduate students in the Whiting School of Engineering who are citizens or permanent residents of the United States, academically eligible, and deserving of financial assistance. A preference will be given to engineering students majoring in materials science and engineering.

Rotary Club of Baltimore Scholarships. Established in 1984 for permanent residents of Maryland, with preference given to permanent residents of Baltimore.

The Rob Roy Scholarship Fund. Established in 2002 by Thomas L. Wheeler, Engr 1953, 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 in the Whiting School of Engineering.

Arthur C. Rubenstein Scholarship. To be awarded annually to students from the District of Columbia.

John F. Ruffle Endowed Scholarship Fund. Established in 2001 by John F. Ruffle, BA '58. This scholarship will support undergraduates in the Krieger School of Arts

and Sciences who, but for the financial assistance provided by this scholarship, would otherwise be unable to attend Johns Hopkins University.

Marshal and Janet Salant Homewood Scholarship. Established in 2006 by Marshal L. Salant, Engr 1980. The scholarship will support an undergraduate student in the Krieger School of Arts and Sciences or the Whiting School of Engineering. Preference will be given to students who major in either economics or applied mathematics and statistics.

Louis M. Sardella Endowed Scholarship for Engineering Undergraduates. Established in 1999 by Louis Sardella, Engr 1969, to support undergraduates in the Whiting School of Engineering with preference given to students from the greater Baltimore area.

Philip Schaefer Fund. This fund was established in 1930 by Mrs. Johanna Raegner of New York to honor Philip Schaefer by providing financial assistance to a deserving student from the city of Baltimore who demonstrates financial need.

Robert C. Scharf PTE Scholarship Fund. Established in 2001 by colleagues and friends of Robert C. Scharf, Engr 1959, who was an alumnus of Johns Hopkins University part-time engineering program. This fund provides scholarship support to part-time undergraduate civil engineering students with a preference for those from Anne Arundel County, and students whose needs resemble those of Robert C. Scharf some 45 years ago.

Dylan Schlott Endowed Scholarship Fund. Established in 2000, this undergraduate scholarship will support a member or members of the men's lacrosse team.

Richard S. Schlotterbeck Memorial Scholarship. Established in 2002 in memory of Richard S. Schlotterbeck, Engr 1937, to provide scholarship support to students majoring in an engineering discipline in the Whiting School of Engineering. Preference is given to first generation students.

Hermann O. Schmidt Memorial Fund JHU. This scholarship is for the benefit of undergraduate students in the Krieger School of Arts and Sciences.

Schrodel Endowed Scholarship Fund. Established by Charles S. Schrodel Jr., Engr 1957, through a planned gift announced in 2001, to benefit undergraduates in the Whiting School of Engineering.

Ruth and Herschel Seder Fund. 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, A&S '39, a university trustee emeritus, is president of Milwaukee Valve Company.

Ida and Jack Sekulow Scholarship Fund. Established in 1987 by Eugene Sekulow '53, Ph.D. '60, and Erwin Sekulow '59, in memory of their parents. Provides scholarship aid to needy undergraduates in the Krieger School of Arts and Sciences.

Barbara and M. Sigmund Shapiro Family Fund. Established by Samuel Shapiro and Company in 1980 to assist needy undergraduate students.

Klara Shorey Memorial Scholarship. Established in 1997 to provide support for undergraduate students in the Krieger School of Arts and Sciences majoring in Russian and literature.

Leonie Shorey Scholarship. Established in 1997 to provide support for undergraduate students in the Krieger School of Arts and Sciences majoring in French and literature.

Michael Shorey Memorial Scholarship. Established in 1997 to provide scholarships for undergraduate students in the Krieger School of Arts and Sciences majoring in chemistry.

Rajendra and Neera Singh Scholarship in the Whiting School of Engineering. Established in 2004 by Dr. and Mrs. Singh to provide need-based scholarship support to undergraduate students in the Whiting School of Engineering.

Albert and Elaine Slechter Scholarship for Engineering Undergraduates. Established in 1999 by Mr. Albert J. Slechter, Engr '62, and his wife, Elaine, to support an engineering undergraduate student with preference being given to Maryland residents based on need. Mr. Slechter is a founding member of the Society of Engineering Alumni.

Smilow Family Fund. Established in 1999 by Michael Smilow, BA '60, and his son David, BA '84, to provide scholarships to undergraduate students in 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.

Society of American Military Engineers Scholarship. Established in 1984 for senior students in the Whiting School. It is based on need, academic excellence, Maryland residency, and U.S. citizenship.

Garrett J. Solomon Scholarship. Established in 2003 by Garrett Solomon BA '93, this scholarship provides support for a Krieger School undergraduate from New Hampshire or the mid-Atlantic area who has declared a major in the humanities and demonstrates a commitment to extracurricular activities.

Scott and Margaret Starks Scholarship Fund. Established in 1999 by Scott Starks, A&S '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 students who are without sufficient funds to complete their undergraduate education.

Osmar Steinwald Memorial Fund. Established in 1995 to provide scholarships to undergraduates in the 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., a member of the Class of 1942. This scholarship is for a 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, A&S '72, in honor of his parents. To be awarded annually to an 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.

Summerfield Scholarships. This scholarship, which provides support to outstanding undergraduate students, is dedicated in memory of Solon E. Summerfield.

Louise and Earl Sweeney Scholarship Fund. 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, Engr 1934, and his wife, Jeannette Tabler. The scholarship provides support to undergraduate students majoring in an engineering discipline in the Whiting School of Engineering.

Morris and Charlotte Tanenbaum Scholarship Fund. This fund provides scholarships for undergraduate students in the Krieger School of Arts and Sciences.

John J. Tatum Memorial Scholarship. Established in 1994 by the estate of Beulah Benton Tatum, A&S '43 (Ph.D.), in honor of John J. Tatum, Engr '93 (M.A.), to provide scholarships for students in the Homewood Schools.

The Honorable Edward O. Thomas Scholarship Fund. Established in 2000 in honor of the Class of 1940's 60th reunion and to provide scholarship aid to undergraduate students in the Krieger School of Arts and Sciences who demonstrate financial need.

J. Trueman Thompson Student Aid Fund. 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 Fund. In celebration of Lauren's life, this scholarship was established in 2003 to support an undergraduate student in the Krieger School.

William S. Todman Sr. Scholarship. Established in 1977 by William S. Todman Sr., Class of 1938, for undergraduate students who demonstrate academic excellence and financial need.

Triumph Scholarship. Established in 1999 by Kenneth K. Yagura, Engr 1963, and his wife, Terry Yagura, to provide scholarship support to deserving undergraduate students from the Los Angeles area public school system, with preference given to students from urban public schools. The scholarship will be given to students based on financial need.

Isabel S. F. and Hadley K. Turner Scholarship Fund. 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.

Glen Wall/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 Fund. The Wallis Memorial Association established in 1906 a fund for scholarships to assist financially needy students.

Arthur and Clara Ward Scholarship. This endowed scholarship is in loving memory of Arthur and Clara Ward and is given by Dorothy Mears Ward and their son Arthur T. Ward Jr., B.A. 1933, M.S., 1939. Awards are based on academic merit and financial need.

Ward Machinery Company Scholarships. Established by the Ward Machinery Company and awarded to students in the Whiting School of Engineering based on financial need and academic merit.

Frederick C. Warring Memorial Scholarship. Established to provide scholarships to students who demonstrate need.

Earl Wasserman Memorial Scholarship. This scholarship was established by Stephen Weissman, Class of 1957, 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 undergraduates who demonstrate need.

Louis Weinberg Scholarship. Established in 1988 to provide undergraduate scholarships.

Westwind Scholarship in the Whiting School of Engineering. Established in 2004 to provide scholarship support to undergraduate students in the Whiting School of Engineering.

Captain Newton White Jr. Fund. Undergraduate scholarships provided for natives of Tennessee or Maryland with second preference given to natives of Alabama, Georgia, or Mississippi.

Jack and Frank Wilen Scholarship Fund. This endowment was 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 student who could not otherwise afford an education at Johns Hopkins.

Joseph S. Wimbrough and Robert W. Gelin Memorial Scholarship Fund. Established in 1976 by Mr. and Mrs. Joseph N. Wimbrough in memory of their sons, Joseph S. Wimbrough and Robert W. Gelin. Preference is given to engineering students who demonstrate financial need.

William E. Woodyear Scholarships. The William E. Woodyear Scholarships were 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 Fund. Established in 1996 by Donald W. Curtis, Engr 1938, to provide scholarship support to undergraduate students in the Whiting School of Engineering.

James Yewell Scholarship Fund. This fund was established in 2006 at the request of the late James M. Yewell. This fund is to be used for general scholarship aid.

Zitzmann Family Scholarship. Established in 1998 to support need-based undergraduates in the 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 for Whiting School students interested in physics by Dr. Baird, Engr '36, an electrical engineer and a trustee of the university. The award is based on academic merit.

Morgan M. Buchner Jr. Scholarship Endowment. Established in 1996 by Morgan M. Buchner Jr., Engr 1961, 1965 (Ph.D.), this endowment provides financial assistance to undergraduate students in the Whiting School of Engineering. The amount of the award and selection of the recipient is based on merit.

Crane-Huntington Endowed Scholarship Fund. Established in 2001 by Sharon Crane, BA '84, MED '90, and her husband, R. Danny Huntington, both patent attorneys in the biotechnology field 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.

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 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.

Heather Murphy Holmes Memorial Scholarship. This fund was established in 1996 by J. Scott and Suzanne Murphy Holmes in loving memory of their daughter, Heather. The scholarship is awarded to a Homewood schools undergraduate who has demonstrated a strong commitment to enhancing the lives of children living in the Baltimore community.

Geraldine Karetzky Jersey Girl Endowed Scholarship Fund. In honor of his mother's "special" birthday, Andy Karetzky, BA '88 and his wife, Pam, established the Geraldine Karetzky Jersey Girl Endowed Scholarship Fund. The fund will provide 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 Pamela Karetzky honor Geraldine Karetzky's commitment to higher education and her charitable spirit.

Phi Gamma Delta Scholarship. Awarded each semester to a fraternity member of Phi Gamma Delta who is not an officer and who best exemplifies the ideals of community-mindedness.

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.

