Northwestern

Undergraduate Study
1993–95

Northwestern Undergraduate Study 1993–95
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This bulletin for the two academic years beginning September 1, 1993, contains University regulations and information on the programs and courses offered by the College of Arts and Sciences, School of Education and Social Policy, Robert R. McCormick School of Engineering and Applied Science, Medill School of Journalism, School of Music, School of Speech, and other undergraduate programs. Northwestern University reserves the right to change without notice any statement in this bulletin concerning, but not limited to, rules, policies, tuition, fees, curricula, and courses.

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Academic Calendar

Academic Year 1993–94

Fall Quarter

September 1993

1	Wednesday	Tuition due
13	Monday	New Student Week begins
16	Thursday	Registration for fall quarter begins
17	Friday	Registration for fall quarter ends
20	Monday	Classes for fall quarter begin 8 a.m.
24	Friday	Last day for late registration, adding any course, or changing a section (no refund or bill reduction made on any change of registration after this date)

October 1993

29	Friday	Last day for dropping any course (no tuition adjustment after Friday, September 24) Last day to withdraw without academic review No refund on tuition for students withdrawing from the University after today

November 1993

16	Tuesday	Advance registration for winter quarter begins
24	Wednesday	Thanksgiving vacation begins 6 p.m.
25	Thursday	Thanksgiving Day
29	Monday	Classes resume 8 a.m.

December 1993

1	Wednesday	Last day for current students to file an undergraduate financial aid application for winter quarter
4	Saturday	Last day of classes for fall quarter
6	Monday	Fall quarter examinations begin
11	Saturday	Examinations end; vacation begins 6 p.m.

Winter Quarter

January 1994

3	Monday	Tuition due Classes for winter quarter begin 8 a.m. Registration for winter quarter
10	Monday	Last day for late registration, adding any course, or changing a section (no refund or bill reduction made on any change of registration after this date)

February 1994

11	Friday	Last day for dropping any course (no tuition adjustment after Monday, January 10) Last day to withdraw without academic review No refund on tuition for students withdrawing from the University after today
22	Tuesday	Advance registration for spring quarter begins

March 1994

1	Tuesday	Last day for current students to file an undergraduate financial aid application for spring quarter
12	Saturday	Last day of classes for winter quarter
14	Monday	Winter quarter examinations begin
19	Saturday	Examinations end; vacation begins 6 p.m.

Spring Quarter

March 1994

29	Tuesday	Classes for spring quarter begin 8 a.m. Registration for spring quarter

April 1994

1	Friday	Tuition due
5	Tuesday	Last day for late registration, adding any course, or changing a section (no refund or bill reduction made on any change of registration after this date)

NOTE: Before the end of spring quarter, students planning to graduate in June or August 1995 must file an application for a degree in arts and sciences, education and social policy, journalism, music, and speech at the Registrar's Office. Others must file at the appropriate school office. Students completing requirements in December or March should file an application for a degree one year in advance.

May 1994

2	Monday	Last day for current students to file undergraduate financial aid applications for Summer Session and for academic year 1994–95
6	Friday	Last day for dropping any course (no tuition adjustment after Tuesday, April 5) Last day to withdraw without academic review No refund on tuition for students withdrawing from the University after today
25	Wednesday	Advance registration for fall quarter 1994–95 begins
30	Monday	Memorial Day—legal holiday; no classes

June 1994

2	Thursday	Advance registration for Summer Session begins
4	Saturday	Last day of classes for spring quarter
6	Monday	Spring quarter examinations begin
11	Saturday	Examinations end 6 p.m.
17	Friday	Baccalaureate
18	Saturday	136th annual commencement

Summer Session

June 1994

20	Monday	Tuition due Registration for Summer Session
21	Tuesday	Classes for Summer Session begin 8 a.m.
24	Friday	Last day for late registration, adding any course, or changing a section (no refund or bill reduction made on any change of registration after this date)

July 1994

4	Monday	Independence Day observance—legal holiday; no classes
29	Friday	Six-week Summer Session examinations begin 8 a.m.
30	Saturday	Six-week Summer Session ends 6 p.m.

August 1994

12	Friday	Eight-week Summer Session examinations begin 8 a.m.
13	Saturday	Eight-week Summer Session ends 6 p.m.

Academic Year 1994–95

Fall Quarter

September 1994

1	Thursday	Tuition due
12	Monday	New Student Week begins
15	Thursday	Registration for fall quarter begins
16	Friday	Registration for fall quarter ends
19	Monday	Classes for fall quarter begin 8 a.m.
23	Friday	Last day for late registration, adding any course, or changing a section (no refund or bill reduction made on any change of registration after this date)

October 1994

28	Friday	Last day for dropping any course (no tuition adjustment after Friday, September 23) Last day to withdraw without academic review No refund on tuition for students withdrawing from the University after today

November 1994

15	Tuesday	Advance registration for winter quarter begins
23	Wednesday	Thanksgiving vacation begins 6 p.m.
24	Thursday	Thanksgiving Day
28	Monday	Classes resume 8 a.m.

December 1994

1	Thursday	Last day for current students to file an undergraduate financial aid application for winter quarter
3	Saturday	Last day of classes for fall quarter
5	Monday	Fall quarter examinations begin
10	Saturday	Examinations end; vacation begins 6 p.m.

Winter Quarter

January 1995

3	Tuesday	Tuition due Classes for winter quarter begin 8 a.m. Registration for winter quarter
10	Tuesday	Last day for late registration, adding any course, or changing a section (no refund or bill reduction made on any change of registration after this date)

February 1995

10	Friday	Last day for dropping any course (no tuition adjustment after Tuesday, January 10) Last day to withdraw without academic review No refund on tuition for students withdrawing from the University after today
21	Tuesday	Advance registration for spring quarter begins

March 1995

1	Wednesday	Last day for current students to file an undergraduate financial aid application for spring quarter
11	Saturday	Last day of classes for winter quarter
13	Monday	Winter quarter examinations begin
18	Saturday	Examinations end; vacation begins 6 p.m.

Spring Quarter

March 1995

27	Monday	Classes for spring quarter begin 8 a.m. Registration for spring quarter

April 1995

3	Monday	Tuition due Last day for late registration, adding any course, or changing a section (no refund or bill reduction made on any change of registration after this date)

NOTE: Before the end of spring quarter, students planning to graduate in June or August 1996 must file an application for a degree in arts and sciences, education and social policy, journalism, music, and speech at the Registrar's Office. Others must file at the appropriate school office. Students completing requirements in December or March should file an application for a degree one year in advance.

May 1995

1	Monday	Last day for current students to file undergraduate financial aid applications for Summer Session and for academic year 1995–96
5	Friday	Last day for dropping any course (no tuition adjustment after Monday, April 3) Last day to withdraw without academic review No refund on tuition for students withdrawing from the University after today
24	Wednesday	Advance registration for fall quarter 1995–96 begins
29	Monday	Memorial Day—legal holiday; no classes

June 1995

1	Thursday	Advance registration for Summer Session begins
3	Saturday	Last day of classes for spring quarter
5	Monday	Spring quarter examinations begin
10	Saturday	Examinations end 6 p.m.
16	Friday	Baccalaureate
17	Saturday	137th annual commencement

Summer Session

June 1995

19	Monday	Tuition due Registration for Summer Session
20	Tuesday	Classes for Summer Session begin 8 a.m.
23	Friday	Last day for late registration Last day for adding any course or changing a section (no refund or bill reduction made on any change of registration after this date)

July 1995

3	Monday	Independence Day observance—legal holiday; no classes
28	Friday	Six-week Summer Session examinations begin 8 a.m.
29	Saturday	Six-week Summer Session ends 6 p.m.

August 1995

11	Friday	Eight-week Summer Session examinations begin 8 a.m.
12	Saturday	Eight-week Summer Session ends 6 p.m.

The University reserves the right to make changes in this calendar. A detailed, current calendar will appear in each quarterly *Class Schedule.*

The University

The Mission of Northwestern University

The mission of Northwestern University is to establish and enhance excellence in its academic and professional programs. This includes quality undergraduate education for a highly selective student body in a comprehensive range of academic and professional fields. At the graduate level, Northwestern's role encompasses offerings in the major academic and professional fields, closely related to research, creative activities, and clinical services. The research program at Northwestern is a major component of University efforts, assuring institutional leadership in scientific discovery, intellectual inquiry, and creative performance. The character of this research shapes all areas of University endeavor, especially graduate education as well as undergraduate studies.

The core academic disciplines provide the foundation of intellectual efforts at Northwestern. Such disciplines are vital to academic life in their own right but also represent an important underpinning for professional school programs. Given Northwestern's tradition of strong professional schools, this relationship between academic disciplines and professional programs is particularly important.

Interdisciplinary study and research should continue to be given significant emphasis at Northwestern. Programs that relate distinctive areas of existing strength within the University to important emerging areas of knowledge will receive increased support.

In response to the reasonable expectations of its students and in its effort to fulfill its unique potential for combining the best features of world-class research institutions with the advantages of smaller, teaching oriented schools, Northwestern seeks to maintain the highest standards of teaching excellence in all divisions of the University. Teaching is given significant weight in faculty personnel decisions, and special programs have been instituted to strengthen the teaching skills of faculty members.

Through teaching and research, the University also serves society. Northwestern continues its commitment to diversity in its student body. Further, it is the role of the University to participate vigorously in discussions of important public policy issues and to engage in selective, cooperative ventures with government and private organizations external to the University.

The Goals of Undergraduate Education

Consistent with its dedication to excellence, Northwestern provides both an educational and an extracurricular environment that enables its undergraduate students to become accomplished individuals and informed and responsible citizens. To the students in all its undergraduate schools, Northwestern offers liberal learning and professional education to help them gain the depth of knowledge that will empower them to become leaders in their professions and their communities. Furthermore, Northwestern fosters in its students a broad understanding of the world in which we live as well as excellence in the competencies that transcend any particular field of study: writing and oral communication, analytical and creative thinking and expression, quantitative and qualitative methods of inquiry. Northwestern expects its graduates, by their experiences in the classroom and in their lives on campus, to have developed the attributes of an educated person: responsibility, both personal and social; critical ability; scientific, technological, and aesthetic awareness; reflectiveness; creativity; and commitment to learning as a lifelong process.

Undergraduate education at Northwestern strongly reflects the University's commitment to excellence in teaching and scholarship and its conviction that at a

great university students also will learn from each other, both within the classroom and beyond it. Our goal each year is to enroll a class of talented young men and women who not only will take full advantage of the University's resources and location but also will challenge the faculty and each other to keep the enterprise of learning a rich and vital activity. The hallmarks of education at Northwestern, throughout its undergraduate schools, are its dedication to liberal learning and its insistence that students have the opportunity to work with teachers who are active and distinguished scholars. Although we share with other institutions an investment in the traditional components of undergraduate education—particularly the intellectual range of general education requirements and the advanced work of departmental majors—we also pride ourselves on making unusual academic opportunities available. At Northwestern, students regularly study with senior faculty members, whose scholarship often crosses the boundaries of a single discipline. Students also are encouraged to pursue independent study and research within their fields of specialization. Through its commitment to a variety of innovative and often interdisciplinary programs, Northwestern provides its students with the knowledge and skills that allow them to become leaders in their chosen careers as well as thoughtful and sensitive individuals with a commitment to learning as a lifetime experience.

To attain these goals, Northwestern recruits students of demonstrated academic achievement from diverse social, ethnic, and economic backgrounds. Diversity is taken very seriously on our campus. We are committed to a classroom and living environment in which students learn to understand and respect the rights and beliefs of others. Northwestern also ensures that students will actively participate in molding their own undergraduate experience. One of Northwestern's strongest traditions is the energetic involvement of our undergraduates in campus life, a tradition that often leads them beyond the campus itself as they explore the rich cultural, political, and intellectual life of Chicago. In both its academic and extracurricular programs, Northwestern encourages its students to develop a sense of responsibility, to obtain a broad understanding of the world in which we live, and to cultivate those abilities—of critical inquiry, creativity, and reflectiveness—that characterize an educated person. We place particular value on the ability of our undergraduates to communicate effectively, to interpret the developments in science and technology that shape our changing world, and to use the techniques of quantitative analysis that are necessary to effective professional and social life. We believe that knowledge—of ourselves as well as others—provides the foundation of personal as well as professional growth. Armed with the knowledge and habits of mind they acquire at Northwestern, our graduates are prepared to formulate ambitious goals and make intelligent choices for themselves and their society.

An Overview of Northwestern

Northwestern University was established in 1851 by a physician, three attorneys, two businessmen, and three clergymen. The founders' immediate goal was to create an institution of "the highest order of excellence" to serve the people of the original Northwest Territory (Ohio, Indiana, Illinois, Michigan, Wisconsin, and part of Minnesota). On the date of its founding, Northwestern had no faculty, students, campus, or buildings and only $9.92 in the treasury.

In 1853, as a site for the new University, the founders purchased a 379-acre tract of farmland along Lake Michigan 12 miles north of Chicago—then a thriving frontier city. The town that grew up around Northwestern was named Evanston to honor one of the University's most prominent founders, John Evans. A well-known physician and researcher, who taught at Rush Medical College in Chicago, Evans established the first Indiana mental hospital and organized the Illinois Medical Society. Evans also became a successful real estate speculator and railroad builder and served as governor of the Colorado Territory, where he helped to found the University of Denver. Evans was a continuous contributor of his time, energy, and money to Northwestern, serving as chairman of the board from the founding of the University in 1851 until his death in 1897.

Having completed its first building in the fall of 1855, Northwestern's College of Liberal Arts opened its doors with 2 faculty members and 10 male students. A pioneer in the education of women, Northwestern first

enrolled female students in 1869. With the 1873 merger of Northwestern and the Evanston College for Ladies, Frances E. Willard became the first dean of women. By 1900, Northwestern was composed of not only a liberal arts college but also six undergraduate and graduate professional schools, including the schools of law, medicine, and dentistry, with 2,700 students, 680 acres in Evanston plus properties in Chicago, and an annual budget of more than $200,000. Thus by the year of Evans's death, Northwestern had made considerable progress toward the founders' initial goal of creating a genuine "university."

With the establishment of the Graduate School in 1910, Northwestern, like Johns Hopkins and other major institutions, adopted the German university model of providing graduate as well as undergraduate instruction and stressing research along with teaching. Today, Northwestern is a major private research university with 12 academic divisions located on two lakefront campuses in Evanston and Chicago, 1,770 full-time faculty and 13,582 full-time students, approximately 7,400 of whom are undergraduates on the Evanston campus, and an annual budget exceeding $640 million.

Education at Northwestern since its founding has been based on the liberal arts as administered through the University's oldest school, now called the College of Arts and Sciences. In addition to completing the requirements for a major field of specialization, all undergraduates must participate in a program of general education, which has recently been restructured and reaffirmed. The main academic linkages between the divisions of the University are the basic departments in the College of Arts and Sciences and the research centers, which foster interdisciplinary study across department and school lines.

Northwestern is a member of the Association of American Universities—the 28 private and 28 public universities that constitute the nation's most distinguished educational institutions as defined by the quality and scope of their research and graduate programs. Recent assessments of the quality of faculty research and doctoral programs include the comprehensive rankings of basic disciplines conducted by the National Academy of Sciences (1986) and the Conference Board of Associated Research Councils (1982). According to these and other assessments, Northwestern has two schools in the top 5 and one in the top 10 nationally, plus three doctoral programs in the top 5, three more in the top 10, five more in the top 15, four more in the top 20, and five more in the top 25 nationally. Northwestern's J. L. Kellogg Graduate School of Management was ranked number one by *Business Week* in 1988, 1990, and 1992. The Medill School of Journalism was ranked first in a poll conducted by the Gannett Media Center at Columbia University and by high school counselors in a recent survey.

In American universities, faculty prominence is based primarily on research, which is highly integrated with graduate education because graduate training is, to a large degree, apprenticeship in research. However, a factor that distinguishes Northwestern from other major research universities is that all faculty members not only perform research but also teach, the majority at the undergraduate as well as the graduate level. No university of comparable size has a research faculty that provides both such a wide range of academic programs and such direct access through instruction.

In recent years, the cumulative rate of freshmen graduating from Northwestern has increased:

Freshmen entering in	*1984*	*1985*	*1986*
Percent graduating in 4 years	78.8	79.5	79.9
Percent graduating in 5 years	86.4	86.6	88.0
Percent graduating in 6 years	88.0	88.3	89.3
Total number graduating	1,613	1,864	1,789

The five-year totals include students in programs designed to be completed in five years, such as cooperative engineering education, combined bachelor's/master's programs, and dual bachelor's programs. Students in the seven-year Honors Program in Medical Education are counted as graduated when they begin the Medical School portion of their program after three years enrolled in an undergraduate school on the Evanston campus.

Schools and Divisions

The undergraduate schools offer the programs and courses of instruction described in the respective sections of this catalog. Undergraduate study may lead to the bachelor's degree as a final academic goal or to advanced work toward a graduate or professional degree.

Evanston Campus

The schools and other institutional divisions, in order of establishment, are as follows:

- The College of Arts and Sciences (1851) offers the degree of bachelor of arts. Through University College, the College of Arts and Sciences also offers the degrees of bachelor of philosophy and bachelor of science in general studies and two certificates in arts and sciences.
- The School of Speech (1878), with departments of communication sciences and disorders, communication studies, performance studies, radio/television/film, and theatre, offers the bachelor of science in speech degree. Through University College, the School of Speech offers the bachelor of philosophy in communication. The school also offers the degree of master of science in communication.
- The School of Music (1895) offers students the degrees of bachelor of music and bachelor of arts in music. In its graduate division, the School of Music offers the degrees of doctor of music and master of music and a certificate in performance.
- The J. L. Kellogg Graduate School of Management (1908) offers the master of management degree. It provides students with the opportunity to study business, health services, manufacturing, public and nonprofit, real estate, and transportation management. In addition to the full-time programs, master's degree programs are offered for part-time evening and weekend students.
- The Robert R. McCormick School of Engineering and Applied Science of the Technological Institute (1909) offers the degrees of bachelor of science and bachelor of science in applied mathematics, biomedical engineering, chemical engineering, civil engineering, computer engineering, computer science, electrical engineering, environmental engineering, industrial engineering, manufacturing engineering, materials science and engineering, and mechanical engineering. All departments offer advanced study for graduate students. The McCormick School also offers the degrees of master of engineering management and master of manufacturing engineering and, jointly with the Kellogg School, the master of manufacturing management.
- The Graduate School (1910) controls all advanced programs leading to the degrees of doctor of philosophy, master of arts, master of fine arts, and master of science. The Graduate School catalog, describing master's and doctoral programs in all schools and departments, is available on request.
- The Summer Session (1920) provides summer programs for undergraduate, graduate, and visiting students.
- The Medill School of Journalism (1921) grants the degree of bachelor of science in journalism at the end of four years of study and recommends a fifth year to qualify students for the degree of master of science in journalism or master of science in integrated marketing communications.
- The School of Education and Social Policy (1926) offers the degrees of bachelor of science in education and social policy and master of science in education and social policy.

Chicago Campus

Schools and institutional divisions on the Chicago campus, in order of establishment, are as follows:

- The Medical School (1859) offers the degrees of doctor of medicine, bachelor of science in medicine, and master of science in physical therapy. High school graduates accepted for the Honors Program in Medical Education can receive the MD degree from the Medical School seven years after they enter the College of Arts and Sciences, McCormick School, or School of Speech as freshmen. The Medical School and McCormick School also cooperate in biomedical engineering programs.
- The School of Law (1859) offers the degrees of doctor of juridical science, master of laws, and juris doctor. The School of Law and the J. L. Kellogg Graduate School of Management offer a joint degree program through which students can earn both juris doctor and master of management degrees in four years. The School of

Law also participates in a program by which students can earn a JD and a PhD in one of the social sciences in five years.

- The Dental School (1891) offers the degree of doctor of dental surgery. It also offers a combined BS/DDS degree in conjunction with the McCormick School's biomedical engineering program and a combined BA/DDS degree in conjunction with the College of Arts and Sciences. Students apply to the Dental School through the American Association of Dental Schools Application Service (AADSAS).
- University College (1933) is the continuing education division of the University, providing an opportunity for adults to return to school in the evenings or on Saturdays on a part-time or full-time basis to earn a degree or to take courses for personal enrichment or professional mobility. Classes are offered on both the Chicago and Evanston campuses. Through University College, the College of Arts and Sciences offers the degrees of bachelor of philosophy and bachelor of science in general studies; the School of Speech offers the bachelor of philosophy in communication; and the Graduate School offers the master of arts in liberal studies and the master of arts in English. Several certificate programs are also offered by University College, including business programs leading to certificates in accounting and administrative techniques.

University Centers

University-wide and specialized research centers facilitate new scholarly approaches to problems by enabling faculty to collaborate across the boundaries of traditional disciplines. These interdisciplinary centers have profound implications for undergraduates, because such research often alters theory and practice within a given academic discipline and results in the development of new curricular programs.

Students also are involved directly with the centers through lectures or other special events and, in some cases, through research projects. The University's centers and programs include the following:

- Program of African Studies
- Annenberg Washington Program in Communications Policy Studies
- Center for Biotechnology
- Center for Catalysis and Surface Science
- Center for Health Services and Policy Research
- Center for High-Temperature Superconductivity
- Infrastructure Technology Institute
- Institute for the Learning Sciences
- Center for the Interdisciplinary Study of Science and Technology
- Materials Research Center
- Center for Mathematical Studies in Economics and Management Science
- Institute for Neuroscience
- Center for Reproductive Science
- Steel Resource Center
- Traffic Institute
- Transportation Center
- Center for Urban Affairs and Policy Research

For detailed information about these centers, see the Graduate School catalog.

Libraries

Northwestern maintains an extensive library system on the Evanston and Chicago campuses to support its programs of study and research. The holdings of the libraries add up to more than 3.6 million volumes, allowing Northwestern students to use the tenth largest library collection among private universities in the United States. Undergraduates are encouraged to explore the full resources of these collections and to acquire experience using a wide range of print and electronic information sources.

Evanston Campus Libraries

University Library

The Northwestern University Library offers excellent work-study facilities. The main library and adjoining Charles Deering Library contain collections in the humanities, history, and social sciences. In the main library building, collections are located in three circular research towers: north for the social sciences, east for history and Africana, and south for the humanities. On each level of the research towers, books and specialized journals are arranged in a radial pattern, with study carrels and seminar rooms along the periphery.

Departments of Special Interest

Major service points are located on the lower levels of the library. The Reference, Government Publications, and Circulation departments are located on level 1, and the Newspaper/Microtext Department is on the lower level. The Reference Department houses a collection of reference books and CD-ROM databases in the social sciences, history, and humanities. Reference staff assist in finding information, teach research skills, and provide on-line information services. The Government Publications Department is a depository for documents of the United States and the United Nations and other international agencies. It also receives selected publications of state and local governments. The Newspaper/Microtext Department contains current newspapers and a large collection of periodicals and primary research materials in microform.

The Core Collection, Reserve Book Room, a microcomputer lab, student lounge, the Forum Room (for special programs and video presentations), a new video theater, and the Media Center are on level 2. The noncirculating Core Collection holds 52,800 books in all disciplines, ensuring easy access and permanent availability of works essential to undergraduates. The Marjorie Iglow Mitchell Media Center has a videotape collection of classic films, performing arts, and documentary titles and spoken word recordings of poetry, prose, and drama. It also has computer-equipped carrels designed for use with interactive laser discs.

Specialized Collections and Libraries

The University Library also contains a number of specialized subject collections and departments. The Transportation Library, located on the lower level, is one of the three major collections of its kind in the United States. It specializes in transportation socioeconomics and law enforcement.

Two special units are located on level 5 of the main library. The Curriculum Collection houses elementary and secondary teaching materials, courses of study, and children's literature. The Melville J. Herskovits Library of African Studies (popularly called Africana) is known internationally for its comprehensive collection of materials on every aspect of Africa.

The Charles Deering Library, which is attached to the main library, houses the Art Collection, Map Collection, and University Archives. Also in Deering is the Special Collections Department, whose holdings include the Twentieth-Century Collections, underground press publications, women's movement literature, and numerous rare books, manuscripts, limited editions, and fine bindings.

The Music Library, in Deering, meets the practical and research needs of students and faculty at Northwestern's School of Music. This library contains scores, journals, books, and more than 37,500 sound recordings, which can be heard in the Listening Center.

Other Evanston Campus Libraries

The Seeley G. Mudd Library for Science and Engineering houses books and journals in applied mathematics, astronomy, biological sciences, chemistry, engineering, and physics. Two smaller departmental libraries also serve the Evanston campus: the Geology Library in Locy Hall and the Mathematics Library in the Lunt Building.

Also open to all Northwestern students are the outstanding collections on religion available at the affiliated United Library of Garrett-Evangelical and Seabury-Western theological seminaries.

Use of the Libraries

Northwestern's information network, LUIS (Library User Information Service), unites all the Northwestern libraries. It provides access to NUcat, the on-line catalog of the library's holdings, and to periodical indexes. LUIS terminals are located throughout the main and branch libraries. LUIS is accessible also by modem or other direct campus computer connections. Card catalogs are available at the various libraries and departments for older materials not yet in NUcat.

Users in need of help searching LUIS or the card catalog may find assistance at the information desk in the main library and at reference and service desks throughout the system. Librarians are ready to answer questions and assist students with their research. They also provide instruction in use of library resources to individual classes, either in the library or in the classroom. Library orientation tours are offered to Northwestern students during New Student Week.

Northwestern undergraduates have full access to interlibrary loan; they can borrow materials from the Center for Research Libraries and other libraries throughout the United States and the world. Many also use the Infopass system for personal admittance to collections in the Chicago area, such as the Newberry Library, Field Museum of Natural History, Art Institute of Chicago, University of Chicago Library, Chicago Public Library, and John Crerar Library for Science.

Access

The primary mission of the libraries is to serve the Northwestern community. During evening and most weekend hours, use of the University Library and the Seeley G. Mudd Library for Science and Engineering is limited to Northwestern students, faculty, staff, and other qualified individuals. Users are required to present their Northwestern identification card to gain admittance during the hours of limited access. A Northwestern identification card also is needed to borrow library materials for home use.

Chicago Campus Libraries

Four libraries maintained principally for the students and faculties on the Chicago campus are open also to students from the Evanston campus. The collections of these libraries are listed in NUcat, and materials from either campus can easily be borrowed through interlibrary loan.

The Joseph Schaffner Library (Wieboldt Hall, second floor), largely an electronic library, serves University College, the evening Managers' Program of the J. L. Kellogg Graduate School of Management, and the extension program of the Medill School of Journalism.

Serving the three major professional schools on the Chicago campus are the Galter Health Sciences Library, the Dental School Library, and the Law Library.

Computing

Computer Study

Students interested in majoring in computing should see the Computer Science Program in the College of Arts and Sciences and the Department of Electrical Engineering and Computer Science in the McCormick School of Engineering and Applied Science.

Computer Facilities

Academic Computing and Network Services (ACNS), the University Library, and individual schools maintain public computer clusters. Some are open to all students; others are devoted to a specific discipline such as engineering, music, or radio/television/film. Software is available for composing and editing text and graphics, developing programs, numerical analysis, and other computing needs. Some labs also contain specialized equipment, including text and graphics scanners, large monitors, laser disk players, and color printers. Most of these clusters are connected to the campus network, allowing users to access remote resources.

Northwestern provides a networked computing environment, consisting of resources local to Northwestern and others that can be reached by connecting to Internet, the worldwide computer network. Northwestern's on-line library catalog, library catalogs of other institutions around the world, information about University events, course offerings and evaluations, University policies and procedures, and access to electronic mail, archives of free and low-cost software, and nearly two thousand on-line worldwide discussion groups on topics as varied as biology and bicycles are some diverse resources available on the network.

Most undergraduate schools at Northwestern recommend but do not require that students own a computer. Students receive an educational discount on a variety of hardware and software at the campus computer store. The ACNS information center offers computing consultation and assistance to students 24 hours a day during the academic year.

Student Services

Division of Student Affairs

The Office of the Vice President for Student Affairs is responsible for many programs and services available to Northwestern students. The objectives of the division are to help students establish and fulfill their personal, social, academic, and career goals; assist students in learning how to confront obstacles that may prevent them from attaining those goals; and provide essential services to students as part of the residential community of Northwestern. To further these objectives in

recognition of students as members of the Northwestern University community, the University has adopted a statement on student rights and responsibilities (see the *Student Handbook* for the complete statement). Students are urged to use the services provided by the staff within this division.

African-American Student Affairs

African-American Student Affairs encourages academic achievement through supportive services, referrals, and cultural programs. The African-American Student Affairs building houses administrative, guidance, and student organization offices and serves as a drop-in counseling center. Meeting places, student rooms and a library also are available for student use. Through these services, the office seeks to help students satisfy their career, developmental, scholastic, and social needs.

Activities include an annual Black History Month observance, firesides, forums, lectures, and the spring blues, gospel, and jazz revue, *A Musical Evening with Our Elders,* as well as events sponsored cooperatively with student organizations and academic divisions. The activities are designed to promote academic excellence, provide cultural and social outlets, and voice the needs and concerns of the black student community at Northwestern.

Dean of Students

The Dean of Students Office is a general information and referral source for students. It coordinates the University disciplinary process, including the University Hearing and Appeals System and the Sexual Assault Hearing and Appeals System. The office supervises the Part-Time Employment and Northwestern University Summer Employment (NUSEP) programs, which counsel students in conjunction with faculty and other University departments.

Health Service

The University maintains a comprehensive health service, including a mental health unit and health education services, and a 12-bed infirmary for students at Searle Hall. Students registered for at least three course units are entitled to full privileges of this service. Students registered for fewer than three course units may have the same privileges by purchasing the optional program within one week after registration. Forms for this purpose are available at the Health Service, where the fee may be paid by check.

All students are required to have hospitalization insurance coverage. For information about the program offered through the University, consult the Health Service insurance office.

Upon acceptance, new full-time students must comply with state of Illinois and Northwestern University health and immunization requirements as described in the Health Service letter. They must complete and return the medical and insurance forms described in the letter at least one month before registration and, upon arrival on campus, attend an orientation presentation about the Health Service. Failure to comply results in registration being withheld until requirements have been met.

Former Northwestern students who have been absent from the campus for two or more years must meet the same requirements as new students. Students continuing into a new program must check with the Health Service to reactivate and update medical records. See the *Student's Information Guide to the Health Service* for more information.

Norris University Center

Norris University Center is the community center of the University. It provides programs and services that enhance the quality of campus life for students, faculty, parents, administration, alumni, and guests. The Norris Center Program Board sponsors a variety of activities that promote social, cultural, and educational interaction outside the classroom. Norris Center works to develop a campus environment that enables students to become accomplished and informed individuals, sensitive to the needs of a pluralistic society.

Additionally, Norris Center provides amenities and conveniences that enrich the quality of daily campus life for the University community. These include the campus bookstore, cafeteria, ice cream parlor, meeting rooms, personal banking machines, box office, convenience store, and more than 25 student organization offices. Special services include student check cashing, game room, outdoor recreation equipment rental, sound and sight equipment rental, and leisure library. Through the

Dittmar Memorial Art Gallery and the craft studio, Norris demonstrates the importance of the arts to the campus environment.

Organizations and Activities

The Campus Activities Office at Norris Center provides leadership development and advice to student groups, many of which are headquartered at Norris. Students brought together by common interests, projects, or cultural heritage may petition for recognition as a student organization. Student organizations are recognized by the University Chaplain, University departments, the Office of the Vice President for Student Affairs, or the Associated Student Government, which also is liaison for students, student organizations, and the University administration. Other representative organizations include the Interfraternity Council; Panhellenic Association; Residence Halls Association; For Members Only; Black Greek Council; Asian-American Advisory Board; Bisexual, Gay, and Lesbian Alliance; and Women's Coalition.

Programs and services to the campus are provided by such groups as the Activities and Organizations Board, Arts Alliance, Dance Marathon, Northwestern Volunteer Network, Legal Aid, Student Blood Services, and Wildcat Council. Other organizations, particularly in the areas of cultural/ethnic affiliation and performing arts, complement academic interests and are open to all. Music, dance, and theater groups as well as a daily newspaper, yearbook, radio station, and literary magazines provide outlets for a variety of talents.

Information Desk

The information desk at Norris provides the University with a central location for inquiries regarding general campus and event information. The desk has access to NUInfo, a computerized campus-wide information system. Visitors are welcome to call or drop by when on campus to ask about University services and special events.

Placement Center

The Placement Center provides consultation, programs, and resources to assist students and alumni in developing and implementing career plans. Students entering the University with a specific career in mind may consult with a professional staff member who can help structure an academic program and improve career options. Other students may receive assistance in assessing skills, values, and interests and in identifying career options. Placement staff seek to help each student make a smooth transition from college to career.

The Placement Resource Library in Hardy Lounge contains directories and information about thousands of employing organizations, materials on writing resumes and letters of application, and videotapes with information about employment interviewing. Computer resources are provided for preparing resumes and include access to a national database of more than 200,000 potential employers.

Senior Placement

Placement consultants can assist seniors in further clarifying career goals and in identifying organizations where their specific talents can be used and developed. Individual consultation is provided on resume preparation, interviewing, and the more sophisticated techniques of the job search.

The Placement Center administers an active campus recruiting program that involves hundreds of employment representatives from business, industry, government, and education. This program offers career opportunities in almost every field. Employers from all over the country send listings of specific positions as the office engages in a continuous program of job development.

To respond to specific needs of students, placement specialists are designated in the following areas:

- Educational placement: Graduates interested in social service opportunities, teaching careers, or staff areas in education should register with this office and establish a personal set of credentials, including references. This renewable file may be used in applying for positions throughout their entire working career.
- Engineering placement: Engineering or science graduates have exceptional exposure to many major corporations. The placement consultant in this area works closely with the faculty and with other resources within the University.
- General placement: Seniors from any division of the University seeking a nontechnical business position are assigned a personal consultant. Individual needs and aptitudes and the presentation of multiple job opportunities receive special attention.

- Communications placement: A communications placement specialist assists students enrolled in music, speech, and journalism. The Placement Center maintains and develops contacts with employers and alumni in an array of communications fields.

While the Placement Center is available to all students and graduates of the University, to meet the specific needs of those seeking careers in journalism or music, placement offices in the following schools provide additional service:

- Medill School of Journalism: The Medill Placement Office seeks job opportunities in journalism and invites recruiters from the media, advertising, and publishing to interview on campus. Alumni placement is available also.
- School of Music: Placement services are provided for music students at the time of graduation and for alumni. The office assists registrants in preparing and maintaining a credential file and notifies them of vacancies for teachers and performers in every area of musical activity.

Alumni Placement

Alumni who have Northwestern degrees may use the services of the Placement Center throughout their careers. Assistance is provided in locating positions requiring experienced personnel. Senior consultants are available for help with midcareer change or career planning and development.

Residence Halls and Food Services

The University provides a variety of living options for students, including small houses, residential colleges, traditional residence halls, and fraternity and sorority houses. Developing a sense of community and responsibility among hall residents is emphasized. Six dining halls provide food service through a range of board plan options.

Student Counseling and Resource Center

At times students' academic or personal life may seem overwhelming. Common problems may be career indecision, poor time management, test anxiety, choosing a major, anxiety about dating, difficulty in relationships with family or friends, concerns about sexual identity, low self-esteem, stress, or loneliness. If students have a problem, talking with an experienced counselor often can provide great relief. Along with individual and group counseling, help is available through the use of career and psychological testing and computer-assisted career guidance. The department's research of hundreds of students and alumni who have used its computer-assisted career guidance system shows that this guidance is helpful and highly recommended. Sometimes counselors will help students with referrals to more appropriate resources. If students are unsure about where to go for help, the Student Counseling and Resource Center is a good place to start.

Resource Center

The Resource Center is a central source of self-help information on topics related to academic, career, and personal life issues. Literature is available on careers, graduate and professional schools, and financial aid. Graduate, professional, undergraduate, and foreign school catalogs are included in a microfiche collection. Yearly summaries of the educational and career plans of Northwestern graduates also are available, as is an expanding collection of videotapes covering topics in career planning, including techniques for job interviewing and resume writing and careers such as accounting, law, and marketing. Students may listen to audiocassettes on career planning and life adjustment topics, including interviews with liberal arts graduates and topics such as stress management, achievement, overcoming procrastination, and depression.