Michael and Jacqueline Vassallo Scholarship. Established to award scholarships to students in the Krieger School of Arts and Sciences on the basis of true merit and non-discrimination.

Roger Westgate Scholarships in Engineering. Established in 1998 by Kwok-leung Li, Engr 1979, and his wife, Felice V. Li, (M.A.) 1980, in honor of Charles Roger Westgate, William B. Kouwenhoven Professor of Engineering at the Whiting School 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.

Yaffe Family Scholarship Fund. Established in 2000 by David Yaffe, BA '74 and his wife, Deborah. This scholarship will be used to support an undergraduate scholarship for a needy Krieger School of Arts and Sciences sophomore who did not receive a need-based grant funding in his/her freshman year. The scholarship will be awarded to an academically talented student who achieves a minimum 3.0 GPA.

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.

A.I.A.C. Memorial Scholarship No. 8. Scholarship support for a senior or last-year graduate student of Italian descent in the Whiting School of Engineering, based on need and academic excellence. Provided by the Associated Italian American Charities of Maryland in memory of Peter and Mary Torrieri.

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.

A.R.C.S. Foundation Fellowships. The Washington Chapter of the A.R.C.S. 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.

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.

William Brown Baxley Memorial Fund. Established in 1959 to aid needy and deserving students from Maryland who are candidates for a degree in the fields of engineering or science in the undergraduate, graduate, or part-time programs of the university. The students who are assisted will be known as the William Brown Baxley Scholars during the period they receive such aid. William Brown Baxley graduated in 1917 from the School of Engineering and lost his life in France in World War I while an officer in the American Expeditionary Forces.

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.

Gustav Bissing Fellowships. These fellowships were established by Mrs. Bessie L. Bissing, who requested that the income from a trust fund be used to establish Gustav Bissing Fellowships in honor of her late husband. These fellowships are to be traveling or resident and in mathematics, physics, ancient languages, or other related subjects.

Dr. Nathaniel Boggs Jr. Memorial Fellowship. This fellowship, established by Paula Boggs, A&S '81, in memory of her father, will support Hopkins 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, Engr 1960, in memory of his parents. Gordon Bowles, a mechanical engineer, was employed with C&P Telephone and Mrs. Bowles was an elementary school teacher.

Andrew and Elvira Bozzelli and S. James and Marion D'Alessandro Fellowship. Established in 1995 by Dolores and Andrew Bozzelli, Engr 1953, in honor of their parents, Andrew and Elvira Bozzelli and S. James and Marion D'Alessandro, to support outstanding M.S.E. degree candidates in the first semester of study in the Department of Biomedical Engineering.

Phillips and Camille Bradford Fellowship. Established in 2004 by Phillips Bradford, Engr '62, and his wife, Camille Bradford, to support deserving graduate students in 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.

Louis M. Brown Engineering Fellowship. Established in 2004 by Louis M. Brown Jr., Engr 1965, to support graduate students in 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.

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, A&S 1942, 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.

Ambrose Howard Carner Scholarship. This fellowship, established in 1946, is open to a native-born citizen of the United States of America and who shall be selected by the faculty of engineering.

Arthur Douglas Chambers and Ivan Fleming Chambers Fellowship. 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 endow two fellowships in the Department of Chemistry.

Howard and Jacqueline Chertkof Endowed Fellowship for Engineering Graduate Students. Established in 1999 by Howard L. Chertkof, Engr 1957, 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.

Estate of Walter Clark. 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.

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 Fund. Established in 2004 by Neil L. Cohen, Engr 1983, and his wife, Sherry Z. Cohen, in memory of Mr. Cohen's mother to provide support for graduate students in the Whiting School of Engineering.

Charles and Catherine Counselman Endowed Fellowship Fund in Mathematical Sciences. Established in 2000 by Charles C. Counselman, Engr '38 and his wife, Catherine Counselman, to provide financial aid to graduate students in the Department of Applied Mathematics and Statistics of the Whiting School of Engineering.

Creel Family Engineering Fellowship. Established in 2004 by George C. Creel, Engr 1955, to support graduate students in the Whiting School of Engineering.

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.

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 in American history.

A. Marshall Elliott Romance Scholarship. A bequest by Dr. A. Marshall Elliott established this scholarship for graduate students in the Department of German and Romance Languages and Literatures.

David 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 Krieger School of Arts and Sciences. Designated to endow a fellowship in the Krieger School of Arts and Sciences for the express purpose of attracting the most outstanding students.

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.

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 Department of German.

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.

Gregory Fellowship in Engineering. Established in 2005 by the estate of Richard Sears Gregory, Engr 1942, to support graduate students in the Whiting School of Engineering.

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, Engr 1950 (Ph.D.) to provide support to a doctoral student in the Department of Geography and Environmental Engineering.

Ferdinand Hamburger Jr. Fellowship in Electrical Engineering. 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. Established in 1994 by the estate of Dr. Hamburger, Engr 1924, 1931 (D.E.E.), and his wife, Opal L. Hamburger, A&S 1939 (M.A.).

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.

James Hart Fellowship in Political Science. By a bequest of Jane Lewis Hart, this fellowship in political science was established in 1972.

Carl E. Heath Fund. Established in 1999 by Dr. Carl E. Heath Jr., Engr 1952. The fund provides support for graduate women in the Whiting School of Engineering.

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.

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. Established in 1982 by the Department of Applied Mathematics and Statistics, in memory of Rufus Isaacs, engineering professor emeritus, to provide a first-year fellowship for a student in mathematical sciences in the Whiting School of Engineering.

Joel Stewart Ish Fellowship Fund. Established to honor the memory of Joel Stewart Ish, B.A. '69, M.A. '71, Ph.D. '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.

Nancy M. and George Simms Jenkins II Graduate Fellowship in Civil Engineering. This fellowship was created in 2000 by George and Nancy Jenkins to be awarded to a deserving graduate student in the Department of Civil Engineering of the Whiting School of Engineering.

Johnston Fellowships. Three Johnston Fellowships were founded by Mrs. Harriet Lane Johnston in memory of her husband and two sons. They are known as the Henry E. Johnston Fellowship, the James Buchanan Johnston Fellowship, and the Henry E. Johnston Jr. Fellowship. Students are selected by the university.

Martha and Rebecca Katz Graduate Loan Fund. This fund provides loans for graduate students in 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 the Department of History of Art.

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.

Zanvyl Krieger Walters Art Museum Fellowship in History of Art. Established in 1999 by Zanvyl Krieger, A&S '28, as a gift to, and matched by, The Walters Art Museum. The fellowship funds Hopkins 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 fel-

lows. 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.

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.

Land Scholarship. Established in 1991 by Dr. W. Everett Land '28, Ph.D. '33, and Mrs. Land, these scholarships provide support for undergraduate or graduate students in the departments of Chemistry or Chemical and Biomolecular Engineering.

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 in the schools of Arts and Sciences or Engineering.

Hassie Roseman Lichtenstein and Reuben Roseman Fellowship. Established by Dr. Ephraim Roseman, B.S. '33, in memory of his sister Hassie R. Lichtenstein and his brother Reuben (B.A. '29, Ph.D. Chemistry '33), the fellowship will support a graduate student in the Department of Chemistry.

Long and Widmont Foundation Fellowships. The Long and Widmont Foundation provides support for summer research projects for talented and financially needy doctoral students in the School of Arts and Sciences, Bloomberg School of Public Health, and the Peabody Institute.

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 and Romance Languages and Literatures Department.

Joseph Meyerhoff Scholarship Fund. Joseph Meyerhoff Scholarship Fund. Established in 1979 by Joseph Meyerhoff who had attended the university in 1918. The scholarship is to provide support to deserving students in the Whiting School of Engineering who major in civil engineering at the undergraduate or graduate level.

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.

Leonard Obert Graduate Fellowship Fund. Awards from this fund, which was set up through the generosity of Dr. Leonard Obert, Ph.D. '38, are made to graduate students in 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 in 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 in the Krieger School of Arts and Sciences who is interested in international relations.

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.

Payback Fellowship. Established in 2004 by an anonymous donor to support graduate students in the Whiting School of Engineering. The fund was established to "pay back" the state of Maryland for Senatorial Scholarships the donor received while attending Hopkins.

Francis J. Pettijohn Scholarship in Geology in the Department of Earth and Planetary Sciences. This scholarship will support a graduate student 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.

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.

David M. Robinson Fellowship. By the bequest of Dr. David M. Robinson, a traveling fellowship for studies at the American School of Classical Studies in Athens, Greece, was established. The fellowship is awarded periodically to a student who has done at least two years of graduate work in Greek and archaeology.

Donald S. Rodbell Memorial Graduate Fellowships in Materials Science and Engineering. Established in 1996 by Adele Rodbell in memory of her husband, Donald S. Rodbell, Engr 1949, 1953 (Ph.D.). The fellowship will 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 Fund. This fund was established to provide fellowships for graduate students in the Krieger School of Arts and Sciences.

The Sadie and Louis Roth Fellowship Fund. 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 Fellowships. Established in 1990 by various alumni and friends in recognition of Rob Roy, Engr '28, former dean of the School of Engineering. This fund supports fellowships for graduate education in the Whiting School of Engineering.

David Sachs Graduate Fellowships in Philosophy. Established in 1999 by the estate of David Sachs, professor emeritus of philosophy at Hopkins. 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, Engr 1960, in honor of his parents, Phil and Helen Samstag, to provide support for graduate students in the Whiting School of Engineering.

William H. Schwarz Instructorship in Undergraduate Chemical Engineering Laboratory. Established by alumni from the Class of 1953 to honor Chemical Engineering Laboratory instructor William H. Schwarz, 1951, 1955 (M.S.), 1957 (Ph.D.), and his commitment to making the Chemical Engineering Laboratory a defining moment of undergraduate education. This fellowship supports graduate students teaching the Chemical Engineering Laboratory undergraduate course.

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.

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.

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.

Student Aid Fund in Honor of Professors Emeriti of Engineering. This endowment fund was established by the Johns Hopkins engineers to honor professors in engineering who had reached the age of retirement. The income is to be used to aid deserving undergraduate and graduate students in engineering science. The fund honors John B. Whitehead, Alexander G. Christie, William B. Kouwenhoven, J. Trueman Thompson, Abel Wolman, Guy L. Bryan, Thomas B. Hubbard, Acheson J. Duncan, Ferdinand Hamburger Jr., Robert H. Roy, and John C. Geyer.