Testing Services

Testing services are available to all students. In addition to career and psychological testing, Student Counseling administers the following graduate and professional school tests: Graduate Record Examination (GRE), Graduate Management Admission Test (GMAT), Law School Admission Test (LSAT), and Medical College Admission Test (MCAT). Students can obtain yearly calendars, information bulletins, and registration forms for these national tests from Student Counseling.

University Chaplain

The Office of the University Chaplain is available to meet the religious concerns and needs of members of the University community. Several religious groups, including most major Protestant denominations, the Roman

Catholic church, the Baha'i faith, and the Jewish community, sponsor ministries to the University's students and faculty. Although these campus ministries are independent of Northwestern University, the Chaplain's Office serves as the University's liaison with all religious groups, of whatever faith, represented at Northwestern, and it facilitates and coordinates their activities. More detailed information on campus religious organizations is published in "Religious Life and Thought," available from the Chaplain's Office.

The Religious Center, which includes Parkes Hall and the Jeanne Vail Meditation Chapel, has facilities for religious programs and services such as lectures, study groups, discussions on faith and life, weddings, baptisms, and other special events. The facilities are available to religious groups of all faiths and to other University and community groups by arrangement through the Chaplain's Office. The University chaplain and other campus religious counselors are available to meet with individuals and groups as counselors, teachers, or resource persons.

International Office

Foreign students, visiting scholars, faculty, and staff will find assistance for themselves and their families at the International Office. The main focus of the office is immigration and visa-related matters. The office provides specific instruction on the rights and responsibilities of each visa category, including the proper forms for arrival, travel, sending for families, and work permission. In addition, it serves as an information center to help visitors locate the services and activities available both on campus and in the larger community.

A volunteer organization, the Community Council for International Students, works with the office to provide international visitors such services as a resale shop, English tutoring, the International-American Women's Group, and a play group for children. All international visitors are encouraged to ask for information at the International Office.

Students with Disabilities

It is Northwestern University policy to ensure that no qualified student with a disability is denied the benefits of, excluded from participation in, or otherwise subjected to discrimination in any University program or activity. In response to a request made by a qualified student with a disability, the University will arrange, at no cost to the student, for the provision of educational auxiliary aids, including sign language interpreters, determined by the University to be necessary to afford such student with the opportunity for full participation in University programs.

Northwestern University's programs and activities are accessible for full participation to all its students, including those with mobility problems and with difficulties such as auditory, visual, or other special problems.

It is important for University students who need assistance with regard to any disability to notify the director of equal employment opportunity, affirmative action, and disability services, 720 University Place, Evanston, Illinois 60208-1145, phone 708/491-7458 or -7461, so the University can assist them in obtaining appropriate service.

A brochure, "Services for Students with Disabilities," describing various support services for students with disabilities is available in University admission offices and from the disability services director. The brochure includes maps of the Evanston and Chicago campuses indicating building access and parking locations.

Women's Center

The Women's Center is an advocacy program serving the Northwestern community. The center's staff, composed of community activists, counselors, and educators, offer support groups, counseling programs, discussion hours, workshops, and other activities. Students, faculty, and staff are invited to learn about and participate in the social change issues of today's campus women.

Recreational Sports

All students are strongly encouraged to participate in recreational sports and fitness activities while at Northwestern. Recreational sports include intramural, club, informal, and instructional sport and fitness programs.

Intramural competition is conducted in a variety of individual and team sports. League play and tournaments are provided for men and women, separately and "co-recreationally." Competition is organized for

individuals and teams, by independent groups, living units, fraternities, sororities, and University departments and organizations.

Club sports offer both competitive and noncompetitive sports experiences. Extramural competition, with outside institutions and sports groups, is available in basketball, equestrian events, downhill skiing, synchronized swimming, soccer, rugby, ice hockey, lacrosse, volleyball, sailing, water polo, crew, tennis, Frisbee, and track. Noncompetitive, special interest clubs include aikido, karate, tae kwon do, jujitsu, and wado kai. Clubs are student directed.

Drop-in recreation periods are scheduled throughout the day and evening at Blomquist Gym, Patten Recreation Center, and the Henry Crown Sports Pavilion/ Norris Aquatics Center. Facilities include opportunities for basketball, volleyball, tennis, racquetball, swimming, badminton, weight training, jogging, squash, and fitness activities.

Instructional sports classes are offered in more than 30 different areas on a noncredit basis. Students can register for sports and fitness classes by visiting the recreational sports administrative office at the sports pavilion. Courses are listed each quarter in the *Class Schedule.*

The Sailing Club offers both instructional and informal sailing programs for beginners and novice sailors. The club fleet consists of 420 class and laser sailboats as well as Windsurfers.

Public Safety

The Department of Public Safety is responsible for crime prevention, law enforcement, parking control, and fire/general safety on both the Evanston and Chicago campuses. University police officers are on duty 24 hours a day, seven days a week, and every incident reported is assigned to an officer for investigation. The officers are graduates of the police academy with full police authority; most have bachelor's degrees.

The police division on the Evanston campus provides a number of services, including crime prevention talks, unlocking vehicle doors, and lending battery cables. Emergency phones on campus, marked by blue lights, operate when an individual lifts the receiver or pushes the button.

Additional information discussing campus crime and crime prevention programs is available by requesting a copy of "Campus Safety: A Shared Responsibility" from the Department of Public Safety, 1819 Hinman Avenue, Evanston, Illinois 60208-1320.

Motor Vehicles

The possession, operation, and parking of motor vehicles on the Evanston campus are described in the parking regulations available at the Parking Office, 1819 Hinman Avenue. All resident freshmen and sophomores and juniors who have not been selected by lottery as well as all students, faculty, and staff who live off campus within the campus walking zone may not apply for permission to park on campus. Exceptions to this rule may be granted only by the University Parking Committee. Parking permits are required in campus lots from 7:30 a.m. to 6 p.m., Monday through Friday (official holidays excluded), except in the few lots that are designated in the regulations as 24-hour enforced.

Personal Losses

The University is not responsible for the loss of or damage to personal property belonging to students in any building owned by the University, whether the loss or damage occurs by theft, fire, or an unknown cause.

Undergraduate Education

Admission

General Requirements for Admission

Northwestern University historically has sought a student body of high ability and diversity representing a cross section of American society.

It is the policy of Northwestern University not to discriminate against any individual on the basis of race, color, religion, national origin, sex, sexual orientation, marital status, age, handicap, or veteran status in matters of admissions, employment, housing, or services or in the educational programs or activities it operates, in accordance with civil rights legislation and University commitment.

Any alleged violations of this policy or questions regarding the law with respect to nondiscrimination should be directed to Office of the Provost, Rebecca Crown Center, Evanston, Illinois 60208-1101, phone 708/491-5117; Director of Equal Employment Opportunity, Affirmative Action, and Disability Services, 720 University Place, Evanston, Illinois 60208-1147, phone 708/491-7458.

Candidates for admission should demonstrate a level of performance in curricular and extracurricular areas that indicates they will be able to compete successfully in a competitive academic environment. In the selection of students, careful attention is given to the ability of each candidate as evidenced by academic record and the results of entrance tests as well as by character and personality. The University attempts to select students who are committed to scholarship and who have shown a willingness to become involved in their expressed interest areas. In determining whether to accept a candidate, the University considers the following:

- Secondary school record
- College record, for transfer candidates
- Recommendations from school officials and other persons who have information pertinent to the candidate's probable success at Northwestern
- Required or recommended tests (scores from the Scholastic Aptitude Test [SAT] or American College Test [ACT] are required of all candidates; scores from three CEEB Achievement Tests [ACH] are required of candidates for certain special programs [see table] and strongly recommended for other candidates)
- Music audition, for School of Music candidates
- The candidate's statements on the application and other evidence of special skills, such as writing, art, music, mathematics, and science, or of special accomplishments in extracurricular areas of interest
- Personal interview (recommended but not required)
- Any other information received by the University that bears on the candidate's readiness for study at Northwestern

Achievement Tests

Recommended for Regular Programs

- College of Arts and Sciences, School of Education and Social Policy, Medill School of Journalism, and School of Speech: English and two others of student's choice (English Composition with essay acceptable but not required)
- McCormick School of Engineering and Applied Science: English, Mathematics (Level I or II), and Chemistry or Physics
- School of Music: Audition required; Achievement Tests optional

Required for Special Programs

- Honors Program in Medical Education: English Composition, Mathematics Level II, and Chemistry

- Integrated Science Program: Mathematics Level II, Chemistry or Physics, and another science unless English is required for another application

Required Subjects

The broadest possible academic experience in high school is the best preparation for admission to Northwestern. Whatever fields of study students follow, the best foundation consists of proficiency in reading, writing, and mathematics. The value of thorough training in fundamental subjects cannot be overemphasized.

In considering the academic record of a candidate, attention is given to the subjects studied and the grades received. The record should include a minimum of 16 units. (A unit represents a course studied for one year.)

The subject recommendations in the following list represent the minimum requirements for entrance to the University. Allowances are made to permit students to pursue special areas of academic interest.

Required Units

The College of Arts and Sciences and the Schools of Education and Social Policy, Journalism, Music, and Speech require 12 units in the following academic areas plus additional course units that bring the total to 16 or more. Recommended are

- English: 4 units
- Foreign language: 2 to 4 units
- Mathematics: 3 to 4 units
- Laboratory science: 2 to 3 units
- History, social studies: 2 to 4 units
- Electives: 1 to 3 units

Students preparing for college are strongly recommended to take four years of work in English with as much emphasis on composition as the curriculum allows. Two units of the same foreign language should be offered. Three or four years of the same language are strongly recommended.

The McCormick School requires a sound secondary school education as described above, with strong preparation in mathematics and science. Specifically recommended are

- Mathematics: 3½ to 4 units (the minimum requirements for mathematics include algebra [2 units], plane geometry [1 unit], and trigonometry [½ unit])
- Science: 2 units (credit in both chemistry and physics is recommended)

Credit in other subjects should bring the total to 16 units or more. This should include 4 units of English and work in social studies and foreign languages.

Admission from Secondary School

Although early application does not insure admission to the University, application early in the final year of secondary school is advisable. Applications may be submitted before candidates take their entrance examinations.

Admission Notification

Northwestern offers freshman candidates a choice of two notification plans, the Early Decision Plan and the Regular Plan. The accompanying table outlines these plans, the notification plans for transfer students, and the financial aid application procedure, including deadlines and the forms available through the College Scholarship Service.

Admission Procedure

To be considered for admission to Northwestern, candidates must complete the following four steps:

- File a completed application form. This may be obtained from the Undergraduate Admission Office, 1801 Hinman Avenue, P.O. Box 3060, Northwestern University, Evanston, Illinois 60204-3060. Applications for admission may be submitted before candidates take the standardized tests required for college admission.
- Arrange with the officials of their high school to complete and forward the Secondary School Report to the Undergraduate Admission Office. All candidates should have their records through the sixth semester sent to Northwestern as early in the senior year as possible. Regular Plan candidates should have seventh semester grades sent as soon as they are available.
- Take standardized tests. The official results of the Scholastic Aptitude Test of the College Entrance Examination Board or the American College Test are required for all students applying for admission to Northwestern as freshmen. In addition, all the special programs require each matriculant to present three CEEB Achievement Tests as specified in the accompanying table. Achievement Tests are strongly recommended for all candidates.

■ If possible, arrange through the Admission Office for a personal interview. Interviews are recommended, but not required, for all candidates for admission to the University. Candidates should ask for an appointment well in advance, preferably six weeks. Throughout the year, interviews are offered during the week. From October to April, interviews are offered on Saturday mornings. The office is closed on major holidays and certain special holidays. Freshman candidates who plan to visit the campus for an interview should do so before January 15.

Application and Testing Deadlines: Notification Plans

Regular Programs for Fall Quarter Matriculation

Freshman candidates for other quarters should request information from the Office of Admission.

	Early Decision	Regular Plan
Apply by	November 1	January 1
Take tests by (SAT or ACT required; 3 ACH recommended[1])	October test	December test
To apply for financial aid, file FAFSA and FAF forms by	November 15[2]	February 15
Northwestern mails decision letter by	December 15	April 15
Reply by	February 15	May 1

Honors Program in Medical Education

	Regular Plan
HPME preapplication deadline	December 15
HPME application deadline	January 15
Freshman application to Northwestern by	January 1
Take tests by (SAT or ACT required; 3 ACH required[1])	December test
To apply for financial aid, file FAFSA and FAF forms by	February 15
Northwestern mails decision letter by	April 15
Reply	Within two weeks

Transfer Students for Any Quarter of Matriculation

	Fall	Winter	Spring	Summer
Apply by (Because space is limited in some programs, transfer candidates should apply well before these dates)	June 1[3]	November 1	February 1	May 1
Take tests by (SAT or ACT; scores from previous academic years are acceptable)	June 1	November 1	February 1	May 1
Apply for financial aid by (Consult with Admission Office)	June 1	November 1	February 1	May 1
Northwestern mails decision letter as soon as possible; reply within three weeks.				

[1]Required for Integrated Science Program and Honors Program in Medical Education. Scores from previous academic years are acceptable.

[2]On receipt of application, Northwestern will send financial aid information to candidates.

[3]Foreign transfer students for fall quarter should apply by May 1.

Advanced Placement

In nearly all areas, Northwestern awards credit for Advanced Placement examination scores of 4 and 5; in some cases, credit is also awarded for scores of 3. Specific questions concerning Northwestern's advanced placement policies should be addressed to the College of Arts and Sciences Office of Studies. In some fields, primarily in mathematics, the sciences, and foreign languages, advanced placement and/or credit can be earned through appropriate performance on examinations administered by Northwestern departments.

Northwestern awards credit for distinguished performance on the British General Certificate of Education (A-Level) Examinations, the International Baccalaureate, and other foreign university entrance examinations.

Northwestern also recognizes college credits earned by students before entering the University as freshmen. To qualify for such recognition, the courses must have been similar to courses offered at Northwestern; must have been taken at an accredited college or university; must not have been submitted in partial fulfillment of the normal secondary school graduation requirement; and must have been given on the campus of a college or university and taken primarily by bona fide college students—i.e., high school graduates pursuing a college degree. Students who have taken college courses that will not qualify for credit under these conditions should take Advanced Placement examinations in the appropriate subjects.

Transfer Candidates

Students may be considered for admission by transfer from another college or university provided they have completed one full year of university studies by the application deadline, are in good standing at their postsecondary institution, and have maintained at least a B average in rigorous academic courses. If students have been enrolled full time at any institution except Northwestern, they cannot be considered for freshman admission and must meet the stated criteria to apply as a transfer candidate. These students must complete at least the last 23 quarter-courses and six full-time quarters in residence at Northwestern to be eligible for a bachelor's degree.

Admission Procedure

To be considered for admission, transfer students must complete the following steps:

- File a completed application form available from the Undergraduate Admission Office, 1801 Hinman Avenue, P.O. Box 3060, Northwestern University, Evanston, Illinois 60204-3060
- Arrange with the officials of the high school to forward the complete high school report to the Undergraduate Admission Office
- Submit the results of the Scholastic Aptitude Test or the American College Test
- Schedule an interview with a member of the Undergraduate Admission Office staff, if possible
- Arrange with the registrar of each college previously attended to forward transcripts of record to the Undergraduate Admission Office
- Request a statement of good academic and social standing from the dean of students at the college from which the student is transferring
- Present a music audition (in person or taped recording) if applying for admission to the School of Music (audition guidelines will be furnished on request)
- Submit application for admission before the deadline of June 1 (for admission in the fall quarter), November 1 (winter), February 1 (spring), May 1 (summer)

Evaluation of Credits

Before matriculation, transfer candidates who are accepted by Northwestern will receive a preliminary evaluation of the credits they have earned to date, assuming all pertinent transcripts have been received. An official evaluation of credits earned will be made by the Office of the Registrar when the admitted student matriculates.

Foreign Students

In addition to meeting all regular admission requirements, foreign students are required to present evidence of their ability to speak, read, and write the English language and to meet the financial obligations associated with their study at Northwestern University. Students for whom English is a second language must present the results of the Test of English as a Foreign Language (TOEFL). Foreign students must have achieved

outstanding school records to be considered for admission. Foreign transfer candidates may apply for fall quarter admission only and must submit their completed application by May 1.

Returning Adult Students

Adults who interrupt their education following high school or during college and, after several years, decide to complete their undergraduate education are considered by the Office of Admission as "returning adult students." Ordinarily, returning adult students have been out of high school for seven years or more. Depending on the amount of college credit previously earned, returning adult students apply as freshman or transfer candidates.

When admitted to Northwestern, returning adult students may begin studies on a full-time or half-time basis. A full-time program includes three or four academic courses per quarter; a half-time program includes no fewer than two courses per quarter. See also Returning Students in the Financial Regulations section.

Evening Students

Adult students who wish to pursue a degree or certificate program through evening or Saturday study or who wish to enroll in courses for personal enrichment or professional mobility may enroll in University College, Northwestern's continuing education division. Courses are offered on the Chicago and Evanston campuses on a semester basis.

University College has an open enrollment policy, which allows adults who have left their previous school in good standing or those with a high school diploma but no prior college work to enroll in courses to establish an academic record. After the semester in which students complete a fourth course, one of which must be a course in writing, their academic record is reviewed and, if they have done well, they are invited to matriculate into an evening degree or certificate program or to continue enrolling in courses as a student-at-large.

Students may transfer to University College up to 90 semester hours of credit, of which 60 hours may be from community colleges.

Special Students

Properly qualified persons who demonstrate a need for certain courses required for their academic or professional advancement may apply to the University as special nondegree-seeking students. Applicants must present official transcripts of previous study and show evidence of successful academic achievement. *Persons who do not meet these requirements should not apply.*

Enrollment as a special student does not constitute admission to any degree program at the University, and credits earned as a special student may not be counted toward a degree at Northwestern. (Exception: Special students who subsequently become eligible to matriculate in University College may apply these credits toward a degree.) Special students are granted academic credit for course work satisfactorily completed, and these credits may be transferred to another institution.

Special students are admitted with the understanding that they may register only after students working toward Northwestern degrees have registered. Some classes will be closed, and some schools or departments may not accept nondegree students. These restrictions do not apply to the Summer Session.

Special students are not permitted to enroll in C99 or D99 Independent Study classes.

All tuition and fees for special students are charged at the undergraduate rate.

Complete instructions and application forms may be obtained from the Office of Special Students, Northwestern University, Evanston, Illinois 60208-2650.

Auditors

Auditors are persons who enroll in a course to observe or listen only. Auditors are not permitted to engage in class discussion, submit written or oral assignments, or take examinations. Academic credit is not granted to auditors.

Since the number of departments of the University that permit auditors is limited, consult the Office of Special Students before applying for admission as an auditor. Formal auditor status and registration are not normally available to regularly enrolled Northwestern students.

Financial Aid

The University awards financial aid on the basis of need as determined by the financial circumstances of the family. Aid may be a loan, part-time employment, a grant, or a combination of these. Recipients may accept all or any part of the aid offered. The amount of an award is confidential between the University and the family of the student. For entering freshmen, financial aid is generally renewable for up to 12 quarters of enrollment, even if they are not offered financial aid for those quarters. For transfer students, the maximum number of quarters of assistance depends on the number of quarters of transfer credit accepted, as determined by the Registrar's Office (i.e., a student who transfers with 3 quarters of acceptable credit is eligible for 9 quarters of assistance). The amount of financial aid may change based upon the family's financial circumstances. Students must reapply each year and maintain the requirements established by the Financial Aid Committee of the University.

During the 1992–93 academic year, undergraduate students at Northwestern received $35,939,730 in grant assistance: $26,282,000 from Northwestern, $6,889,280 from federal and state governments, and $2,768,450 from outside sources. The average grant for the 3,591 students receiving aid at Northwestern was $7,320. In addition, $8,621,751 in loan assistance and more than 3,000 campus jobs were available.

Assistance that is not need-based is provided by the Reserve Officers Training Corps (see Military Studies) and from other sources that are discussed in the Northwestern publication "Financing Private Higher Education," distributed by the Office of Undergraduate Admission (see Where to Write for the address).

Who Should Apply

Any undergraduate students who believe they cannot afford the full cost of a Northwestern education may apply for financial aid.

Students graduating from community colleges and transfer students from four-year colleges may apply for financial assistance; however, funding is limited. Transfer students must obtain a transfer financial aid application and financial aid transcript from the Office of Undergraduate Admission.

Application Procedure

Applicants request consideration for financial aid when submitting an application for admission. The Financial Aid Committee cannot make a decision until the University has admitted the applicant. Candidates should do the following:

- Complete and submit the application for admission, which provides a place to request financial aid
- File the Free Application for Federal Student Aid (FAFSA) and a Financial Aid Form (FAF) of the College Scholarship Service and request that copies of both reports be sent to Northwestern (the FAFSA and FAF are available at local high schools)
- File the applications as soon as the need for assistance is realized by the family, but not later than the dates indicated in the table, Application and Testing Deadlines

Satisfactory Academic Progress

To comply with federal regulations, students at Northwestern University are considered to be maintaining "satisfactory academic progress" for the disbursement of federal student assistance funds if they complete an average of nine units of academic credit per year. Federal regulations also state: "If a student does not have a C average or equivalent or the required academic standing at the end of the second academic year, he or she may not receive further aid from the federal financial aid programs." These policies are supplemented by the academic requirements established by the undergraduate schools (see each school's section in this catalog).

If students fail to maintain satisfactory academic progress as defined above, they may be awarded assistance for one additional payment period to reestablish "satisfactory" standing. Students who successfully complete a minimum full-time course load during this period will be considered once more to be making satisfactory academic progress. Students who fail to complete successfully a minimum full-time course load during this period will remain ineligible for any additional assistance during subsequent quarters, unless they, while ineligible, successfully complete a minimum full-time course load for one payment period at Northwestern or they present to the Office of Financial Aid evidence of

unusual circumstances that are deemed by the staff sufficient to justify an exception to this policy.

The above procedure will be followed except when students (1) are academically dismissed from the University according to the academic policies of their particular school and program or (2) have been in attendance at Northwestern for 12 quarters or the equivalent (unless the course of study normally requires more than 12 quarters of enrollment). As to the first case, students will be eligible for financial assistance during the first quarter of full-time study on returning to Northwestern in order to reestablish "satisfactory academic progress." On successful completion of a minimum full-time course load with a 2.0 grade average, they will again be considered to be making satisfactory academic progress and will be eligible for financial assistance in subsequent quarters. As to the second case, students are ineligible for financial assistance from University funds beyond the 12th quarter, even if they are maintaining satisfactory academic progress. However, the Committee on Financial Aid to Students may decide to continue aid when unusual circumstances exist and students demonstrate academic promise.

Financial Regulations

University Enrollment Requirement

The University Enrollment Requirement policy applies only to undergraduates in bachelor's degree programs. It does not apply to graduate students or special students. This requirement must be completed in addition to the degree requirements established by the various school faculties.

All students, except those enrolled in accelerated programs designed to be completed in fewer than four years, are expected to be enrolled for full-time study for 12 regular academic-year quarters. This 12-quarter requirement is referred to as the University Enrollment Requirement (UER). Note that the degree requirements set by the various school faculties are separate from the UER. Although some students may be able to complete their academic degree requirements, as established by the faculty, in fewer than 12 academic-year quarters, such students must still fulfill the 12-quarter UER.

Students who, due to circumstances beyond their control, are unable to complete the bachelor's degree requirements in 12 quarters may petition to the University Enrollment Committee for a 13th quarter at no additional tuition charge.

For purposes of the UER, full-time study is determined by the payment of full-time tuition. Students who withdraw and receive a partial refund will receive a prorated credit toward the UER based on the tuition paid. The normal full-time course load is three or four courses per quarter.

Students may, with approval of their school, take more than four courses per quarter without additional charge. These excess courses may be applied toward fulfillment of degree requirements of the various schools so long as they are not used to accelerate graduation. However, for students who desire to apply the excess courses toward the UER, there will be an excess course charge for each course of 25 percent of the full-time quarter's tuition in effect at the time of graduation. Such acceleration must be approved by the dean of the student's school. Students wishing to apply excess courses toward the UER must indicate their desire to do so when applying for the degree. Any excess course charges will appear on the bill for the last quarter of enrollment. Financial aid recipients will not receive additional grant assistance to cover excess course charges; however, they may apply for additional loan assistance.

Normally, the UER will be fulfilled by three quarters of full-time study during each of four academic years. In addition, credits from one or a combination of the following sources may be applied toward the UER. Each course credit fulfills one-fourth of a quarter of the UER. That is, four course credits are required to reduce the UER by one quarter. Students who enter as freshmen with 10 or more course credits will reduce their UER by one year. Regardless of the amount of credit earned outside the University, the minimum UER for all entering students as freshmen is nine quarters, which may include approved study abroad.

The approved sources of credit are

- Advanced Placement credit through the College Board.
- Placement credit awarded by Northwestern University.
- Approved foreign study during the academic year.

- Approved credit from another college or university, subject to restriction. Students entering with four or more courses from another institution may not apply any additional credit from another institution toward the UER, except for approved foreign study. Students entering with fewer than four courses from another institution may apply a maximum of four courses toward the UER, including those taken before matriculation. Any courses from another institution must be completed before achieving senior standing. Courses beyond the maximum may be applied toward academic requirements but *not* toward the UER.
- Summer Session at Northwestern. All students may apply four Summer Session courses toward the UER. Although four courses are normally required to reduce the UER by a quarter, a three-course Northwestern Summer Session load may be used to reduce the UER by one quarter. All three courses must be taken the same summer and this exception may be used only once.

Students who are denied any exceptions to the UER may appeal to the University Enrollment Appeals Committee. For further information about the UER or the appeals process, contact the Office of the Registrar, 633 Clark Street, Evanston, Illinois 60208-1118, 708/491-5234.

Returning Students

Students who withdraw from the University and wish to return must submit a Returning Student Application form to the Registrar's Office six weeks before the desired date of reentry. Students who want credit for course work taken at another institution must submit an official transcript to the Registrar's Office. The Registrar's Office will determine the extent to which credit earned away from Northwestern may reduce the four-year UER. Students who wish to apply more than four courses taken at another institution toward the UER must petition the University Enrollment Committee.

Transfer Students

Students who transfer to Northwestern from another institution will be informed of the extent to which their previous work reduces their 12-quarter UER. A transfer student is one who enrolled for a minimum of one year as a degree-seeking student at another institution. All transfer students have a six-quarter minimum UER. Transfer students who enter the University with four or more credits will not be allowed any further credit toward the UER for courses taken at other institutions. All transfer students, regardless of the amount of credit previously earned, must complete nine full-time quarters at Northwestern before becoming eligible for a quarter at no tuition charge.

Special and Part-Time Students

Special and part-time students are subject to the tuition rates shown under Undergraduate Tuition: Exceptions. Students must be approved for part-time study by the Office of Admission, the University Enrollment Committee, or the associate dean of their school. The Registrar's Office determines the extent to which the UER will be satisfied by part-time study.

Financial Aid Recipients

Students who elect to accelerate their education by taking course overloads while receiving grant assistance from the University will not receive additional grant assistance to pay for the cost of acceleration. The University will provide such students additional loan assistance.

Summer Session Students

The tuition policies of the Northwestern Summer Session are independent of the University's tuition policies for the normal academic year. Enrollment in the Summer Session may reduce the 12-quarter requirement, subject to the restrictions previously cited.

Cooperative Engineering Students

Students enrolled in the Murphy Cooperative Engineering Education Program will be charged tuition consistent with that of their entering class for the quarters they are enrolled in classes.

Tuition and Fees

The cost of education at Northwestern is only partly covered by tuition charges. The balance is met by the income from invested funds and by the gifts of alumni and other supporters of the University.

Tuition and fees for 1993–94 are listed below. Rates are subject to change without notice, and increases should be expected in subsequent years. For tuition

purposes, the term *course* refers to course credit. Some course offerings carry more than one course credit.

Undergraduate Tuition

All undergraduate students in degree programs must fulfill the University Enrollment Requirement (see the previous two pages).

Tuition: each quarter $5,268

Undergraduate Tuition: Exceptions

These rates apply only to special students, part-time students, and other students not subject to the University Enrollment Requirement.

Full-time: each quarter $5,268
Full-time registration is three or four courses.

Excess courses: each course $1,875
Excess courses are more than four courses.

Part-time:
One course, each quarter $1,875
Two courses, each quarter $3,750

Auditor's fee:
Each course audited, each quarter $1,455

Performance study:
P01 Private Instruction $937
P02 Private Instruction $1,875
Students who pay full tuition and take only three credit courses may take P01 or P02 at no additional charge.

Service Fees

Student Hospitalization Plan $700
Required for all students unless they have equivalent hospitalization coverage.

Study abroad enrollment fee $1,500

Tuition deposit fee $200
Required for each new undergraduate student; applied on the first tuition bill and not refundable.

Application fee (not refundable) $45

Returned check service fee $15

Financial transcript $5

Replacement identification card fee $20

Transcript fee $3

Makeup laboratory time, breakage fee varies

Other Fees

Late registration fee $25
If fee is billed $30
For registering at other than the scheduled times.

Retroactive registration fee $200
If fee is billed $225
For registering for a term after the last day of classes for that term.

Housing deposit fee $200

Late payment penalty fee $100
For late payment of bills.

Associated Student Government $12
Activity fee, each quarter.

Dependent Hospitalization Plan $1,350
For each dependent.

Field trip fee varies
For courses in which field trips are required to earn credit.

Bills and Payments

The Division of Student Finance issues student bills at Northwestern. A due date is shown on each University bill. Payment must be received by the due date. Due dates cannot be extended because bills are not received.

Installment Payment Plan

The University provides a tuition and fee installment payment plan, 9PAY, which offers the benefit of spreading the educational costs for the academic year into nine monthly payments. For information, contact the Division of Student Finance, Northwestern University, 619 Clark Street, Evanston, Illinois 60208-1132, phone 708/491-5224, fax 708/467-2451.

Withdrawal from the University: Refunds

Students who withdraw from the University must immediately file a withdrawal form, available at the Registrar's Office, Rebecca Crown Center. The completed form, bearing the required signatures, must be filed at the Registrar's Office.

The Student Finance Office considers the date the completed form is received at the Registrar's Office as the effective date in making financial adjustments.

Tuition deposits are not refundable under any circumstances. Tuition is refunded in full if the student withdraws on or before the seventh day of classes. After that the following policy applies:

- Between the eighth day of classes and the third Friday after classes begin, three-fourths of the tuition is refunded
- Between the third Friday and the sixth Friday after classes begin, one-half of the tuition is refunded
- After the sixth Friday of classes, no refunds are given

Residence and meal contracts are signed for the full school year. Students who leave a residence before the end of the year are liable for the entire year's rent or for charges to the date another student takes the vacated space in University housing. Meal charges are assessed until the end of the week in which withdrawal is effected. Adjustments may be made at the discretion of the Housing Office for students who for financial reasons must make other room and board arrangements than those for which they first contracted.

Change of Registration

No refund or bill reduction is made on any course dropped after the fifth day of classes in the quarter.

Financial Obligations

Students whose University bills are overdue will not be given a transcript or have their enrollment or degrees confirmed until all financial obligations are paid in full. Students whose accounts are overdue must pay a late payment penalty fee of $100. The director of student finance may cancel or prevent the registration of a student whose bills are past due.

Each student is liable for any costs associated with the collection of his or her past due account, including but not limited to collection agency costs, court costs, and legal fees.

Academic Regulations

Registration for All Students

- Instructions for registration are contained in the *Class Schedule* issued each quarter. Failure to read the *Class Schedule* does not excuse students from compliance with the information and regulations stated therein.
- The dates of registration for each quarter are announced in advance, and students not registered at the time specified are subject to a fee for late registration. This fee is assessed to cover partially the cost of registration at other than the scheduled time and is not intended as a penalty. Inconvenience, illness, and other personal reasons for registering late are not acceptable as reasons for waiving the fee. Late registration is permitted only through the fifth full day (Saturday is not a full day) of classes in any academic year and through the fourth full day in the Summer Session.
- Credit is not given for work in a course in which a student is not properly registered.
- Any course duplicated for credit increases the required number of credits to graduate by an equal amount. Both the original and the duplicated course entries remain on the student's permanent record and are used to calculate the cumulative grade point average. (Engineering students must consult the McCormick School Records Office as the policy may differ.)
- Credit is not given for a course that is a prerequisite for a more advanced course if that prerequisite is taken after the more advanced course has been completed. Waiver of prerequisites for admission to courses, however, may be obtained from the instructor concerned or the chair of the department in which the course is offered.
- Undergraduate students may not enroll for fewer than three quarter-courses except by permission of the dean of their school. Permission is given only in extraordinary circumstances.
- In the College of Arts and Sciences and School of Journalism, undergraduate students may not enroll for more than four quarter-courses except by permission of the dean's office. This regulation applies to total credit for courses taken in other institutions in addition to credit obtained in residence at Northwestern. Additional tuition may be charged for excess registration (see University Enrollment Requirement under Financial Regulations).

Changes of Registration

Changes in registration in fall, winter, and spring quarters are subject to the following provisions:

- In no case may a course be added after the fifth day of classes. No course may be dropped after the sixth Friday of classes.
- Undergraduate students may change registrations from grade to the pass/no credit (P/N) option or vice versa through the third Friday of the quarter. Check regulations of the individual schools for specific information on the P/N option.
- To make any change of registration, students must pick up a Change of Registration form at the Registrar's Office and obtain the signature of the adviser if required by their school.
- To add or drop a course, students must obtain a signature from the instructor or department representative for each course added and for each course dropped. The completed form must be returned to the location indicated in the *Class Schedule.*
- Changes in ungraded sections (laboratory or discussion) are made in the departments and do not require notification of the registrar.
- Students who receive permission to drop a course after the first five days of class must return a properly signed Change of Registration form to the Registrar's Office.
- If students drop a course by the sixth Friday of a quarter, the course does not appear on the permanent academic record and no grade is recorded provided a Change of Registration form has been properly filed. Failure to file this form within the time allowed is regarded as a course dropped without permission. A course dropped without permission is regarded as a failure and is recorded with a grade of F.

See also Withdrawal from the University: Refunds and Change of Registration under Financial Regulations.

Identification Cards

An identification (ID) card is issued to each student and must be validated each quarter. ID cards identify students at the library, Norris University Center, Henry Crown Sports Pavilion, athletic events, student elections, and other campus events. If an ID card is found, it should be turned in at the Registrar's Office.

Registration in University College

University College, on both the Chicago and the Evanston campuses, operates on the semester system. Students enrolled in an undergraduate school may take courses in University College only with the approval of the office of the dean of their school and only when the courses are not given on the quarter system during the day or when there are clear cases of conflict. Such work is counted as a regular part of a student's registration.

Students enrolled in undergraduate schools are not guaranteed a place in University College courses.

To register for University College courses, students must

- Secure from the Registrar's Office in Evanston the special form, Authorization for Dual Registration
- Secure approval from the office of the dean of their school
- Turn in the form at the Registrar's Office in Evanston before the first meeting of the class

Fall semester courses are included as part of fall quarter registration; spring semester courses are included as part of spring quarter registration.

To drop a University College course, students must pick up a dual registration form from the Registrar's Office, secure approval from the office of their dean, and return the form to the Registrar's Office.

Interschool Transfers

Undergraduate students who wish to transfer from one school or college of the University to another within the University must have an interschool transfer approved by the dean's office of both schools. A return to the original school must be approved in the same way. Approval of an interschool transfer is usually contingent on satisfactory performance in the original school. Consult the *Class Schedule* for appropriate dates to process an application for interschool transfer.

Cancellation of Registration

Students who complete advance registration for a quarter and later decide not to attend classes that quarter must notify the Registrar's Office in writing before the first day of classes of the quarter to avoid being charged the applicable tuition and fees.

Withdrawal from the University

Students who wish to withdraw from the University after registering for classes in any quarter must file a withdrawal form available at the Registrar's Office. The withdrawal takes effect the day the completed form, bearing the required signatures, is received at the Registrar's Office. See also Withdrawal from the University: Refunds under Financial Regulations.

Readmission to the University

Undergraduate and graduate students who have not registered for one or more quarters of an academic year must file at the Registrar's Office an application to reenter no later than six weeks before the first day of registration of the quarter in which they plan to return.

Students are not required to file the application to reenter under the following circumstances:

- If they have registered during the spring quarter and intend to return in the fall
- If they have registered in the spring quarter and intend to return during the Summer Session of the same year
- If they are students in the Graduate School who have attended the preceding Summer Session and intend to register during the next Summer Session and have not registered during the academic year

Students should obtain advance approval from the dean of their school if they wish to transfer credit of work taken elsewhere during an absence from Northwestern. A transcript of that work must be furnished to the Registrar's Office before the end of the next quarter in residence at Northwestern University, or credit for such work is not allowed.

If students interrupt a program of study for an extended period of time and if degree requirements are changed during this period, the new requirements normally must be met. Any modification of the requirements is made by the appropriate administrative officers of the school in which the student is registered.

Residence Requirement

The last 23 quarter-courses of the total required for the bachelor's degree must be taken while students are enrolled as undergraduates at Northwestern University. The last three quarters must be completed while students are enrolled in the school or college of the University that is to grant the degree. (Degree requirements are listed by school in this catalog.) *This residence requirement is in addition to the University Enrollment Requirement.*

To enable qualified undergraduate students to study abroad during their junior year, the residence requirement may be waived. For complete information, including definition of what constitutes qualification, interested students should consult the assistant or associate dean of their school or the College of Arts and Sciences Office of Studies.

CAS students desiring to study abroad and students from other schools who wish to participate in one of Northwestern's affiliated programs should consult the study abroad adviser in the CAS Office of Studies. Students participating in an affiliated program retain their enrollment at Northwestern during their study abroad and need not petition for waiver of the residency requirement.

Work at Other Institutions

After enrolling at Northwestern, students who want to study at other accredited institutions and transfer that work to Northwestern must obtain advance approval of their proposed study. Forms for obtaining such approval are available in the Registrar's Office. The McCormick School Records Office has forms available for engineering students. Students in the College of Arts and Sciences should secure the appropriate CAS forms (and a copy of the regulations governing study away from Northwestern) in the CAS Office of Studies. Also, students should check the regulations for the University Enrollment Requirement.

If students take course work elsewhere during an absence from Northwestern (or during the summer), a transcript of that work must be on file in the Registrar's Office before the end of the next quarter in residence at Northwestern, or credit for such work is not allowed.

Students may not register concurrently at Northwestern University and at another institution and receive transfer credit for work taken at the other institution unless permission is granted in advance by the office of the dean of their school. This applies to evening courses as well as to regular courses in residence.

Application for a Degree

All undergraduate students must file a degree application one calendar year before anticipated graduation. Undergraduates in the College of Arts and Sciences and the Schools of Education and Social Policy, Journalism, Music, and Speech must file their applications with the Registrar's Office. Undergraduates in the McCormick School must file with the McCormick School Records Office.

Classification of Students

Students are classified as follows:

- Senior: students who have completed at least 33 quarter-courses
- Junior: students who have completed at least 22 but fewer than 33 quarter-courses (engineering co-op students are considered preseniors when they have completed 32 quarter-courses and seniors when they have completed 40 quarter-courses)
- Sophomore: students who have completed at least 11 but fewer than 22 quarter-courses
- Freshman: students who have completed fewer than 11 quarter-courses
- Graduate student: students who have a bachelor's degree or its equivalent and have been admitted to a graduate program
- Special student: students who are not working toward a degree at Northwestern University but are working for credit
- Auditor: students who attend classes and listen to lectures, are not eligible to participate in class discussions or exercises, and do not receive credit (must have approval of the school and instructor concerned)

All the above except auditors may be either full time or part time:

- Full time: students enrolled in at least three quarter-courses or the equivalent
- Part time: students enrolled in fewer than three quarter-courses or the equivalent

Grading Policies

The following grading system is used in computing the grade point average:

Grade		*Grade Points*
A		4.0
A−		3.7
B+		3.3
B		3.0
B−		2.7
C+		2.3
C		2.0
C−		1.7
D		1.0
F		0
X	Failed to earn credit: missed final examination	0
Y	Failed to earn credit: work incomplete	0

The following notations are ignored in computing the grade point average:

P Pass with credit
N No grade, no credit
K In progress
S Satisfactory: noncredit course
U Unsatisfactory: noncredit course
W Dropped course with permission

At the end of a quarter a grade of X or Y will be given only if the instructor believes the student has a reasonable chance of passing the course by taking an examination or turning in the required work or both. Students should contact their individual school for regulations concerning X and Y grades.

If a grade of X or Y is to be changed and credit established, the deficiencies must be made up before the end of the next quarter in which the student is in residence in any school of Northwestern, or credit is forfeited. A notation of K must be resolved before graduation. An unresolved K will be changed to Y and the grade point average recomputed.

Class Attendance and Absence

Students are expected to attend all sessions of the courses for which they are registered. Excessive absence is cause for failure in the course. Some courses require attendance at the first class meeting; students may be dropped for nonattendance (see the *Class Schedule*).

Grade Reports

At the end of each quarter, a copy of each undergraduate student's grades is sent to the parent or guardian at the home address as well as to the student at the local address, except as noted below. Notices of deficiencies in scholarship may be reported to a student before the end of a quarter, but the University does not assume the responsibility of issuing such warnings.

The University will supply grade reports to parents of undergraduates unless the registrar receives written instructions from the parents indicating that the student is not a dependent and was not claimed as an exemption on the previous year's income tax return.

Transcripts

Students who have satisfied all financial obligations to the University are entitled to an official transcript of their academic record, which they may order from the Registrar's Office. A fee is charged for all transcripts (see Service Fees under Tuition and Fees).

Except for internal educational uses, Northwestern University issues official transcripts only upon written authorization of the student concerned. Because of the confidential nature of a student's record, telephone requests for transcripts will not be accepted. Written requests should be submitted to the Registrar's Office.

Requests for transcripts initiated by persons or agencies other than the student or appropriate educational agencies will not be filled until written authorization has been secured from the student. When these requests can be anticipated, students can avoid delay by providing such authorization in advance.

Allow one week for a transcript to be issued at any time except between quarters, when three weeks is necessary.

Academic Integrity

Academic integrity at Northwestern is based on a respect for individual achievement that lies at the heart of academic culture. Every faculty member and student, both graduate and undergraduate, belongs to a community of scholars where academic integrity is a fundamental commitment.

Registration at Northwestern requires adherence to the University's standards of academic integrity. These standards may be intuitively understood and cannot in any case be listed exhaustively; the following examples represent some basic types of behavior that are unacceptable:

- Cheating: using unauthorized notes, study aids, or information on an examination; altering a graded work after it has been returned, then submitting the work for regrading; allowing another person to do one's work and submitting that work under one's own name; submitting identical or similar papers for credit in more than one course without prior permission from the course instructors
- Plagiarism: submitting material that in part or whole is not entirely one's own work without attributing those same portions to their correct source (material discussing the use and acknowledgment of sources is available at the Office of Studies in the College of Arts and Sciences)
- Fabrication: falsifying or inventing any information, data, or citation; presenting data that were not gathered in accordance with standard guidelines defining the appropriate methods for collecting or generating data and failing to include an accurate account of the method by which the data were gathered or collected
- Obtaining an unfair advantage: stealing, reproducing, circulating, or otherwise gaining access to examination materials prior to the time authorized by the instructor; stealing, destroying, defacing, or concealing library materials with the purpose of depriving others of their use; unauthorized collaborating on an academic assignment; retaining, possessing, using, or circulating previously given examination materials, where those materials clearly indicate that they are to be returned to the instructor at the conclusion of the examination; intentionally obstructing or interfering with another student's academic work; otherwise undertaking activity with the purpose of creating or obtaining an unfair academic advantage over other students' academic work
- Aiding and abetting dishonesty: providing material, information, or other assistance to another person with knowledge that such aid could be used in any of the violations stated above; providing false information in connection with any inquiry regarding academic integrity

- Falsification of records and official documents: altering documents affecting academic records; forging signatures of authorization or falsifying information on an official academic document, grade report, letter of permission, petition, drop/add form, ID card, or any other official University document
- Unauthorized access to computerized academic or administrative records or systems: viewing or altering computer records; modifying computer programs or systems; releasing or dispensing information gained via unauthorized access; interfering with the use or availability of computer systems or information

It is the responsibility of every member of the academic community to be familiar with the specific policies of his or her own school. Students who violate these policies are subject to penalties, including course failure and exclusion from the University. Students charged with academic dishonesty may not change their registration in a course in which the charge is pending or in which a finding of academic dishonesty has been made. Information on procedures that will be followed in cases of alleged dishonesty can be obtained from the dean's office of each school. A complete statement of the University's principles regarding academic integrity can be obtained from the Office of the Provost.

The student-faculty Undergraduate Academic Conduct Committee works to maintain a high level of academic integrity at Northwestern; on the request of the provost, that committee also hears appeals from students regarding school decisions concerning academic dishonesty.

Regular Examinations

Regular course examinations are held during the last week of each quarter. Summer Session examinations are held at the times indicated in the quarterly *Class Schedule.* Students are responsible for determining the time and location of each examination. Early examinations are not permitted. Permission to be absent from the final examination is given by the instructor and the dean only for cause beyond the student's control. Normally such permission must be secured in advance of the date of the examination. Any deficiency must be made up before the end of the next quarter in which the student is in residence in any school of Northwestern University, or credit is forfeited. In no case may such a grade be made up after a lapse of one year.

Makeup Examinations

Grades of X (absent) and Y (incomplete) must be made up before the end of the following quarter in which the student is in residence in any school of Northwestern University, or credit is forfeited. Students not in residence may apply for a makeup examination. All such grades, however, must be made up within one year after the course was taken, or credit is forfeited. Permission to take a makeup examination to remove a grade of X must have the written approval of the instructor and the dean. Makeup examinations are conducted by the departments concerned, early in each quarter. An application for a makeup examination must be filed several weeks in advance at the office of the school in which the course is offered. See the *Class Schedule* for exact dates the applications are due.

Academic Standing

The decision concerning the academic standing of a student is the responsibility of the faculty of the school in which the student is registered.

Academic probation constitutes notice of unsatisfactory academic performance; it is a warning that minimum standards for graduation are not being met. Unless a student demonstrates significant scholastic improvement during the period of probation and thereby indicates ability to fulfill degree requirements within a reasonable period of time, the student may be dismissed from the University. A student will be notified in writing no later than the middle of a term that, because of unsatisfactory work in a previous term or terms, he or she will be excluded in the event of unsatisfactory work during the term for which the notice is issued.

Academic Probation

The following are ordinarily placed on academic probation:

- Students who, in any quarter or Summer Session, have received final grades below C in two or more courses

- Sophomores, juniors, or seniors who have a cumulative academic record below a C average on all work attempted at Northwestern University
- Students who fail in two consecutive quarters to complete at least three quarter-courses or the equivalent in each of the two quarters or have failed at the end of the sixth quarter of residence to earn credit for an average of three quarter-courses for each quarter of residence by reason of dropped courses, failure, or uncompleted courses
- Students who have failed to maintain a C average in the major or a professional field of study; the faculty of each school may impose such additional conditions of academic probation as they may deem appropriate

Removal from Academic Probation

Students on academic probation are ordinarily removed from probation if the deficiencies that resulted in probation have been remedied during the next succeeding quarter in residence. Students are rarely removed from probation on the basis of a program consisting of fewer than four courses graded on a basis other than the pass/no credit option.

If students on probation who receive grades of X or Y are not dismissed, probation continues until they have completed all courses or until the end of the next quarter in residence, when the students' records are again subject to scrutiny.

In no case are students removed from probation at the end of a quarter in which they have failed any course.

Academic Dismissal

The following will be dismissed for academic deficiencies (in every case the decision is determined in part by the student's cumulative academic record):

- Students on academic probation whose academic records have not improved significantly during the period of probation (which will not exceed two consecutive quarters)
- Students not on academic probation who fail in half the work in any quarter or Summer Session
- Students who demonstrate flagrant neglect of academic work at any time
- Students who do not make satisfactory progress toward completion of degree requirements

As a matter of general policy, the probation period for a freshman may be extended to the third quarter of residence if such extension appears to be in the best interests of the student and the University. Such consideration is not granted to a freshman whose record clearly discloses lack of aptitude or flagrant neglect of work.

Disciplinary Dismissal

Students suspended from the University by the Hearing and Appeals Board may not receive credit for academic work at any other institution during the period of suspension.

Honors and Prizes

Academic Honors

Degrees "with distinction" and "with highest distinction" are granted to approximately the top 5 percent of the graduating class of each undergraduate school. These honors are determined by the grades in all work at Northwestern University. Students in the highest 2 percent of the class are awarded "highest distinction" and in the next 3 percent, "distinction."

Department honors may be granted to graduating seniors who have done outstanding work in a department in connection with a research project or an integrative type of work. Students are nominated for these honors by their departments. The faculty of the school concerned makes the final awards.

Prizes

Prizes established through gifts and endowments are awarded to undergraduate students at Northwestern. Some are all-University prizes and others are available only to students registered in the school that administers the awards.

Honorary Organizations

Students who qualify by reason of superior scholarship or outstanding achievement are eligible for membership in certain honorary societies. New members of the following organizations are announced in the annual commencement program.

- Arts and Sciences: Phi Beta Kappa
- Engineering: Alpha Pi Mu, Eta Kappa Nu, Pi Tau Sigma, Tau Beta Pi
- Journalism: Kappa Tau Alpha
- Music: Pi Kappa Lambda

Other honorary organizations in various fields include Alpha Kappa Delta, Alpha Lambda Delta, Deru, Mortar Board, Norleggama, Orchesis, Phi Delta Kappa, Phi Eta Sigma, Pi Mu Epsilon, Sextant, Shi-Ai, and the Society of Professional Journalists (Sigma Delta Chi). Additional professional and technical societies represented at Northwestern are identified in the *Student Handbook.*

Academic Options

For more detailed information about the following programs, see other sections of this catalog.

Accelerated Degree Programs

Honors Program in Medical Education

The Honors Program in Medical Education is designed for highly talented high school seniors who should be able to qualify for advanced placement in chemistry, mathematics, and one of the humanities on the basis of superior achievement in high school. Each year 60 freshmen are admitted to the seven-year program and to the College of Arts and Sciences, McCormick School of Engineering and Applied Science, or School of Speech. Only candidates applying directly from high school are considered.

The first three years of the program are spent on the Evanston campus in the College of Arts and Sciences, McCormick School, or School of Speech and the last four years at the Medical School on the Chicago campus.

Students in CAS devote half their time in the first two years to chemistry, physics, and the biological sciences, arranged in a sequence so that each course builds on those that precede it and leads to those that follow. The other half of the students' time in the first two years is devoted to courses in the humanities, social sciences, and arts. The third year is a culminating experience in which students complete advanced course work and research in an intellectual discipline. This may be done as a senior concentration in a department or program, by studying abroad in a Northwestern-affiliated program, or by completing the requirements for the BA degree in the College of Arts and Sciences. Students may also take an additional undergraduate year at Northwestern or elsewhere.

Students in the McCormick School follow a curriculum in biomedical engineering.

Speech students spend three years in the Department of Communication Sciences and Disorders, studying the anatomy and physiology of hearing, speech, and the central nervous system as it relates to cognition and memory. They have opportunities to learn how people of all ages hear, speak, and learn—both normally and in the presence of handicapping conditions. The students also take courses in chemistry, physics, the biological sciences, the social sciences, and the humanities.

On completion of the first three years, students move to the Chicago campus as members of the Medical School regular first-year class, which includes students who have completed the traditional four years of premedical education. After successful completion of three undergraduate years and one year at the Medical School, CAS students who have not received a BA degree qualify for a bachelor of science in medicine, McCormick students qualify for a bachelor of science in biomedical engineering, and Speech students qualify for a bachelor of science in speech; at the end of seven years, they qualify for the doctor of medicine degree from the Medical School.

Students who wish to be considered candidates for the Honors Program in Medical Education should request, before December 1, a preliminary evaluation form to provide information that will determine whether they will be suitable candidates. If the request is approved, they will be sent and must complete the special HPME application in addition to the regular application for admission to the College of Arts and Sciences, McCormick School, or School of Speech by the appropriate deadlines (see table, Application and Testing Deadlines).

Seven-Year Programs in Dental Education

Combined BS/DDS for Biomedical Engineers

Qualified students in the McCormick School who have completed three years of biomedical engineering studies as well as predental courses may apply for admission to the Dental School as candidates for the doctor of dental surgery degree. Accepted students complete the requirements for the bachelor of science degree during their first of four years at the Dental School, following which the McCormick School awards the BS.

Combined BA/DDS

Students complete 35 quarter-courses required for a bachelor of arts degree from the College of Arts and Sciences as well as the courses required for admission to the Dental School. If the applicant is admitted to the Dental School, 11 Dental School courses are counted toward the BA, which is awarded by CAS. Typically, students in this program complete three years of course work in CAS followed by four years at the Dental School.

Integrated Science Program

Northwestern University offers a highly selective undergraduate program of integrated science studies within the College of Arts and Sciences. The Integrated Science Program (ISP) is designed for students with superior high school records and strong motivation in science and mathematics. Its special curriculum provides a thorough and rigorous background in the major scientific disciplines and mathematics. ISP can lead to a bachelor's degree in three years or, after a fourth year at Northwestern, to a double-major or an advanced degree.

Enrollment in ISP is limited to assure small class sizes. Selection is made on the basis of scholastic record, test scores, and recommendations. Background requirements are a year of calculus, a year of chemistry, and a year of physics. Students who wish to be considered for ISP should request the special ISP application and brochure in addition to the regular application from the Admission Office. See Integrated Science Program in the College of Arts and Sciences section of this catalog.

Four-Year Master's Programs

Exceptional undergraduates at Northwestern University may be able to earn both a bachelor's degree and a master's degree in less than the usual period of time. The combined degree programs—BA/MA, BA/MS, BS/MS, BSSp/MA—enable students who commit themselves early in a discipline to accelerate their study toward the doctorate at Northwestern or elsewhere. (There are concurrent five-year degree programs in certain departments in the McCormick School; see that section
of the catalog.)

Combined degree programs are special in their intellectual demands. Except in the McCormick School, students receive a double count of nine credits—that is, nine credits are applied toward both the bachelor's and master's degrees.

The following departments and programs in the College of Arts and Sciences and the School of Speech have combined degree programs approved by the Graduate School:

- Anthropology
- Chemistry
- Classics
- Communication studies
- Economics
- English
- French and Italian
- Geological sciences
- Hispanic studies
- Linguistics
- Mathematics
- Political science
- Sociology

The approved departmental programs vary, but they share a common goal: the selection and training of exceedingly able students. The programs also share several underlying premises. First, each department selects students for participation in the program. Students do not select themselves, though they may, of course, inquire about their eligibility. Second, selection by a department is a recommendation to the Graduate School for admission. Students are officially admitted to the Graduate School only after their credentials have been

thoroughly reviewed and approved by the dean of the Graduate School.

For these reasons, students should be aware of guidelines used by the dean of the Graduate School and other guidelines affecting the operation of the program:

- No particular grade point average, however high, automatically entitles a student to participate in a combined degree program.
- *Only* one academic year—three quarters or two semesters or less—of transfer credit from another institution may be applied as credit toward the bachelor's portion of the combined degree, including credit for a junior year abroad. Any participating department may, if it desires, impose a more restrictive standard.
- A combined degree program requires a minimum of 12 full quarters of work. The master's portion must be completed during the final three contiguous quarters of registration, beginning with fall quarter. In schools or departments of the University that operate on a four-quarter system, that is, which offer a full program during the Summer Session staffed by the regular faculty, one Summer Session only may be counted toward fulfillment of the 12-quarter requirement. In schools of the University that do not operate on a four-quarter system, cases of one summer of credit will be considered on an ad hoc basis by petitioning the dean of the Graduate School.
- All requirements, both undergraduate and graduate, must be met by the conclusion of the fourth academic year. The bachelor's and master's degrees are awarded simultaneously.
- Both degrees will appear on a single transcript, as will the results of all work completed for both degrees.
- Continuation of graduate work at Northwestern by those who complete a combined degree program must receive separate approval by the department and the dean of the Graduate School.

Accelerated Master's Program in Journalism

Students who exhibit exceptional ability in undergraduate work in the Medill School of Journalism may apply to that school's graduate division for early admission to the graduate editorial program. This program allows students to qualify for bachelor of science in journalism and master of science in journalism degrees in 12 to 14 quarters of full-time study. Students apply for this program during their junior year; however, interested students are encouraged to begin planning for this option early in their undergraduate career. Information and admissions materials are available from the Medill Office of Graduate Admissions and Financial Aid. See Accelerated Master's Program in the Medill School section of this catalog.

Combined Bachelor's Programs

Combined Liberal Arts and Engineering Program

Qualified students may undertake a program to earn both a bachelor of arts in a liberal arts discipline from the College of Arts and Sciences and a bachelor of science in an engineering field from the McCormick School. Students in this BA/BS program, which takes four or five years, must complete all requirements of both schools. To do the necessary planning, interested students should consult with the CAS Office of Studies and the Counseling Office at the McCormick School as soon as possible after enrolling at Northwestern. See Five-Year BA/BS in the McCormick School section of this catalog.

Combined Liberal Arts and Music Program

Northwestern offers qualified students the opportunity to earn in five years both a bachelor of arts degree from the College of Arts and Sciences and a bachelor of music degree from the School of Music.

Participants in this BA/BMus program must meet the admission standards of both the College of Arts and Sciences and the School of Music. Applicants should have a high school background in a foreign language at least equivalent to a first-year college-level course and may apply directly from secondary school or at any time during their freshman year. Candidates may consult with the coordinator of undergraduate admissions, School of Music. See Five-Year BA/BMus in the School of Music section of this catalog.

Combined Music and Engineering Program

Northwestern offers unusually capable students the opportunity to earn in five years both a bachelor's degree from the School of Music and a bachelor's degree from the McCormick School of Engineering and Applied Sci-

be accepted by both the School of Music and the McCormick School. Students may apply to the program directly from high school or at any time before the beginning of their sophomore year. See Five-Year BS/BMus or BS/BAMus in the School of Music section of this catalog and Engineering and Music under McCormick School.

Combined Journalism and Engineering Program
A combined program of the McCormick School of Engineering and Applied Science and the Medill School of Journalism is designed for students with a strong interest in science, applied science, and engineering and in effective communication in these areas. For engineering students, at least five of the journalism courses could form a "theme" and at least three science and/or mathematics courses could be used jointly to fulfill the science/mathematics requirement in journalism and some basic science and mathematics requirements in engineering. Students in this combined program, which normally takes five years to complete, must fulfill all course requirements for a degree in engineering as well as in journalism. See Engineering and Journalism in the McCormick School section of this catalog.

Interdisciplinary Study

Mathematical Methods in the Social Sciences Program
The Program in Mathematical Methods in the Social Sciences (MMSS) in the College of Arts and Sciences enables students to combine the study of social sciences with training in formal analytical methods. The program is intended for students with high mathematical aptitude and strong interest in social problems and issues, including their policy and research implications.

Admission to the MMSS is very selective; it is limited to entering freshmen and students beginning their sophomore year who have earned superior academic records and demonstrated strong aptitude in mathematics. Prerequisite for admission consideration is a full-year course in calculus. See Mathematical Methods in the Social Sciences in the College of Arts and Sciences section of this catalog.

Integrated Science Program
See Accelerated Degree Programs.

Interschool Certificates and Adjunct Major
Students in any undergraduate school may enroll in the Undergraduate Leadership Program. All undergraduates may enroll in the International Studies Program as an adjunct major. Students in the College of Arts and Sciences and Schools of Music and Speech also are eligible for the Integrated Arts Program, and the Music Theatre Program is open to School of Music voice majors and School of Speech theatre majors. (See Other Undergraduate Programs.)

Undergraduates in other schools may enroll in College of Arts and Sciences certificate programs. (See Special Certificate Programs under Academic Options in the CAS section of this catalog.)

McCormick School Honors Programs

Honors Program in Undergraduate Research
The Honors Program in Undergraduate Research in the McCormick School provides an unusual opportunity for prospective freshmen with superior motivation and scholastic credentials to be admitted to work with an engineering faculty mentor/adviser in a challenging research project, beginning in the first year and continuing throughout the undergraduate years.

Students may request the names and current research interests of participating faculty, enabling them to apply to a project of their choice. With the participation of a faculty sponsor, students will be selected for the program based on their high school records; SAT or ACT, achievement, and advanced placement test scores; and usually, an interview. Interested students may request an application and additional information from the McCormick School Office of Undergraduate Affairs. (See Honors Program in Undergraduate Research in the McCormick School section of this catalog.)

Honors Program in Engineering and Management
Honors students are eligible to participate in a joint program of the McCormick School and the J. L. Kellogg Graduate School of Management. High school students

with superior scholastic credentials and strong motivation for study beyond the bachelor's degree may be admitted to an undergraduate engineering program at the McCormick School and also granted deferred admission to the Kellogg School.

Interested students should request an application and additional information from the McCormick School Office of Undergraduate Affairs. (See Honors Program in Engineering and Management in the McCormick School section of this catalog.)

Formal options

Pass/No Credit (P/N)

The P (pass) or N (no credit) option allows students to explore fields beyond the areas of their specialization without concern about grade point average. Most undergraduate courses are open to the P/N option. For information about a particular school's P/N policy, see that school's section in this catalog.

Student Organized Seminars (SOS)

Students who wish to pursue studies not included in the catalog may plan and initiate their own courses under the supervision of sponsoring faculty members. SOS credit courses may be developed in the undergraduate schools except the Medill School of Journalism.

Independent Study (C99)

Many departments offer undergraduate seminars and independent studies for qualified students. C99 in any department enables a student to engage in individual special study and research. Depending on the student's interests, independent projects may involve work in a laboratory or library, fieldwork outside the University, or the creation of a work of art. The maximum credit a student may receive for C99 during any one quarter is two units.

Program of Individualized Instruction in Foreign Language

This program allows students to determine with the instructor the reading or conversation skills to be developed and the pace to be followed.

Double Major

A double major is available to all students who complete a full major program in two departments.

Self-Designed Major

A self-designed major permits all students, with the permission of the school's curriculum committee or dean, to concentrate advanced study in an area other than one of those recognized through a departmental or interdisciplinary major. This option is identified as an ad hoc major in the College of Arts and Sciences, the interdepartmental studies major in the School of Speech, and the Combined Studies Program in the McCormick School.

Departmental Honors Programs

Departmental honors programs are available to students through most departments of the College of Arts and Sciences, all departments of the McCormick School, and the School of Education and Social Policy. They involve advanced study through special undergraduate seminars or graduate courses and/or independent work under faculty supervision.

Teacher Certification

See Teacher Certification at Northwestern in the School of Education and Social Policy section.

Off-Campus Programs

Field Study

Many off-campus field studies, internships, and research opportunities sponsored by various schools and departments are available to Northwestern students. The programs vary greatly: some carry academic credit; some are undertaken in conjunction with a class or seminar; some make provision for a stipend; some entail living away from campus.

Following is a representative list of field studies programs with their sponsoring school or department:

- Northwestern Archaeological Field School (anthropology)
- Internships in the Arts (art history)
- Political Campaigning (political science)

- Human Development and Social Policy Practicum (education and social policy)
- Teaching Magazine Program (journalism)
- Teaching Newspaper Program (journalism)
- Teaching Television Program (journalism)
- Professional Apprenticeship in Music Education (music)
- Communication Studies Field Studies Program (communication studies)
- Internship in Television Production (radio/television/film)
- Theatre Field Experience (theatre)
- Chicago Field Studies Internship (arts and sciences)

Study Abroad

Northwestern encourages qualified students to pursue study abroad when such study promises to enrich their academic programs. Through its affiliated and exchange programs, Northwestern helps arrange foreign study; when necessary, financial aid is available for participating students during the regular academic year.

Northwestern-affiliated programs include the Sweet Briar Junior Year in France, the Wayne State Junior Year in Munich, the Intercollegiate Center for Classical Studies Program in Rome, the One-Year Program of the Hebrew University in Jerusalem, the program in Russia of the American Council of Teachers of Russian, the Bologna Cooperative Studies Program at the University of Bologna in Italy, the University of Massachusetts at Amherst Program in the People's Republic of China, the Year Abroad Program of the American University of Cairo, and the One-Year Program of the International Christian University in Tokyo.

An exchange program with the University of Sussex allows Northwestern students to spend a year in England and Sussex students to study in Evanston. An exchange program with the University of Seville in Spain enables a number of Northwestern students to spend an academic year taking courses at the university and special seminars offered by the Northwestern program in Seville.

Summer programs at the University of Guanajuato in Mexico and at the University of Laval in Quebec are sponsored jointly by Northwestern and several other American universities.

Students participating in affiliated programs should have linguistic proficiency at least at the second-year college level and be prepared in the subject fields they plan to pursue abroad. Information on these and other programs is available from the study-abroad adviser in the CAS Office of Studies.

Undergraduate Schools and Courses

Key to Course Listings

Changes

Although the course listings in this catalog are as complete and exact as is possible at the time of printing, some changes may occur later and courses may be dropped or added. The official *Class Schedule* issued for each quarter contains a complete and updated listing of courses for that quarter. The University reserves the right to cancel courses for which registration is not sufficient.

Arrangement

Courses offered by each school are listed by departments arranged alphabetically. In the departments, courses are arranged by A, B, C, D, and E:

- A-level courses are primarily for freshmen and sophomores, usually without college prerequisite
- B-level courses are primarily for sophomores and juniors, usually with the prerequisite of sophomore standing or an A-level course in the same or a related department
- C-level courses are primarily for upperclass and graduate students, with the prerequisite of junior standing or an A- or B-level course in the same or a related department
- D-level courses or seminars are primarily for graduate students, in which the major part of the work is not research
- E-level courses are for graduate students only, seminars in which the work is primarily research or special research by the individual student under faculty direction

Course Credit and Quarters

Daytime work in all the schools on the Evanston campus is on the quarter system. A quarter-course, the unit of instruction, is the work done in a class meeting at least three hours per week and has the value of one unit of credit. An exception is a course meeting fewer than three hours per week, which may carry less than one unit. A quarter-course is the equivalent of $2^2/_3$ semester hours. (For transfer to other institutions or for certification stated in credit hours, undergraduates may consider a quarter-course equivalent to four quarter hours of credit.)

Summer Session combines the course offerings of University College, which is on the semester system, and the schools on the Evanston campus, which are on the quarter system. For transfer credit, courses taken during Summer Session should be considered the equivalent of four quarter hours or three semester hours.

Numbering System

Each course carries three sets of characters. The first set (three numbers) indicates the school and department or area of study, the second (a letter and two numbers) is the course number, and the third (one, two, or three numbers) indicates whether the course is part of a sequence. Some special groups of courses may have special sequence numbers for identification. Examples:

- **425-A01-1,2,3 Elementary German**
  4 = College of Arts and Sciences
  25 = German Language and Literature Department
  A01 = specific course
  1,2,3 = three-quarter sequence
- **710-C07-0 Kinetics**
  7 = McCormick School
  10 = Chemical Engineering Department
  C07 = specific course
  0 = one-quarter course

Numbers in parentheses following a course title indicate units of credit in special cases.

College of Arts and Sciences

Undergraduate study in the arts and sciences has formed the core of Northwestern University since its founding in 1851. The oldest and largest of Northwestern's 13 schools, the College of Arts and Sciences is one of the nation's leading liberal arts institutions and stands at the center of the University's academic and intellectual life.

The college's outstanding faculty of more than 400 women and men are dedicated to excellence in both teaching and scholarship. Organized into 25 departments and more than a dozen interdisciplinary programs, the college faculty offer more than 2,000 undergraduate and graduate courses each year. This immense array of intellectual activities provides the college's approximately 3,600 undergraduates and more than 1,000 graduate students the opportunity to share with the faculty the triple missions of preserving, transmitting, and advancing human knowledge.

At the undergraduate level, the purpose of the college is to provide a superior liberal education, emphasizing the ability to think rigorously and to communicate clearly and forcefully. Further, the liberal education offered by the college helps each student become familiar with our world—that made by nature and that made by man, that of the past and that of the present, that nearby and that far away. This education assumes the acquisition of knowledge, but above all it requires learning how to acquire it, how to use the techniques and methods by which we come to know the laws that govern natural phenomena, the properties of the abstract worlds of logic and mathematics, the complex interrelations of human societies. Finally, liberal education at Northwestern involves development of a thoughtful sensitivity about what is beautiful and what is good. This education contributes to students' judgment and understanding, even as it makes them aware of what must yet be found out or mastered.

Liberal education in the college is "prelife," then, but it is also preprofessional in the best sense. It serves as the foundation for many kinds of careers and professional activities. The ability to reason clearly, to absorb and make sense of large bodies of information, to apply general principles in new contexts, and to communicate effectively—these are skills required in most occupations. They are also the principal concerns of a liberal education. Moreover, a liberal education develops the qualities of mind needed by the citizenry of a democracy. The college's graduates typically take positions of leadership in public and private life, and one aim of the college is to ensure that these leaders make decisions informed by knowledge, rationality, and understanding.

The research done by the college's faculty members goes hand in hand with their teaching. Undergraduate education is but one among several enterprises in which the Northwestern faculty are engaged; training of graduate students and pursuit of research are the others. Many faculty have achieved international scholarly reputations, and many of the college's departments stand among the leading departments in the nation. Both undergraduate and graduate students benefit from the fact that their instructors are actively contributing to knowledge or adding to our understanding of the human experience in new ways. Students in the college benefit from being in a university: they gain from the prestige of the college, from the fact that their teachers are continually refreshed by advanced research, and from the availability of Northwestern's outstanding library, research facilities, and professional schools.

Academic Policies

Program of Study for the Degree of Bachelor of Arts

The college offers courses of study in the arts and sciences leading to the degree of bachelor of arts. Within a framework of requirements established by the University and the college faculty, students have considerable flexibility in structuring their academic programs.

Before graduation each student must have completed 45 one-quarter courses and must have fulfilled the residence and grade requirements described in the next section. The faculty has also established distribution requirements, which are designed to ensure that each graduate of the college has at least an elementary acquaintance with the distinctive approaches, concepts, and contributions of the major domains of knowledge. In addition, completion of a major ensures that each graduate has a comprehensive grasp of the material of at least one academic discipline. The faculty also requires that each freshman student complete two freshman seminars during the first year at Northwestern; further, all students before graduation must demonstrate proficiency in English composition and competence in a classical or modern foreign language.

The variety of academic options available and the differences in student preparation and interest make it unlikely that many students will follow precisely the same program of courses at Northwestern. But each student should attempt to design a program that is intellectually rigorous and coherent and that will assist in the development of powers of independent and critical thinking and lead to an awareness of the interrelations among fields of knowledge.

The flexibility possible in a liberal arts education presupposes that each student will be able to fashion a course of study that is both personally rewarding and intellectually challenging. Though the faculty has provided some guidance through the establishment of requirements and major programs, much of the responsibility for the design of an undergraduate program rests with the student. However, students are urged to take advantage of the various forms of counseling that are available. Upon entrance to the college each student is assigned a freshman adviser—a faculty member usually chosen from a department related to the student's stated interests. Upon declaration of a major, the student becomes formally associated with a department and is assigned a department adviser. Any student at any time may call upon the CAS Office of Studies, where faculty members designated as college advisers are available throughout the day to talk with students.

For various reasons some students will graduate with fewer than four years in the college. Some students transfer to the college from other schools within the University. Others transfer to Northwestern from other institutions. A number of freshmen enter with advanced placement and credit on the basis of work done before admission. Students pursuing abbreviated programs in the college should be particularly attentive to general education and major requirements.

Superior students are encouraged to participate in departmental undergraduate seminars or to investigate individual research problems under the direction of a member of the faculty. Students whose performance at Northwestern suggests they could profit from study abroad are encouraged to explore the possibilities with the Office of Studies.

Departmental honors are awarded at graduation to students who complete the regular courses of a departmental major program with distinction and who also do superior work in honors seminars, independent study, or both.