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.

Gaston I. Sweitzer Fellowship Fund. As a result of a bequest of Ida Lockwood Sweitzer, this fund was established to aid minority students in the Krieger School of Arts and Sciences.

Richard A. Swirnow Fund. Established in 1984 by Richard A. Swirnow, Engr 1961, to provide graduate student support in the Whiting School of Engineering.

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.

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 in 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/or tuition support.

Vogeler Memorial Archaeological Fund. This fund was established by the bequest of Mr. Charles A. W. Vogeler, a former student of the university. It is used in a variety of ways for work in the field of archaeology.

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.

Abel Wolman Graduate Fellowship. Established in 1986 by the Whiting School of Engineering in honor of long-time faculty member Abel Wolman, Engr 1915, to attract the strongest doctoral applicants. Wolman Fellowships are one-year, non-renewable awards of a stipend and full-tuition waiver, given on a competitive basis to outstanding first-year doctoral students.

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 in the 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. An award presented to the chemical and biomolecular engineering student with the highest scholastic standing after the sophomore year.

American Society of Civil Engineers Maryland Section Scholarship. This award is presented annually to an outstanding junior or senior in civil engineering who is a member of the Johns Hopkins American Society of Civil Engineering student chapter.

The American Society of Mechanical Engineers Award. An award presented in recognition of outstanding efforts and accomplishments on behalf of the ASME Student Section.

AT&T Outstanding Senior Award in Computer Science. This award is presented to a senior for demonstrated record of academic excellence, leadership, and service in computer science.

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 in his life outside.

James F. Bell Award. Established in honor of James F. Bell, professor emeritus in Mechanical Engineering, this award is presented to the outstanding mechanical engineering student in the freshman or sophomore class.

H. L. Brown Family Travel Award. Awarded to an undergraduate majoring in international studies to assist with travel expenses related to their major.

John D. Bruck Memorial Scholarship. This award is presented to an outstanding junior or senior civil engineering student.

Lucien Brush Award for Excellence in Environmental Engineering. Established in memory of Lucien M. Brush Jr., faculty member of the Department of Geography and Environmental Engineering (1969-94), this award is presented annually to the graduating senior with the highest academic achievement in environmental engineering.

Alexander R. 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.

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.

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 by the dean of the Whiting School of Engineering, is restricted to a sophomore or junior student. The purpose of this award is for the student to purchase a book of his or her choosing which will assist or complement their studies. It is hoped that the book will offer diversity in the student's course of study and help the student broaden his or her perspective as they move into the final years at Hopkins.

Creel Family Teaching Assitant Award. Established in 2004 by George C. Creel, Engr 1955, to honor a graduate student in the Department of Mechanical Engineering.

The Evangelia Davos Prize. Established in 2007 by Peter Davos (Class of 2000) in memory of his aunt, this prize is awarded annually to the Classics major or minor whose work in Greek studies has been outstanding.

Robert George Gerstmyer Award. Established in memory of Mr. Gerstmyer, Class of 1943, 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. Hammerman, Class of 1950. 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, awards are presented to a senior and a junior in 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.

IBM Outstanding Undergraduate Award in Computer Science. Awarded to an undergraduate for a demonstrated record of academic excellence, leadership, and service in computer science.

Richard J. Johns Award for Academic Achievement in Biomedical Engineering. 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 a Biomedical Engineering senior.

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 out-standing 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.

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.

Charles A. Miller Award. Named for Charles A. Miller Jr., A&S 1940, this award is presented to the outstanding mechanical engineering student in the junior or senior class.

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 \$1,000 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.

Muuss Research Award. Established by Dr. Rolf Muuss in honor of his son, Michael J. Muuss, 1979 graduate of the Johns Hopkins electrical engineering program, the award is given each year to a Computer Science undergraduate for the best application of research to practice.

Naddor Prize. This prize is awarded to an undergraduate 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. Pistrutto Research Award. This undergraduate research award in Computer Science was established in 2000 by Joseph C. Pistrutto, Engr 1979, an Electrical and Computer Engineering alumnus, to encourage research to advance the levels of online accessibility, speed, resolution malleability, and convenience in the retrieval, display, and storage of documents and images.

Professor 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.

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, Ph.D. '89, Chemistry, 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 a student for exceptional accomplishment in civil engineering.

Shriver-Howard Scholar Athlete Award. Established by Dr. William H. B. Howard, Class of 1963, 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. All symposium-related expenses are covered by the Smile Train Awards will be presented in the amount of \$2,500 to each Smile Train Scholar. Applicants must submit a proposed budget that may include expendable supplies, related travel, and living expenses. An additional stipend of \$500 is available to the faculty sponsor to defray costs associated with the project.

George M. L. Sommerman Engineering Graduate Teaching Assistant Award. This endowment provides an annual award to one or more Whiting School of Engineering graduate teaching assistants who have demonstrated excellence in their teaching responsibilities in the school. Preference is given to students who have demonstrated excellence and talent in instruction of undergraduate students. The associate dean of academic affairs in the Whiting School conducts selection of the Sommerman Award.

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 in 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.

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.

Florence "Meg" Long Walsh/Second Decade Society Leadership Award. This award was established in memory of Meg Walsh, BA '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 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 Engr 1954, this award is presented for a demonstrated record of academic excellence, leadership, and service in chemical and biomolecular engineering by graduating seniors.

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, MD '69, established the Bander Family Fund to support undergraduate independent study in 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.

The 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.

The J. Brien Key Graduate Student Assistance Fund. This fund is used to provide graduate students in 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.

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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.

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Aihud Pevsner, Ph.D.

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Decker Professor Emeritus

Earth and Planetary Sciences

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Harry C. Black Professor Emeritus

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Orest Ranum, Ph.D.

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Arnold Stein, Ph.D.

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Nancy Struever, Ph.D.

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James C. Walker, Ph.D.

Physics and Astronomy

Mack Walker, Ph.D.

History

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

David Altschuler (1987)

Adjunct Associate Professor, Sociology

Amanda Anderson (1999)

Professor and Chair, English

Caroline Donovan Professor in 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)

Assistant Professor, Sociology

B.A. 1995, University of Illinois at Chicago;

M.A. 1998, University of California, Los Angeles

N. Peter Armitage (2005)

Assistant Professor, Physics and Astronomy

B.Sc. 1994, Rutgers University

Ph.D. 2002, Stanford University

Giovanni Arrighi (1998)

Professor, Sociology

Dottore in Economia 1960, Universit Bocconi,

Milan

William Badecker (2002)

Associate Professor, Cognitive Science

B.A. 1973, LaSalle College

M.A. 1980, Indiana University

Ph.D. 1983, Indiana University

Jonathan Bagger (1989)

Professor and Chair, Physics and Astronomy; Mathematics

Krieger-Eisenhower Professor

A.B. 1977, Dartmouth;

M.A. 1980, Princeton, Ph.D. 1983

Gregory F. Ball (1991)

Professor, Psychological and Brain Sciences

B.A. 1977, Columbia; Ph.D. 1983, Rutgers

Laurence Ball (1/1994)

Professor, Economics

B.A. 1980, Amherst; Ph.D. 1986, M.I.T.

Bruce Barnett (1976)

Professor, Physics and Astronomy
B.A. 1965, Harvard;
Ph.D. 1970, University of Maryland

Burton Barnow (1992)

Adjunct Professor, Economics

Douglas Barrick (1997)

Associate Professor, Biophysics; Biology
B.A. 1986, University of Colorado;
Ph.D. 1993, Stanford

Steven Beckwith (9/1998)

Professor, Physics and Astronomy;
Space Telescope Science Institute
B.S. 1973, Cornell;
Ph.D. 1978, California Institute of Technology

Karen Beemon (1981)

Professor and Chair, Biology; Biophysics
B.S. 1969, University of Michigan;
M.A. 1972, UC Berkeley, Ph.D. 1974

David Bell (1996)

Professor, History
Andrew W. Mellon Professor in the Humanities
Dean of Faculty (2007)
Zanvyl Krieger School of Arts and Sciences
A.B. 1983, Harvard; M.A. 1987, Princeton,
Ph.D. 1991

Charles Bennett (1/2005)

Professor, Physics and Astronomy
B.S. 1978, University of Maryland
Ph.D. 1984, M.I.T.

Jane Bennett (2004)

Professor and Chair, Political Science
B.A. 1979, Siena College;
Ph.D. 1986, University of Massachusetts

Pamela Bennett (2004)

Assistant Professor, Sociology
B.A. 1992, Louisiana State University
M.A. 1995, Louisiana State University
Ph.D. 2002, University of Michigan

Sara S. Berry (1990)

Professor, History; Anthropology
B.A. 1961, Radcliffe;
M.A. 1965, University of Michigan, Ph.D. 1967

Maurice J. Bessman (1958)

Professor, BiologyMcCollum-Pratt Institute
A.B. 1949, Harvard; M.S. 1952, Tufts, Ph.D. 1955

Richard Bett (1991)

Professor, Philosophy, Classics
B.A. 1980, Oxford;
Ph.D. 1986, University of California

William Blair (12/1993)

Research Professor, Physics and Astronomy

Barry Blumenfeld (1981)

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B.S. 1968, M.I.T.; M.A. 1970, Columbia,
M.Phil. 1973, Ph.D. 1974

Mark Blyth (1977)

Associate Professor, Political Science
B.A. 1990, Strathclyde University;
M.A. 1993, Columbia, M.Phil. 1995, Ph.D. 1999

John Boardman (1969)

Professor, Mathematics
B.A. 1961, Cambridge University, Ph.D. 1965

Hilary Bok (2000)

Associate Professor, Philosophy
Henry R. Luce Professorship in Bioethics and
Moral and Political Theory
B.A. 1981, Princeton; Ph.D. 1991, Harvard

John Boland (2005)

Research Professor, Earth and Planetary Sciences

Doreen Bolger (3/1998)

Adjunct Professor, History of Art

Alex Bortvin (2004)

Adjunct Assistant Professor, Biology

Kit H. Bowen (1980)

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B.S. 1970, University of Mississippi;
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Michael Ching (2005)