Requirements for the Degree of Bachelor of Arts

Residence and Grade Requirements

Of the required 45 quarter-courses, the last 23 must be taken while the student is enrolled as an undergraduate at Northwestern, and the student must be enrolled in the College of Arts and Sciences for the last three quarters preceding the granting of the degree.

Not more than 11 of the required quarter-courses may be courses in undergraduate schools at Northwestern other than the College of Arts and Sciences; no more than 3 of those 11 may be instruction in applied music; and no more than 4 of the required quarter-courses may be courses offered by the programs of Aerospace Studies, Military Science, or Naval Science. Qualified students may *with the prior approval of the*

faculty take their junior year abroad or take work at another institution in the summer between the junior and senior years.

The grade average in courses offered to meet the requirements for a degree may not be lower than C. The number of courses with grades of P or D taken at Northwestern and offered for graduation may not exceed one-fifth of the total. No work passed with a grade of D may count in satisfaction of a program of major study, including any course prerequisite to a course required in the departmental unit or any related course required for a major.

Transfer students are required to complete at Northwestern the equivalent of at least four one-quarter upperclass (C-level) courses in the department of their major.

In addition to and independent of the requirements set by the College of Arts and Sciences, all students must satisfy the University Enrollment Requirement (see Financial Regulations).

Freshman Seminar Requirement

All students are required to take two one-quarter freshman seminars during their freshman year.

Writing Proficiency Requirement

All students before graduation must meet a two-part writing proficiency requirement: (a) they must pass the writing proficiency examination (or have the examination waived on the basis of admissions test scores), and (b) they must write satisfactorily in courses taken at Northwestern. Ordinarily, freshman seminar instructors provide the assessments of students' writing in courses. Students who do not write well on the exam or in courses may be asked to take English A05 Basic Composition. Courses in basic and intermediate composition are also available for all students who wish to increase their skill and confidence in writing. The writing proficiency requirement is administered by the CAS Writing Program.

Foreign Language Requirement

All students before graduation must demonstrate proficiency in a classical or modern foreign language. Proficiency is normally equivalent to the work covered in a second-year, college-level course. Proficiency may be demonstrated in any of the following ways: (a) by achieving a score on a CEEB advanced placement or achievement examination that meets the criterion determined by the CAS Committee on Language Proficiency, (b) by passing a proficiency examination administered at Northwestern during New Student Week and periodically thereafter through the school year, (c) by successful completion of course work designated by the Committee on Language Proficiency, or (d) by successfully passing a proficiency examination in a language not usually taught at Northwestern. Students who desire such proficiency testing must petition the Committee on Language Proficiency; petitions are available in the Office of Studies. In extraordinary cases, the Committee on Language Proficiency has the authority to waive the proficiency requirement and suggest substitution. The committee will not, however, simply excuse the student from the language requirement. Language departments may impose a limit on the number of times a proficiency examination may be taken.

Distribution Requirements

All students will normally complete two quarter-courses, selected from a list of approved courses, in each of the following distributional areas:

- I. Natural Sciences
  Courses in this area will introduce students to methods of inquiry and/or fundamental concepts in the natural sciences.
- II. Formal Studies
  Courses in this area will introduce students to the abstract languages used in such fields as mathematics, linguistics, computer science, and symbolic logic for describing relationships among concepts and/or objects. Such courses will consider how objects of thought or experience and their relationships can be analyzed.
- III. Social and Behavioral Sciences
  Courses in this area will introduce students to the theories, methods, and findings of empirical research on human behavior and its relations to social, cultural, economic, and political institutions.
- IV. Historical Studies
  Courses in this area will introduce students to the chronological development and historical relationships

in cultural, social, political, economic, and military affairs in a broad temporal perspective.

- V. Values

  Courses in this area will introduce students to the principles by which people orient and conduct their lives, to the nature of social and moral values, to the nature of knowledge and reality, and to the modes of religious understanding and conduct.

- VI. Literature and Fine Arts

  Courses in this area will introduce students to major works of art—literary, visual, or musical—and will explore the characteristics that make an aesthetic object worthy of appreciation.

More detailed information concerning the distribution requirements is available in the CAS Office of Studies.

Major Study Requirements

All students must fulfill the requirements of a major program of study. A student may elect a major and become formally affiliated with a department or program any time after the first quarter of the freshman year, and such a declaration of a major must be made no later than the end of the sophomore year. The declaration of a major is made by completing a form available in the CAS Office of Studies. After declaring the major, the student should contact the appropriate department office to be assigned a faculty adviser.

A student may elect a major program of study from among the following options:

- Departmental Major

  Each department offers one or more programs of specialization, which are described in detail immediately preceding the departmental course offerings in this catalog. Interested students may pursue a double major by completing the major requirements in two departments of the college. With very limited exceptions in dual major programs, the same course may not be applied to the major requirements of two departments. However, a course used as a major course in one department may be counted as related work for another major program.

- Ad Hoc Major

  Upon the recommendation of a member of the faculty, the Curricular Review Committee may approve an ad hoc major program of study for a student whose special and legitimate interests cannot be satisfied by one of the regular major programs offered by the college. Ad hoc major programs approved in recent years include South Asian studies and ethology; there are established curricula for ad hoc majors in Asian studies, geography, and neuroscience (see these entries). Students interested in this option should consult the associate dean for undergraduate studies.

- Area or Divisional Major

  At present the college offers 10 programs that have as their core, not the materials and discipline of one department, but those of several departments as they are related to certain scientific, cultural, and political areas. These programs, described in the corresponding entries, are American culture, cognitive science, comparative literary studies, computer studies, drama, environmental sciences, integrated science, international studies, mathematical methods in the social sciences, and urban studies. The last three programs are available only as adjunct majors.

The Senior Year

In their senior year, undergraduates may take elective courses designed especially for them and distinct from other courses in the college. Linkage seminars are taught by nonacademic persons whose fields of expertise are related to the values of liberal education. Topics have included the role of philosophy in the practice of medicine, polling and public opinion, patent law, and Christian and Jewish attitudes toward statehood. Linkage seminars are announced to CAS seniors before registration each quarter.

Registration in Undergraduate Seminars, Independent Study, and Courses in Other Undergraduate Schools in the University

Course C98 Undergraduate Seminar is open only to seniors by invitation of the department concerned. Credit up to a maximum of four one-quarter courses is allowed. It may be taken in one or more quarters.

Course C99 Independent Study is limited to seniors and, in exceptional cases, also to juniors with excellent records who are invited by the department.

Students must receive approval from the department concerned in the quarter preceding that in which they wish to enroll in C99, and a detailed description of the course and the basis of evaluation must be submitted to the department chair and kept on file.

Students enrolled in C99 must also submit for the departmental C99 files an abstract of the work completed.

Students may not register for more than two one-quarter courses of credit in C99 in any one quarter.

Students may not receive credit for more than nine one-quarter courses in C98 and C99.

Credit for courses taken in University College can be counted toward the BA degree only if the courses are similar to the ones offered in the regular curricula of the Evanston undergraduate schools.

Students in the college may count toward the BA degree no more than 11 one-quarter courses offered by other schools of the University, including dual registration in University College. A maximum of 3 of these 11 may be instruction in applied music. No more than 2 courses outside the college may be taken concurrently except by permission of the CAS Office of Studies.

No credit is given for shop work, individual instruction in speech, correspondence courses, or course work in music education or physical education.

Pass/No Credit Option

Full-time students in the college may elect to enroll in some courses with the understanding that they will not receive a regular letter grade but will receive the notation P (pass) or N (no credit). They may elect only one course per quarter under this option for a total of no more than six. They may not elect this option in any course used to fulfill distribution or major requirements or related work. The number of courses with grades of P or D taken at Northwestern and offered for graduation may not exceed one-fifth of the total.

Preprofessional Study

The College of Arts and Sciences offers students excellent preparation for further study in professions such as law, medicine, and management. Each year a substantial number of graduates go on to pursue graduate study in these areas, and some students take positions in business.

No one major is designed simply as preprofessional training. In fact, all majors can be suitable preparation for professional schools, provided certain appropriate courses are included in the student's program. The college advisers in the CAS Office of Studies help students design academic programs that combine the breadth of a liberal arts education with adequate preparation for further professional study. The Office of Studies also has prepared pamphlets describing in detail the admission requirements of graduate professional schools and the ways in which those requirements can be filled at Northwestern. All students interested in attending a graduate professional school should consult a college adviser in the Office of Studies.

Academic Options

Combined Bachelor's and Master's Degree Programs

Exceptional undergraduates may be able to earn both a bachelor's degree and a master's degree in four years of study. The following departments and programs in the college have established four-year BA/MA or BA/MS programs for exceedingly able majors: anthropology; chemistry; classics; economics; English; French and Italian; geological sciences; Hispanic studies; linguistics; mathematics; political science; and sociology. Students are admitted to these programs only upon departmental recommendation to and approval by the Graduate School. (See Four-Year Master's Programs in the Undergraduate Education section of this catalog.)

Combined Bachelor's and Professional Degree Programs

Combined courses of study leading to a bachelor's degree from the college and a degree from a professional school are offered with other schools of Northwestern University. Such combined courses of study are not offered with schools outside Northwestern University. Students pursuing one of these combined programs may count 10–11 quarter-courses (or their equivalent) of professional credit toward the requirements for the bachelor's degree. Except for students in the combined college and music program, credit for all courses taken outside the college in one of these programs may not exceed 13 quarter-courses.

Combined College and Dental Program

Students in this program must complete the specific course requirements for a degree from the college and also the courses required for admission to the Dental School. When the students have completed them and also satisfactorily completed 35 one-quarter courses (the last 23 while enrolled in the college) and been admitted to the Dental School, they transfer to the Dental School. Credit for 11 quarter-courses is granted for the science courses taken in the first five quarters in the Dental School. When students have satisfactorily completed these courses, a bachelor's degree is awarded by the college.

The Dental School catalog and application forms may be obtained from the Office of Admissions of the Dental School, 311 East Chicago Avenue, Chicago, Illinois 60611-3008. Predental students on the Evanston campus are advised to arrange a visit to the Dental School and a conference with an admission officer.

Combined College and Medical Program

Students in this program must complete the specific course requirements for a degree from the college and the courses required for admission to the Medical School. After completing these requirements and satisfactorily completing 35 one-quarter courses (the last 23 while enrolled in the college) and having been admitted to the Medical School, they transfer their registration to the Medical School. Upon satisfactory completion of the first year in the Medical School, these students are awarded the bachelor's degree by the college.

Further information can be obtained from the premedical adviser in the Office of Studies.

Combined College and Music Program

Students in this program must complete all requirements for a degree in the college (including 30 CAS courses) as well as all requirements for the bachelor of music degree in the School of Music (including 30 music courses). Fulfillment of both college and music requirements will necessitate five years of full-time study. Upon graduation the student is awarded both the BA degree from the college and the BMus degree from the School of Music.

All participants in this combined program must be accepted by both the School of Music and the college. Students admitted to the program will be expected to have a high school background in a modern or classical foreign language at least equivalent to a first-year college-level course. Students may apply to the program directly from high school or at any time until the end of their freshman year.

Further information can be obtained from the coordinator of undergraduate admissions in the School of Music.

Teaching Certification

Students enrolled in a number of departments of the College of Arts and Sciences may simultaneously pursue secondary teacher certification through the School of Education and Social Policy. Areas of certification are art, biological sciences, chemistry, economics with history, English, French, German, history, Latin, mathematics, physics, political science with history, Russian, sociology with history, and Spanish. Majors in any of these areas who wish to be considered for this option must apply for, be admitted to, and complete all programmatic requirements of the Secondary Teaching Program as described in the School of Education and Social Policy section of this catalog. Application should be made with the Office of Student Affairs in the School of Education and Social Policy early in the sophomore year.

Special Certificate Programs

The College of Arts and Sciences offers programs of study leading to an undergraduate certificate in the following (for program descriptions, see the appropriate listing):

- African Studies
- Asian Studies
- Business Institutions
- Jewish Studies
- Latin American and Caribbean Studies
- Science in Human Culture
- Women's Studies

CAS students may enroll also in the Integrated Arts and Undergraduate Leadership interschool certificates and the International Studies adjunct major (see Other Undergraduate Programs).

Study Abroad Policies

CAS students studying during the regular academic year in Egypt, England, France, Germany, Israel, Japan, the People's Republic of China, Russia, or Spain typically do so through Northwestern's affiliated programs in those countries. Students pursuing classical studies abroad are also expected to take advantage of Northwestern's affiliated program in Rome.

In countries where Northwestern has an affiliated program, students are directed to that program. CAS students who wish to receive credit for study in another program in that country are directed to seek out full-year, high-quality programs and to petition the CAS Study Abroad Committee, outlining substantive academic justification for the program.

In evaluating petitions the committee is concerned not only with the academic qualifications of the student but also with the quality of the program in which the student desires to participate. An important general concern of the committee is that programs endeavor to achieve the greatest possible integration of American students with the academic and social life of the foreign country.

The CAS Study Abroad Committee believes strongly that full-year abroad programs are far superior to two- or one-quarter (or one-semester) experiences. When there is not a high-quality, full-year program in the country of choice or when the student can demonstrate significant academic justification, the committee will consider petitions for less than a full year abroad. The committee will *not* approve petitions of students who wish to study abroad for less than the full academic year when the major justification for such a period is merely reluctance to be away from the United States or Northwestern for a longer period.

Students who study abroad are expected to spend upon return at least three quarters of full-time study at Northwestern.

Students must secure the approval of the CAS Study Abroad Committee *before* beginning foreign study and are encouraged to submit their petitions well in advance of the date when a deposit is required to the program office.

The Study Abroad Committee also reviews applications from CAS students who desire to receive credit for summer study abroad. Application forms and information about various opportunities are available in the Office of Studies. Again, students are expected to have demonstrated academic achievement at Northwestern and to possess appropriate linguistic competencies.

Students interested in foreign study are encouraged to consult early in their Northwestern careers with a college adviser in the CAS Office of Studies to plan an academic program that will support their applications for study abroad.

Freshman Seminars

Freshman seminars, offered by nearly all departments in the college, are small, discussion-oriented courses designed to introduce students to fundamental concepts and methods of various disciplines, typically through the investigation of a specific theme or issue. They also seek to develop basic intellectual skills: how to read critically, think logically, and communicate effectively. Expository writing is an essential activity in each seminar. The seminars usually do not provide the preparation necessary for advanced work in a departmental program as they ordinarily supplement rather than replace the standard introductory courses.

Every student in the college is required to complete two freshman seminars in the freshman year. To ensure that class sizes are limited and that registrations are equally distributed, the college specifies the two quarters in which each student will take the seminars. The seminars to be offered are announced before registration each quarter.

General Studies

These interdivisional courses are open to all qualified students.

401-B98-0 Student Organized Seminars

Students who desire to study topics in arts and sciences that are not covered in the college's course offerings may initiate their own courses under the supervision of sponsoring faculty members. Enrollment in these seminar courses is limited to 20 students. The student organizer or organizers must, in consultation with the faculty sponsor, prepare a plan for the seminar and submit it to the associate dean for undergraduate studies before the middle of the quarter preceding the quarter in which the seminar is held. The plan must include a topic description, a reading list, specification of the work that will be graded (such as term papers and written examinations), prerequisites, and the meeting schedule. The associate dean for undergraduate studies forwards proposals to the Curricular Review Committee of the college, which must review and approve all seminars to be offered. Students may enroll in only one Student Organized Seminar per quarter, and enrollment must be on the P/N basis. Students interested

in organizing a seminar should consult the associate dean for undergraduate studies for further details.

401-C50-0 Foreign Study
Registration for students participating in a Northwestern-affiliated foreign study program in England, France, Germany, Israel, Italy, Japan, the People's Republic of China, or Russia. Four units of P/N credit each term.

401-C51-0 Foreign Study in Seville
Registration for the Northwestern/University of Seville Junior Year Program in Spain. Four units of P/N credit each term.

401-C93-0 Chicago Field Studies Internship
(4 units) Full-time participant-observer experience in Chicago-area political, planning, and policy organizations; service, civic, and community institutions; groups committed to social change. Placement of students in responsible volunteer positions; "real world" mode of inquiry complementing conventional campus-based and outside-observer approaches to understanding urban processes. Number of credits applicable toward the major, if any, determined by student's department. Prerequisite: consent of program director.

African-American Studies

The study of the African-American experience has a very long and distinguished history in the United States. The field has developed exciting insights as well as firm intellectual and empirical foundations for the systematic study of the African-American experience and, through such study, for a greater understanding of the larger American experience. From its beginnings, the field has been strongly interdisciplinary, bringing the perspectives of different disciplines to bear on understanding black life. The Department of African-American Studies exemplifies these traditions and strengths, and through its courses provides students the opportunity to explore the richness and diversity of the African-American experience in a meaningful and coherent way.

The primary focus of courses in the department is on blacks in the United States. At the same time, because of the scope and importance of the African diaspora throughout the New World, serious attention is also given to peoples of African descent in the Caribbean and in Latin America. Many courses in the department compare the black experience in one part of the New World with that in another as well as with that of other racial minorities in the New World. This broad study of the African-American experience is one of the key features of the department, one that distinguishes it from similar departments in other institutions. Other major themes in the department's curriculum include the nature of colonization and its impact on the colonizer and on the colonized; racism and its effects on society as well as on scholarship; the importance of oral language, history, and tradition in the African-American experience; the roots and development of African-American music, literature, and religious styles; and analysis of key institutions such as the family.

African-American studies provides good preparation for graduate work in the social sciences, the humanities, and the professions as well as for jobs and careers in a variety of fields. Education, law, journalism, urban planning, health-care delivery and administration, business, social work, and politics are only a few of the fields for which African-American studies provides an excellent background. In addition, since considerable attention is being paid by scholars and political leaders to the Caribbean and Latin America as well as to blacks and other minorities in the United States, students of African-American studies will enter a field that touches on issues of far-reaching national and international significance.

Program of Study for Departmental Majors

Core courses: five core courses required: B10-1,2; B25-0; B36-1,2

Courses of concentration: in addition to the core sequence, five courses selected from one of the following areas:

- Social and behavioral studies: C20 and four other courses, one to include data handling and analysis
- Historical and comparative studies: B45, C32, and three other courses
- Cultural studies of the black experience: C48 and four other courses

Senior sequence: two-quarter sequence taken in the senior year: C90 and either C96 or C99.

Related courses: subject to approval of the department adviser, majors must take five courses offered by other departments at the B or C level, at least three of which are at the C level. Students are expected to choose related courses that develop the methodological skills and substantive focus appropriate to their areas of concentration.

Core Courses

404-B10-1,2 Survey of African-American Literature
Two-quarter sequence on the literature of blacks from slavery to freedom. Works of major writers and significant but unsung bards of the past.

404-B25-0 African-American Culture
Principal facets of African-American culture, slavery to the present. Interconnections between African-American culture and the sociopolitical context in which it developed. Role of African-American culture in the larger American culture.

404-B36-1,2 Introduction to African-American Studies
1. Method, historical overview (Africa, slavery, rural, urban), social class, racism. **2.** Institutional development of politics, church, education, culture, women/family; historical and contemporary liberation struggle.

Social and Behavioral Studies

404-B20-0 The Language of Protest
Selected discourses, postslavery period through the '60s. Works by Garvey, Washington, DuBois, King, and others. Content, structure, and purpose of each discourse in the development of trends in black protest.

404-B30-0 The Civil Rights Movement
Interdisciplinary analysis of the civil rights movement, focusing on the period between the end of World War II and 1966. Opposition to the movement, competition among movement organizations, radicalization, and the movement as a problem in historiography.

404-C20-0 The Social Meaning of Race
Race as a social concept and recurrent cause of differentiation in multiracial societies. Impact of race on social, cultural, economic, and political institutions. Discussion of prejudice, racism, and discrimination.

471-C24-0 Social Structure in African-American Communities
See Sociology.

449-C27-0 Black American Politics in the United States
See Political Science.

Historical and Comparative Studies

404-B14-1,2 History of Racial Minorities in North America
Problems and experiences of racial minorities: blacks, Native Americans, Asian-Americans, and Hispanic-Americans. Comparative exploration of their relationships to each other and to the majority society. **1.** 1600–1865. **2.** 1865–1974.

404-B45-0 Black Communities in Diaspora
Comparative exploration of social and cultural life in communities of African slaves and their descendants in the Caribbean, Latin America, Asia, and the United States. Common heritage and diverse developments.

427-C01-1,2,3 Survey of African-American History
See History.

404-C16-0 Writing for the Theater
Lectures, readings from work in progress, class criticism. Performance of collective work at end of term. Third world, European, and American plays and criticism.

404-C26-0 Making of the Caribbean Peoples
Destruction of Indian peoples and their culture. Era of slavery and slave trade. The colonizer and colonized. Plantation system, emancipation, church and state. Slave rebellions, era of independence.

404-C30-1,2,3 The Third-World Literature
Selected works in creative and nonfictional literature by writers from Africa, Asia, the Caribbean, Latin America, and minority segments of the United States. Criticism and history.

Cultural Studies of the Black Experience

404-B40-1,2,3 Survey of African-American Music
Development of black American music from Africa to the Americas. Secular and sacred works, styles, performance practices. Blues forms, jazz, ragtime, musicals, black composers, black-derived music of Latin America.

404-B59-0 Introduction to African-American Drama
Thematic and historical survey of African-American drama. Sociopolitical context, thematic issues and styles, the aesthetic reflected in the work, impact on African-American and general theater audiences.

404-C31-0 The African-American Novel
Readings in classic black American fiction. The author as creator and participant. Works of Wright, Ellison, Baldwin, and others. Prerequisite: sophomore standing or above.

404-C38-0 Dostoevsky's Way
The impact of Dostoevsky's *Notes from the Underground* and *Crime and Punishment* on Wright's *Native Son,* Ellison's *Invisible Man,* and Faulkner's *Light in August.*

404-C44-0 Black Presence in Faulkner
Centrality of black culture to the themes of violence, rites of passage, tradition, guilt, and the family in Faulkner's *The Sound and the Fury, Light in August, Absalom, Absalom!* and *Go Down, Moses.*

404-C48-0 Black Images in Literature, Film, and Art
The images of black people and the development of stereotypes as depicted in American literature, film, and art. Interplay among the three media. Literary and social significance of these portrayals. Prerequisite: consent of instructor.

404-C49-0 Black Families in Literature
Starting with James Baldwin's novel, *Go Tell It on the Mountain* (1953), much of the most significant literature written by black American authors has had at its center a deep concern for the problems of family life, particular and even peculiar to African-Americans living under the duress of racism.

404-C60-0 The Art of Toni Morrison
Investigates all the published novels by Toni Morrison: *The Bluest Eye, Sula, Song of Solomon, Tar Baby,* and *Beloved.* The mythical powers of Morrison's art, her ability to haunt the reader's imagination with some of the most memorable characters in modern literature, and her evocative way of storytelling.

404-C79-0 African-American Women Playwrights
Texts written approximately 1916–present. Recuperation of biographical information, theatrical representations of the "folk" and of black feminism, antilynch and other propaganda plays, and development of analytical tools. Prerequisite: consent of instructor and B59 and/or other African-American literature courses.

404-C80-0 Topics in African-American Studies
Advanced work on social, cultural, or historical topics. Examples: images of black women in the diaspora, urban revolts of the 1960s, the black church in the 19th century. May be repeated with change in topic.

Courses for Advanced and Senior Students

404-C90-0 Research Seminar in African-American Studies
Methods of researching the African-American experience. Identification of research problems; location, selection, and critique of relevant literature; data gathering and analysis; report writing. Topics vary.

404-C96-0 Internship in African-American Studies
Direct participation in the regular activities of a community organization in Evanston or Chicago. Analysis of social and cultural institutions through field study and participant observation.

404-C99-0 Independent Study
Open to advanced students with consent of the department.

African and Asian Languages Program

The Program of African and Asian Languages (PAAL) offers an opportunity to explore through language study some of the fascinating cultures that are most vital for Americans to understand: those of Africa, China, Japan, and the Middle East. Students who combine study of one of PAAL's African or Asian languages with a major or strong background in such departments as history, economics, political science, or sociology will be well prepared for graduate and professional programs and a future career in international business, journalism, trade, law, or diplomacy. Even in the natural sciences there are now exchange programs in which knowledge of one of the non-Western languages is useful.

PAAL offers courses in Amharic, Arabic, Chinese, Hebrew, Japanese, and Swahili. Other African languages can be made available. Pali and Sanskrit are offered through PAAL in conjunction with the degree programs of the Department of Religion. Any PAAL language can be taken to fulfill the CAS requirement of two years of foreign language study.

For degree and certificate programs in African and Asian studies of which the language offerings of PAAL are an integral part, see African studies, Asian studies, and Jewish studies. Opportunities for study abroad are available.

Undergraduates may take advanced language study through C99 registration. Work in the language laboratory is an integral part of some of the following courses.

African Language Courses

433-C30-1,2,3 Introduction to Amharic
Sounds, structure, syllabary, and basic vocabulary of Amharic. Oral drills and simple reading tests.

433-C31-1,2,3 Intermediate Amharic
Spoken and written Amharic. Development of usable levels of conversational and reading ability. Prerequisite: C30-3 or equivalent.

433-A05-1,2,3 Elementary Arabic
Three-course introduction to modern standard Arabic. Speaking, reading, and listening comprehension skills developed.

433-A06-1,2,3 Intermediate Arabic
Grammar, reading of Arabic texts, oral communication in Arabic. Prerequisite: A05-3 or equivalent.

433-B07-1,2,3 High Intermediate Arabic
Reading and discussion of Arabic writings relevant to students' interests and needs. Emphasis on writing skills. Prerequisite: A06-3 or equivalent.

433-A21-1,2,3 Swahili I
Basic literacy and interactive proficiency, in cultural and historical context.

433-A22-1,2,3 Swahili II
Development of literacy and interactive proficiency skills; introduction to verbal arts. In Swahili. Prerequisite: A21-3 or equivalent.

433-B23-1,2,3 Introduction to Swahili Literature
Overview of Swahili oral verbal arts, classical literature, modern writing. In Swahili. Need not be taken in sequence. Prerequisite: A22-3 or equivalent.

433-C99-0 Independent Study
For undergraduate students of any of the above languages who have advanced beyond the regular course offerings.

Asian Language Courses

433-A11-1,2,3 Elementary Chinese
Speaking, aural comprehension, reading, writing of basic vernacular Chinese. Both standard and simplified characters involving about 1,500 compounds.

433-A12-1,2,3 Intermediate Chinese
Conversation, aural comprehension, writing based on reading Chinese stories, poems, ballets, historical and cultural texts. Prerequisite: A11-3 or equivalent.

433-B13-1,2,3 Advanced Chinese
Readings from the works of contemporary Chinese writers. Discussion and writing based on the reading materials. Prerequisite: A12-3 or equivalent.

433-A01-1,2,3 Elementary Hebrew
Understanding, speaking, reading, writing of mainly conversational Hebrew. Hebrew used as language of instruction. Drill in language laboratory.

433-A02-1,2,3 Intermediate Hebrew
From language to literature: review of grammar; reading and discussing Hebrew literary works (prose and poetry) and newspaper articles. Compositions and oral presentations. Prerequisite: A01-3 or equivalent.

433-B03-1,2,3 Advanced Hebrew
Reading Hebrew literature, some Biblical but mostly modern prose. Compositions and oral presentations. Prerequisite: A02-3 or equivalent.

433-A15-1,2,3 Japanese I
Conversation, grammar, reading, writing for beginners. Issues of U.S.-Japan cross-cultural communication. Five class meetings a week plus language laboratory.

433-A16-1,2,3 Japanese II
A comprehensive approach to conversation, grammar, reading, writing. Four class meetings a week. Prerequisite: A15-3 or equivalent.

433-B17-1,2,3 Intermediate Japanese
Advanced readings in modern colloquial Japanese; prose essay, literary, and newspaper styles. Prerequisite: A16-3 or equivalent.

433-C18-1,2,3 Advanced Japanese
1. Advanced reading skills: comprehension, vocabulary acquisition, speed. Oral and written translation. **2.** Newspaper reading and developing oral/aural skills. **3.** Advanced writing skills, further reading, and oral/aural skill development. Prerequisite: B17-3 or equivalent.

433-C50-1,2,3 Introduction to Pali

433-C54-1,2,3 Introduction to Sanskrit

433-C99-0 Independent Study
For undergraduate students of any of the above languages who have advanced beyond the regular course offerings.

African Studies Program

Courses with African content at Northwestern, first offered in 1927 by the distinguished scholar Melville J. Herskovits, were formally organized into the Program of African Studies in 1948. As one of the earliest centers of African studies in the United States, Northwestern's multidisciplinary program established a model of teaching and research now followed by many other colleges and universities. The program maintains close liaison with African scholars and institutions. Over the years, moreover, it has greatly expanded its responsibilities and contributions at home—to Northwestern and to the community at large.

The program features weekly lectures and seminars that bring specialists to campus to share insights and information about Africa. There are also periodic conferences, workshops, arts festivals, and cooperative research projects on topics of current interest, such as national integration, economic development, adaptive strategies for ecological stress, and Islam in Africa.

The program's administrative office serves as the social and academic center for the Africanist community. The renowned Melville J. Herskovits Library of African Studies draws scholars from other parts of the United States and abroad. Students and visiting professors from Africa reinforce the close collegial ties between many African universities and Northwestern.

Undergraduate Certificate in African Studies

The program encourages students to develop their own multidisciplinary programs both inside and outside the social sciences. Students concentrating on communications or management, for instance, can supplement their professional training programs with a core of African-content courses. Students in other University centers and schools are welcome to participate either formally or informally in program activities; similarly, program students are urged to profit from such University resource centers as the Transportation Center, the Center for Urban Affairs and Policy Studies, and the Schools of Law, Education and Social Policy, Journalism, and Speech. Program students and faculty are also encouraged to participate in voluntary community projects, including teacher-training institutes, film festivals, and public service broadcasting arrangements. In brief, the Program of African Studies has two main purposes: to promote and coordinate the training of African specialists and to encourage an awareness of African problems and realities in other specialties.

Basic requirements for the Certificate in African Studies:

- Six courses with African content from at least two departments:
  Option A: History B55-1,2,3 Background to African Civilization and Culture and three additional courses
  Option B: Any two quarter-courses of History B55-1,2,3 and four additional courses
- Demonstrated competence in an African language (Amharic, Arabic, Hausa, Swahili, Twi, or Zulu) or a European language other than English that is used in Africa (French or Portuguese) either by completing the second year of study in any of these languages or through certification by the appropriate language department. (Students in the professional schools whose curriculum precludes meeting this requirement may petition the program for a variation.)
- Minimum of an overall B average in these courses. Courses taken for P/N are not counted toward the certificate.

Students applying for CAS certificates must present records showing a minimum of five courses not double-counted in their majors. Certificates are conferred at the end of each spring quarter; students should periodically inform the program of progress toward satisfying the requirements.

American Culture Program

The American Culture Program is an integrated interdisciplinary major involving faculty members from several departments. By drawing upon a broad range of knowledge from the humanities and social sciences, the program examines the

components of American culture and ways of integrating them. Students are allowed a wide-ranging yet disciplined exploration of problems that cross the boundaries of traditional academic fields. Freshmen and sophomores apply for admission to the major in the spring quarter.

Program of Study for Majors in American Culture

Main courses: all sophomore and junior majors must enroll in C01-1,2,3.

Related courses: 10 quarters at the B and C levels in those courses throughout the college comprising the general curriculum in American culture. These courses will be apportioned in a way that satisfies the interdisciplinary purpose of a major in American culture and expresses each student's explicit intellectual goals, but every major is normally expected to take History B10-1,2 or an approved equivalent as early as possible in his or her undergraduate career.

Senior majors may remain in the three-quarter seminar for majors, American Culture C02, until their requirement is fulfilled and/or enroll in a three-quarter sequence, American Culture C90, and prepare a senior project under the direction of a faculty sponsor.

Courses Primarily for Freshmen and Sophomores

418-B10-0 Topics in American Culture
Topics of interest to the American cultural analyst and historian. Samples: early American symbols of heroism; the meaning of the frontier. Aimed at large general undergraduate enrollment. With consent, course may be elected more than once.

418-B15-1,2 Humanistic Dimensions of Technological Change
Technological change in America, 1830–1920, and imaginative responses to this change. **1.** General survey. **2.** A significant aspect of American life (e.g., work) in relation to technological change. Prerequisite: B15-1 or consent of instructor required for B15-2.

Courses Primarily for Juniors, Seniors, and Graduates

418-C01-1,2,3 Seminar for Majors
Yearlong sequences sharing a broad theme, integrating methods and materials from different disciplines. Change of instructor each quarter; change of theme every year. Limited to 20 students—majors only.

418-C10-0 Studies in American Culture
Readings and discussions of topics in American cultural life. Samples: law in 19th-century America; manners and morals in antebellum society. Limited enrollment with emphasis on student participation. Prerequisites vary (check with program director or in program office); with consent, course may be elected more than once.

418-C20-0 American Culture and Public Policy
Specific public policy issues in American life, their historical context, and their relationships to society as a whole. Change of issues (e.g., nuclear diplomacy, electoral reform) from year to year. Prerequisites vary (check with program director or in program office); with consent, course may be elected more than once.

418-C30-0 America's Political Enlightenment
American political thought of the late 18th and early 19th centuries. Sample topics: the ratification of the Constitution; *The Federalist Papers.* Prerequisites vary (check with program director or in program office).

418-C90-1,2,3 Senior Project
Thesis, field study, or work of creative art. With permission, majors may take both C90 and C01 senior year. Required for honors.

418-C99-0 Independent Study
Readings and conferences on special subjects for students pursuing their area of interest within the major.

Anthropology

Anthropology studies humankind from a broad comparative and historical perspective: the biological evolution of the human species and aspects of the biology of living human populations, the comparative study of living primates, the origins of languages and cultures, the long-term development of human cultures over many millennia, and the social life of humans in groups—families, communities, and nations. Anthropologists attempt to describe specific cultural traditions, forms of social structures, languages, and specific transitions in human evolution and cultural history. They compare cultures and societies to assess what cultures are similar or different and why. The ultimate aim is to find principles to which all cultures, social structures, and languages conform. Thus anthropology is at once a biological science, a social science, and one of the humanities.

Anthropology's breadth and its emphasis on biological and cultural change and cross-cultural comparison make it an ideal major for anyone seeking a solid liberal education as well as for those seeking careers in academic or applied anthropology or archaeology. It serves as an excellent background for students who plan to pursue specialized training in law, medicine, nursing, social work, education, conservation, international relations, or commerce. The world is an ever-smaller and more culturally mixed global community. Knowledge of the developmental processes that explain biological and cultural differences is relevant to a variety of careers. For example, prelaw students would profit from the

cross-cultural study of conflict and conflict resolution; premedical students from courses in human evolution, ethology, primate anatomy, and genetics as well as the cross-cultural study of health and disease (epidemiology).

Northwestern's Department of Anthropology has many strengths: (1) the application of evolutionary, ethological, and other biological perspectives to the development of humankind; (2) American prehistoric archaeology; (3) the study of North and South American Indian and African societies; and (4) the application of anthropological methods and theory to policy-oriented research in our own society. The department is strong in basic theory and refinements of qualitative and quantitative (mathematical) analysis of anthropological data. Two field schools, one in archaeology and one in cultural anthropology, provide practical proving grounds for classroom theorizing.

Program of Study for Departmental Majors

Prerequisites: B11, B13 or B16, B14, and B15. Students with previous background may petition to substitute a C-level course for a B-level requirement.

Major courses:

- C62-1 or C89
- C70
- Four additional C-level quarter courses. The four courses should be selected in consultation with the student's adviser and should be integrated around a theoretical, methodological, or substantive focus. Examples of such integrative foci for a major are the following:

  Archaeology: four courses from among C01, C02, C11, C21 (offered in summer), C22, C25, C29, C81, C84, C91, C96 (offered in summer)

  Biological anthropology/primatology: four courses from among C06, C09, C12, C14, C90

  Cultural/social/linguistic anthropology: four courses from among C10, C11, C20, C30, C32, C41, C46, C47, C50, C54, C60, C76, C77, C83, C91, C92, C95

  Students may develop other foci in consultation with the adviser.