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Basil L. Gildersleeve Professorship in Classics
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Russ Family Professorship in the Humanities
M.A. 1983, University of Leiden, Ph.D. 1989
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- Gabor Domokos** (1968)
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Joint Institute of Nuclear Research, Dubna, Russia
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University Professor, Physics and Astronomy
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Ru-Chih Huang (1965)

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Rutgers; Ph.D. 1982, University of Pennsylvania
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Zanvyl Krieger School of Arts and Sciences (2004)*
B.A. 1962, Harvard;
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- Yuan Chuan Lee** (1965)
Professor, Biology/McCollum-Pratt Institute
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- Geraldine Legendre** (1995)
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- Nettie E. Legters** (1996)
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A.B. 1989, Princeton;
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- Stuart W. Leslie** (1984)
*Professor, History of Science and Technology,
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Blum-Iury Professorship*
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- Ruth Leys** (1980)
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- Mario Livio** (1/1993)
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B.S. 1982, Griffith University
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- Louis Maccini** (1969)
Professor and Chair, Economics
B.S. 1965, Boston College;
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B.A. 1965, Cambridge University;
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M.A. 1988, Università degli studi di Pisa;
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B.S. 1985, SUNY at Albany; Ph.D. 1989,
University of Wisconsin
- Tobie Meyer-Fong** (2000)
Associate Professor, History
B.A. 1989, Yale; M.A. 1994, Stanford, Ph.D. 1998
- William P. Minicozzi II** (1994)
Professor, Mathematics
J.J. Sylvester Professor in Mathematics
B.A. 1990, Princeton; Ph.D. 1994, Stanford
- Sidney Mintz** (2004)
Research Professor, Anthropology
- Robert A. Moffitt** (1995)
Professor, Economics; Institute for Policy Studies
Public Policy Program
Krieger-Eisenhower Professor
B.A. 1970, Rice; M.A. 1972, Brown, Ph.D. 1975
- H. Warren Moos** (1964)
Professor, Physics and Astronomy
Gerhard H. Dieke Professorship in Physics and Astronomy
Sc.B. 1957, Brown, M.A. 1959;
Ph.D. 1961, University of Michigan
- Jack Morava** (1980)
Professor, Mathematics; Physics and Astronomy
Ph.D. 1969, Rice
- Philip Morgan** (2000)
Professor, History
Harry C. Black Professor in History
B.A. 1971, Cambridge University;
Ph.D. 1977, University College London
- Kenneth Moss** (2002)
Assistant Professor, History
Felix Posen Professor in Modern Jewish History
B.A. 1996, Rutgers University
- Evangelos N. Moudrianakis** (1965)
Professor, Biology; Biophysics
B.S. 1959, University of Athens;
M.A. 1963, Johns Hopkins University, Ph.D. 1964
- Dean Moyar** (2002)
Assistant Professor, Philosophy
B.S. 1994, Duke University; M.A. 1998,
University of Chicago, Ph.D. 2002
- Steven Muller** (1970)
Political Science Professorial Lecturer
President of the University (1972)
President Emeritus (1990)
- Jacques Neefs** (2006)
Professor, German and Romance Languages and Literatures
Maitrise 1968, Ecole Normale Supérieure (Ulm)
Ph.D. 1987, Université de Paris VIII
- David Neufeld** (1989)
Professor, Physics and Astronomy
B.A. 1981, Cambridge University;
M.Sc. 1983, University of Sussex;
Ph.D. 1987, Harvard
- Stephen Nichols** (1982)
Professor and Chair, German and Romance Languages and Literatures; Humanities Center
James M. Beall Professor of French
B.A. 1958, Dartmouth; Ph.D. 1963, Yale
- David Nirenberg** (2000)
Professor, History; German and Romance Languages and Literatures
Charlotte Bloomberg Professor in the Humanities
A.B. 1986, Yale; M.A. 1989, Princeton, Ph.D. 1992

- William Noel** (2004)
Adjunct Professor, History of Art
- Aaron Noonberg** (1989)
Adjunct Assistant Professor, Psychological and Brain Sciences
- Colin Norman** (12/1983)
Professor, Physics and Astronomy
B.E. 1969, University of Melbourne;
D.Phil. 1973, Oxford
- Antonella Nota** (2004)
Adjunct Professor, Physics and Astronomy
- Peter Lee Olson** (1977)
Professor, Earth and Planetary Sciences;
B.A. 1972, University of Colorado;
M.A. 1974, UC Berkeley, Ph.D. 1977
- Takashi Ono** (1969)
Professor, Mathematics
M.A. 1952, Tokyo University;
Ph.D. 1958, Nagoya University
- Thomas Osborn** (1987)
Professor, Earth and Planetary Sciences; Engineering
A.B. 1963, University of Illinois, M.S. 1964;
Ph.D. 1969, UC San Diego
- Katrin Pahl** (8/2005)
Assistant Professor, German and Romance Languages and Literatures
Maitrise 1992, Universite de Paris, IV, Sorbonne
Ph.D. 2001, University of California, Berkeley
- Anand Pandian** (2007)
Assistant Professor, Anthropology
B.A. 1994, Amherst University
Ph.D. 2004, University of California, Berkeley
- Peter Parshall** (1999)
Adjunct Professor, History of Art
- Owen M. Phillips** (1998)
Research Professor, Earth and Planetary Sciences
- Stephen Plank** (1997)
Assistant Professor, Sociology
B.A. 1990, Northwestern;
M.A. 1992, University of Chicago, Ph.D. 1995
- Douglas Poland** (1969)
Professor, Chemistry
B.A. 1961, Cornell, Ph.D. 1966
- Deborah Poole** (2002)
Professor, Anthropology
B.A. 1974, University of Michigan;
Ph.D. 1984, University of Illinois
- Gary H. Posner** (1969)
Professor, Chemistry
Jean and Norman Scowe Professorship in Chemistry
B.A. 1964, Brandeis; Ph.D. 1968, Harvard
- Lawrence Principe** (1997)
Professor, History of Science and Technology; Chemistry; Philosophy (2004)
Drew Family Professorship in the Humanities
B.A. and B.S. 1983, University of Delaware;
Ph.D. 1988, Indiana University;
Ph.D. 1996, Johns Hopkins University
- Peter Privalov** (1991)
Professor, Biology; Biophysics
Faculty of Physics 1956, Tbilisi University, Georgia USSR; Ph.D. 1964
- Lawrence Raifman** (1992)
Adjunct Assistant Professor, Psychological and Brain Sciences
- Brenda Rapp** (1994)
Professor, Cognitive Science; Psychological and Brain Sciences
B.S. 1979, University of Maryland;
M.A. 1987, Johns Hopkins University, Ph.D. 1991
- Daniel Reich** (1990)
Professor, Physics and Astronomy
B.A. 1977, Harvard, M.S. 1985;
Ph.D. 1988, University of Chicago
- Pamela Reynolds** (2002)
Professor, Anthropology
B.A. 1965, University of Cape Town, B.Ed. 1968,
Ph.D. 1984; M.Ed. 1970, Harvard; M.Lit. 1975,
University of Delhi
- Adam Riess** (1/2006)
Professor, Physics and Astronomy
B.S. 1992, M.I.T.
A.M. 1994, Harvard University
Ph.D. 1996, Harvard University
- Mark O. Robbins** (1/1986)
Professor, Physics and Astronomy
B.A. 1977, Harvard; M.A. 1977;
Ph.D. 1983, University of California
- Matthew Roller** (1994)
Professor and Chair, Classics
B.A. 1988, Stanford; M.A. 1990, UC Berkeley,
Ph.D. 1994
- George Rose** (2002)
Professor and Chair, Biophysics, Biology
Krieger-Eisenhower Professor
B.S. 1963, Bard College; M.S. 1972, Oregon State
University, Ph.D. 1976
- Saul Roseman** (1965)
Professor, Biology; McCollum-Pratt Institute
Ralph S. O'Connor Chair in Biology
B.S. 1941, City College of New York;
M.S. 1943, University of Wisconsin, Ph.D. 1948
- Justine Roth** (2003)
Assistant Professor, Chemistry
B.S. 1994, University of Florida
Ph.D. 2000, University of Washington
- William Rowe** (1982)
Professor, History
John and Diane Cooke Professor of Chinese History
A.B. 1967, Wesleyan; M.A. 1976, Columbia
University, Ph.D. 1980