Related courses: subject to approval of the department adviser, five quarter-courses to be selected from other departments or programs. These courses should be planned to strengthen the focus that guided the selection of C-level courses in anthropology.

Four-Year BA/MA

The department offers a four-year BA/MA program in anthropology for outstanding undergraduate majors. Interested students should contact their adviser or department chair and should see Four-Year Master's Programs in the Undergraduate Education section of this catalog.

Honors in Anthropology

Students wishing to be considered for the departmental honors program should make inquiries no later than spring quarter of the junior year. It is expected that honors candidates will have an overall grade average above 3.3 in anthropology courses. Enrollment is required in two quarters of C99 or in graduate-level courses where a special project is completed under the supervision of an honors adviser.

Courses Primarily for Freshmen and Sophomores

403-A05-0 Fundamentals of Anthropology
Introduction to anthropology; the biological evolution of humankind; the evolution of culture; and the comparative study of existing or historically recorded societies.

403-A12-0 New Directions in Archaeology
Current archaeological interpretation, from earliest evidence of man-apes to beginnings of agriculture and rise of urban civilization. How archaeological concepts of evolution and ecology initiate major changes in goals and methods.

403-A32-0 Myth and Symbolism
Introduction to different approaches to the interpretation of myth and symbolism, e.g., Freudian, functionalist, and structuralist. Symbols as means of communication and the reasons for their effectiveness.

403-B11-0 Culture and Society
Introduction to the comparative study of culture, exploring different types of social organization, their evolutionary significance, and their economic and political correlates.

403-B13-0 Human Origins
Emergence of human species through the process of organic evolution, emphasizing the genetic basis for evolution, fossil record of human's ancestors, comparative models derived from human's nearest living relatives.

403-B14-0 Culture Origins
The evolution of culture from its earliest beginnings through the development of urbanism and the state. Principles of archaeological research.

403-B15-0 The Study of Culture through Language
The scope of linguistic anthropology, from the study of language as an end in itself to the investigation of cultures through the medium of human languages.

403-B16-0 The Living Primates
The classification, life-history, social behavior, ecology, and conservation of the living primates are surveyed.

403-B20-0 Evolution of Moral Systems
Critical examination of evolutionary theories of the origin and development of the human propensity to make moral judgments.

Courses Primarily for Juniors, Seniors, and Graduates

For C-level courses in anthropology, the prerequisite is sophomore or higher standing or one A- or B-level course unless a specific prerequisite is included in the description below. A student without the prerequisite occasionally may be admitted to a course with consent of instructor.

403-C01-0 Hunter-Gatherer Archaeology
Human biological evolution and culture history of Pleistocene epoch. Interrelationship of biology, environment, and culture from earliest hominids through appearance of *Homo sapiens.*

403-C02-0 Origins of Civilization
Comparative survey of prehistoric civilizations and systematic examination of the formative factors in their evolution. Prerequisite: B14 or equivalent.

403-C06-0 Evolution of Life Histories
The essence of life history evolution is found in the strategies evolved by species for allocating metabolic resources between growth and reproduction. The strictly regulated growth patterns of the higher animals suggest severe constraints in achieving optimal life history strategies. These may be revealed in the correlations between the various life history parameters (such as gestation length, litter size, age at first reproduction, longevity, etc.).

403-C09-0 Primate Biology
The zoogeography, systematics, ecology, adaptations, population organization, and social behavior of the living primates. Prerequisite: B13 or the equivalent biology course.

403-C10-0 Evolution and Culture
Introduction to the application of theory from evolutionary biology to cultural anthropology; principles of evolutionary biology; application of principles to human social behavior and culture.

403-C11-0 The Indians of North America
Survey of aboriginal cultures of northern Mexico, continental United States, Alaska, and Canada. Languages, art, and social, economic, and religious life of representative North American Indian tribes.

403-C12-0 Human Genetics
Introduction to quantitative approaches in human and medical genetics. Chromosomal variation, segregation analysis, genetics of disease, population genetics, and polygenic inheritance with applications to morphology, behavior, and disease. Prerequisite: Math A13 or equivalent or consent of instructor.

403-C13-0 Anthropological Population Genetics
Principles of population genetics applied to primates. Mathematical models, analyses of small populations, and interaction of social and genetic processes in light of the shifting balance theory of evolution. Prerequisite: Math A13 or equivalent, C12, or consent of instructor.

403-C17-0 Human Evolution
Evolution of the human lineage, emphasizing the fossil record and the reconstruction of the phylogeny and morphological and behavioral adaptation of early hominids and their forebears.

403-C20-0 Peoples of Africa
A survey of the cultures of Africa and the significant similarities and differences among the indigenous societies of the continent. Prerequisite: B11.

403-C21-0 Archaeological Field Methods
Practical training in archaeological field methods and techniques by participating in the excavation of a prehistoric site. Given in conjunction with Summer Archaeology Field School.

403-C22-0 Introductory Archaeological Methods
Quantitative and numerical approaches to the description and analysis of patterns in archaeological data, including typology, sequence ordering, and attribute analysis. Prerequisite: C01 or C02 or equivalent.

403-C25-0 Archaeological Methods Laboratory
Training in contemporary methods of analysis, with focus on one specific method (e.g., faunal, botanical, artifact, or soil analysis) or one technique (e.g., photography, survey, or sampling methods). May be repeated for credit.

403-C29-0 Near Eastern Prehistory
Introduction to the prehistory of the Levant and Mesopotamia from 9000 to 2400 B.C. Evidence for first domestication of plants and animals and earliest village communities, emergence of urban civilization in Mesopotamia.

403-C30-0 Peoples of the World
Ethnography and comparative study of a regionally or historically associated group of cultures or a type of community defined in ecological, ideological, or other terms (e.g., utopian cultures, cultures of marginal trading peoples). May be repeated for credit.

403-C32-0 Strategies of Marriage and Reproduction
Trends in marriage and reproduction throughout the world, particularly the developing world and Africa. Conjugal strategies, adolescent fertility, natural fertility, birth spacing, contraception, abortion, fatherhood, child fostering, and adoption.

403-C41-0 Economic Anthropology
Economic organization as it relates to society and culture in small-scale, nonindustrialized communities. Traditional structures of primitive and peasant economies. Problems and processes of socioeconomic change and development at the community level.

403-C46-0 The Evolution of Human Sexuality
Biological theories concerning ways in which sex and reproduction shape animal and human social behavior, especially male-female differences in behavior; empirical assessment of the validity of these theories for human beings; social and political implications.

403-C47-0 Political Anthropology
Cross-cultural study of political organization in stateless and state societies; analysis of authority and power structures and of political processes. The state, its origin, and changing role in developing countries.

403-C50-0 Anthropology of Religion
The human relationship with the supernatural and action patterns accompanying beliefs. Correlation between patterns of religion and other aspects of culture; comparison of nonliterate religions and historical religions. Prerequisite: B11.

403-C54-0 Gender and Anthropology
Cross-cultural survey of women's roles from three perspectives: biosocial, sociocultural, politicoeconomic. Theory of gender inequality; emphasis on the third world.

403-C60-0 Language and Culture
Relationship between language and culture; language as the vehicle of culture and as the manifestation of thought.

403-C62-1,2,3 Quantitative Methods of Analysis
1, 2. A broad range of classical statistical methods, univariate and multivariate, currently being applied to anthropological data. **3.** Recently developed distribution-free techniques, e.g., multidimensional scaling, entailment analysis. Prerequisite: graduate standing or consent of instructor.

403-C67-0 Social Networks and Social Structure
Introduction to the idea of social structure from a networks perspective. Examination of classic concepts of status and role, prestige, stratification, hierarchy, and the like using formal network ideas such as centrality, density, cliques, and structural equivalence.

403-C70-0 Anthropology in Historical Perspective
The works and contributions of major scholars in social, archaeological, and biological anthropology over the last century. Prerequisite: one B-level course in anthropology or consent of instructor.

403-C76-0 Socialization
Cross-cultural study of the intergenerational transmission of culture; processes by which social groups pass on social tradition and behavior to succeeding generations. Prerequisite: B11, introductory psychology, or consent of instructor.

403-C77-0 Psychological Anthropology
Contemporary approaches to cross-cultural behavior research: ecocultural aspects of behavior development through maturation and socialization in human and nonhuman primates. Prerequisite: introductory survey courses in psychology or anthropology or consent of instructor.

403-C81-0 North American Prehistory
Intensive study of cultural history of one or more areas of the continent from archaeological evidence.

403-C83-0 Ecological Anthropology
Theory of interactions between organisms and their environments, with application to human populations.

403-C84-0 Introduction to Zooarchaeology
Introduction to the study of animal bones from archaeological sites. Identification, sampling, quantification, hunting economies, domestication, and herding systems in complex societies. Prerequisites: B14, C01 or C02, or consent of instructor.

403-C89-0 Ethnographic Analysis
Descriptive, naturalistic study of the culture of human social groups. Data gathering through observation and interview. Data analysis for ethnographic reporting. Prerequisites: B11 and B15.

403-C90-0 Topics in Anthropology
Advanced work in areas of developing interest and special significance. Can be repeated for credit.

403-C91-0 The Anthropology of Complex Societies
Development and dynamics of the world's civilizations. The social and cultural institutions characteristic of the state or prestate societies. Prerequisite: a basic social science course or consent of instructor.

403-C92-0 Urban Anthropology
Cities as an evolutionary stage and the social and cultural context of urbanism. Contemporary problems of urban subcultures and rural-urban migration. Prerequisite: a basic social science course or consent of instructor.

401-C93-0 Chicago Field Studies Internship
See General Studies.

403-C95-0 Field Study in Anthropology
For exceptional students, ethnographic field experience in the United States (e.g., the Southwest) or abroad. Offered in conjunction with field schools. Prerequisite: consent of instructor.

403-C96-0 Advanced Archaeological Field Methods
Complex excavation and survey procedures, including topographic map-making, surveying a grid system, drawing excavation profiles, etc. Open only to students who have previously taken C21 and C22 in the Northwestern field school or who have had comparable field training elsewhere.

403-C96-7 Junior Tutorial
Intensive work on a topic not normally offered.

403-C99-0 Independent Study
Open with consent of department to juniors and seniors who have completed with distinction at least two quarter-courses or equivalent in anthropology. Under direction of individual members of department.

Related Courses in the School of Music

530-C23-0 Proseminar in Ethnomusicology

530-C26-1,2 Music of the World's Peoples

Summer Field Schools

Archaeology Field School: courses may include C21, C22, C25, and C96, some of which are also offered on the Evanston campus.

Ethnographic Field School in Cultural and Linguistic Anthropology: course C95.

For further information, contact the Department of Anthropology.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Art History

Art history is the historical study, in the widest sense, of the production and use of architecture and the visual and decorative arts. It focuses on technical practices, aesthetic ideals, modes of pictorial representation, iconographies, changing economic conditions, and social functions within different cultures. The study of art history offers a firm factual and theoretical basis for further study of or work in various areas of cultural studies. It also offers sound training in writing and critical thinking for students who wish to pursue vocations both inside and outside the arts.

The Department of Art History is particularly strong in the Western European tradition from prehistoric times to the present day. Interested undergraduates can choose from a wide range of courses that include surveys of Western and non-Western art as well as more specialized surveys and "special topics" courses in a variety of fields. An active program of extracurricular seminars, lectures, and field trips supplements the formal program of study.

Many undergraduate majors profit from participation in a Northwestern-affiliated study-abroad program, thereby obtaining firsthand experience with another culture and its art. Upper-division undergraduate majors also are encouraged to supplement their regular programs by taking a museum studies course in preparation for an internship with a local museum or gallery. An undergraduate seminar (content varies) offered on a regular basis provides majors with an opportunity to study a specific topic in depth in a discussion format. Superior students may qualify for departmental honors in their senior year by enrolling in C90 or a D-level course, followed by C99, in which a written project is completed under the supervision of an individual faculty member.

Program of Study for Departmental Majors

Course requirements:

- Three B-level quarter-courses: B01-1,2,3 Introduction to the History of Art
- Nine C-level quarter-courses in art history: four courses, one in each of four fields (Ancient and Medieval, Renaissance and Baroque, 19th and 20th century, and non-Western art) and five additional courses chosen from these fields
- Six B- and C-level related quarter-courses, of which at least one must be a studio course in art and the remainder chosen from one or more of the following departments and programs with the approval of the adviser: anthropology, art theory and practice, classics, comparative literature and theory, English, European thought and culture, French and Italian, German language and literature, Hispanic studies, history, history of film, music history, philosophy, religion, Slavic languages and literatures, and women's studies

Note: sequence courses do not need to be taken in order; special topics courses may be repeated for credit with a change in topic.

Courses Primarily for Freshmen and Sophomores

405-B01-1,2,3 Introduction to the History of Art
Architecture, sculpture, painting, and allied arts in relation to their social and historical settings. **1.** Antiquity and the Medieval world. **2.** World arts in social perspective. **3.** From the Renaissance to the present.

405-B02-0 Introduction to the History of Architecture
The evolution of architecture from Stonehenge to the present, taught on a conceptual basis for nonspecialists.

405-B05-0 Introduction of the History of Graphic Arts
A survey of the graphic arts, including prints and drawings, from their origins to the present, considering their historical and cultural significance.

405-B60-0 Introduction to 20th-Century Art
Issue-oriented approach to modern art, beginning with the Eiffel Tower. Painting, sculpture, architecture, film, and design in the context of developments in technology, anthropology, psychology, literature, music, and dance.

405-B65-0 Introduction to American Visual Culture
An examination of photography, cinema, television, and advertising as well as sculpture and architecture in America from the Revolution to today to provide a general understanding of our visual environment for the nonspecialist.

405-B89-0 Introduction to the Art of Buddhism
Introduction to Buddhist art and architecture in India, East and Southeast Asia; Buddhist symbolism.

Courses Primarily for Juniors and Seniors

405-C10-1,2,3 Ancient Art
Painting, sculpture, architecture, and allied arts in the ancient world. **1.** Ancient Egypt and the ancient Near East. **2.** Greek art and architecture beginning with Minoan art and ending with art in the 5th century B.C. **3.** Hellenistic and Roman art from the 4th century B.C. to about 300 A.D.

405-C19-0 Special Topics in Ancient Art
Content varies. Samples: prehistoric art of Europe, including cave painting and megalithic construction; structuralist and other approaches to anthropological arts; text and image in the ancient world.

405-C20-1,2,3 Medieval Art
Art and architecture in Europe during the Middle Ages. **1.** Early Christian and Byzantine. **2.** Carolingian and Romanesque. **3.** The Gothic world.

405-C29-0 Special Topics in Medieval Art
Content varies. Sample: history of illuminated manuscripts.

405-C30-1,2,3 Renaissance Art
Painting, sculpture, and allied arts in Europe from the late Middle Ages through the 16th century. **1.** The monastic style in Italy through the 15th century. **2.** The 16th century in Italy. **3.** France, the Netherlands, and Germany from the 14th to the 16th centuries.

405-C32-0 Renaissance Architecture
Architecture in Europe in the 15th and 16th centuries, with emphasis on Italian architects.

405-C39-0 Special Topics in Renaissance Art
Content varies (see also listings under C49). Samples: the art of Hieronymus Bosch and Pieter Bruegel; the graphic arts in northern Europe from the 15th to the 17th centuries.

405-C40-1,2 Baroque Art
Painting, architecture, and sculpture of the European Baroque. **1.** The Baroque in Rome and Italy. **2.** The Low Countries and Western Europe.

405-C49-0 Special Topics in Baroque Art
Content varies (see also listings under C39). Sample: French art of the 16th and 17th centuries.

405-C50-1,2 19th-Century Art
A survey of European painting and sculpture from the late 18th through the end of the 19th centuries. **1.** Late 18th century to 1848. **2.** 1848–1900.

405-C59-0 Special Topics in 19th-Century Art
Content varies. Sample: the art of Georges Seurat.

405-C60-1,2 20th-Century Art
The artist and the environment: a survey of European and American painting, sculpture, architecture, and design from the 1890s to the present. **1.** Postimpressionism to constructivism. **2.** The Bauhaus to postmodernism.

405-C65-1,2 American Art
A survey of the visual arts in the United States from the 17th century to the present. **1.** 17th to late 19th centuries. **2.** 20th century.

405-C67-0 Special Topics in American Art
Content varies. Samples: nationalism and internationalism in American art; the myth of America; the artist in American society; elite and popular visual traditions.

405-C68-0 Special Topics in Modern Art and Performance
Advanced interdisciplinary study of the interrelated histories of visual and performance arts in the 20th century. Content varies. Samples: American painting and dance; postmodern art and performance from the Judson Church to Pina Bausch. Prerequisites: B-level courses in two of the following areas: integrated arts, art history, theater; consent of instructor.

405-C69-0 Special Topics in 20th-Century Art
Content varies. Samples: American art with a French accent; totalitarian art.

405-C70-1,2 Modern Architecture
Development of architecture from 1800 to the present. **1.** 19th-century architecture. **2.** 20th-century architecture.

405-C79-0 Special Topics in Modern Architecture
Content varies. Samples: Chicago architecture, including the work of Sullivan and Wright; Beaux-Arts architecture in Europe and America; modernism in architecture; American architecture from Thomas Jefferson to Frank Lloyd Wright.

405-C86-1,2 Art of Africa
Thematic and historical survey of the arts and architecture of Africa. **1.** From the ancient periods (Nubian Egypt) to the 19th century. **2.** From the 19th century to the present.

405-C89-0 Special Topics in Non-Western Art
Content varies. Samples: Art and architecture of the ancient Maya; African architecture.

Courses Primarily for Art History Majors

405-C90-0 Undergraduate Seminar: Theories and Problems of Art History
Content varies. Sample: the methods of cultural history.

405-C94-0 Senior Linkage Seminars
Content varies. Samples: prints and drawings (at the Art Institute of Chicago); the museum and its public.

405-C95-1,2 Museums
Museum studies seminars. **1.** Power, politics, ethics: history of museums, their ethical basis, community responsibilities, educational prerogatives, future directions. **2.** Architecture of the muses: museum architecture from the 18th to the 20th centuries.

405-C96-0 Internship in the Arts
Direct participation in the regular activities of an established arts organization in Evanston and the Chicago area, under the supervision of a faculty member. By petition, on a limited basis; may be taken only once.

405-C99-0 Independent Study
Special projects in art history, involving reading and conferences and culminating in a paper. Open only to qualified seniors with consent of instructor. Required for departmental honors.

Related Courses in Other Departments

406-C20-0 Media and Process in Art
414-C55-0 Greek Archaeology
414-C58-0 Roman Architecture
414-C59-0 Topography of Imperial Rome
416-C75-0 Literature and the Arts

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Art Theory and Practice

The study of art involves the development of skills and techniques plus the stimulation of critical awareness, understanding, and appreciation of the visual arts. Philosophical questions raised in both theory and studio courses help students integrate and enrich their lives and perceptions. Nonmajors and majors share the unique experience offered by this diverse range of courses. Suggested introduction: survey course B70 or B72.

Programs of Study for Departmental Majors

Each major in art theory and practice plans a program of study in consultation with and subject to the approval of a department adviser. Areas of concentration are painting, printmaking, and the teaching of art. Specific requirements in each area are listed below. Qualified students may petition a department committee for exemption from one or more prerequisites. Outstanding students may qualify for departmental honors in their senior year by enrolling in two consecutive or interrelated C99 or D99 courses in which they complete an approved studio project and related essay under the supervision of department faculty.

Practice of Art—Painting Concentration

Prerequisites (6): A20; A24; A25; B70 or B72; any two courses chosen from Art History B01-1, B01-2, or B01-3.

Major courses (8): B20; B22; B25, B40, or B50-1; C22-1,2; C25-1 or C25-2; C31, C32, C33, or C34; one quarter-course from those listed below under Art Criticism and the Tradition of Art.

Related courses: five quarter-courses at the B and C levels chosen from one or more of the following departments with the approval of the adviser: anthropology, art history, classics, English, French and Italian, German language and literature, Hispanic studies, history, music, philosophy, Slavic languages and literatures.

Practice of Art—Printmaking Concentration

Prerequisites (6): A20; A24; A25; B70 or B72; any two courses chosen from Art History B01-1, B01-2, or B01-3.

Major courses (8): B20; B25; C31; C32; C33 or C34; C25-1 or C25-2; Art History B05 or other approved art history course; one quarter-course from those listed below under Art Criticism and the Tradition of Art.

Related courses: same as for Practice of Art—Painting.

Teaching of Art Concentration

CAS students pursuing a major in art who also wish to be certified for secondary teaching must be admitted to the program and complete all requirements as outlined in the School of Education and Social Policy section of this catalog. Students are urged to contact the Office of Student Affairs in the School of Education and Social Policy as early as possible in their academic careers.

Courses Primarily for Undergraduates

An asterisk (*) preceding the course number indicates a lecture course open to all upperclass students and requiring no art skills or background unless otherwise noted.

Painting and Drawing

406-A20-0 Basic Painting and Composition
Introduction to watercolor, oil, or acrylic painting techniques. Includes surface preparation, color mixing, composition. Emphasis on still life.

406-A24-0 Essentials of Design
Principles of visual composition. Color theory; fundamentals of line, shape, texture, and value. Pictorial illusion; symbolic and narrative form. No previous studio experience necessary.

406-A25-0 Basic Drawing
Problems in line, tonal value, and space. Drawing techniques and application to perception and invention. Relation of drawing to experience. No previous studio experience necessary.

406-B22-0 Intermediate Painting
Still-life and figure painting. Problems in composition and content. Exploration of techniques with oil or acrylic paint. Prerequisite: A20 or acceptable substitute.

406-B25-0 Intermediate Drawing
Modes of describing form; survey of traditional methods. Various techniques include charcoal, crayon, and ink. Prerequisite: A20, A25, or acceptable substitute.

406-C20-0 Media and Process in Art
Use of various media to show the relation between content and process in art. Workshop demonstrations include visiting artists. Required for students in Mellon Program in Art Objects; open to others with departmental permission.

406-C22-1,2 Advanced Painting
Problems in form and meaning. Painting concepts and objectives with emphasis on originality and development of skills and perception. Oil or acrylic. Prerequisites: junior or senior standing, B22 or equivalent.

406-C25-1,2 Advanced Drawing
Studies in light and space in drawing with emphasis on development of drawing disciplines in relation to figure drawing from life. Problems in form and style in drawing. Prerequisite: B25 or equivalent.

Printmaking

406-C31-0 Relief Printmaking
The design and production of prints from wood, linoleum, and plastic surfaces; also collograph and monoprint techniques.

406-C32-0 Intaglio
Printmaking with etching, engraving, aquatint, mezzotint, and drypoint.

406-C33-0 Lithography
Design and production of prints in basic lithographic processes.

Sculpture

406-B40-0 Sculpture in Traditional Materials
Form-making with water clay modeling and plaster casting. Figurative and abstract work.

406-C40-0 Sculpture in Metal and Plastic
Contemporary methods of metal fabrication with stock materials. Welding, brazing, and instruction in the use of power tools.

406-C42-0 Process Sculpture and Environmental Art
New sculptural activities, including earth art conceptual sculpture and environmental work. Variety of materials approaches; collective and individual projects.

Photography

406-B50-1,2 Basic Photography
1. Extensive darkroom instruction focusing on high-quality processing of black and white film prints. Aesthetic problems; mastering techniques; some history. **2.** Further exploration of techniques: zone system, different papers, developers, and archival processing. Historical trends through slide lectures.

406-C50-0 Photography: History, Concepts, and Ideas
Stylistic trends of contemporary photographic imagery. Photography's position in relation to other art forms. Lectures, lab work, and class discussion.

406-C52-0 Color Photography
Techniques and issues of contemporary color photographic process; color-negative processing and printing.

Art Criticism and the Tradition of Art

***406-B70-0 Introduction to the Understanding of Art**
Nonchronological examination of Western art from all periods, emphasizing critical perception of artistic intent and cultural context. Lecture and discussion. Visits to exhibitions.

***406-B72-0 Introduction to the Understanding of 20th-Century Art**
Intuitive and artist-oriented approach to some major examples of modernist and postmodernist art; visual analysis and critical methods. Lecture and discussion.

***406-C72-0 Contemporary Criticism**
Theoretical and visual background for the major ideas influencing present art criticism, focus on writing about current exhibitions and interviewing practicing artists.

Independent Study

406-C99-0 Independent Study
Special projects in the practice of art. Open to qualified seniors.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Asian Studies Program

On the recommendation of an Asian studies adviser, students who complete the following plan of study may apply for a major in Asian studies. Students must take 18 quarter-courses selected, in consultation with the adviser, from an approved list of Asian-related courses. The major should include an appropriate geographic or other focus and normally also at least six quarter-courses selected from each of three departmental clusters:

- Anthropology, economics, and political science
- History
- Literature, philosophy, and religion

With the adviser's consent, students may substitute up to six quarter-courses of language study in Chinese, Japanese, Arabic, or Hebrew. (Native-speaker proficiency does not count for course credit.) See the Program of African and Asian Languages for specific language offerings.

Undergraduate Certificate in Asian Studies

Students wishing to do some concentrated course work in Asian studies but not wishing a major in this field should consider the program for the undergraduate Certificate in Asian Studies. Students may qualify for this certificate by satisfactorily completing eight quarter-courses selected from an approved list of Asian-related courses, including at least two quarter-courses from each of three departmental clusters:

- Anthropology, economics, and political science
- History
- Literature, philosophy, and religion

Six such courses, including two from each cluster, will suffice for students who also complete satisfactorily two years of language study in Chinese, Japanese, Arabic, or Hebrew. (Native-speaker proficiency does not count for course credit.) Independent study courses and nonrepetitive special topic courses, such as Anthropology C90 and History C92, will normally count for credit toward the certificate if they deal substantially with Asia. Students applying for CAS certificates must present records showing a minimum of five courses not double-counted in their majors.

Within the framework of the above requirements, students will normally be expected to organize their programs with emphasis on one of the main regions or countries of Asia. Students are encouraged to take courses on more than one country in Asia. Students are also encouraged to complete at least one quarter of research in their area of interest in the form of independent study. Each student may select an Asian studies adviser who will help in planning a program to meet his or her individual needs and interests.

For further information, contact the CAS Office of Studies.

Astronomy

See Physics and Astronomy.

Biochemistry, Molecular Biology, and Cell Biology

The Department of Biochemistry, Molecular Biology, and Cell Biology does not offer a major to incoming students. See Biological Sciences, Undergraduate Program in, for a description of the major in biological sciences.

Biological Sciences, Undergraduate Program in

The science of biology is the study of living organisms at all levels of complexity and in all their diversity. The Undergraduate Program in Biological Sciences draws particularly on two departments: biochemistry, molecular biology, and cell biology (BMBCB) and neurobiology and physiology (NBP). Additional opportunities in life sciences are available for students in a variety of departments: anthropology, biomedical engineering, chemistry, engineering sciences and applied mathematics, psychology, and communication sciences and disorders. The curriculum is intended to maximize students' access to offerings from these departments. The baccalaureate degree offered in CAS through the Undergraduate Program in Biological Sciences is the bachelor of arts with a major in biological sciences.

The Study of Biological Sciences

The goal of a baccalaureate degree program in biological sciences at a research university is to develop and enhance the intellectual and creative potential of life sciences students. To this end, the program includes the following components:

- A foundation in mathematics, chemistry, and physics
- A core curriculum offering an introduction to fundamental areas of biological science
- Areas of concentration that subsequently focus students' interests within the disciplines of biological science
- Opportunities to participate in basic research through the independent study program

Program of Study for Majors in Biological Sciences

Foundation in Mathematics, Chemistry, and Physics

Because biology is grounded in the principles of chemistry, mathematics, and physics, all majors must complete the following courses:

- Mathematics B14-1,2 and either B14-3 or Statistics B02 or C02
- Physics A35-1,2,3
- Chemistry A01, A02, and A03 (or A71 and A72)
- Chemistry B10-1,2 (or B12-1,2)

During the freshman year, students usually complete A-level chemistry and most or all of the mathematics requirements. In the sophomore year, students start Organic Chemistry B10-1 in the fall quarter concurrent with Biological Sciences B10-1. Physics should be completed by the end of the junior year.

Core Curriculum

To set the stage for study in biological sciences at the advanced level, each major must complete a three-course core at the B-level, Biological Sciences B10-1,2,3. This sequence also serves the needs of preprofessionals majoring in other disciplines and those in specialized programs. These three courses taken in sequence address the central topics in contemporary biology with the goal of preparing students for further study in either the biological sciences or professional school. In this sequence, students are presented with a series of questions: What is the hypothesis? the concept? the principle? Finally, and very important: How do we experimentally test the hypothesis? To this end, the B-level core curriculum is augmented by a complementary laboratory sequence that provides biology students with an appreciation of the discipline as an experimental science.

Areas of Concentration

The continuing expansion of knowledge in biology makes it difficult to master all areas in a four-year curriculum. Thus,

the junior and senior years are designed to permit students to explore in depth a focused area in the biological sciences that builds on the principles of the B-level core curriculum. To provide a variety of coherent pathways, five areas of concentration have been designed. In addition to the five courses specifically required for each concentration, each student must take three C-level life science elective courses approved by the adviser. If a student satisfies one of the recommended concentrations, this will be noted on the transcript; only one concentration can be noted. Following are the five concentrations and a summary of their requirements.

Molecular and Cell Biology

- Concentration: C01 Biochemistry, C15 Cell Biology, C90 Molecular Biology I, plus any *one* of C21 Biology of Animal Viruses, C50 Macromolecules, C55 Immunobiology, C91 Molecular Biology II, C92 Developmental Biology
- Laboratory requirement: C54 Experimental Techniques in Biochemistry and Molecular Biology

Biochemistry and Biophysics

- Concentration: C01 Biochemistry, 411-C42-1 Thermodynamics, plus any *two* of C50 Macromolecules, C51 Membranes and Cell Surfaces, C52 Supramolecular Systems, 411-C56 Physical Biochemistry
- Laboratory requirement: C54 Experimental Techniques in Biochemistry and Molecular Biology

Evolutionary Biology

- Concentration: C12 Evolutionary Processes, C20 Behavioral Ecology, C45 Phylogenetics, plus *one* of C92 Developmental Biology, 403-C06 Evolution of Life Histories
- Laboratory requirement: C45 Evolutionary Morphology of Vertebrates

Neurobiology

- Concentration: C01 Biochemistry plus *three* of C02 Fundamentals of Neurobiology, C03 Molecular Neurobiology, C06 Central Nervous System Physiology, C77 Sensory Neurobiology
- Laboratory requirement: C05 Neurophysiology Laboratory or C08 Neuroanatomy

Physiology

- Concentration: C01 Biochemistry, C25 Animal Physiology, plus *two* of C06 Central Nervous System Physiology, C56 Vertebrate Endocrinology, 765-C02 Systems Physiology
- Laboratory Requirement: C05 Neurobiology Laboratory

Advising

Sophomores who plan to major in biological sciences are assigned to a specific faculty adviser by the director of the Undergraduate Program in Biological Sciences. The program hosts an information reception in the fall for prospective majors. Information on courses, subdisciplines, independent study, and possible careers is presented. Juniors and seniors involved in independent study (C99) have a specific research adviser.

Research/Independent Study/Honors Program

This program offers students the unique opportunity to work early in their careers on a research project in a faculty member's laboratory. It is recommended for all students who may wish to consider a career involving research. The experience frequently proves to be one of the most rewarding parts of an undergraduate education.

Students who have completed at least five quarters of course work and have attained a grade point average of 3.0 in science and mathematics courses are eligible to apply for independent study (C99). (The GPA requirement is occasionally waived after petition by adviser to the director of UPBS.) A directory of research training faculty is available at the program office. The directory contains information (including brief descriptions of research projects) from research training faculty located on the Evanston campus and at the Medical School.

At least two weeks before the registration period for the quarter in which students begin a C99, an application/proposal form for independent study should be obtained from the program office. Students visit the faculty members whose research areas are of interest and explore with them the possibility of doing research in their laboratories. By mutual agreement, a plan of study is proposed; the application/proposal is signed by the student and the faculty member. Students bring the completed, signed application to the program office, where they are given a course authorization form to take to registration and a quarterly summary report for future use. The brief quarterly summary report must be completed and returned to the program office at the end of each quarter of C99. A biological sciences major's first two quarters of independent study are graded on the P/N option. Subsequent quarters are taken for a letter grade.

Students engaged in C99 research are encouraged to submit a senior thesis proposal by the beginning of their senior year. A faculty committee evaluates each proposal and either recommends or does not recommend that the student should proceed with the writing of a senior thesis. Students complete the laboratory work, data analysis, and writing of the thesis (literature survey, materials and methods, results, discussion) according to an established timetable. Satisfactory completion of the thesis allows the faculty committee to recommend students for departmental honors, making them eligible to compete for one of three awards given yearly for superior honors research. A summary evaluation of credentials and achievements of each student recommended for honors is written by the faculty committee and made available as a letter of recommendation to graduate and professional schools. (Completion of a senior thesis in the spring quarter enables students to use the spring quarter C99 independent study course as a C-level elective toward the major. Additionally, prior participation in C99 independent study for two quarters is mandatory for the spring quarter of C99 to count as a C-level elective.)

The most modern research facilities, which include general and special use laboratories equipped with the latest scientific instruments, are available to students who participate in the C99 program.

Integrated Science Program

The Integrated Science Program is a highly selective BA program in the College of Arts and Sciences (see Integrated Science Program). Students majoring in ISP who wish to complete a second major in biological sciences should fulfill the following requirements instead of those listed above. They may not substitute ISP C98 for any biology or chemistry course in the ISP curriculum and must take the following additional courses:

- Chemistry B12-2
- An appropriate laboratory course for the chosen concentration: 409-C05, C45, or C54
- Two or three additional courses, as specified below for the indicated concentration:

Molecular and cell biology: 409-C15, C90, C91
Biochemistry and biophysics: 409-C50, C52
Evolutionary biology: 409-C12, C20, C45
Neurobiology: 409-C03, C06
Physiology: 409-C06, C25, C56

Honors Program in Medical Education

Students in the HPME normally enter courses in the Undergraduate Program in Biological Sciences in their second year, as specified by the program advisers. The recommended sequence is B10-1,2,3.

Premedical, Predental, and Preveterinary Students Majoring in Other Departments

The three-quarter sequence B10-1,2,3 satisfies the biology requirements of most U.S. schools offering degrees in medicine, dentistry, and veterinary medicine. Students with these career objectives should begin this sequence in their second year.

The Teaching of Biological Sciences

CAS students pursuing a major in biological sciences who also wish to be certified for secondary teaching must be admitted to the program and complete all requirements as outlined in the School of Education and Social Policy section of this catalog. Students are urged to contact the Office of Student Affairs in the School of Education and Social Policy as early as possible in their academic careers.

Core Courses

Note: All CAS students other than HPME and ISP students or those with an AP score of 5 in biology must take a Biology Placement Exam before entering Biological Sciences B10-1. Depending on the results of that exam, an A-level biology course may be required as a prerequisite for B10-1.

409-B10-1 Biology
Genetics and evolutionary biology. Lecture and laboratory. Prerequisites: Mathematics B14-1,2,3; Chemistry A01, A02, A03 or A71, A72.

409-B10-2 Biology
Biochemistry and molecular biology. Lecture and laboratory. Prerequisite: B10-1 and Chemistry B10-1; concurrent registration in Chemistry B10-2.

409-B10-3 Biology
Cell biology and systems physiology. Lecture and laboratory. Prerequisite: B10-2.

Courses Primarily for Undergraduates

409-A03-0 Diversity of Life
Comparative survey of the five kingdoms of organisms, emphasizing adaptation and phylogenetic relationships. Major phyla and classes of animals and plants.

409-A22-0 Ecology and the Planet
Basic ecological principles. Consideration of the human species in an evolutionary and ecological context. Environmental issues.

409-A63-0 Human Biology
Basic principles underlying the biology of humans. No credit allowed for majors.

409-A64-0 Genetics and People
Principles of inheritance with emphasis on human characteristics and the interaction of genetics and society. No credit allowed for majors.

409-A65-0 Evolution and Genetics
How the study of genes and their operations gives insight into the mechanisms of evolutionary progress. No credit allowed for majors.