- A. J. R. Russell-Wood** (1972)
Professor, History
Herbert Baxter Adams Professorship of History
B.A. 1963, University of Oxford, M.A. 1967,
D.Phil. 1967
- Elena Russo** (2000)
Professor, German and Romance Languages
and Literatures
Baccalaurat 1977, Lycée Chateaubriand;
Licence ès Lettres 1982, Université de Genève; Ph.D.
1988, Princeton
- David Rust** (2006)
Research Professor, Physics and Astronomy
- Mary Ryan** (2002)
Professor, History
John Martin Vincent Professor in History
B.A. 1967, University of Wisconsin, M.A. 1968; Ph.D.
1971, University of California
- Robert Rynasiewicz** (1986)
Professor, Philosophy
Sc.B. 1974, Brown;
Ph.D. 1981, University of Minnesota
- Lester M. Salamon** (1986)
Professor, Political Science
B.A. 1964, Princeton; Ph.D. 1971, Harvard
- Olya Samilenko** (1992)
Adjunct Associate Professor,
Language Teaching Center—Russian
- George Scangos** (1/1992)
Adjunct Professor, Biology
- Joel Schildbach** (1996)
Professor, Biology
B.A. 1986, Oregon State University;
Ph.D. 1992, Harvard
- Robert Schleif** (1989)
Professor, Biology, Biophysics
B.S. 1963, Tufts; Ph.D. 1967, UC Berkeley
- Ethan Schreier,** (2004)
Adjunct Professor, Physics and Astronomy
- Trina Schroer** (1/1990)
Professor, Biology
B.S. 1980, Stanford; Ph.D. 1986, UC San Francisco
- Glenn Schwartz** (1996)
Professor, Near Eastern Studies
Whiting Professorship of Archaeology
B.A. 1976, Yale, M.Phil. 1980, Ph.D. 1982
- Howard H. Seliger** (1963)
Research Professor, Biology; McCollum-Pratt Institute
- Joseph Shalika** (1971)
Professor, Mathematics
A.B. 1961, Johns Hopkins University, Ph.D. 1966
- Alan Shapiro** (1997)
Professor, Classics; History of Art
W. H. Collins Vickers Professorship in Archaeology
B.A. 1971, Swarthmore; M.A. 1972, UC Berkeley;
Ph.D. 1977, Princeton
- Adam Sheingate** (2000)
Assistant Professor, Political Science
B.S. 1991, University of Wisconsin, M.A. 1993;
Ph.D. 1998, Yale
- Amy Shelton** (1/2002)
Assistant Professor, Psychological and Brain Sciences
B.S. 1993, Illinois State University;
Ph.D. 1999, Vanderbilt
- Bernard Shiffman** (1973)
Professor, Mathematics
B.S. 1964, M.I.T.;
Ph.D. 1968, University of California
- Vyacheslav Shokurov** (1991)
Professor, Mathematics
D.Sc. 1976, Steklov Institute; Ph.D. 1976, Moscow
State University
- Stephen Shore** (2007)
Assistant Professor, Economics
A.B. 1998, Princeton University
M.A. 2001, Harvard University
Ph.D. 2003, Harvard University
- Matthew Shum** (2000)
Associate Professor, Economics
B.A. 1992, University of Toronto;
Ph.D. 1998, Stanford
- Harry Sieber** (1967)
Professor, German and Romance Languages and
Literatures; History
B.A. 1963, Baylor; Ph.D. 1967, Duke
- Beverly J. Silver** (1992)
Professor, Sociology
B.A. 1980, Barnard;
Ph.D. 1992, SUNY, Binghamton
- Harris J. Silverstone** (1/1965)
Professor, Chemistry
A.B. 1960, Harvard;
Ph.D. 1964, California Institute of Technology
- Robert E. Slavin** (1976)
Adjunct Professor, Sociology
- David Smith** (1/2003)
Professor and Chair, Writing Seminars
Elliott Coleman Professorship
B.A. 1965, University of Virginia
M.A. 1969, Southern Illinois University;
Ph.D. 1976, Ohio University
- Wayne Smith** (2000)
Adjunct Professor, Political Science;
Director, JH Cuba Exchange Program
- Paul Smolensky** (1994)
Professor, Cognitive Science
Krieger-Eisenhower Professor
A.B. 1976, Harvard; M.S. 1977, Indiana University,
Ph.D. 1981

- Christopher Sogge** (1996)
Professor, Mathematics
B.A. 1982, University of Chicago;
Ph.D. 1985, Princeton
- Lester Spence** (2005)
Assistant Professor, Political Science
B.A. 1991, University of Michigan
Ph.D. 2001, University of Michigan
- Gabrielle Spiegel** (1993)
Professor and Chair, History
Krieger-Eisenhower Professor
B.A. 1964, Bryn Mawr; M.A.T. 1965, Harvard;
M.A. 1970, Johns Hopkins University, Ph.D. 1974
- Allan Spradling** (1980)
Adjunct Professor, Biology; Carnegie Institution
- Joel Spruck** (1992)
Professor, Mathematics
B.S. 1967, Columbia University;
M.S. 1969, Stanford, Ph.D. 1971
- Steven Stanley** (1969)
Adjunct Professor, Earth and Planetary Sciences
A.B. 1963, Princeton; Ph.D. 1968, Yale
- Craig Stark** (2001)
Assistant Professor, Psychological and Brain Sciences
A.B. 1992, Harvard; Ph.D. 1997, Carnegie Mellon
- Walter Stephens** (1999)
Professor, German and Romance Languages
and Literatures
Charles S. Singleton Professorship in Italian Studies
B.A. 1972, Yale, M.A. 1976; Ph.D. 1979, Cornell
- Mark Stiles** (2004)
Adjunct Professor, Physics and Astronomy
- Maureen Stone** (1996)
Adjunct Professor, Cognitive Science
- Carl Strehlke** (1998)
Adjunct Professor, History of Art
- Darrell F. Strobel** (1984)
Professor, Earth and Planetary Sciences;
Physics and Astronomy
B.S. 1964, North Dakota State University;
A.M. 1965, Harvard, Ph.D. 1969
- Veit Stuphorn** (2004)
Assistant Professor, Psychological and Brain Sciences;
Mind/Brain Institute
B.S. 1993, Ph.D. 1998, Ruhr-Universität Bochum,
Germany
- Raman Sundrum** (2000)
Professor, Physics and Astronomy
Alumni Centennial Professor
B.Sc. 1984, University of Sydney; Ph.D. 1990, Yale
- Dimitri A. Sverjensky** (1984)
Professor, Earth and Planetary Sciences
B.S. 1974, University of Sydney; M.Phil. 1977, Yale,
Ph.D. 1980
- Morris Swartz** (1998)
Professor, Physics and Astronomy
B.S. 1976, Worcester Polytechnic Institute;
Ph.D. 1983, University of Chicago
- Alexander Szalay** (1989)
Professor, Physics and Astronomy
Alumni Centennial Professor
B.Sc. 1969, Kossuth University;
M.Sc. 1972, Eotvos University, Ph.D. 1975
- Katalin Szlavecz** (1998)
Associate Research Professor, Earth and Planetary Sciences
- Oleg Tchernyshyov** (2002)
Assistant Professor, Physics and Astronomy
Engineer-physicist 1990, Moscow Institute of Physics
and Technology; Ph.D. 1998, Columbia University
- Zlatko Tesanovic** (1987)
Professor, Physics and Astronomy
B.Sc. 1979, University of Sarajevo;
Ph.D. 1985, University of Minnesota
- Rochelle Tobias** (1996)
Associate Professor, German and Romance Languages
and Literatures
B.A. 1985, Bryn Mawr; M.A. 1990, UC Berkeley,
Ph.D. 1996
- Joel Tolman** (2002)
Assistant Professor, Chemistry
B.A. 1990, Rutgers; Ph.D. 1997, Yale
- John Toscano** (1995)
Professor and Chair, Chemistry
B.A. 1987, Princeton; Ph.D. 1993, Yale
- John Tovar** (2005)
Assistant Professor, Chemistry
B.S. 1997 UCLA.; Ph.D. 2002, M.I.T.
- Craig Townsend** (1976)
Professor, Chemistry; Biophysics
Alsoph H. Corwin Chair in Chemistry
B.A. 1969, Williams; Ph.D. 1974, Yale
- Kellee Tsai** (2000)
Associate Professor, Political Science
B.A. 1989, Barnard; M.Phil. 1996, Columbia
University, Ph.D. 1999
- Kathryn Tuma** (2005)
Assistant Professor, History of Art
Second Decade Society Career Development Professorship
A.B. 1991, Harvard University;
M.A. 1993 UC Berkeley, Ph.D. 2000
- Herica Valladares** (2005)
Assistant Professor, Classics
B.A. 1995 Oberlin College;
M.A. 1999, Columbia University, M.Phil. 2000,
Ph.D. 2005
- Roeland Van der Marel** (2002)
Adjunct Professor, Physics and Astronomy
- Mark Van Doren** (1999)
Associate Professor, Biology
B.A. 1987, Cornell; Ph.D. 1994, UC San Diego

- David R. Veblen** (1981)
Professor, Earth and Planetary Sciences; Engineering
B.A. 1969, Harvard, M.A. 1974, Ph.D. 1976
- Gary Vikan** (1984)
Adjunct Professor, History of Art
- Ben Vinson** (2006)
Professor, History
A.B. 1992, Dartmouth University
M.Phil, M.A. 1992, Columbia University
Ph.D. 1998, Columbia University
- Ethan T. Vishniac** (8/1998)
Professor, Physics and Astronomy;
Director, Center for Astrophysical Sciences
B.S/B.A. 1976, University of Rochester;
Ph.D. 1980, Harvard
- Judith Walkowitz** (1989)
Professor, History
A.B. 1967, University of Rochester, M.A. 1968,
Ph.D. 1974
- Ronald Walters** (1970)
Professor, History
A.B. 1963, Stanford; M.A. 1965, UC Berkeley;
Ph.D. 1971
- Darryn W. Waugh** (1997)
Professor and Chair; Earth and Planetary Sciences
Morton K. Blaustein Professorship and Chair in
Earth and Planetary Sciences
B.S. 1985, University of Waikato; M.S. 1987;
Ph.D. 1991, University of Cambridge
- Hal Weaver** (2006)
Research Professor, Physics and Astronomy
- Kimberly Weaver** (1998)
Adjunct Professor, Physics and Astronomy
- Beverly R. Wendland** (1998)
Associate Professor, Biology
B.S. 1986, UC San Diego; Ph.D. 1994, Stanford
- Richard Wentworth** (1998)
Professor and Chair, Mathematics
B.S. 1985, University of Wisconsin;
Ph.D. 1990, Columbia University
- Raymond Westbrook** (1989)
Professor, Near Eastern Studies; Classics
B.A. 1968, Oxford University;
Ll.M 1970, Hebrew University; Ph.D. 1982, Yale
- Edith Widder** (5/2000)
Adjunct Research Professor, Earth and Planetary Sciences
- Graeme Wilkin** (2006)
J. J. Sylvester Assistant Professor, Mathematics
B.Eng. 1997, Melbourne University
B.Sc. 1999, Melbourne University
Sc.M. 2003, Brown University
Ph.D. 2006, Brown University
- Meredith Williams** (2000)
Professor, Philosophy
B.A. 1969, New York University;
M.A. 1970, University of Chicago;
Ph.D. 1974, New York University
- Michael Williams** (2000)
Professor and Chair, Philosophy
Krieger-Eisenhower Professor
B.A. 1968, Oxford University;
Ph.D. 1973, Princeton
- Robert Williams** (11/1993)
Adjunct Professor, Physics and Astronomy
- W. Stephen Wilson** (1977)
Professor, Mathematics
S.B. 1968, M.I.T., S.B. 1969; Ph.D. 1972
- Sarah Woodson** (3/1999)
Professor, Biophysics; Biology
B.A. 1982, Kalamazoo College; Ph.D. 1987, Yale
- Tiemen Woutersen** (2004)
Assistant Professor, Economics
B.A. University of Groningen
A.M. 2000, Brown University
Ph.D. 2000, Brown University
- Rosemary Wyse** (1987)
Professor, Physics and Astronomy
B.Sc. 1978, University of London;
Ph.D. 1982, University of Cambridge
- Steven Yantis** (1986)
Professor, Psychological and Brain Sciences;
Cognitive Science
B.S. 1978, University of Washington;
Ph.D. 1985, University of Michigan
- David R. Yarkony** (1977)
Professor, Chemistry
D. Mead Johnson Professor in Chemistry
B.A. 1971, SUNY Stony Brook;
Ph.D. 1975, UC Berkeley
- Dimitrios Yatromanolakis** (2003)
Assistant Professor, Classics
- H. Peyton Young** (1994)
Professor, Economics
Scott and Barbara Black Chair in Economics
B.A. 1966, Harvard;
Ph.D. 1970, University of Michigan
- Raffaella Zanuttini** (1996)
Adjunct Associate Professor, Cognitive Science
- Melinda Zeder** (2001)
Adjunct Professor, Near Eastern Studies
- Steven Zelditch** (1985)
Professor, Mathematics
B.A. 1975, Harvard; M.S. 1978, University of
California, Ph.D. 1981
- Qiao Zhang** (2003)
Assistant Professor, Mathematics
B.S. 1996, Shandong University, China, M.S. 1998;
Ph.D. 2003 Columbia University, China
- Haiqing Zhao** (2002)
Assistant Professor, Biology
B.S. 1985, Beijing University, M.S. 1988;
Ph.D. 1997, Yale University

Yixian Zheng (1999)
Adjunct Associate 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

Douglas Basford, M.A.
The Writing Seminars 2000 (part-time)

Mary M. Bensabat-Ott, Ph.D.
Senior Lecturer
German and Romance Languages and Literatures 9/1991

Vivian Braun, M.A.
Near Eastern Studies 1991

Lucy Bucknell, M.A.
The Writing Seminars 2000 (part-time)
English 2002

Beatrice Caplan, Ph.D.
German and Romance Languages and Literatures 2006

Donald J. Clark Jr., M.A.
Senior Lecturer, German and Romance Languages and Literatures 2002

Michele Cotton, Ph.D.
Senior Lecturer, English 2005

Annalisa Czeczulin, M.A.
Language Teaching Center—Russian 2003 (part-time)

Tristan Davies, M.A.
Senior Lecturer
The Writing Seminars 1987; 1997

Dariush Dehghan, Ph.D.
Language Teaching Center—Persian 2006 (part-time)

Linda DeLiberio, M.A.
Senior Lecturer, English 2001

DeAnn DeLuna, Ph.D.
The Writing Seminars 1/97 (part-time)

Maria del Mar Encinas, Ph.D.
German and Romance Languages and Literatures 2000

Stephen Drigotas, Ph.D.
Senior Lecturer
Psychological and Brain Sciences 2004

William Evans, M.F.A., M.A.
Senior Lecturer, English 2005

Liping Feng, Ph.D.
Language Teaching Center—Chinese 1995

Patrick Fleming, Ph.D.
Biophysics 2004

James D. Goodyear, Ph.D.
Senior Lecturer
History of Science and Technology 2000

Linda Gorman, Ph.D.
Senior Lecturer
Psychological and Brain Sciences 2004

Claude Guillemard, D.E.A.
Senior Lecturer
German and Romance Languages and Literatures 1991

Stephen Harris, J.D.
Sociology 1/1993 (part-time)

Floyd Hayes, Ph.D.
Senior Lecturer
Political Science 2004

Robert Horner, Ph.D.
Biology 1989

Rebecca Hsieh, M.S.
Language Teaching Center—Chinese 2000

Patricia Kain, M.A.
Senior Lecturer
English 2004

Choonwon Kang, Ph.D.
Language Teaching Center—Korean 1990

Satoko Katagiri, M.A.
Language Teaching Center—Japanese 2003

Jian Kong, Ph.D.
Senior Lecturer
Mathematics 2004

Liman Lievens, B.A.
Language Teaching Center—Chinese 1996

Eunice Maguire, Ph.D.
Senior Lecturer
History of Art 2000

John Mann, Ed.D.
Senior Lecturer
English 2004

Deborah Mifflin, M.A.
German and Romance Languages and Literatures 1999

Yasmina Mobarek, Ph.D.
Senior Lecturer
German and Romance Languages and Literatures 2000

Hannah Mugambi, Ph.D.
Language Teaching Center—Kiswahili 2006 (part-time)

Makiko Nakao, M.A.
Language Teaching Center—Japanese 1994

Carolyn Norris, Ph.D.
Senior Lecturer
Biology 2000

Felicity Northcott, B.A.
Senior Lecturer, Anthropology
Associate Director, Institute for Global Studies in Culture, Power, and History

Sakiko Olsen, Ph.D.

Senior Lecturer

Earth and Planetary Sciences 1996

Patricia Palmer, M.A.

Lecturer and Coordinator, ESL

Language Teaching Center—2004 (part-time)

Rebecca Pearlman, Ph.D.

Biology 2001

Swadesh Rana, Ph.D.

Language Teaching Center—Hindi 2006 (part-time)

Ellen Robbins, Ph.D.

Near Eastern Studies 1992

Elizabeth Rodini, Ph.D.

History of Art 2004

Suzanne Roos, Ph.D.

German and Romance Languages and Literatures 1993

Uma Saini, M.A.

Language Teaching Center—Hindi 2000

Director, Language Teaching Center

Loreto Sánchez Serrano, M.A.

Senior Lecturer

German and Romance Languages and Literatures 1999

Ida Shekel, M.A.

Near Eastern Studies 1995 (part-time)

Doris Yaffe Shiffman, M.L.A.

Language Teaching Center—English as a Second

Language 9/1989

Katalin Szlavecz, Ph.D.

Senior Lecturer

Earth and Planetary Sciences 1998

Khalil Tahrawi, Ph.D.

Language Teaching Center—Arabic 2004

Tina Trapane, Ph.D.

Senior Lecturer

Chemistry 1999

Magda von der Heydt, Ph.D.

Senior Lecturer

Sociology 2006

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

Kazue Yamamoto Zon, M.A.

Language Teaching Center—Japanese 1992

Military Science

Kenneth A. Romaine Jr.

Lieutenant Colonel

Director and Professor of Military Science

Derick Beatty

Sergeant First Class

Army Instructor

Matthew Eversmann

Master Sergeant

Senior Army Instructor

Thomas Langston

Captain

Assistant Professor of Military Science

Lezlie Shackell

Major

Assistant Professor of Military Science

Amy Wallace

Captain

Assistant Professor and Recruiting Officer of Military Science

Joint Appointments

Emily Agree, Ph.D.

Associate Professor (Public Health)

Sociology 1/1996

Marilyn Albert, Ph.D.

Professor (Medicine)

Psychological and Brain Sciences 2005

Nan Marie Astone, Ph.D.

Associate Professor (Public Health)

Sociology 1989

David Bishai, Ph.D.

Associate Professor (Public Health)

Economics 2006

Dana F. Boatman

Associate Professor (Medicine)

Cognitive Science 5/1993

Samuel Boyer, Ph.D.

Professor Emeritus (Medicine)

Biology 1973

Shiyi Chen, Ph.D.

Professor (Engineering)

Physics and Astronomy 4/2006

Bernice Cohen, Ph.D.

Professor (Public Health)

Biology 1973

Nathaniel Comfort, Ph.D.

Associate Professor (Medicine)

History of Science and Technology 2004

Charles Edward Connor, Ph.D.

Associate Professor (Medicine)

Psychological and Brain Sciences 2006

Krieger Mind/Brain Institute

Robert Dalrymple, Ph.D.

Professor (Engineering)

Earth and Planetary Sciences 1/2002

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

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

Mary Fissell, Ph.D.

Professor (Medicine)

History 1/2007

History of Science and Technology 1/1992

Kevin Frick, Ph.D.

Associate Professor (Public Health)

Economics 1997

Barry Gordon, M.D.

Professor (Medicine)

Cognitive Science 1992

David Gracias, Ph.D.

Assistant Professor (Engineering)

Chemistry 2004

Steve Hanke, Ph.D.

Professor (Engineering)

Economics 1971

Jennifer Haythornthwaite, Ph.D.

Associate Professor (Medicine)

Psychological and Brain Sciences 1996

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.

Associate 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

Frederick Jelinek, Ph.D.

Professor (Engineering)

Cognitive Science 1994

Howard Katz, Ph.D.

Professor (Engineering)

Chemistry 2004

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

Harry Marks, Ph.D.

Associate Professor (Medicine)

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

Victor McKusick, Ph.D.

Professor (Medicine)

Biology 1973

Richard Miech, Ph.D.

Assistant Professor (Public Health)

Sociology 2000

Barbara Migeon, M.D.

Professor (Medicine)

Biology 1978

Albert S. Mildvan, M.D.

Professor (Medicine)

Chemistry 1980

Graham Mooney, Ph.D.

Assistant Professor (Medicine)

History of Science and Technology 2004

Laura Morlock, Ph.D.

Professor (Public Health)

Sociology 1975

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

Randall Packard, Ph.D.

Professor (Medicine)
History 2003
History of Science and Technology 1/2002

David S. Salkever, Ph.D.

Professor (Public Health)
Economics 1976

Erica J. Schoenberger, Ph.D.

Professor (Engineering)
Anthropology 1989

Peter Searson, Ph.D.

Professor (Engineering)
Physics and Astronomy 4/2006

Barbara Sollner-Webb, Ph.D.

Professor (Medicine)
Biology 1/1992

Daniel Todes, Ph.D.

Professor (Medicine)
History of Science and Technology 1984

Amy Ong Tsui, Ph.D.

Professor (Public Health)
Sociology 2002

David Valle, M.D.

Professor (Medicine)
Biology 1/1992

Bert Vogelstein, M.D.

Professor (Medicine)
Biology 1/1992

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.

Assistant Professor (Engineering)
Chemistry 2001

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

Alan J. Goldman, Ph.D.

Applied Mathematics and Statistics

Moise H. Goldstein Jr., D.Sc.

Electrical and Computer Engineering

Willis Gore

Electrical and Computer Engineering

Richard I. Joseph, Ph.D.

Electrical and Computer Engineering

Jerome Kruger, Ph.D.