409-A66-0 Biology of the Flowering Plant
Characteristics of the plant kingdom, focusing on the growth, development, and reproduction of flowering plants.

409-A70-0 Concepts of Biology
Fundamentals of biology: chemical composition, cellular organization, energy conversion, genetics, reproduction, evolution. Credit not allowed for both A70 and A90.

409-A71-0 Principles of Cell Biology
Present concepts in cell biology. May not be taken for credit by any student who has completed B10-1.

409-A90-0 Characteristics of Living Organisms
Rigorous introduction to biology as a descriptive and experimental science, focusing on features typifying all living things. Laboratory. Prerequisite: consent of instructor. Credit not allowed for both A70 and A90.

409-A91-0 Evolution and Ecology
Major evolutionary and ecological principles.

409-C01-0 Biochemistry
Major areas and principles of biochemical processes at the molecular level; structure, metabolism, energetics, and control mechanisms. Prerequisites: B10-1,2,3 and Chemistry B10-1.

409-C02-0 Fundamentals of Neurobiology
Cellular and biochemical approaches to the nervous system, focusing on neuron structure and function; mechanisms underlying cell-cell communication. Prerequisites: B10-3 and Physics A35-2.

409-C03-0 Molecular Neurobiology
Biochemical and cell biological aspects of neural function. Cell-cell interactions; mechanisms of signal transduction and synaptic plasticity; basic neurochemistry. Prerequisites: B10-3 and C02.

409-C04-0 Developmental Neurobiology
Cellular aspects of nervous system development; relationship between structure and function during development. Prerequisites: B10-3 and C02.

409-C05-0 Neurobiology Laboratory
Hands-on experience in the performance of classical experiments in cellular neurophysiology. Laboratory course for students of neurobiology. C02 strongly recommended.

409-C06-0 Central Nervous System Physiology
Integrative approach toward understanding functions of the mammalian central nervous system. Prerequisite: B10-3.

409-C08-0 Neuroanatomy Laboratory
Organization and morphology of the nervous system. Levels of organization extend from single neurons to emphasis on mammalian nervous system. Prerequisite: B10-3 or consent of instructor.

409-C09-0 ISP Biochemistry and Cell Biology
The cell, its basic organization, chemistry of cellular macromolecules, genetics, enzymology, intermediary metabolism. Prerequisite: ISP enrollment.

409-C10-0 ISP Quantitative Biochemistry and Molecular Biology
Protein interaction with small molecules, location of genetic markers, X-ray diffraction studies of DNA fibers, protein tertiary structure determination, etc. Prerequisite: C09.

409-C11-0 ISP Neurobiology
Detailed look at membrane properties of single neurons and synaptic transmission. Mechanisms of basic sensory and motor processes in the brain. Prerequisite: C09.

409-C12-0 Evolutionary Processes
Theoretical foundations of population genetics and ecology; overview of major current foci of evolutionary research. Prerequisite: A91, B10-1, or equivalent.

409-C15-0 Cell Biology
Relationship of shape, structural dynamics, and function with the cellular state and gene expression; chromosomal and cellular structure; cell-cell communication. Prerequisite: B10-3.

409-C20-0 Behavioral Ecology
Evolutionary study of animal behavior, emphasizing theory but using field data to test and/or illustrate aspects of theory. Prerequisite: A91, B10-1, or equivalent.

409-C21-0 Biology of Animal Viruses
Virus structure, synthesis of viral nucleic acids and proteins, the interaction of the viral and cellular genomes, structural and functional alteration of virus infected cells. Prerequisite: B10-3.

409-C24-0 Biological Clocks
Physiological time measurement; daily or circadian clocks and their importance in adaptation to changing environments.

409-C25-0 Animal Physiology
Physiological principles and mechanisms responsible for the ability of animals to regulate variables in the steady state and to survive in the face of alterations in the external environment. Prerequisite: B10-3.

409-C30-0 Evolutionary Embryology
Investigation of embryological patterns from a comparative evolutionary perspective. With laboratory. Prerequisite: B10-3.

409-C33-0 The Physiology and Ecological Impact of Bacteria
Structure, growth, metabolism, and genetics of prokaryotic organisms; their interactions with other members of the plant and animal kingdom; their effects on environment. Prerequisites: B10-3 and 411-B10 or equivalent.

409-C34-0 Vertebrate Histology
Tissue and microscopic anatomy of organs and organ systems; origins of tissues and organs; relation of structure to function. Prerequisite: B10-3.

409-C40-0 Biological Aspects of Disease
Cellular response to injury; biology of cancer, including molecular and genetic aspects; inflammation and immunity; genetic basis of human disease; and developmental pathology. Prerequisite: B10-3.

409-C45-0 Topics in Evolutionary Biology
Topics vary, but always deal with phylogenetic techniques and/or the biology of a major group of organisms. With laboratory. May be taken again if topic is different. Prerequisite: A03, A04, A65, A91, B10-1, or C12.

409-C50-0 Structure and Function of Macromolecules
Structure determination and common structural features observed in proteins; properties of proteins; relating DNA binding proteins to structure and function in biological systems. Prerequisite: C01 or equivalent.

409-C51-0 Membranes and Cell Surfaces
Dynamics of cell membranes and surface organization; membrane-membrane interaction and membrane-protein interaction. Prerequisite: C01 or equivalent.

409-C52-0 Structure and Function of Supramolecular Systems
Large multiprotein systems, especially membrane-bound systems; ion and metabolite transport, electron and proton transfer, photosynthesis and signal transduction. Prerequisite: C01.

409-C54-0 Experimental Techniques in Biochemistry and Molecular Biology
Biochemical and molecular biological experiments using microorganisms to probe fundamental problems in biology. Prerequisite: B10-3.

409-C55-0 Immunobiology
Nature of host resistance; characteristics of antigens, antibodies; basis of immune response; hypersensitivity; specific immunologic paralysis and transplantation. Prerequisite: B10-3.

409-C56-0 Vertebrate Endocrinology
Physiology and biochemistry of hormones and glands of internal secretion in vertebrates; hormone structure, measurement, function, and interrelationship among endocrine glands. Prerequisite: B10-3.

409-C65-0 Plant Structure and Function
Molecular aspects of normal plant structure, with emphasis on plant chromatin structure, gene regulation, and current technology related to plant genetic engineering. Prerequisite: C15.

409-C77-0 Sensory Neurobiology
Physiological process in sensory receptor cells; chemical senses, vision, hearing, and lateral line organs; analysis of specialized sensory systems. Prerequisite: B10-3.

409-C90-0 Molecular Biology I
Nucleic acid structure; cell and virus genetics; DNA mutation, repair, recombination, replication, restriction and modification; translation; lysogeny; recombinant DNA technology. Prerequisite: B10-3.

409-C91-0 Molecular Biology II
RNA splicing; eukaryotic gene regulation; oncogenes; control of growth, differentiation, development. Prerequisite: C90.

409-C92-0 Developmental Biology
Processes that result in predictable spatial arrangements of cells from gametogenesis to the differentiation of specialized cell types; cytodifferentiation, mechanisms of morphogenesis and pattern formation. Prerequisite: B10-3.

409-C93-0 Cytogenetics
Lectures on selected topics in cytogenetics. Prerequisite: B10-3.

409-C98-0 Undergraduate Seminar
Advanced work for superior students through supervised reading, research, and discussion. Prerequisite: consent of faculty supervisor and UPBS.

409-C99-0 Independent Research
Supervised individual research open only to juniors and seniors meeting specified requirements. Prerequisite: consent of faculty research supervisor and UPBS.

Related Courses in Other Departments

451-A12-0 Introduction to Neuroscience

451-C12-1,2 Neurobiology and Behavior

451-C21-0 Neuroscience and Behavior Laboratory

451-C24-0 Perception

620-C02-0 Anatomy and Physiology of the Hearing Mechanism

710-C71-0 Transport Phenomena in Living Systems

750-C65-0 Electron Microscopy and Electron Diffraction in Materials Science

760-C81-0 Models in Biochemistry and Molecular Biology

765-C01-0 Systems Physiology

765-C02-0 Systems Physiology

765-C03-0 Systems Physiology

765-C15-0 Application of Genetic Engineering to Immunochemistry

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Business Institutions Program

The Program in Business Institutions in the College of Arts and Sciences is based on the assumption that the study of business is best approached through a thoughtful investigation of the cultural, political, philosophical, literary, and social consequences of business institutions. Therefore, business institutions is not intended to constitute a narrowly conceived preprofessional training or to function as a business concentration within any single departmental major. This program is instead conceived as a means to a broad, multidisciplinary perspective on a significant area of inquiry in late 20th-century society. Students who wish to pursue the CAS Certificate in Business Institutions should be open to inquiries grounded in the intellectual approaches of many disciplines.

Undergraduate Certificate in Business Institutions

The Certificate in Business Institutions requires the successful completion with a grade of C− or above of eight courses: three required core courses and five elective courses selected from the two groups listed below. Two courses of the five electives are to be selected from option A, two from option B, and one additional elective from either option A or option B. The program director may approve courses, including C94 senior linkage seminars or C80 junior tutorials, given in a particular year as substitutions for the elective courses in options A and B when the syllabus demonstrates a business institutions emphasis.

Required Core Courses

- Economics B01 and B02, which count together as one course, or Economics C10-1 Microeconomics
- Economics C34 Business and Government
- Sociology C02 Sociology of Organizations

Elective Courses

- Option A (select at least two)
  - Economics C08 Money and Banking
  - Economics C39 Labor Economics
  - Economics C49 Industrial Economics
  - Economics C50 Monopoly, Competition, and Public Policy
  - Sociology C31 Markets, Hierarchies, and Democracies
  - Sociology C32 Work and Occupation in Modern, Industrialized Societies
- Option B (select at least two)
  - American Culture B15-1,2 Humanistic Responses to Technological Change
  - Anthropology C41 Economic Anthropology
  - Economics C20 Rise of Industrial Society
  - Economics C23 Economic History of the United States
  - History C18-1,2 Legal and Constitutional History of the United States
  - History C20-1,2 Environmental History of the United States
  - History C22-1 Development of the Modern American City to 1870
  - History C22-2 Development of the Modern American City, 1870–present
  - History C67 Politics and Development in Latin America
  - Philosophy B60 Ethics
  - Sociology C15 Industrialism and Industrialization

Students applying for CAS certificates must present records showing a minimum of five courses not double-counted in their majors. Grades of P/N are not accepted in the Business Institution Program.

Students interested in the Certificate in Business Institutions should consult with one of the advisers for the program. Information is available in the CAS Office of Studies and the program office, 1810 Chicago Avenue, room 115.

Chemistry

Chemistry is the study of molecular structure, chemical reactions, and the molecular basis of solids, liquids, and gases. The broad applicability of phenomena and rigorous methodology of chemistry provide a wide range of career options for chemistry majors. Training in chemistry blends descriptive, conceptual, and mathematical elements in both lectures and laboratory work. While developing chemical knowledge is essential, the progressive honing of analytical abilities is equally important.

The chemistry department offers courses carefully designed to provide a rigorous introduction to chemistry for science or nonscience students. Additional courses provide several chemistry program options and serve the needs of Northwestern's engineering, biology, and medical programs. The chemistry faculty conducts vigorous, original research that includes undergraduates, graduate students, and visiting scholars from around the world. This environment, i.e., modern instrumentation, seminars, colloquia, and informal contacts, invigorates the educational process and provides exciting opportunities for undergraduates.

Programs of Study for Departmental Majors

Several chemistry major programs are offered to meet the needs of students with diverse career objectives, including professional chemistry, medicine, and teaching.

Chemistry

Major courses: A01; A02; A03 or A71; A72; B10-1,2,3 or B12-1,2,3; B15; C29; C33; C35; C42-1,2,3; C45; C61.

Related courses: Math B14-1,2,3 and B15 (the accelerated math courses B90-1,2 or B91-1,2 also satisfy this requirement); Phys A35-1,2,3 or A25-1,2,3 or A90-1,2,3.

This program is recommended for students planning careers in chemistry. It is suitable preparation for graduate study in chemistry and for positions as professional chemists. Only this program qualifies the student for certification as a professional chemist by the American Chemical Society.

Chemistry Program with Biochemistry Emphasis

This program is designed for students who wish to emphasize the biochemical aspects of chemistry. For example, this program is suitable preparation for medical school or for advanced study in fields that require a strong background in

chemistry. Three courses from the regular chemistry program (C35, C61, and B15 or C45) are replaced by Biol B10-1,2 and one of the following: Chem C56, C97, D14; Biol C01, C50, C52, C54, C90.

The Teaching of Chemistry

CAS students pursuing a major in chemistry who also wish to be certified for secondary teaching must be admitted to the program and complete all requirements as outlined in the School of Education and Social Policy section of this catalog. Students are urged to contact the Office of Student Affairs in the School of Education and Social Policy as early as possible in their academic careers.

Integrated Science Program

The Integrated Science Program (ISP) is a highly selective BA program within the College of Arts of Sciences (see Integrated Science Program). Students majoring in ISP who wish to complete a second major in chemistry must take the courses listed under one of the following options.

Chemistry option: Chem B12-2,3; B15; C29; C33; C35; C45; C61.

Biochemistry option: Chem B12-2,3; C29; C33; B15 or C45. ISP C98 may not be substituted for Biol C01, C09, or C10.

Program in the teaching of chemistry: Chem B12-2; C29; C33; three B- or C-level chemistry electives.

Honors in Chemistry

Seniors who have done outstanding work in connection with a research project are eligible for honors in chemistry. Students who are recommended must have completed the courses required by the department with at least a 3.3 grade point average and at least two quarter-courses in C98 or C99. A strong recommendation from the professor(s) who guided the honors research is necessary.

Four-Year BA/MS

Students who have done outstanding work during the first three years and who have a professional interest in chemistry or biochemistry are eligible to apply for the four-year BA/MS program. Applications should be made during the spring quarter of the junior year. By the end of three years, the applicant should have completed all the C-level chemistry courses, all or nearly all CAS requirements, and one quarter of independent study. To fulfill the MS requirements, students must take nine graduate courses, including four chemistry courses selected from a department-approved list and at least three units of independent study. None of these nine courses can be used to fulfill any specific undergraduate CAS or major course requirement. See Four-Year Master's Programs in the Undergraduate Education section of this catalog and consult a department adviser.

Advanced Placement

Entering students seeking advanced placement will be advised to register for Chemistry A71, B10, or B12 according to their score on either the College Board advanced placement chemistry examination or the department chemistry placement examination.

Courses Primarily for Freshmen and Sophomores

411-A01-0 General Chemistry
Descriptive chemistry, elements and compounds; basic chemical calculations, mole problems, stoichiometry, and solution concentrations; gas laws; thermochemistry; quantum theory and electronic structure of atoms; periodic properties of the elements; nuclear chemistry; chemical bonding.

411-A02-0 General Inorganic Chemistry
Descriptive chemistry, inorganic reactions; chemical bonding; condensed phases; introduction to chemical equilibria; phase equilibria; solutions and colligative properties; metal complexes. Prerequisite: C− or better in A01 or permission of the department.

411-A03-0 General Physical Chemistry
Chemical equilibrium; equilibria in aqueous solution, thermodynamics; chemical kinetics; electrochemistry and oxidation-reduction reactions; solid state chemistry; industrial chemical processes. Prerequisites: C− or better in A02 or permission of the department and Math B14-1. A grade of C− or better in this course is required to enroll for any higher-level chemistry course.

411-A71-0 Accelerated General Inorganic Chemistry
Review of mole problems and stoichiometry; descriptive chemistry, elements, compounds, and inorganic reactions; gas laws; phase equilibria and colligative properties; chemical equilibrium; aqueous equilibria; topics in chemical bonding and molecular structure. Prerequisite: placement by the department through department placement exam.

411-A72-0 Accelerated General Physical Chemistry
Thermodynamics and equilibrium; chemical kinetics and mechanism; electrochemistry; electronic structure of the atom and quantum theory; advanced topics in chemical bonding; coordination compounds; solid state chemistry; nuclear chemistry. Prerequisites: C− or better in A71 and Math B14-1.

411-B01-0 Chemistry of Nature and Culture
Chemistry for the nonscientist. Chemicals commonly encountered in everyday life. With laboratory.

411-B02-0 Color Science
Science necessary to understand color. For students with majors not in the physical or biological sciences.

411-B10-1,2,3 Organic Chemistry
1. Basic concepts of structure, stereochemistry, and reactivity of organic compounds. The chemistry of hydrocarbons and alcohols. Prerequisite: grade of C− or better in A03 or A72. No P/N registration. **2.** The chemistry of aromatic, carbonyl, and nitrogen compounds; characterization of organic substances by chemical and spectral methods; reaction mechanisms. With laboratory. Prerequisite: C− or better in B10-1. No P/N registration. **3.** The chemistry of polyfunctional compounds of biological and medicinal interest. Modern organic synthesis, bioorganic chemistry, and recent developments in organic chemistry. With laboratory. No P/N registration. Prerequisite: C− or better in B10-2.

411-B12-1,2,3 Organic Chemistry
Primarily for chemistry majors and students in ISP. Similar to B10-1,2,3 except with laboratory in the first and second quarters. Prerequisites: C− or better in A72 or A03 and permission of the department, enrollment in ISP, or departmental placement. No P/N registration.

411-B15-0 Organic Synthesis Laboratory
A laboratory course in modern methods of synthesis, separation, and spectroscopic characterization of organic compounds. Included are organization, access, and use of chemical information. Prerequisite: B10-3 or B12-3 (B12-3 may be taken concurrently).

Courses Primarily for Juniors and Seniors

411-C29-0 Analytical Chemistry with Laboratory
Principles and applications of analytical methods with emphasis on chromatography and electrochemistry. With laboratory. No P/N registration. Prerequisites: C42-1, C42-2 or C43 (C43 may be taken concurrently).

411-C33-0 Inorganic Chemistry
Descriptive chemistry of some important elements. Current concepts and models of chemical bonding. Prerequisites: two units of B- or C-level chemistry.

411-C35-0 Inorganic Synthesis Laboratory
Laboratory course in modern methods synthesis, separation, and spectroscopic characterization of inorganic compounds. Introduction to current topics in inorganic chemical research. Prerequisites: B12-3 or B10-3 and C33 (C33 may be taken concurrently).

411-C42-1 Thermodynamics
Laws of applications of thermodynamics. Thermochemistry, chemical potentials, solution thermodynamics, nonideal gases. Prerequisites: A03 or A72 with a grade of at least C; Math B14-3; Phys A35-1,2 (Phys A35-2 may be taken concurrently).

411-C42-2 Quantum Mechanics and Spectroscopy
Quantum mechanics with emphasis on atomic and molecular electronic structure. Electronic, vibrational, rotational, and magnetic resonance spectroscopy. Prerequisites: Math B14-3 (B15 recommended); Phys A35-1,2.

411-C42-3 Kinetics and Statistical Thermodynamics
Chemical kinetics, including experimental techniques and theories of rate processes. Statistical mechanics, including Boltzmann distribution, partition functions, and applications to thermodynamics. Prerequisites: C42-1,2.

411-C43-0 Kinetics and Spectroscopy
Chemical kinetics, including experimental techniques and elementary theory. Ultraviolet, visible, infrared, and magnetic resonance spectroscopy. For nonmajors. Prerequisites: C42-1 or Phys A35-1,2; Math B14-3.

411-C45-0 Spectroscopy Laboratory
Experiments on modern spectroscopic methods and data analysis. Prerequisite: C42-2 (may be taken concurrently).

411-C48-0 Physical Chemistry for ISP
Gas laws and properties; kinetic theory; first, second, and third laws; phase equilibria; kinetics. Prerequisites: ISP enrollment; A72; Math B91-1,2,3; or department consent.

411-C61-0 Advanced Laboratory
Advanced laboratory in analytical and physical chemistry. Prerequisites: C29; C42-1,2; C45.

411-C80-0 Cooperative Chemistry Education
Participation in approved industrial work experience away from the campus. No credit, no tuition. Prerequisite: department consent.

411-C97-0 Medicinal Chemistry: The Organic Chemistry of Drug Design and Action
Introduction to principles of drug design and mechanisms of drug action from a chemical viewpoint. Historical introduction, drug design and development, receptors, enzyme and enzyme inhibitors, drug metabolism, and prodrugs. Prerequisite: B10-3, B12-3, or consent of instructor.

411-C98-0 Undergraduate Seminar
Advanced work for superior students through supervised reading, research, and discussion. Prerequisite: department consent.

411-C99-0 Independent Study
Faculty-directed research. Prerequisite: department consent.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Classics

Classics is the multidisciplinary study of Greek and Roman civilization. The chief purpose of the undergraduate programs is to elucidate the classical foundations of our culture and to sharpen the abilities that grow from the study of the classical languages, literature, and history. The department also offers MA and PhD programs that prepare scholars for a career in teaching and research.

The classics programs at Northwestern are particularly strong in history and literature. Complemented by resources in the Department of Philosophy, the department also is well qualified to offer undergraduate and graduate programs in Greek philosophy. A major commitment to classical studies is evident in the holdings of the University Library, which provides extensive research opportunities to classics undergraduate and graduate students.

Programs of Study for Departmental Majors

A departmental major may elect either of two programs: classics or classical civilization. The first stresses competence in the Greek or Latin language against a historical background. The second allows students to study classical humanities without an extensive language background. Most courses of study in classics include supplementary work in related subjects, such as philosophy, English, comparative literary studies, history, and art.

Classics

The major in classics provides the fullest possible contact with Latin and/or Greek literature in the original language, together with a general knowledge of classical civilization. Students may specialize in Latin or in Greek, ideally with some work in both languages. For continued work at the graduate level, proficiency in German or French is also desirable. Classics majors may also plan a combined program of study with art and archaeology, history, other literatures, philosophy, or other related fields. Such a program may lead to an interdepartmental major.

Prerequisite: Latin A01-1,2,3 or Greek A01-1,2,3 or equivalent.

Major courses: six C-level courses in Greek (413) and/or Latin (415). Three classics courses given in English (414) or any relevant European thought and culture (430) course as approved by department adviser.

Related courses:

- Option 1: Greek A01-1,2,3 and B01-1,2,3, if concentrating in Latin and wishing to combine
- Option 2: Latin A01-1,2,3 and B01-1,2,3, if concentrating in Greek and wishing to combine
- Option 3: six B- and C-level courses from no more than two of the following: other languages and literatures, art history, philosophy, cultural anthropology, history, religion, linguistics

Classical Civilization

Students without a strong language background may elect this program, which offers a broad knowledge of classical civilization, its place in the Western tradition, and its pertinence to modern society. The major in classical civilization also includes work in ancient history and classical archaeology and provides a background for graduate work in those areas. It is easily adaptable to the requirements of a dual major program.

Prerequisites: 414-B20-1,2,3 Ancient World; 414-B40-1,2,3 Literary Achievement of Greece and Rome.

Major courses: at least two quarter-courses from each of the following three categories (note: 413 courses are Latin courses, with reading in Latin; 414 courses are classics courses, with reading in English; 415 courses are Greek courses, with reading in Greek):

- 413-B01-1,2,3 Introduction to Latin Literature; 415-B01-1,2,3 Introduction to Greek Literature
- Any 414 course at the B or C level not listed as a prerequisite; any B-level 413 course, if concentrating in Greek; any B-level 415 course, if concentrating in Latin
- One quarter-course from each group (a, b):
  (a) 413-A01-6 The Language of Virgil or 413-A01-1 Elementary Latin (if major courses in the first category are Greek); 415-A01-6 The Language of Homer or 415-A01-1 Elementary Greek (if major courses in the first category are Latin)
  (b) 416-B04 Introduction to Tragedy; 430-B10 Ancient Civilization: Israel and Greece; 430-B11 Greek Civilization; 430-B12 Rome: City of Man and God; 439-B65 Philosophy of Law; 439-C20 Ancient Philosophy; any C-level 413 or 415 course.

Related courses: six B- and C-level courses from one or two of the following fields: other literatures, art history, philosophy, cultural anthropology, history, religion.

Study Abroad

Qualified majors will have the opportunity to attend the Intercollegiate Center for Classical Studies at Rome during their junior or senior year. Students interested in this program or similar opportunities in Greece should consult the department chair.

Four-Year BA/MA

Students with a strong background may apply for a two-degree program that can be completed in four years. This is ideal for persons interested in continued graduate studies in any of several fields. It also serves to prepare highly qualified secondary school teachers of classics, for whom there is a renewed demand. See Four-Year Master's Programs in the Undergraduate Education section of this catalog and consult a department adviser.

Honors in Classics

Outstanding seniors in classics are encouraged to prepare an honors thesis based on two or more quarters of C99 Indepen-

dent Study. Successful completion of this project entitles the candidate to nomination for honors in classics.

Courses in Latin

413-A01-1,2,3 Elementary Latin
Classical Latin vocabulary, grammar, and syntax with graded readings for translation. Four class meetings a week.

413-B01-1,2,3 Introduction to Latin Literature
Readings in Catullus, Horace, and other selected comedy and prose authors, with an emphasis on literary analysis. Prerequisite: A01 or department placement.

413-C10-0 Readings in Latin Literature
Authors and topics arranged in a three-year cycle. Authors include Plautus, Terence, Lucretius, Cicero, Virgil, Horace, Ovid, and Tacitus. Prerequisite: B01 or equivalent.

413-C99-0 Independent Study
For advanced students approved by the department, individual programs under the direction of a department member.

Courses in Greek

415-A01-1,2,3 Elementary Greek
Vocabulary, forms, and syntax of the Homeric dialect of ancient Greek, using Homer's *Iliad* as the basic text.

415-A06-1,2,3 Modern Greek I
Reading, writing, and speaking modern Greek. Literature, primarily poetry, introduced during winter and spring quarters. Given alternate years with B06-1,2,3.

415-B01-1,2,3 Introduction to Greek Literature
Review of basic grammar and vocabulary. Representative selections from Greek authors in their historical and cultural context. **1.** Epic. **2.** Drama. **3.** History, philosophy. Prerequisite: A01 or equivalent.

415-B06-1,2,3 Modern Greek II
Second year of modern Greek. Short review of first-year grammar, vocabulary, and sentence structure; intermediate material, including poetry and prose readings. Given alternate years with A06-1,2,3.

415-C01-0 Readings in Greek Literature
Authors and topics arranged in a three-year cycle. Authors include Homer, Pindar, Herodotus, Thucydides, and Plato. Prerequisite: B01 or equivalent.

415-C99-0 Independent Study
For advanced students approved by the department, individual programs under the direction of a department member.

Courses with Readings in English

These courses offer an understanding of classical culture and its influence in history, literature, and art. There are no prerequisites in Greek or Latin.

414-A10-0 Scientific Vocabulary through Classical Roots
Greek and Latin etymology in the vocabulary of the sciences. Designed primarily for science or medical students. Self-paced independent study.

414-B10-0 Introduction to Greek Philosophy
Survey of pre-Socratic philosophy, Plato, and Aristotle.

414-B20-1,2,3 The Ancient World
Origins and development of Greek and Roman civilization. **1.** The rise of civilization in the Near East; Mycenaean and archaic Greece. **2.** Classical Greece; Alexander and the Hellenistic kingdoms; early Roman Republic. **3.** Late Roman Republic and the Empire.

414-B40-1,2,3 The Literary Achievement of Greece and Rome
1. Homer and Hellenism: the *Iliad,* the *Odyssey,* and their early influence. **2.** The Athenian drama: 5th-century tragedy and comedy. **3.** Hellenistic and Roman humanism; new values in comedy, Virgil's *Aeneid,* satire.

414-B60-0 Greek Myth
Stories of gods and heroes as reflections of the structure and attitudes of Greek (and Roman) society and as changing models for human behavior.

414-C15-0 History of Greece
Advanced seminar focusing on Aristotle's concept of history. Evaluation of Aristotle's approach through the perspectives of his philosophy and Greek historical research.

414-C21-1,2 Roman History
Politics, economics, and society. **1.** The Republic, from the founding of Rome to the death of Julius Caesar (753–44 B.C.). **2.** The Empire, from Augustus to the death of Constantine (31 B.C.–337 A.D.).

414-C22-0 Ancient Greek Law
The procedural and substantive law, chiefly of democratic Athens, from historic and juridic perspectives.

414-C40-0 Women in Antiquity
Primary and secondary readings in translation examining the lives and image of women in Classical, Hellenistic, and Roman periods.

414-C55-0 Greek Archaeology
The origins, development, and historical context of Greek architecture, painting, and sculpture from the second millennium through the 5th century B.C.

414-C58-0 Roman Architecture
Architecture and urbanization, 700 B.C.–337 A.D. Important sites outside Rome: Pompeii, Herculaneum, Baalbek, Jerash, Palmyra, and Lepcis Magna.

414-C59-0 Topography of Imperial Rome
Covers the period of Rome's maximum ancient development, the reign of the Emperor Constantine. Presented alternate years with C58-0.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Related Courses in Other Departments

405-C10-3 Hellenistic and Roman Art
416-B04-0 Introduction to Tragedy
430-B10-0 Ancient Civilization: Israel and Greece
430-B11-0 Greek Civilization
430-B12-0 Rome: City of Man and God
439-B65 Introduction to the Philosophy of Law
439-C20-0 Studies in Ancient Philosophy

Cognitive Science Program

Cognitive science, a new interdisciplinary major in the college, introduces the scientific study of cognition. Students learn the ways in which converging sources of evidence may be integrated to discover the mechanisms underlying the complex, adaptive properties of human cognition. Areas covered include current methods in cognitive psychology, linguistics, artificial intelligence, and neuroscience (human and animal research). A junior proseminar focuses on ongoing research in the field by Northwestern faculty. Qualified seniors will be invited to take a senior honors seminar to engage in independent research under the guidance of department faculty and to write a senior thesis.

For additional information about the Program in Cognitive Science, see the program director.

Program of Study for Majors in Cognitive Science

Introductory courses (3):

- B07 Introduction to Cognitive Modeling
- B10 Introduction to Cognitive Science: Language, Vision, and Memory
- B11 Introduction to Cognitive Science: Learning, Representation, and Reasoning

Basic prerequisites (3):

- EECS A10 Introduction to Computer Programming *or* EECS A11 Fundamentals of Computer Programming
- Psych B01 Statistical Methods in Psychology *or* equivalent
- Psych B05 General Experimental Psychology

Intermediate requirements (3 of 4):

- Ling B06 Syntax and Meaning in Human Language
- Psych A12 Introduction to Neuroscience
- Psych C28 Cognitive Psychology
- EECS C48 Introduction to Artificial Intelligence

Advanced electives: six courses chosen from four areas; at least three must be in one area (major emphasis) and at least two must be in another area. Asterisks denote courses required for major emphasis in that area.

- Artificial Intelligence
  - EECS C25-1 Artificial Intelligence Programming I*
  - EECS C25-2 Artificial Intelligence Programming II
  - EECS C37 Natural Language Processing
  - EECS C44 Design of Computer-Based Problem Solvers
- Cognitive Psychology
  - Psych C11 Human Learning and Memory
  - Psych C22-1,2 Learning and Motivation
  - Psych C24 Perception
  - Psych C27-1,2 Formal Models of Cognition
  - Psych C33 Psychology of Thinking
  - Psych C34 Psychology of Language
  - Psych C35 Heuristic Decision Processes
  - Psych C60 Human Memory and Cognition
- Cognitive Neuroscience
  - Biol B10-3 Biology*
  - Biol C02 Fundamentals of Neurobiology
  - Biol C03 Molecular Neurobiology
  - Biol C04 Developmental Neurobiology
  - Biol C06 Central Nervous System Physiology
  - Biol C08 Neuroanatomy Laboratory*
  - Biol C77 Sensory Neurobiology
  - Psych C12-2 Neurobiology and Behavior
  - Psych C21 Neuroscience and Behavior Laboratory
- Linguistics
  - Ling B07 Sound Patterns in Human Language
  - Ling C05 Lexical Semantics
  - Ling C06 Fundamentals of Syntax
  - Ling C09 Psycholinguistics
  - Ling C16 Phonetics
  - Ling C29 Pragmatics
  - Ling C46 Introduction to Computational Linguistics
  - Ling C71 Morphology

Junior Proseminar
Senior Honors Seminar

Courses

452-B07-0 Introduction to Cognitive Modeling
Introduction to artificial intelligence and cognitive science from a nontechnical perspective. Fundamental questions concerning thinking, beliefs, language understanding, education, and creativity.

452-B10-0 Introduction to Cognitive Science: Language, Vision, and Memory
Scientific study of human cognition with an emphasis on vision, language, and memory. Prerequisite: Psych A10, A12, Ling A10, B06, B07, or consent of instructor.

452-B11-0 Introduction to Cognitive Science: Learning, Representation, and Reasoning
Interdisciplinary study of the nature of the mind with emphasis on learning, representation, and reasoning. Prerequisite: B07, B10, Psych A10, A12, Ling A10, B06, or consent of instructor.

D-Level Courses
Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Comparative Literary Studies Program
Comparative literary studies is an interdepartmental, interdisciplinary program for the study of literature across national and linguistic lines and within its historical and cultural contexts. Drawing on faculty from the various literature departments and related disciplines (such as art history and philosophy), the program reflects the belief that literature is truly an international activity best understood within the larger context of other literatures and other cultural activities. Whereas specific national literature majors encourage students to trace the development of a single tradition over time, comparative literature juxtaposes literatures of several cultures and epochs in a variety of ways: for example, by period, epoch, cultural milieu, or any of the larger questions raised by the very existence of literature as a way of representing and interpreting the world. Thus, the program enables students not only to read texts critically but also to reflect upon the theories and methods that have guided literary study in the past and in the present.

The Program in Comparative Literary Studies offers an undergraduate major and a graduate program leading to the PhD degree.

Program of Study for Majors in Comparative Literary Studies
The major in comparative literary studies includes a core curriculum and areas of concentration. The core curriculum consists of general course requirements common to all majors that introduce basic texts, methods, and theoretical models of the discipline. In the areas of concentration, students choose one of three possible concentrations that represent important orientations within CLS.

Concentration 1, theory and culture, focuses on the relations between literary study and the study of related disciplines. Concentration 2, world literatures, presents literature as a truly international phenomenon and exposes students to a variety of literary traditions, with special emphasis on non-Western literatures. Concentration 3, language and literature, develops comparative skills through in-depth study in the original language of one or more literatures other than English or American.

Each student's program is carried out in close consultation with the program adviser. During the spring quarter of the junior year, each CLS major submits a written proposal to the program adviser explaining in detail the concentration chosen and how the requirements will be fulfilled. Majors on study-abroad programs in their junior year must submit this proposal in the sophomore year before leaving Northwestern. Majors may preregister each quarter in the week preceding general registration. Additional information may be obtained from the program office.

Core Curriculum
Eight (sometimes nine) courses required of all majors:
- B01-1,2
- B02
- B80
- Two courses at the B level or above in a literature other than English in the original language (three B-level courses when the language is Japanese, Chinese, or Arabic)
- C01, C02, or C03
- C98

Areas of Concentration
Eight courses in one of three concentrations, including one course in Western literature before 1750; one course in Arabic, African, or Asian literature (two courses in concentration 2); and five C-level courses.

Concentration 1: Theory and Culture
Eight courses (at least three from CLS offerings):
- At least one C-level CLS theory course chosen from C01; C02; C03; C80; C82-1,2,3; C83
- At least three courses in literature
- Four courses in literary theory or in another discipline of demonstrable relevance to literary study (e.g., anthropology, communication studies, film theory, history, linguistics, philosophy) chosen in consultation with the program adviser

Concentration 2: World Literatures
Eight courses (at least three from CLS offerings and two from Arabic, Asian, or African literature):
- Five literature courses organized into an area under one of the following groupings: historical period (e.g., 20th century or European Renaissance), genre (e.g., epic or novel), geographical area (e.g., Africa or East Asia); the area must be approved by the program adviser
- Three additional courses in literature or related disciplines

Concentration 3: Language and Literature
Eight courses (at least two from CLS offerings):
- Either four courses in a national literature other than English or two courses each in two national literatures, one of which

may be English (in addition to the language/literature requirement of the core curriculum)
- Four additional courses selected from offerings in CLS, the national literature departments, or other related disciplines, at least two of which must be in CLS

Double Major

Students who wish to combine a major in comparative literary studies with another major may, with the approval of the program adviser, use up to four courses from their major to satisfy requirements in CLS.