Materials Science and Engineering

Charles R. O'Melia, Ph.D.

Geography and Environmental Engineering

C. Harvey Palmer Jr., Ph.D.

Electrical and Computer Engineering

Robert B. Pond Sr., B.S.

Materials Science and Engineering

Wilson J. Rugh, Ph.D.

Electrical and Computer Engineering

Eugene D. Shchukin (1994)

Research Professor Emeritus, Geography and Environmental Engineering

Charles (Roger) Westgate, Ph.D.

Electrical and Computer Engineering

Professors

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 (1989)

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

Juan I Arvelo, Jr., (2004)

Assistant Research Professor, Mechanical Engineering

Dilipkumar Asthagiri (2006)

Assistant Professor, Chemical & 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)

Assistant 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

Patrick Barta (2003)

Associate Research Professor, Center for Imaging Science

Michael J. Betenbaugh (1988)

Professor, Chemical and Biomolecular Engineering

B.S. 1981, University of Virginia;

Ph.D. 1988, University of Delaware

Edward J. Bouwer (1985)

Professor, Geography and Environmental Engineering;

Civil Engineering

B.S. 1977, Arizona State University;

M.S. 1978, Stanford, Ph.D. 1982

Grace S. Brush (1981)

Professor, Geography and Environmental Engineering

B.S. 1949, St. Francis Xavier University;

M.S. 1951, University of Illinois;

Ph.D. 1956, Radcliffe

Philippe Burlina (2007)

Assistant Research Professor, Computer Science

Randal Burns (2001)

Assistant Professor, Computer Science

B.S. 1993, Stanford; M.S. 1997, UC Santa Cruz,

Ph.D. 2000

- Ilene J. Busch-Vishniac** (1998)
Professor, Mechanical Engineering
B.S./B.A. 1976, University of Rochester;
M.Sc. 1978, M.I.T., Ph.D. 1981
- William Byrne** (2001)
Associate Research Professor, Electrical and Computer Engineering
- Robert C. Cammarata** (1987)
Professor and Chair, Materials Science and Engineering; Mechanical Engineering
B.S. 1979, M.I.T.; M.S. 1980, Harvard, Ph.D. 1985
- Gert Cauwenberghs** (1994)
Research Professor, Electrical and Computer Engineering
- Shiyi Chen** (1999)
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 and Chair, 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
- Jonathan Cohen**
Assistant Research Professor, Computer Science
- Robert Cole**
Assistant Research Professor, Computer Science
- A. Brinton Cooper** (2001)
Associate Research Professor, Electrical and Computer Engineering
- Noah Cowan** (2003)
Assistant Professor, Mechanical Engineering; Computer Science
B.S. 1995, Ohio State, M.S., 1997;
Ph.D. 2001 University of Michigan
- Robert A. Dalrymple** (2002)
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
- Christopher Diehl** (2004)
Assistant Research Professor, Electrical and Computer Engineering
- Marc D. Donohue** (1979)
Professor, Chemical and Biomolecular Engineering
Associate Dean for Research, Whiting School of Engineering (1999), Director, Advanced Technology Lab; Center for Education and Outreach
B.S. 1973, Clarkson College of Technology;
Ph.D. 1977, UC Berkeley
- Bharat Doshi** (2004)
Research Professor, Department of Computer Science
- Andrew S. Douglas** (1983)
Professor, Mechanical Engineering; Biomedical Engineering
Associate Dean for Academic Affairs, Whiting School of Engineering (1999)
B.S. 1975, University of Cape Town, M.S. 1977;
Ph.D. 1982, Brown
- German Drazer** (2005)
Assistant Professor, Chemical & Biomolecular Engineering
B.S. 1991, University of Buenos Aires
M.S. 1994, University de Cuyo & Instituto Balseiro
Ph.D. 1999
- Jason Eisner** (2000)
Assistant Professor, Computer Science
B.S. 1990, Harvard; M.S. 1993, Cambridge University; Ph.D. 2001, University of Pennsylvania
- Virantha N. Ekanayake** (2005)
Assistant Professor, Electrical and Computer Engineering
B.E. and B.A. 1999, Dartmouth College;
M.Sc. 2003, Cornell University, Ph.D. 2004
- Jennifer Elisseff** (2001)
Assistant Professor, Biomedical Engineering
B.S. 1994, Carnegie Mellon;
Ph.D. 1999, Harvard M.I.T.
- J. Hugh Ellis** (1984)
Professor, Geography and Environmental Engineering; Chair, Civil Engineering
B.S. 1979, University of Waterloo, M.S. 1981,
Ph.D. 1984
- Hana El Samad** (2007)
Assistant Professor, Electrical & Computer Engineering
B.E. 1998, American University of Beirut
M.S. 1999, Iowa State University
Ph.D. 2004, University of California at Santa Barbara
- Jonah Erlebacher** (2000)
Associate Professor, Materials Science and Engineering; Chemical and Biomolecular Engineering
B.S. 1991, Yale; Ph.D. 1999, Harvard
- Ralph R. Etienne-Cummings** (1998)
Associate 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
- 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

Gabor Fitchinger (2002)

Associate Research Professor, Computer Science; Mechanical Engineering

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

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)

Assistant 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)

Assistant Professor, Chemical and Biomolecular Engineering
B.S.E. 1994, University of Michigan;
Ph.D. 2000, University of Texas

Robert E. Green Jr. (1960)

Professor, Materials Science and Engineering
Theophilus Halley Smoot Professor of Engineering
B.S. 1953, William and Mary; M.S. 1956, Brown;
Ph.D. 1959

Joseph Greenstein (2005)

Assistant Research Professor, Biomedical Engineering

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

Gregory D. Hager (1999)

Professor, Computer Science; Electrical and Computer Engineering
B.S. 1983, Luther College;
M.S. 1985, University of Pennsylvania, Ph.D. 1988

Keith Hall

Assistant Research Professor, Computer Science

Roger Hammons

Assistant Research Professor, Electrical & Computer Engineering

Shih-Ping Han (1989)

Professor, Applied Mathematics and Statistics
B.S. 1968, National Taiwan University;
M.S. 1971, University of Wisconsin, Ph.D. 1974

Justin Hanes (1998)

Associate Professor, Chemical and Biomolecular Engineering; Biomedical Engineering
B.S. 1991, UCLA; Ph.D. 1998, M.I.T.

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, 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

Reagan Herman (2007)

Assistant Research Professor & Lecturer, Civil Engineering

Markus Hilpert (2002)

Assistant Professor, Geography and Environmental Engineering
B.S. 1993, University of Karlsruhe, Germany;
Dr-Ing., 1997

Benjamin F. Hobbs (1996)

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 (2007)

Assistant Professor, Computer Science
B.S. 2000, Ohio State University
M.S. 2003, MIT; Ph.D. 2006, MIT

Emanuel Horowitz (1981)

Professor, Materials Science and Engineering (part-time)

Kalina Hristova (2001)

Assistant 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

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

Bruno Jedynak (2003)

Assistant Research Professor, Applied Mathematics and Statistics

Frederick Jelinek (1993)

Professor, Electrical and Computer Engineering; Director, Center for Language and Speech Processing; Computer Science
Julian Sinclair Smith Professor of Electrical and Computer Engineering
 B.S. 1956, M.I.T., M.S. 1958, Ph.D. 1962

Nicholas P. Jones (2004)

Dean, Whiting School of Engineering (2004); Professor of Civil Engineering (2004)
 B.E. 1980, The University of Auckland;
 M.S. 1981, California Institute of Technology,
 Pasadena, Ph.D. 1986

Jin Ung Kang (1999)

Professor, 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

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, Materials Science and Engineering
 B.S. 1978, Massachusetts Institute of Technology
 Ph.D. 1982, UCLA

Joseph Katz (1987)

Professor, Mechanical Engineering; Dept. of Geography and Environmental Engineering
 B.S. 1977, Tel Aviv University; M.S. 1978,
 California Institute of Technology, Ph.D. 1982

Joseph L. Katz (1979)

Professor, Chemical and Biomolecular Engineering; Materials Science and Engineering
 B.S. 1960, University of Chicago, Ph.D. 1963

Peter Kazanzides (2003)

Assistant 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)

Assistant 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

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)

Associate Professor, Chemical and Biomolecular Engineering; Biomedical Engineering
 B.S. 1989, National Technology University of Athens;
 Ph.D. 1995, Rice

S. Rao Kosaraju (1970)

Professor, Computer Science; Applied Mathematics and Statistics
Edward J. Schaefer Professor in Engineering
 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

Subodh Kumar (2004)

Assistant Research Professor, Computer Science

Eva Lai (2005)

Assistant Research Professor, Chemical & Biomolecular Engineering

Andre Levchenko (2001)

Assistant 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

Hai-Quan Mao (2002)

Assistant 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

Science Patricia McGuiggan (2006)

Associate Research Professor, Materials Science and Engineering

Charles V. Meneveau (1990)

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 and Chair, Electrical and Computer Engineering
 M.S. 1967, UC Berkeley, Ph.D. 1970

Michael I. Miller (1998)

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

Jean-Francois Molinari (2000)

Associate Research Professor, Mechanical Engineering

Fabian Monrose (2002)

Assistant Professor, Computer Science
 B.S. 1993, Barry University; M.S. 1996, New York University, Ph.D. 1999

Daniel Q. Naiman (1982)

Professor and Chair, Applied Mathematics and Statistics
 B.S. 1977, Cornell; M.S. 1979, University of Illinois, Ph.D. 1982

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)

Associate 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

Marc B. Parlange (1996)

Professor, Geography and Environmental Engineering; Mechanical Engineering
 B.S. 1984, Griffith University, Brisbane;
 M.S. 1987, Cornell, Ph.D. 1990

Michael Paulaitis (2005)

Research Professor, Chemical and Biomolecular Engineering

Christine Piatko

Assistant Research Professor, Computer Science

Theodore O. Poehler (1973)

Research Professor, Electrical and Computer Engineering; Materials Science and Engineering;
Vice Provost for Research (1992)

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)

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)

Professor, Mechanical Engineering
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.