Honors in Comparative Literary Studies

Students may qualify for honors in any of the three concentrations with a grade point average of 3.3 or above in the major. In addition, they must take one or two units of C99 Independent Study beyond the regular course requirements of the major, leading to the writing of an honors paper of 25 to 30 pages. The paper will be evaluated by the director of the independent study and a second reader appointed by the CLS director of undergraduate study. Students who wish to pursue honors must declare in writing their intention to do so by the end of the junior year.

Preparation for Graduate Study

While it is possible to complete the Northwestern BA in CLS with only two B-level courses in one language other than English, most PhD programs in comparative literature require significant mastery of at least two languages in addition to English.

Study Abroad

The Program in Comparative Literary Studies encourages all majors who qualify to consider a year of study abroad during the junior year.

Courses Primarily for Freshmen and Sophomores

416-B01-1,2 Western European Literature: Tradition and Transformation
A two-quarter sequence interweaving selected classics of the Western European literary tradition from Homer and Genesis forward with modern transformations of traditional themes.

416-B02-0 Practices of Reading
Introduction to fundamental skills and problems of close reading, with special focus on the "conflict of interpretations" between competing practices of reading.

416-B03-0 Introduction to Comedy
Survey of comic drama from Aristophanes to the present day.

416-B04-0 Introduction to Tragedy
Survey of tragic drama from Aeschylus to Racine.

416-B05-0 Introduction to Modern Drama
Survey of principal dramatic movements since Ibsen.

416-B06-0 European Fiction Since 1900
Reading in translation of some important works written in continental languages during the present century, by writers such as Dostoevsky, Thomas Mann, Kafka, Rilke, Sartre, Camus.

416-B10-0 The Bible as Literature
Selected books of the Hebrew Bible and New Testament studied from a literary perspective; issues of plot, character, genre, narrative strategy, and theories of interpretation.

416-B11-0 Introduction to Poetry
Different views of poetry and representative poems from diverse periods (classical, Romantic, avant-garde) and cultures.

416-B13-0 Introduction to Fiction
Fictional modes such as the novella, the short story, and the novel. May be repeated with different topics.

416-B71-1,2,3,4 Japanese Literature in Translation
A set of four courses surveying Japanese literature from the 8th century to the present.

416-B74-1,2,3 Introduction to Chinese Literature
Survey of Chinese poetry and fiction from the 5th century B.C. to the present.

416-B76-0 African Literature in Translation
Continental African literature. Content varies. May be repeated for credit.

416-B78-0 Modern Hebrew Literature in Translation
Introduction to the main works of contemporary Israeli writers.

416-B79-0 Modern Jewish Literature
A study of modern European, American, and Israeli Jewish literature in its historical context.

416-B80-0 Interpreting Culture
Introduction to the theory and practice of interpreting "cultural texts," the literary and other texts through which human culture imposes structures of meaning on the world.

Courses Primarily for Juniors, Seniors, and Graduates

Comparative literary studies and language majors will read the texts and be tested in their language or area of expertise whenever the course material allows.

416-C01-0 Writing in Society
Studies in relations between literature and society through a series of theoretical readings in the sociology of literature, juxtaposed with two literary examples from very different societies.

416-C02-0 Language in the Text
Close reading of exemplary literary and theoretical texts with a focus on the relationship between the meaning of texts and the linguistic devices that produce meaning: that is, on the tension between what a text means and how it means.

416-C03-0 Literature in History
Studies in the historicity of literature, with attention to the development of literary kinds over time and to the historical circumstances in which literature is produced.

416-C10-0 Studies in Literary Genres
Selected literary genres, such as epic, pastoral, autobiography, comedy, satire, the essay. May be repeated for credit with different topics.

416-C11-0 Studies in Poetry
Content varies. May be repeated for credit with different topics.

416-C12-0 Studies in Drama
Content varies. May be repeated for credit with different topics.

416-C13-0 Studies in Fiction
Content varies. May be repeated for credit with different topics.

416-C21-0 Medieval Epic and Romance
Major forms of Medieval narrative from heroic saga to courtly romance.

416-C24-0 Backgrounds of Medieval Literature
Intellectual background of Medieval literature, with special emphasis on the interpretations of Plato and Aristotle by late classical and scholastic philosophers.

416-C62-1,2,3 Modern Drama
1. Major developments from the late 19th century to the end of the first World War. **2.** From the 1920s into the 1950s. **3.** From Absurdist theater to the present.

416-C63-0 Studies in Modern Poetry
Major poets of the 20th century. May be repeated for credit with different topics. Prerequisite: reading knowledge of French, German, Italian, or Spanish.

416-C65-0 The Avant-Garde
Nature, origins, and development of the avant-garde movements in Europe, North America, and Latin America since the early 20th century.

416-C75-0 Literature and the Arts
Differences and similarities of literature and the visual arts and/or music. Content varies. May be repeated for credit.

416-C80-0 Theory of Literature
Introduction to the theory of literature and literary criticism, covering the nature of literature, poetic language, fiction, interpretation and evaluation, and the social functions of literature and literary criticism.

416-C82-1,2,3 History of Literary Criticism
1. Changing concepts of mimesis, genre, and style, from Plato to the Renaissance. **2.** The emergence of Neoclassical theories in France and England and their replacement by Romantic theories in England and Germany. **3.** Major themes and movements in 20th-century criticism.

416-C83-0 Special Topics in Theory
For students with previous study of criticism and literary theory. Content varies. May be repeated with different topics.

416-C90-0 Topics in Comparative Literature
Content varies. May be repeated for credit with different topics. Samples: problems of literary translation; literature and psychoanalysis.

416-C98-0 Senior Seminar
Variable topics and reading lists to develop work undertaken in earlier courses in a setting that introduces the active give-and-take of current intellectual debates. Required of senior majors in CLS. Prerequisite: permission of the program adviser.

416-C99-0 Independent Study (1–3 units)

Courses in Literature in Translation

The following courses are from other department listings, which should be consulted for fuller descriptions.

414-B40-1,2,3 The Literary Achievement of Greece and Rome

425-B10-1,2,3 German Literature in Translation

425-B12-0 Introduction to German Culture and Literature

425-B20-0 The German Film

425-B40-0 The Theme of Faust throughout the Ages

425-B61-0 Turn-of-the-Century Vienna: In Search of New Values

425-B62-0 Berlin: The Golden 20s

425-C14-0 German Contributions to World Literature

455-B75-0 Modern French Literature in Translation

455-C75-0 French Literature

457-B75-0 Dante's *Divine Comedy*

457-C80-0 Topics in Italian Cinema

459-C97-0 Topics in Luso-Brazilian Culture and Civilization

463-B23-0 Cervantes

463-B43-0 Contemporary Spanish-American Prose Fiction

463-C96-0 Topics in Spanish Culture and Civilization

463-C97-0 Topics in Latin American Culture and Civilization

467-B10-1,2 Introduction to Russian Literature

467-C10-0 Tolstoy

467-C11-0 Dostoevsky

467-C18-0 19th-Century Russian Comedy and Satire

467-C30-0 Old Russian Literature

467-C35-0 18th-Century Russian Literature

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Computer Science Program

The Program in Computer Science offers an alternative to the more engineering-oriented computer science degree program in the McCormick School of Engineering and Applied Science. Together the two programs offer a wide range of personalized opportunities. The Program in Computer Science builds on the strengths of the McCormick School's Department of Electrical Engineering and Computer Science, which provides the courses for the program. Each area of computer science offers interesting projects, including database and information retrieval, systems programming, theoretical foundations, computer hardware and architecture, numerical analysis, and artificial intelligence. Computing facilities include the Academic Computing and Network Services, an ENCORE computer system in EECS, a database machine, many work stations and terminals, and a minicomputer network. There are also computer hardware laboratories. Some of these facilities are available on an individual basis to students who are willing to contribute to ongoing projects.

The CAS and engineering programs have different emphases. Students in CAS pursue a degree with emphasis on application in the arts or sciences; the particular strength is that students may choose to combine the study of computers with mathematics, economics, linguistics, a physical science, or a social science. People who can apply computer expertise to problems in different fields are in strong demand.

In addition to a strong, flexible curriculum, the engineering program offers the opportunity to combine industrial experience with academic experience through the cooperative engineering education program. Students choosing this option spend alternating quarters in the junior and senior years working off campus, applying and reinforcing classroom concepts.

Program of Study for Majors in Computer Science

Prerequisites: Mathematics B14-1,2,3 and B17, normally to be completed in the first two years, and Mathematics C30-1 or equivalent. Students with an interest in areas of application that are highly mathematical in nature, such as numerical analysis, would be expected to have additional preparation in mathematics.

Major courses:

- Basic courses in electrical engineering and computer science (727), normally begun in the freshman year:
  Introductory sequence: EECS A10 Introduction to Computer Programming and B30 Programming Techniques *or* EECS A11 Fundamentals of Computer Programming and B11 Fundamentals of Computer Programming II
  EECS B01 Fundamentals of Computer Organization
  EECS B05 Fundamentals of Computer System Software
  EECS C10 Mathematical Foundations of Computer Science
  EECS C11 Data Structures and Data Management
  EECS C36 Design and Analysis of Algorithms
  One chosen from the following (the course not taken can be used as an elective below):
  EECS C20 Formal Languages and Automata Theory
  EECS C52 Applied Combinatorics
  Four chosen from the following (the three courses not taken can be used as electives below):
  EECS C22-1 Compiler Construction
  EECS C28 Numerical Methods for Engineers
  EECS C39 Introduction to Database Systems
  EECS C43-1 Operating Systems
  EECS C48 Introduction to Artificial Intelligence
  EECS C51 Introduction to Computer Graphics
  EECS C55 Computer Architecture I
- Advanced courses in computer science, normally taken in the third and fourth years. Six electives chosen with the approval of the adviser from the following:
  EECS C13 Introduction to Telecommunication Science
  EECS C14 Applied Artificial Intelligence
  EECS C20 Formal Languages and Automata Theory
  EECS C22-1,2 Compiler Construction
  EECS C25-1,2 Artificial Intelligence Programming
  EECS C32 Introduction to Computer Vision
  EECS C33 Introduction to Communication Networks
  EECS C37 Natural Language Processing
  EECS C39 Introduction to Database Systems
  EECS C41 Design of Real-Time Digital Systems
  EECS C43-1,2 Operating Systems
  EECS C44 Design of Computer Problem Solvers
  EECS C46 Microprocessor System Design
  EECS C47 Digital Electronic Systems Design Projects
  EECS C48 Introduction to Artificial Intelligence
  EECS C49 Introduction to Theorem Proving
  EECS C51 Introduction to Computer Graphics
  EECS C53 Digital Electronic Circuits and Systems
  EECS C55 Computer Architecture I
  EECS C56 Computer Architecture II
  EECS C57 Design Automation in VLSI
  EECS C90 Introduction to Robotics
  EECS C91 VLSI Systems Design
  EECS C94-1,2 Software Project Management and Development
  EECS C99 Projects
  IE C33 Systems Engineering and Analysis
  IE C35 Systems Simulation

Ling C06 Fundamentals of Syntax
Ling C46 Introduction to Computational Linguistics
Math C75 Mathematical Logic
Math C76 Theory of Computability and Turing Machines
Psych C35 Heuristic Decision Processes
Other courses in mathematics, industrial engineering, statistics, engineering sciences and applied mathematics, and psychology can be used as electives. For a complete list, see the program director.

Courses

Course descriptions are provided in the appropriate department listings of this catalog.

Drama Program

The Program in Drama offers undergraduates the opportunity to combine the study of dramatic literature in classics, comparative literary studies, English, and modern language courses with performance studies and theater courses in the School of Speech. Recognizing the uniqueness of drama among literary genres as a performing art, it seeks to develop an understanding and appreciation of dramatic literature informed by the study of acting, interpretation, playwriting, or directing. The program is not intended for students interested in professional performance but is directed rather toward those who wish to bring to the study of dramatic history and criticism a developed awareness of the problems and techniques involved in bringing a dramatic text to full life. Major requirements insure a balance of historical, literary, and theatrical approaches to drama; they are flexible enough to allow for special interests and concentrations, including the study of non-English drama in the original language. All students electing this major must work out a long-range plan of study with the program's official adviser.

Program of Study for Majors in Drama

Prerequisites: 2 units from the following set of courses, one each from CAS and Speech:

- CAS
  - Comparative Literary Studies B03 Introduction to Comedy
  - Comparative Literary Studies B04 Introduction to Tragedy
  - English B12 Introduction to Drama
  - Integrated Arts B91-1 Modes of Theater
- Speech
  - Performance Studies A03 Analysis and Performance of Literature
  - Performance Studies B10-3 Performance of Drama
  - Theatre A40-1,2,3 Theatre in Context
  - Theatre A43 Acting I: Basic Techniques

Major courses: 12 units (with a minimum of nine C-level courses) distributed as follows:

- At least 6 units in the history and criticism of drama, including 3 units in drama before 1850 (but not all in Shakespeare) and 2 units in drama after 1850. Applicable courses include
  - Classics B40-2 Literary Achievement of Greece and Rome: Athenian Drama
  - Comparative Literary Studies B05 Introduction to Modern Drama
  - Comparative Literary Studies C12 Studies in Drama
  - Comparative Literary Studies C62-1,2,3 Modern Drama
  - English C12 Studies in Drama
  - English C32 Renaissance Drama
  - English C34-1,2 Shakespeare
  - English C39 Special Topics in Shakespeare
  - English C42 Restoration and 18th-Century Drama
  - French B72 Introduction to French Theater
  - German C14 German Contributions to World Literature: Modern German Drama
  - Hispanic Studies C21 Golden Age Drama
  - Hispanic Studies C42 Latin American Drama
  - Theatre B44-1,2 The Development of Contemporary Theatre
  - Theatre C45-1,2,3 History of Western Theatrical Practice
  - Theatre C65 American Theatre and Drama
  - Theatre C66 Studies in Individual Dramatic Styles
- At least 3 units in performance studies and theater. Applicable courses include
  - Integrated Arts C90-1 Performance Seminar
  - Performance Studies B24 Adapting Narrative for Group Performance
  - Performance Studies C18-1 Shakespeare's Comedies: Performance and Criticism
  - Performance Studies C18-2 Shakespeare's Tragedies: Performance and Criticism
  - Theatre B43-1,2,3 Acting I: Principles of Characterization
  - Theatre C40-1,2 Stage Directing
  - Theatre C41-1,2,3 Acting II: Analysis and Performance
  - Theatre C46-1,2 Playwriting
- At least 1 unit of Drama C80 Seminar in Drama, or an equivalent D-level course designated by the program faculty committee.

To maintain a balance between literary and theatrical approaches to the study of drama, students should select no more than 7 of the total 12 units comprising the major courses from any one school.

Related courses: 4 units at B or C level in subjects related to the study of drama, approved by the major adviser. Applicable areas include aesthetics, criticism, cultural and intellectual history, humanities, literature, teaching of dramatics, etc.

Course

420-C99-0 Independent Study in Drama
For senior drama majors who have completed C80 and wish to undertake a project in candidacy for honors in drama. Prerequisite: approval of program director.

Economics

The program in economics enables students to understand the basic concepts, theories, and techniques of economics as they apply to economic problems and policies. These may focus on macroeconomics, applied microeconomics, quantitative economics, or economic history. Whatever courses students take, they will become familiar with the way economists think about problems and devise solutions to them. Although the program does not offer specialized professional training in economics, it is an excellent preparation for graduate work in economics, the study of law, or a career in business or government. Students should consult a department adviser about elective courses to fit their needs.

Program of Study for Departmental Majors

Economics majors are strongly urged to complete Mathematics B14-1,2 before taking any C-level courses. Many of the C-level electives require math up to B14-1,2. Math B14-3 is recommended.

Prerequisites: Econ B01, B02, Stat B10 or equivalent, Econ B81 before taking any C-level courses in economics.

Required courses: Econ C10-1, C11-1, and seven additional C-level courses; C10-1 and C11-1 should be completed before other C-level courses are taken.

Related courses: five one-quarter courses selected from the other social sciences, history, mathematics, or other departments that meet with the approval of the adviser. These courses may not be taken P/N, and no more than one may be at the A level. Econ B60 may be offered in partial fulfillment of this requirement.

The Teaching of Economics

CAS students pursuing a major in economics who also wish to be certified for secondary teaching must be admitted to the program and complete all requirements as outlined in the School of Education and Social Policy section of this catalog. Students are urged to contact the Office of Student Affairs in the School of Education and Social Policy as early as possible in their academic careers.

Four-Year BA/MA

The department offers a four-year BA/MA for outstanding students in economics. Graduate-level courses in economic theory are required. Interested students should consult the director of undergraduate studies in their sophomore year and should see Four-Year Master's Programs in the Undergraduate Education section of this catalog.

Honors in Economics

Superior students in economics may qualify for departmental honors by completing, in addition to the regular requirements of the major, one of the following three options: (1) Senior Honors Seminar C98-1,2 by invitation; (2) two quarters of C99; or (3) two D-level field courses in economics. Interested students should consult with the director of undergraduate studies.

Courses Primarily for Freshmen and Sophomores

417-B01-0 Introduction to Macroeconomics
Scarcity and choice; elements of demand and supply, determinants of aggregate output, employment, inflation, growth, and balance of payments; government expenditures, taxation, and monetary policies.

417-B02-0 Introduction to Microeconomics
Consumers' and producers' influence on structure of output and prices and distribution of income. Social efficiency in resource allocation. Government impact on allocative efficiency and distributive equity. Prerequisite: B01.

417-B13-0 Economics of Gender
Analysis of gender differences in employment and earning. Family, labor market, discrimination, segregation, historical and international conditions, and antidiscrimination legislation.

417-B60-0 Accounting and Business Finance
Accounting and managerial finance, including the principles of accounting, the elementary concepts of the theory of capital and its relationship to the objectives and problems of managing the firm. Prerequisites: B01 and B02 or consent of instructor.

417-B81-0 Introduction to Applied Econometrics
An introduction to applied econometrics. Estimate and analyze a variety of empirical econometric models. Descriptive statistics, univariate regression, multiple regression, simultaneous equations, and forecasting. Prerequisite: Statistics B10 or equivalent.

Courses Primarily for Juniors, Seniors, and Graduates

Prerequisites: B01, B02, and B81 or consent of instructor are required of students taking elective C-level courses. Additional prerequisites are indicated for specific courses.

417-C05-0 Comparative Economic Systems
Development of welfare capitalism, market socialism, and centrally planned socialism and the problems confronting them in the contemporary world.

417-C06-1,2 International Economics
1. International and interregional trade. Factors influencing trade in goods and services between areas. Reasons for and effects of impediments to trade, such as transport costs, tariffs, quotas, and voluntary export restrictions. Prerequisites: C10-1 and Math B14-1. **2.** International finance. Determination of exchange rates, balance of payments, and international asset flows and prices; international transmission of macroeconomic disturbances. Prerequisites: same as for C06-1 and C11-1.

417-C08-0 Money and Banking
Nature of money and bank credit. Development, functions, and operation of monetary standards and credit systems. Banking and credit policies; price levels. Interrelationships of domestic and foreign monetary systems. Prerequisites: C10-1, C11-1, and Math B14-1.

417-C09-0 Elements of Public Finance
Theory and practice of public finance. Welfare aspects of taxation and public expenditure decisions. Budgeting, public investment, external costs and benefits, and public debt. Prerequisites: C10-1 and Math B14-1.

417-C10-1,2 Microeconomics
1. Microeconomics and resource allocation. Behavior of consumers and firms; determination of prices and allocation of resources in competitive and monopolistic markets. **2.** Advanced microeconomics. Welfare and general equilibrium theory, imperfect competition and regulation of industry, decision making under uncertainty, alternatives to profit maximization, and other topics. Prerequisites: C10-1, B81 or equivalent, and Math 14-1,2.

417-C11-1,2 Macroeconomics
1. Macroeconomics and monetary policy. Behavior of economy as a whole. Income, inflation, unemployment, and growth; consumption, investment, and rate of interest; monetary and fiscal policy. **2.** Advanced macroeconomics. Microeconomic foundations of aggregate demand and supply; consumption, investment, money demand and supply; labor-market behavior; rational expectations. Prerequisites: B81 or equivalent, C11-1, and Math B14-1,2.

417-C12-0 Economic Planning for Stable Growth and Maximum Social Welfare
Japanese industrial policy, macroeconomic policy, savings behavior, investment behavior, and trade policy. The pragmatic and forward thinking of Japanese government organization in response to changes in international environment. Lessons for American firms and government bodies. Prerequisites: C10-1, C11-1, and Math B14-1,2.

417-C14-0 Socialist Economic Theory
Economic theories developed by revolutionary and evolutionary socialists: Marx and Engels, Sweezy, and Lange.

417-C15-0 Classical Problems in Economic History
Decline of European feudalism, Malthusianism, convertibility and free trade, constant wage shares during growth, the origins of the welfare state. Prerequisites: C10-1 and C11-1.

417-C17-0 Population and Economic Growth
Role of population growth in the process of economic growth; the effect of changes in economic conditions on the growth of population.

417-C18-0 History of Economic Thought
Development of economic thought from the advent of the Mercantilists to the formation of current schools of economics. Prerequisites: C10-1 and C11-1.

417-C20-0 Rise of Industrial Society
Lessons of economic change based primarily on the experience of Western Europe and its overseas offshoots in the transformation from agrarian and commercial economics to modern industrial states. Prerequisite: C10-1.

417-C23-0 Economic History of the United States
Economic development of the United States with emphasis on changing structure and performance of the economy from the colonial period to the present.

417-C24-0 Western Economic History
Western European developments, 1750 to the present: demographic, technical, social, and economic change. Prerequisites: C10-1 and C11-1.

417-C25-0 Economic Development
Structure, performance, and problems of developing economics in the third world—Africa, Asia, and Latin America. Prerequisites: C10-1 and C11-1.

417-C26-0 Economic Development in Africa
Economic change in sub-Saharan Africa, emphasizing current issues and policies in their historical contexts. Agriculture and rural development, industrialization, and international economic relations.

417-C27-0 Imperialism in Economics and History
Theoretical and historical analysis of the use of force in economic systems. Literature of neoclassical economics, imperialism, and neoimperialism.

417-C30-0 Economic Analysis and the Social Sciences
Relationship between economics and the other social sciences. The economic analysis of "noneconomic" topics; economic insights of other social sciences. Prerequisites: C10-1, C11-1, and Math B14-1,2.

417-C34-0 Business and Government
Survey of the functions, origins, and evolution of government control over business decisions in the American economy. Special emphasis on the modern structure of government regulation with attention to remote origins.

417-C36-0 Analytic Methods for Public Policy Analysis
Formulation of objectives, structuring decision problems, choices under uncertainty, interactive decisions, and the impact of organizational structure on project outcomes. Prerequisites: C10-1, C11-1, and Math B14-1.

417-C37-0 Economics of State and Local Governments
Economic functions and financing of state and local governments in theory and practice; costs and demands for local public services; role of government finance in urban and regional growth. Prerequisites: C10-1, C11-1, and Math B14-1.

417-C38-0 Theories of Income Distribution
Issues of economic equity and the distribution of economic resources. Alternative models of a just economic distribution, analysis of existing U.S. income distribution and its underlying causes, analysis of government policies designed to redistribute income. Prerequisite: C10-1.

417-C39-0 Labor Economics
Survey of economic problems growing out of employment relationship; theories and processes of wage and employment determination, income distribution, and the role of trade unions and issues of economic security. Prerequisites: C10-1, C11-1, and Math B14-1,2.

417-C40-0 Economic Analysis of the Family
The application of microeconomic theory to the analysis of the family. Marriage and divorce, the decision to have children, the role of the family in redistributing resources and in providing credit and insurance. Prerequisites: B81 and C10-1.

417-C49-0 Industrial Economics
Price and efficiency performance of American industries representative of various types of market structures and practices. Prerequisites: C10-1 and Math B14-1,2.

417-C50-0 Monopoly, Competition, and Public Policy
Present public policy and unsettled issues with respect to structure and practices of industrial markets; concentration, vertical integration, and forms and effectiveness of competition. Prerequisites: C10-1 and Math B14-1,2.

417-C53-0 Urban and Regional Economics
Influence of various factors on spatial distribution of economic activity. Consideration of methods for analyzing economic structure of urban areas.

417-C54-0 Issues in Urban Economics
Applications of economic analysis to specific problems of urban areas, such as housing markets, zoning restrictions, and racial patterns of employment and housing. Prerequisites: C10-1 and Math B14-1,2.

417-C55-0 Transportation Economics and Public Policy
The demand for alternative modes by passengers and shippers. Cost of providing transportation, competition, regulation, optimal pricing, subsidies, congestion pricing, and urban transit. Prerequisites: C10-1 and Math B14-1.

417-C56-0 Soviet Economic History and the Transition to a Market Economy
Structure and functioning of the former Soviet economy; ways in which a centrally planned economy differs from a market economy. Difficulties facing emerging nations of the former Soviet Union in becoming market economies.

417-C60-0 Foundations of Corporate Finance Theory
How corporations allocate resources over time as facilitated by capital markets. Theory of asset evaluation, economic analysis of uncertainty, and capital budgeting and capital structure decisions. Prerequisites: C10-1, C11-1, and Math B14-1,2.

417-C70-0 Environmental and Natural Resource Economics
Externalities and the role of property rights, pollution, waste disposal, common property problems, renewable resource management, nonrenewable resource use and depletion, recyclable resources, water allocation, and management of public lands. Prerequisites: C10-1 and Math B14-1.

417-C80-1,2 Introduction to Mathematical Economics
Mathematical techniques to analyze economic problems. **1.** Noncooperative game theory, with applications to industrial organization, auctions, and theories of the firm. Prerequisites: C10-1, C11-1, and Math B14-2. **2.** Cooperative and noncooperative game theory, and decision making under uncertainty. Prerequisite: same as for C80-1 or consent of instructor.

417-C81-1,2 Introduction to Econometrics
1. Foundations and methods of econometrics building on B81. Probability, sampling, hypothesis testing, correlation, and regression. Applications to labor, housing, and other markets. **2.** Time series analysis, simultaneous equations, and other econometric problems. Applications to financial markets, macroeconometric models, efficient markets. Prerequisites: B81, C10-1, C11-1, and Math B14-1,2.

417-C82-0 Welfare Economics and Social Choice
Rigorous analysis of the classical problems of welfare economics. Efficiency of competitive equilibrium, social versus private costs, norms for evaluating economic systems, social rankings, and social welfare functions. Prerequisites: C10-1, C11-1, and Math B14-1,2.

417-C83-0 Economic Forecasting
Techniques for making and evaluating economic and business forecasts, including univariate regressions, autoregressive and ARMA models, vector autoregressive models, and structural econometric models.

417-C90-1,2 Reform in the Soviet Union and Reform in Tsarist Russia
In-depth analysis of the problems and options that face the former Soviet Union today and that faced Russia in the middle of the 19th century. A two-quarter interdisciplinary course taught by an economist, historian, and political scientist. Grade of K given in C90-1.

417-C95-0 Junior Seminar
Small seminars led by different department members on their special interests. Advanced work through supervised reading, research, or discussion. Prerequisites: C10-1, C11-1, and Math B14-1,2.

417-C98-1,2 Senior Honors Seminar
For students of superior ability. Use of scientific method and relationship of economics to other social sciences. Individual choice of seminar paper. By department invitation only. Grade of K given in C98-1. Prerequisites: C10-1, C11-1, Math B14-1,2, and most economics electives.

417-C99-0 Independent Study
Advanced work through reading, research, and discussion in areas of particular interest to the student. Project to be decided by mutual agreement with a faculty member.

D-Level Courses
Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Related Course in Anthropology
The course below can be taken in partial fulfillment of the seven elective courses in economics.

403-C41-0 Economic Anthropology

English
During the past 20 years, the English profession has changed dramatically in its approach to literature. The study of English now addresses such issues as what counts as "literary," the place of literature in society, and the relationship of literature to history. In response to such questions, the Department of English has devised a major that encourages students to situate literature in relation to history, philosophy, and culture. Students in the English program also have the opportunity to study the writing of verse and fiction as well as to practice the writing of clear, concise, effective expository prose. Rigorous training in thinking and writing is valuable for any career that an undergraduate may ultimately pursue and makes English an attractive major for students preparing for careers in medicine, law, and business as well as in the teaching of English at all levels.

The Department of English is not doctrinaire, consistently promoting one particular ideology of literary and cultural studies, but rather a pluralistic one that takes pride in the variety of emphases and perspectives it offers. In addition to teaching "English" courses, members of the department contribute substantially to the comparative literary studies and American culture programs.

The University Library is a valuable resource for the advanced study of British and American literature, maintaining notable collections in 19th- and 20th-century materials, especially modern "little" magazines. English majors also often profit from University programs for foreign study, particularly at the University of Sussex in England.

Programs of Study for Departmental Majors
A complete description of undergraduate English major programs can be obtained from the department office. Detailed descriptions of courses offered each quarter are published in "English Notes," available from the department office three times a year in advance of registration. A tentative list of course offerings for the following year is available also each spring. Writing courses (B06, B07) and other courses whose content varies may be repeated, but only with consent of the department.

English and American Literature Major
Prerequisites: two B-level courses.

- Choice of any B-level literature course except B05, B06, and B07
- Followed by 419-B98 Introductory Seminar in English

Major courses: 11 additional courses.
Up to 2 courses in comparative literary studies (416) or courses that deal with English and American literature and are offered by other departments or schools may be counted among the 11 additional courses. However, this provision does not apply to courses in criticism (416-C80, C81, C82-1,2,3, and C83), which count as C-level English courses.

- 9 courses must be at the C level or above
- 7 courses must fulfill the following area requirements: *Ordinarily 20s courses fulfill area 2 requirement; 30s courses, area 3; 40s courses, area 4; 50s courses, area 5; 60s courses, area 6; 70s courses, area 7. Area 1 is fulfilled by courses in Comparative Literary Studies C80; C82-1,2,3; and C83. (For information on the use of current offerings to fulfill area requirements, students should consult "English Notes.")*
  1. Literary criticism and theory
  2. Medieval and Tudor literature
  3. Renaissance literature
  4. Restoration and 18th-century literature
  5. 19th-century British literature
  6. Modern British, American, and postcolonial literatures
  7. American literature before 1900
- At least one course must be C98 Senior Seminar. A senior seminar may not be used to meet an area requirement.

Related courses: at least two quarters of one of the following sequences in history (427) or European thought and culture (430): 427-B01-1,2 European Civilization; 427-B10-1,2 History of the United States; 427-B60-1,2 History of England; 427-C17-1,2,3 American Cultural History; 427-C50-1,2,3,4 The Intellectual History of Europe; 430-B10–B19 Patterns of European Thought and Culture.

English Major in Writing

Students majoring in English may apply to major in writing. The writing major includes the writing of poetry and fiction, but it is not restricted to "creative writing" alone. A required course in prose style and argument helps students focus on discursive forms, while a strong literature component and a course in cultural criticism further attempt to place the writing done in the practical workshop courses in poetry and fiction within a context of general literacy.

Admission: Students may apply for admission to the writing major through the English office, University Hall 102, in the early spring of each year.

Prerequisites: 2 B-level courses: B06 Reading and Writing Poetry and B07 Reading and Writing Fiction. Prospective writing majors who are not admitted to the program may count this sequence instead of a B-level 419 literature course.

Major courses:

- 6 additional courses, one from each of areas 2–7 of the English and American literature major
- 1 theory and practice sequence: C96-1,2,3 Theory and Practice of Poetry or C97-1,2,3 Theory and Practice of Fiction (students who wish to work in both genres may do so with permission of the director of the writing major)
- C92 The Situation of Writing
- C95 Fundamentals of Prose
- Optional C99 Independent Study, culminating in a final honors project

Related courses: as in the English and American Literature requirement. Substitutions may, however, be arranged at the discretion of the adviser.

Writers in residence: Each year, two or more visiting writers hold week-long seminars in poetry and fiction, confer individually with advanced students, and read and discuss their own work in public forums. Frequently, writers are invited to give courses through a quarter or year.

The Teaching of English

CAS students pursuing a major in English who also wish to be certified for secondary teaching must be admitted to the program and complete all requirements as outlined in the School of Education and Social Policy section of this catalog. Students are urged to contact the Office of Student Affairs in the School of Education and Social Policy as early as possible in their academic careers.

Honors in English

Superior students may qualify for honors by submission of a substantial writing project to the departmental Honors Committee. Students whose projects are judged to be outstanding and who have achieved a GPA of 3.4 or higher in the English major will be recommended to the CAS Honors Committee.

The writing project should be produced during one or two quarters of C99 Independent Study, which will build on previous work done in a C98 Senior Seminar, another C-level course, or graduate course with consent of the instructor. Students interested in honors through the writing major should consult with the director.

Related Programs

Department of English courses are used in the American culture, drama, and comparative literary studies programs.

Courses Primarily for Freshmen and Sophomores

419-A05-0 Basic Composition
Expository writing, emphasizing all phases of the composition process: gathering and analyzing material, drafting, revising, and editing.

419-B05-0 Intermediate Composition
Expository writing at an intermediate level. Emphasis on techniques for writing clearly, precisely, and persuasively.
Prospective writing majors take both B06 and B07.

419-B06-0 Reading and Writing Poetry
Forms and techniques of verse.

419-B07-0 Reading and Writing Fiction
Forms and techniques of fiction.

404-B10-1,2 Survey of African-American Literature
See African-American Studies.

419-B11-0 Introduction to Poetry
Elements of lyric and narrative poetry—diction, imagery, metrics, plot—with emphasis on the ways these can create meaning and elicit response. Examples primarily from works written in English.

419-B12-0 Introduction to Drama
Fundamental elements of drama as perceived in performance. How a play communicates from text to stage and from stage to audience, through analysis of representative early and modern plays. Prerequisite for drama major. Examples primarily from works written in English.

419-B13-0 Introduction to Fiction
Major 19th- and 20th-century fiction examined to define the genre (novel or short story) and distinguish between its conventional and experimental modes. Examples primarily from works written in English.

419-B34-0 Introduction to Shakespeare
Representative Shakespearean plays.

404-B59-0 Introduction to African-American Drama
See African-American Studies.

419-B60-0 Introduction to 20th-Century British Literature
Principal writers and works since World War I.

419-B70-1,2 Introduction to American Literature
Representative writers and works of American literature in cultural context, including history, art, and other extraliterary forms. **1.** Puritans to *Moby Dick.* **2.** Mid-19th century to 1900.

419-B73-0 Introduction to 20th-Century American Literature
Principal writers and works since World War I.

419-B98-0 Introductory Seminar in English
Several genres with emphasis on literary traditions and conventions, generic evolution, and historical contexts. Prerequisite: any B-level 419 literature course except B05, B06, and B07.

Courses Primarily for Juniors and Seniors

419-C02-0 History of the English Language
The English language from the earliest times to today. Examples from Old English, Middle English, and Early Modern English literature.

419-C04-0 Practical Rhetoric
The theory of writing and of skills that underlie good writing. Intended to meet the special problems of teachers in secondary schools and universities.

419-C05-0 Advanced Composition
For students with previous formal training in composition; admission by consent of department.

419-C07-0 Advanced Creative Writing: Fiction
For students with previous formal training in creative writing who are not writing majors; admission by consent of department.

419-C10-0 Studies in Literary Genres
Content varies. Samples: satire, biography, epic, pastoral. With departmental consent, course may be elected more than once.

419-C11-0 Studies in Poetry
Such elements of poems as diction, imagery, rhythm, structure; how they work with the subject matter to determine the individual poem, and how they guide interpretation of the poem.

419-C12-0 Studies in Drama
Content varies. Samples: Ibsen, Shaw, and Pirandello; theater and audience. With departmental consent, course may be elected more than once.

419-C13-0 Studies in Fiction
Content varies. Samples: the subversive hero in 20th-century literature; experiments in modern literature. With departmental consent, course may be elected more than once.

419-C20-0 Medieval English Literature
Representative works in their intellectual and cultural contexts.

419-C21-1,2 Old English
1. The Old English language and readings in prose and poetry. **2.** *Beowulf* and other poetry. Prerequisite for C21-2: C21-1.