Jack Roberts (1993)

Research Professor, Mechanical Engineering

Aviel Rubin (2003)

Professor, Computer Science
 B.S. 1989 University of Michigan, M.S. 1991, Ph.D. 1974

Steven Salzberg (1989)

Research Professor, Computer Science; Chemical and Biomolecular Engineering

Jennifer Sample (2005)

Assistant Research Professor, Chemical & Biomolecular Engineering

Benjamin Schafer (2000)

Associate Professor, Civil Engineering
 B.S. 1993, University of Iowa; M.S. 1995, Cornell, Ph.D. 1997

- Christian Scheideler** (2000)
Assistant Research Professor, Computer Science
- Edward R. Scheinerman** (1984)
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)
Professor, Materials Science and Engineering; Chemical and Biomolecular Engineering
B.S. 1978, University of Manchester, M.S. 1980, Ph.D. 1982
- Jonathan Shapiro** (2000)
Assistant Professor, Computer Science
B.S. 1986, Haverford; M.S. 1989, Stanford; Ph.D. 1999, University of Pennsylvania
- William N. Sharpe, Jr.** (1983)
Professor, Mechanical Engineering
Alonzo G. Decker Chair in Mechanical Engineering
B.S. 1960, North Carolina State, M.S. 1961; Ph.D. 1966, Johns Hopkins University
- Lian Shen** (2004)
Assistant Professor, Civil Engineering
B.S. 1997, University of Science and Technology of China; Ph.D. 2000, M.I.T.
- John Sheppard** (2005)
Assistant Research Professor, Computer Science
- Scott F. Smith** (1988)
Professor and Chair, Computer Science
B.S. 1983, Purdue; Ph.D. 1989, Cornell
- Raymond Sova** (2004)
Assistant Research Professor, Electrical and Computer Engineering
- 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
- Kathleen Stebe** (1991)
Professor and Chair, Chemical and Biomolecular Engineering; Materials Science and Engineering; Mechanical Engineering
B.S. 1984, City College of New York, M.S. 1989, Ph.D. 1989
- 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 Strohheln** (2004)
Assistant Research Professor, Electrical and Computer Engineering
- Adam Stubblefield** (2005)
Assistant Research Professor
- Lester K. Su** (2002)
Assistant Professor, Mechanical Engineering
B.A. 1990, University of Chicago; M.S.E. 1991, University of Michigan, M.S. 1994, Ph.D. 1995
- Sean Sun** (2003)
Assistant Professor, Mechanical Engineering
B.S. 1994, Pennsylvania State University Ph.D. 1998, UC Berkeley
- 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
- Andreas Terzis** (2003)
Assistant Professor, Computer Science
B.S. 1995, University of Patras, 1995, M.S. 1997; Ph.D. 2000, University of California
- Michael E. Thomas** (1998)
Research Professor, Electrical and Computer Engineering
- 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
M.S. 1982, Sofia University, Bulgaria Ph.D. 1986, Bulgarian Academy of Sciences
- David Van Wie** (2004)
Research Professor, Mechanical Engineering
- Rene Vidal** (2004)
Assistant Professor, Biomedical Engineering; Computer Science; Mechanical Engineering
B.A. 1995, Catholic University M.S. 2000, UC Berkeley, Ph.D. 2003
- Liming Voo** (2004)
Associate Research Professor, Mechanical Engineering
- I-Jeng Wang** (2004)
Associate Research Professor, Computer Science
- Tza-Huei (Jeff) Wang** (2002)
Assistant Professor, Mechanical Engineering
B.S. 1995, University of Patras; M.S. 1997, UCLA
- Mandy Ward** (2003)
Assistant Professor, Geography and Environmental Engineering
B.S. 1986, Greenwich University; Ph.D. 1990, University of Glasgow, U.K.

- Timothy P. Weihs** (1995)
*Professor, Materials Science and Engineering;
Mechanical Engineering*
B.S. 1983, Dartmouth; M.S. 1985;
Ph.D. 1990, Stanford
- 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, M.S. 1988, Ph.D. 1992
- Dennis Wickenden** (2004)
Research Professor, Mechanical Engineering
- 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)
*Professor, Chemical and Biomolecular Engineering;
Materials Science and Engineering*
B.S. 1998, University of Belgium; M.S. 1990,
Stanford, Ph.D. 1993
- Lawrence Wolff** (1996)
Research Professor, Computer Science
- M. Gordon Wolman** (1968)
*Professor, Geography and Environmental Engineering
(part-time)*
*B. Howell Griswold Professor of Geography and
International Affairs*
- Kevin Yarema** (2001)
Assistant 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; 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)
*Assistant Professor, Materials Science and Engineering;
Chemical and Biomolecular Engineering; Chemistry*
B.S. 1990, Korea University, M.S. 1993;
Ph.D. 1998, University of Massachusetts
- Zijun Zhang** (2005)
Assistant Research Professor, Biomedical Engineering

Other Faculty Appointments

Lecturers

- Vural Aksakalli**
Applied Mathematics and Statistics
- Hedy Alavi, Ph.D.**
*Senior Lecturer and Assistant to the Dean for
International Programs*
Geography and Environmental Engineering 1997
- Nicholas Allocca, M.F.A.**
Professional Communication Program 2000 (part-time)
- Lawrence Aronhime, M.B.A.**
*W.P. Carey Program in Entrepreneurship and Management
2001 (full-time)*
- David Audley**
Applied Mathematics and Statistics
- Beryl Castello**
Applied Mathematics and Statistics 2004 (part-time)
- Joan Cavanaugh-Simpson**
Professional Communications Program 2006 (part-time)
- Andrew F. Conn, Ph.D.**
Senior Lecturer 1990
Mechanical Engineering 1989 (part-time)
- Joan Davenport**
Professional Communications Program 2007(part-time)
- Kevin Dungey, Ph.D.**
Professional Communication Program 1998 (part-time)
- David Fisher, J.D.**
Senior Lecturer
*W.P. Carey Program in Entrepreneurship and Management
2001 (part-time)*
- Mark Franceschini**
*W.P. Carey Program in Entrepreneurship and Management
2000 (part-time)*
- Philip Friesen**
*W.P. Carey Program in Entrepreneurship and Management
2007 (part-time)*
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- Robert E. Glaser, Ph.D.**
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Mechanical Engineering 2001***Paul Bottomly, Ph.D.***Professor, Radiology (Medicine)
Electrical and Computer Engineering 2000***Kit Bowen, Ph.D.***Professor, Chemistry (Arts and Sciences)
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*Professor Orthopedic Surgery (Medicine)
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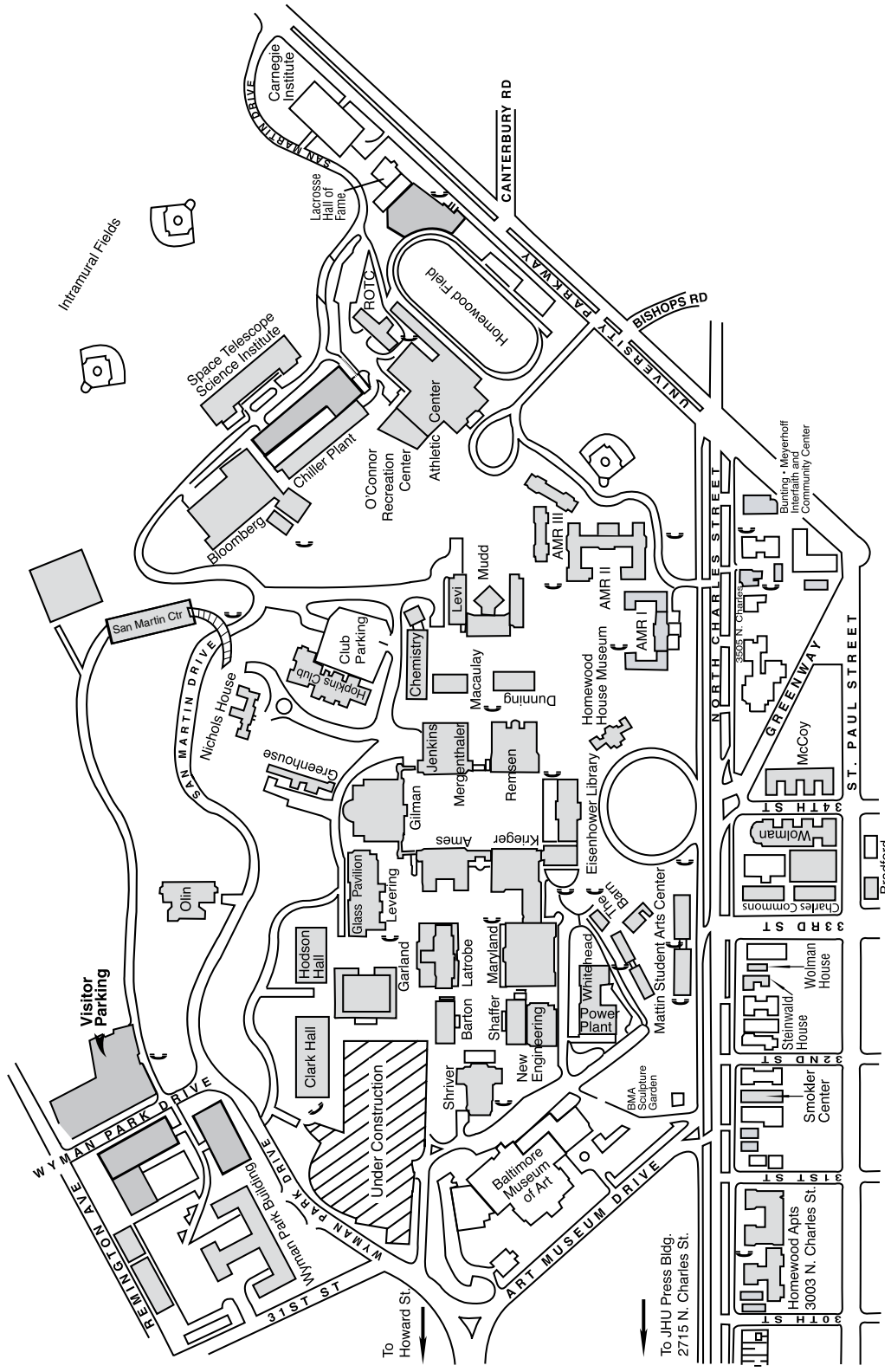
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