419-C23-1,2 Chaucer
1. *The Canterbury Tales.* **2.** *Troilus and Criseyde* and other works.

419-C24-0 Studies in Medieval Literature
Content varies. Samples: courtly romance; fabliaux; mystery plays; Arthurian tradition; women in medieval culture.

419-C25-0 Spenser
Spenser's major poetry with emphasis on *The Faerie Queene.*

419-C28-0 Studies in Tudor and Elizabethan Literature
Content varies. Normally covers poetry and prose of late 16th- and early 17th-century England. Samples: Marlowe, More, Skelton, Sidney and Spenser, Tudor/Elizabethan lyricists.

419-C30-0 Renaissance and 17th-Century Literature
Representative works in their intellectual and cultural contexts.

419-C31-0 Renaissance Poetry
English poetry from the Elizabethan period to 1660, including such writers as Wyatt, Jonson, Donne, Herbert, and the Cavalier poets.

419-C32-0 Renaissance Drama
English plays of the Tudor, Elizabethan, and Jacobean periods, including such writers as Marlowe, Jonson, Beaumont and Fletcher, Webster, Middleton, and Ford.

419-C34-1,2 Shakespeare
1. Principal plays up to 1600. **2.** Principal plays after 1600.

419-C35-0 Milton
Milton's poetry, with those parts of the prose that illuminate his poetical and intellectual development.

419-C38-0 Studies in Renaissance Literature
Content varies. Sample: Marvell, Herbert, and Vaughan.

419-C39-0 Special Topics in Shakespeare
Content varies. Samples: Shakespeare's political plays; Renaissance world of *Hamlet*; Shakespeare on the Elizabethan stage.

419-C40-0 Restoration and 18th-Century Literature
Representative works in their intellectual and cultural contexts.

419-C41-0 Restoration and 18th-Century Poetry
Dryden, Pope, and other poets of the period 1660–1744.

419-C42-0 Restoration and 18th-Century Drama
English drama from 1660 to the end of the 18th century.

419-C43-0 18th-Century Prose
Johnson, Swift, Gibbon, Burke, Wollstonecraft, and other nonfiction prose writers.

404-C44-0 Black Presence in Faulkner
See African-American Studies.

419-C44-0 18th-Century Fiction
Defoe, Richardson, Smollett, Fielding, Sterne, Fanny Burney, Mrs. Radcliffe, and Jane Austen.

419-C48-0 Studies in Restoration and 18th-Century Literature
Content varies. Samples: biography and autobiography; literary careers; literature and social criticism.

404-C49-0 Black Families in Literature
See African-American Studies.

419-C50-0 19th-Century British Literature
Representative works in their intellectual and cultural contexts.

419-C51-0 Romantic Poetry
Blake, Wordsworth, Coleridge, Byron, Shelley, and Keats.

419-C53-0 Studies in Romantic Literature
Content varies. Samples: Blake: poet and painter; Wordsworth; Coleridge and Keats; Byron and the Byronic.

419-C56-0 Victorian Poetry
The principal British poets from Tennyson to Hopkins, with attention to cultural context and developments in form.

419-C57-0 19th-Century British Fiction
Important and representative novels written between 1800 and 1900.

419-C58-0 Dickens
Representative major works of Charles Dickens.

419-C59-0 Studies in Victorian Literature
Content varies. Samples: Victorian autobiography; pessimism and decadence in later Victorian literature; Victorians and some inheritors.

419-C60-0 20th-Century British and American Literature
Representative works in their intellectual and cultural contexts.

419-C61-1,2,3 20th-Century Poetry
1. Major British poets such as Yeats, Eliot, Auden. **2.** Major American poets from Frost and Robinson to Hart Crane. **3.** British and American poetry since World War II.

416-C62-1,2,3 Modern Drama
See Comparative Literary Studies.

419-C63-1,2 20th-Century Fiction
1. British writers such as Conrad, Ford, Forster, Greene, Huxley, Lawrence, Waugh, and Woolf. **2.** American writers such as James, Hemingway, Fitzgerald, Faulkner, and West.

419-C67-0 Postwar British Fiction
Representative British novels since 1945, including such writers as Orwell, Greene, and Waugh.

419-C68-0 Studies in 20th-Century Literature
Content varies. Samples: boundaries of modernism (Kafka, Joyce, Nabokov); grail myth in modern literature.

419-C69-0 African Literature
Twentieth-century African literature in English.

419-C70-0 American Literature before 1914
Intellectual and cultural contexts of American literature from the Puritans to 1914. Such writers as Bradford, Edwards, Franklin, Emerson, Thoreau, Fuller, and Henry Adams; a few pertinent poems and fictional works.

419-C71-0 American Novel
Writers such as Cooper, Alcott, Chopin, Hawthorne, Melville, Poe, Twain, James, Howells, Crane, Dreiser, and Wharton, from the beginning to 1914.

419-C72-0 American Poetry
Writers such as Bradstreet, Freneau, Bryant, Poe, Whitman, Dickinson, Robinson, and Frost, from the beginning to 1914.

419-C78-0 Studies in American Literature
Content varies. Samples: radicalism in American literature; Mark Twain; slavery and American literature; black women's fiction.

416-C80-0 Theory of Literature
See Comparative Literary Studies.

416-C82-1,2,3 History of Literary Criticism
See Comparative Literary Studies.

416-C83-0 Special Topics in Theory
See Comparative Literary Studies.

419-C85-0 Topics in Combined Studies
Special topics in literature and related disciplines. Content varies. Samples: opera and literature; mythology and the arts.

419-C86-0 Studies in Literature and Film
Content varies; comparison of representative films and literary works with emphasis on aesthetic principles and social and historical contexts they share.

419-C92-0 The Situation of Writing
Literary and cultural contexts of writing; the competing claims of tradition and innovation; current literary ideologies; the relation of writer to audience and marketplace. Prerequisite: admission to writing major.

419-C95-0 Fundamentals of Prose
The techniques of prose for writing majors. How syntax, diction, special vocabularies, and methods of argument and analysis contribute to tone and expression.

419-C96-1,2,3 Theory and Practice of Poetry
1. Reading and discussion of published poems; emphasis on principles of craft. Student imitations, critiques. **2.** Intensive writing practice in the forms of lyric. **3.** Writing the long poem. Prerequisite: admission to sequence or writing major.

419-C97-1,2,3 Theory and Practice of Fiction
1. Reading and discussion of published fiction, with emphasis on principles of craft. Student imitations, critiques. **2.** Intensive writing practice in the short story. **3.** Writing the novella. Prerequisite: admission to sequence or writing major.

419-C98-0 Senior Seminar
Open to English majors only. Advanced reading, research, and writing; discussion format. With departmental consent, course may be elected more than once.

419-C99-0 Independent Study
Reading, writing, and conferences on special subjects for senior majors with excellent records. May be elected three quarters but only one unit at a time. Prerequisite: consent of instructor or director of writing major.

D-Level Courses
Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Environmental Sciences Program
The primary challenge facing our species is to learn to understand and coexist with the natural environment. Accordingly, the environmental sciences major is designed to provide students with an understanding of the workings of the environment and the relation of humans to it. Environmental science necessarily differs from the more traditional divisions of scientific inquiry. The intellectual approach is that of synthesis, where the focus is concentrated on the integration of knowledge rather than on further refinement of knowledge within a particular scientific field. Also, the concern for translating theory into practice requires a strong association with engineering. With this approach, environmental sciences provides a mechanism for motivated, independent students to work in a multidisciplinary framework with a common theme.

The major gives students the expertise to address issues of environmental concern from a scientific basis, such as energy options, environmental law, the relation of society and resources, and health problems of air and water pollution. It provides a background for employment in environmentally oriented firms or for graduate study in any of several different environmental science disciplines as well as an exceptional preprofessional experience for students interested in law or business.

Advising and Course Selection
As soon as students have declared a major in environmental sciences, they should consult with the environmental sciences adviser to plan their programs. They should try to complete the foundations in science and mathematics courses by the end of their sophomore year.

Premedical students and students interested in advanced study in environmental biology are advised to take the B-level sequence in biological sciences and one or two additional quarters of organic chemistry.

Program of Study for Majors
The major is rigorous but reasonably flexible. It requires a basic grounding in the sciences and mathematics, a core curriculum that introduces students to environmental problems, courses that consider society's impact on the environment, and a series of advanced courses tailored to each student's interest. This is capped by a senior seminar where students participate in environmental research and present their results.

Foundations in Science
Basic science courses are necessary to understand the environmental sciences; all the following are required for the major:
- Chem A01, A02, A03 General Chemistry
- Chem B10-1 Organic Chemistry
- Phys A35-1,2 General Physics
- Biol A70 Concepts of Biology *or* A90 Characteristics of Living Organisms
- Geol B01 The Skin of the Earth

Foundations in Mathematics
The standard calculus sequence is an important tool in understanding the environmental sciences; all the following are required for the major:
- Math B14-1,2,3 Calculus

Core Curriculum
Important environmental factors are emphasized in various disciplines; any three of the following are required for the major:
- Biol A91 Evolution and Ecology
- CE B06 Environmental Literacy
- Geog B11 World Biogeography
- Geol B04 Environmental Geology

Environment and Society
Society's place in and interaction with the environment is described in social science courses; any two of the following are required for the major:
- Econ C70 Environmental and Natural Resource Economics
- Hist C20-1,2 Environmental History of the United States
- PolSci C71 Environmental Politics
- Soc C12 Social Basis of Environmental Change

Advanced Studies
The following courses focus on developing skills for detailed understanding of specific environmental issues described in the core curriculum and preparing students for research; any four courses with no more than two from one department are required for the major:

- Biol C12 Evolutionary Processes
- Biol C20 Behavioral Ecology
- Chem C29 Analytical Chemistry with Laboratory
- Chem C42-1 Thermodynamics
- Geol C01 Geochemical Processes in Earth's Surface Environment
- Geol C12 The Earth's Changing Climate
- Stat C02 Elementary Statistical Methods
- CE C58 Airphoto Interpretation
- CE C60 Environmental Impact Evaluation
- CE C61 Public Health Engineering
- CE C63 Community Air Pollution
- CE C66 Environmental Biology
- CE C67 Chemistry of the Aquatic Environment

Integrated Science Program

The Integrated Science Program is a highly selective BA program in the College of Arts and Sciences (see Integrated Science Program). Students majoring in ISP who wish to complete a second major in environmental sciences should fulfill the following requirements instead of those listed above. They may not substitute ISP C98 or Env C98 for the ISP courses 435-C91-2, 412-C11, and 408-C03 and must take the following additional courses:

- Geol B01
- Biol A91
- Two of the following 3 courses: CE B06, Geog B11, Geol B04
- Two of the four courses listed under Environment and Society
- Two courses, not in the same department, from those listed under Advanced Studies, except Chem C42-1 and Stat C02
- May take the two quarters of Env C98 instead of ISP C98 as substitutions for starred courses in the ISP major.

Course Required of All Majors

422-C98-1,2 Environmental Research Seminar
In the fall and winter quarters of the senior year, majors participate in seminars given by environmental science experts and also present results of their own studies.

European Thought and Culture

The series of courses Patterns of European Thought and Culture is a joint enterprise of faculty in classics, the modern language and literature departments, art history, history, music, philosophy, and religion. Through a study of the forms and values of particular ages in their historical context, the courses aim at tracing patterns of social and cultural representation that are shared by different European societies and give to the different eras of European history their temporal boundaries. The courses are frequently team-taught by faculty from different disciplines. They meet various distribution requirements in the areas of historical studies, values, and literature and fine arts, but any combination of six may be used to meet all the requirements in those three areas.

Patterns of European Thought and Culture

430-B10-0 Ancient Civilization: Israel and Greece
A comparative study of the earliest documents of ancient Greek and Judaic culture in their historical and archaeological contexts.

430-B11-0 Greek Civilization
Survey of Greece in the classical period, from the Persian Wars to the age of Alexander. How art, architecture, drama, and philosophy reflect evolving notions of the individual, society, and humanity in this formative stage of European culture.

430-B12-0 Rome: City of Man and God
Introduction to Rome between Augustus and Augustine, with special emphasis on the conflicts and compromises between imperial Rome and early Christianity.

430-B13-0 The Middle Ages
Introduction to the distinctive institutions, political and spiritual horizons, and aesthetic expressions of medieval culture, with special emphasis on the 12th and 13th centuries.

430-B14-0 The Renaissance
Introduction to some themes associated with the Renaissance, principally humanism, the invention of printing, the discovery of the Americas, the Copernican revolution, the Reformation and Counter-Reformation, and more generally, radically new ways of conceiving the self and its relation to social orders.

430-B15-0 The Birth of Modernity (1550–1720)
Introduction to the social, political, and intellectual history of Europe from 1580 to 1720, with special emphasis on the change from medieval monarchy to the modern nation state and on the origins of modern philosophy and natural science.

430-B16-0 The Age of Enlightenment
Introduction to European scientific and philosophical thought in the 18th century, with special emphasis on natural philosophy and evolving concepts of gender and race.

430-B17-0 The Romantic Period
Introduction to the Romantic movement and the radical shift it introduced to traditional concepts of the self, with special emphasis on philosophy, lyric poetry, and music as dominant cultural forms of this period.

430-B18-0 Modern Culture: The 19th Century
Survey of 19th-century culture with special emphasis on the political and social consequences of the French Revolution, the industrial revolution, and the emergence of the novel as the most characteristic form of artistic expression.

430-B19-0 Modern Culture: The 20th Century
Survey of the relationship between history, thought, literature, and the fine arts in the 20th-century, with special emphasis on the massive revaluation of traditional norms in modernism, the political implications of philosophic movements

(Nietzsche, existentialism), and the impact of mass phenomena (wars, revolution, urban life) on modern experience.

French and Italian

Studies in French or Italian provide insight into the language, thought, and character of cultures different from our own. Such knowledge builds an awareness of our own society's diversity and of the ways it resembles and differs from others. As the merging of domestic and international events increasingly affects the material and intellectual life of every individual, the ability to communicate with other peoples assumes vital importance. Whether a student is planning a career in teaching, government, science, the professions, or business, the study of a foreign language, literature, and culture is a wise option in a university education.

Programs in the department are varied. Language courses, from the elementary through the graduate level, develop communication skills that allow students to function at ease with foreign texts or in a foreign environment. Courses in literature and civilization not only broaden and deepen insights into the thought and writing of another culture; they also train students to think independently, to organize and analyze materials thoughtfully, and to discuss ideas effectively.

There are three undergraduate programs in French and one in Italian, plus MA and PhD programs in both languages. These may be supplemented by foreign study, which allows students to increase their knowledge of a foreign language and society while continuing university work abroad in a variety of fields. It is not necessary to be a major to participate in these programs. An excellent library, modern audiovisual resources, and a learned faculty (of which nearly one-half are native speakers) further strengthen studies in French and Italian.

French

Programs of Study for Departmental Majors

Courses indicated as a prerequisite for an advanced course may not be taken for credit after the advanced course is completed.

French Language and Literature

Prerequisites: B02, B03, B10; 1 unit from B71, B72.

Major courses: 13 units at the C level, including 5 in language (C02-1, C02-2, C03, C91-1, C91-2), 3 in the survey of literature and culture (C15-1,2,3), 2 in undergraduate seminars (C96, C97), and 3 in other French courses at the C level (at least 2 in literature). Students may count up to 2 units in independent study (C99) toward the major.

Related courses (one of the following options):

- 4 courses (at least 2 at the C level) in the humanities or social sciences in topics pertinent to France or to the study of language and literature in general
- 4 units in another foreign language, at least 2 of which are at the B level or higher

French Studies

Prerequisites: B02, B03, B10, B80-1, B80-2.

Major courses: 12 units, including 6 in language (C02-1, C02-2, C03, C05, C91-1, C91-2), 2 in the survey of literature and culture (chosen from C15-1,2,3), 2 in civilization (C80, C92), and 2 in seminars (C96, C97).

Related courses: 4 units in courses pertinent to France chosen from the following disciplines, including at least 2 units at the C level and at least 2 in one discipline: anthropology, art history, economics, European thought and culture, history, linguistics, philosophy, political science, radio/TV/film, sociology.

The Teaching of French

CAS students pursuing a major in French who also wish to be certified for secondary teaching must be admitted to the program and complete all requirements as outlined in the School of Education and Social Policy section of this catalog. Students are urged to contact the Office of Student Affairs in the School of Education and Social Policy as early as possible in their academic careers.

Four-Year BA/MA

The department offers a four-year BA/MA program in French for outstanding undergraduate majors. Interested students should consult with the department chair and should see Four-Year Master's Programs in the Undergraduate Education section of this catalog.

Courses Primarily for Undergraduates

455-A11-1,2,3 First-Year French
Conversation, grammar, reading, writing for beginners. Five class meetings a week.

455-A15-1,2 Accelerated First-Year French
For students with some previous experience in French. Review and development of skills in speaking, understanding, and reading as preparation for work at the second-year level. Four class meetings a week. Prerequisite: department placement.

455-A21-1,2,3 Second-Year French
Grammar review, conversation, reading, writing. Four class meetings a week. Prerequisite: A11 or A15.

455-A23-0 Second-Year French: Individualized Instruction
Intermediate French in a format allowing students a choice of skill concentrations and learning pace. Credit possible for up to three quarters. Prerequisite: department placement.

455-A27-1,2,3 Second-Year French for Reading
Designed to develop skill in reading prose, theater, and poetry texts through discussion and translation. Grammar review. Preserves previously acquired oral skills. Prerequisite: A11, A15, or department placement.

455-B01-1,2 Introduction to French Studies
Development of fluency, accuracy, and creativity in speaking, comprehension, reading, and writing French; introduction to social, cultural, and literary topics central to an understanding of France and French-speaking peoples.

455-B02-0 Intermediate Grammar and Composition
Practical study of French grammar and structure, to develop and improve writing skills through practice in preparing short compositions. Prerequisite: CAS proficiency in French or equivalent.

455-B03-0 Intermediate Conversation
Practical course to increase listening comprehension, build vocabulary and idiom use, and enhance communication skills. Three hours per week. Prerequisite: B02.

455-B10-0 Introduction to French Literature
Study of texts illustrating various genres from the 16th century to the present such as poetry, drama, fairy tale, novel, autobiography. Prerequisite: department placement, AP score of 5, or B02.

455-B71-0 Introduction to the French Novel
Fundamental concepts and significant achievements of the French novel. Representative novels chosen from writers of the 17th to the 20th centuries. In French.

455-B72-0 Introduction to French Theater
Basic concepts and representative works of the French theater with emphasis on the 17th and 20th centuries. Principles of tragedy and comedy; contemporary developments. In French.

455-B80-1,2 Introduction to French Civilization
History and structure of modern French society. **1.** The 19th century, from the *ancien régime* to the Dreyfus Affair. **2.** The 20th century: economic growth, transformation of society, and politics. Prerequisite for B80-1: B02 or B03. French majors should take B80-1 before taking B80-2.

Courses with Reading and Discussion in English

No prerequisite required in French; readings, discussions, papers, and exams in English.

455-B75-0 Modern French Literature in Translation: Texts and Contexts
Reading and discussion of outstanding authors and works of French literature from the Renaissance to the present.

455-B81-0 Problems in Contemporary French Politics and Society
A study of contemporary France and its recent mutations, through historical analysis of social, economic, and political trends.

455-C75-0 French Literature
Content varies. Samples: medieval movies, the French novel since World War II, literature by women authors.

455-C81-0 French Civilization
The *ancien régime* and the nobility, the Revolution and the rise of the bourgeoisie, the Romantic generation, intellectual life in France 1880–1980. Prerequisite: B81.

Courses with Prerequisite in French

Prerequisite for these courses are at least 3 units on the B level in French, including B10.

Topic courses (C20, C30, C40, C50, C60, C90, C91, C92) may be repeated for credit with different topics. For current topics consult "French and Italian Course Descriptions," available in the department three times a year before registration.

For French majors, C15 is a prerequisite to all other C-level literature courses.

455-C02-1,2 Advanced Grammar and Composition
Grammar, vocabulary, and discourse features related to a particular linguistic function (such as narrating, describing, persuading) and writing practice to synthesize these elements. Prerequisite for C02-1: B02 or consent of instructor. Prerequisite for C02-2: C02-1.

455-C03-0 Advanced Conversation
Free oral practice based on short readings and spontaneous scenarios. No formal grammar or composition. Language laboratory required. Prerequisite: C02 or consent of instructor.

455-C05-0 French Phonetics
Analysis of speech organs, vowels, consonants, syllabic division, intonation, rhythm, accent, timbre, linking. Corrective exercises for pronunciation difficulties.

455-C15-1,2,3 French Literature and Culture
Intersections of French literature and culture in historical context. **1.** Middle Ages, Renaissance, and early classical period. **2.** Late classicism, Enlightenment, and Revolution. **3.** Modernism and Postmodernism.

455-C20-0 Topics in 16th-Century Literature
Content varies. Samples: prose writers; Renaissance poetry.

455-C30-0 Topics in 17th-Century Literature
Content varies. Samples: theater in the 17th century; Descartes, Pascal, and 17th-century French thought.

455-C40-0 Topics in 18th-Century Literature
Content varies. Samples: facets of Enlightenment literature; the moral dilemma in 18th-century French thought; comedy and satire: Marivaux, Voltaire, Beaumarchais.

455-C50-0 Topics in 19th-Century Literature
Content varies. Samples: romanticism; the novel in the 19th century; Baudelaire and symbolism.

455-C60-0 Topics in 20th-Century Literature
Content varies. Samples: from Proust to Beckett; 20th-century French poetry.

455-C80-0 Political and Social Thought in France
An inquiry into the major French political and social trends from the *ancien régime* to the 20th century. The intellectual and cultural framework for study of French political life.

455-C90-1,2,3, Special Topics in Literature
Content varies. Samples: literature and psychoanalysis; French comedy; the fantastic in literature; images of women in French literature.

455-C91-1,2 Topics in Language
Content varies. Samples: translation; the structure of French; semantics. Prerequisite: C02-2, C03, or consent of instructor.

455-C92-1 History of Paris: An Introduction to French Cultural History
Origins and development of the city from pre-Roman times to recent discoveries and construction in the Halles and Louvre areas. The urban landscape as inspiration or reference for painters, poets, novelists, and other literary commentators. In French.

455-C93-0 Topics in Civilization
Content varies. Samples: the *ancien régime;* mythologies of Versailles; individual and society in modern France.

455-C96-0 Contemporary French Thought
An examination of different perspectives and paradigms for understanding literature and culture.

455-C97-0 Studies in Literature and Culture
In-depth research and analysis of a problem or topic concerning cultural representation.

455-C99-0 Independent Study
Independent reading and research. Topics arranged through consultation with an instructor and approval of the department.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Italian

Program of Study for Departmental Majors

Courses indicated as a prerequisite for an advanced course may not be taken for credit after the advanced course is completed.

Prerequisites: B01, B02, B03

Major courses: C01, C02; five units of other C-level courses, one of which must be a course on Dante. No more than one unit of C99 and no more than two courses in translation may be counted toward the major. Exceptions regarding C99 units will be made for honors candidates.

Related courses (one of the following options):

- Language: five units in French, German, Greek, Hebrew, Latin, Russian, or Spanish, including at least two units at the B level
- Literature: five units of B- and C-level work in literature other than Italian, including literature in translation; at least two units must be at the C level
- Culture: five units in courses pertinent to Italy in the fields of art history, classics, European thought and culture, history, linguistics, music, philosophy, or political science; the choice of related courses in culture must be approved by the major adviser

Courses Primarily for Undergraduates

457-A01-1,2,3 Elementary Italian
Pronunciation, grammar, composition, reading, and conversation. Drill in language laboratory. Five class meetings a week.

457-A02-1,2,3 Intermediate Italian
Grammar review, conversation, composition, and readings in modern prose and drama. Four class meetings a week. Prerequisite: A01 or two units of Italian.

457-A33/A34-1,2,3 Intensive Italian
Beginning course designed to complete the work of A01 and A02 in one year. Students must enroll in A33 and A34 concurrently, for which they receive two credits per quarter. Five class meetings a week.

457-B01-0 Italian through Newspapers and Magazines: Composition and Conversation
Issues from Italian media; frequent oral and written reports. Samples: America in Italian media; advertising; immigration; youth culture. Grammar review. Produce newspaper or newscast at end of quarter.

457-B02-0 The Culture of Regional Italy: Conversation
Major authors and cultural movements throughout Italian history, emphasizing regional differences. Samples: cooking and folklore, poetry, city planning, theater, film. Some grammar; spoken Italian emphasized.

457-B03-0 Culture of Unified Italy: Composition
Idea of unified Italy in literature and culture. Nationalism in poets from Dante to Leopardi; government; influence of television on language; opera; education and childhood. Some grammar; written Italian emphasized.

Courses with Reading and Discussion in English

No prerequisite required in Italian.

457-B75-0 Dante's *Divine Comedy*
Introduction to the *Divine Comedy,* its artistic and intellectual achievement, and its cultural and historical content.

457-B80-0 Italy: Myths and Realities
Historical survey of Italian thought, culture, and politics, 1300 to the present.

457-C75-0 Topics in Italian Culture
Content varies. Samples: arts and letters in Renaissance Florence; Italian opera; fascism and culture. Prerequisite: consent of instructor.

457-C80-0 Topics in Italian Cinema
Introduction to major Italian filmmakers and cinematic trends.

Courses with Prerequisite in Italian

Prerequisite for these courses: B01, B02, B03, or equivalent.

457-C01-0 Advanced Grammar and Composition
Analysis of grammar and syntax. Intensive work in composition and translation.

457-C02-0 Introduction to Literary Study
Introduction to techniques of close reading and to various critical approaches through analysis of representative works of prose and poetry from the Middle Ages to the present.

457-C10-1,2,3 Studies in Dante
Interpretations of the *Divina Commedia,* the *Vita Nuova,* and selections from other works.

457-C11-0 Topics in Medieval Literature
Content varies. Samples: *dolce stil nuovo,* Petrarch, Boccaccio.

457-C20-0 Topics in Renaissance Literature
Content varies. Samples: epic poems of Ariosto and Tasso; drama; Machiavelli and Italian humanism.

457-C30-0 Topics in 17th- and 18th-Century Literature
Content varies. Samples: theater of Metastasio, Goldoni, Alfieri; Vico and the new science.

457-C50-0 Topics in 19th-Century Literature
Content varies. Samples: Romantic prose and poetry; Verga and Italian realism.

457-C60-0 Topics in 20th-Century Literature
Content varies. Samples: prose fiction of Pavese, Svevo, Moravia; theater of Pirandello, D'Annunzio, Betti; poetry of Ungaretti, Quasimodo, Montale.

457-C99-0 Independent Study
Independent reading under supervision (consult department chair).

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Geography Program

The Program in Geography offers three types of courses to students who seek a knowledge of the physical earth and its various modes of human occupance. Introductory courses develop global perspectives on environments, economies, and cultures that are relevant to many social and physical science fields. Courses in regional geography present a unique way of understanding how nature and culture have interacted over time to give character to specific places or regions. Advanced courses focus on the concepts and techniques of professional geography, especially on the construction of maps and on the uses of maps in solving geographical problems.

Program of Study

Students, on the recommendation of the Geography Program adviser, may apply for an ad hoc major in geography. In addition to the following requirements, students also must complete a major in a social or natural science field.

Required courses: B10, C41, and four additional geography courses, including at least one unit of research (C98 or C99).

Related courses: Mathematics B14-1,2; Economics B01, B02; Statistics B10 or equivalent.

Introductory Courses

421-A10-0 Introduction to Geography
Survey of the factors and principles of location that influence the world's map of environments, economies, and cultures. Comparative study of selected world regions emphasizing differences in resource endowments and economic development.

421-B10-0 The Natural Environment
Introduction to the physical elements of geography. Major local and global atmospheric processes producing weather and climate. Study of the earth-shaping forces that give rise to the geography of landform features.

421-B11-0 World Biogeography
Geography of the world's major ecosystems based on the global climate model. Physical processes of soil formation and vegetation development in various ecosystems. Human impacts on natural systems resulting from past and present land-use practices.

Regional Geography

421-C13-0 North America
Detailed study of the regional geography of the United States and Canada. The regional distribution of landform types. Patterns of culture, history, and economic development that underlie the distribution of distinctive lifeways in the two countries.

Advanced Courses

421-C32-0 Geomorphology
The agents and processes responsible for shaping the earth's surface form, including the actions of running water, wind, waves, and ice. Prerequisite: B10 or a course in geology.

421-C41-0 Principles of Cartography
Introduction to the design, construction, and use of maps as graphic communication. The varieties of thematic maps used to present spatial data effectively. Elements of map design and construction, including typography and symbolization. Coordinate systems and map projections. Prerequisite: Math B14-1.

421-C42-0 Map Production Techniques
Advanced techniques for constructing publication-quality maps. Compilation from multiple sources, scribing, and

negative construction. Photographic methods, peel coats, screen printing techniques. Prerequisite: C41.

421-C98-0 Undergraduate Seminar
Advanced work through readings, research, and discussion. Open only to undergraduate majors. Prerequisite: department permission.

421-C99-0 Independent Study
Independent research projects. Open to qualified advanced students by permission of department only.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Geological Sciences

The geological sciences use diverse and interdisciplinary approaches to the study of complex physical, chemical, and biological processes occurring within the earth. The undergraduate program combines fundamental background in mathematics, physics, and chemistry with courses applying these techniques to geological problems. Undergraduates are encouraged to select individual programs reflecting their scientific interests and career goals, whether graduate study in the earth sciences, professional employment, or advanced study in areas such as management or law.

Undergraduates are involved in the full spectrum of departmental activities beyond class work: research, seminars, field trips, and social functions. The resulting educational environment offers unusual opportunities for motivated and interested students.

Program of Study for Departmental Majors

Major courses: B01, B02, and four C-level courses.

Related courses:

- Mathematics B14-1,2,3; B15; B17; B21
- Physics A35-1,2,3; or A90-1,2,3
- Chem A01, A02, and A03; or A71 and A72

Mathematics, chemistry, and physics are prerequisites for C-level courses and should be taken at the earliest opportunity.

Integrated Science Program

The Integrated Science Program is a highly selective BA program within the College of Arts and Sciences. Students majoring in ISP who wish also to complete a major in geological sciences must take B01 and three C-level courses in addition to C15. These requirements replace the usual major requirements noted above.

Four-Year BA/MS

Students with a professional interest in the earth sciences and a grade point average of at least 3.5 may be eligible for the four-year BA/MS honors program offered by the Department of Geological Sciences. The department only recommends students for this program; final approval is made by the Graduate School. Students may apply for this program in the spring quarter of their junior year; by the end of that year, applicants should complete all courses required for the major in geological sciences and all (or nearly all) the CAS BA requirements. See Four-Year Master's Programs in the Undergraduate Education section of this catalog and consult with a department adviser.

To fulfill the MS requirements, students must complete

- 12 courses approved by the student's advisory committee and bearing graduate credit in science or engineering (Math B21, Chem C42-1, and the four C-level courses taken for the BA may be counted)
- A final independent research report (not necessarily a formal thesis)

Courses Primarily for Freshmen and Sophomores

423-A01-0 Earth Processes and Products
Minerals, rocks, and structures of earth's crust and changes wrought through geologic time. Special emphasis on factors and processes controlling location, composition, interior structure, and surface morphology, convergent and divergent plate boundaries, continental collision belts, and rift zones. Lectures, lab; weekend field trip.

423-A06-0 The Ocean, the Atmosphere, and Our Climate
Physical, chemical, and geological oceanography, with emphasis on interactions with the atmosphere and the role of the world ocean in the earth's climate. Lectures.

423-A07-0 Plate Tectonics: New View of the Earth
Evidence for drift of continents and spreading of sea floor; pattern of modern motions; history of drifting. Relation of continental drift to earthquakes, great faults, volcanism, mountains, and nature of earth's interior. Lectures and discussion.

423-A08-0 History and Evolution of the Continents
Character and evolution of the earth's continents, including the processes of continental drifting, rifting, collision, accretion, and underplating. Consideration whether continents are promordial or have grown recently in the history of the earth. Earthquakes, volcanism, convection, and other phenomena critical to understanding continents.

423-A10-0 The Earth As a Planet
Origin of the solar system, primary accretion, and differentiation of the earth, origin and early history of the moon, abundance of elements, geologic time.

423-A11-0 Global Environmental Change
Earth's environments before mankind. Growth of human populations; historical patterns and future trends. Natural and man-made causes of changes on land, in waters and atmosphere, on long- and short-time scales. Good background in high school mathematics, chemistry, or physics recommended. Lectures.

423-A12-0 Energy Sources and the Global Environment
Fossil and nuclear energy sources. Generation and disposal of fuel and nuclear wastes. Energy trends.

423-B01-0 The Skin of the Earth
Introduction to the processes that control the formation and destruction of rocks, minerals, and earth surface features: weathering, sedimentation, glaciation, mountain building, deformational features, metamorphism, volcanism, and historical geology. Field trip. Prerequisite: Chemistry A02 or equivalent.

423-B02-0 The Body of the Earth
Introduction to the earth as a planet: origin, composition, and evolution of the solar system and earth; internal structure of the earth; plate tectonics. Prerequisite: Math B14-2, Physics A35-1, Chemistry A02, or equivalent.

423-B04-0 Environmental Geology
Introduction to hazardous earth processes, human interaction with the environment, and problems of resource availability and use. Lab and one-day field trip. Prerequisites: A01 or B01, Math B14-2, and Chemistry A02.

423-B88-0 Earth and Life in Science and Art
Major ideas and discoveries of science as reflected in pictorial art of their time. Emphasis on physical world, earth, and life. Similarities and differences in views of science and art. Lasting achievements and trends in science and art. Lectures and discussion. Prerequisite: college-level physics, chemistry, or geological sciences course or consent of instructor.

Courses Primarily for Juniors, Seniors, and Graduates

423-C01-0 Geochemical Processes in Earth's Surface Environment
Fundamentals of surficial processes: weathering, transport, deposition. Chemical evolution of the outer shells of the earth. Prerequisite: Chemistry A03.

423-C07-0 Tectonics and Structural Geology
Deformation of rock masses: strain, fracture, slip, stress, and rheologic regimes; rock structures; folds, faults, foliations; seismic parameters in tectonic studies; orogenic belts and their tectonic evolution. Lectures and lab. Prerequisites: B01, Math B17, Physics A35-1, or equivalents.

423-C08-0 Geophysical Fluid Dynamics
Principles of fluid dynamics applied to problems in the earth sciences. Kinematics; momentum, mass, energy conservation in rotating earth system; viscous motions; turbulence and Reynolds stress models; convection; applications to problems in the ocean, atmosphere, mantle, asthenosphere, magma flow, lava domes, etc.

423-C09-0 Reflection Seismology
Acquisition, processing, and interpretation of reflection seismograms. Applications to hydrocarbon prospecting, structural geology, tectonics, stratigraphy, and deep continental reflection profiling. Prerequisites: Math B14-3, Physics A35-1, or consent of instructor.

423-C11-0 Geochemistry of the Earth's Interior
Composition and petrology of the lower crust and mantle; thermal regimes of the earth's interior; mantle heterogeneity and metasomatism, formation of magmas.

423-C12-0 The Earth's Changing Climate
The physics of climate and climate change; methods of study of past climates of the earth. The climate from the Cretaceous to the present.

423-C13-0 Sedimentary Geology
Analysis and interpretation of sedimentary rock bodies within their geological frameworks. Global facies and event stratigraphy related to paleogeography. Prerequisite: B01.

423-C15-0 Physics of the Earth
Solid earth geophysics: earth's gravity field, earth's magnetic field, interior of the earth, heat flow, elementary wave propagation. Prerequisite: second-year standing in ISP or comparable background in mathematics and physics.

423-C24-0 Seismology and Earth Structure
Elastic theory, seismic waves, seismometers and seismograms, ray paths, travel times; internal structure of the earth; earthquakes: location, characteristics, mechanism, and relation to plate motions. Prerequisites: Math B21 and Physics A35-2.

423-C25-0 Global Tectonics
Global tectonics, emphasizing the kinematics of plate tectonics. Geometry, determination, and description of plate motions. Paleomagnetism, marine magnetism, and hot spots. Applications to the history of the ocean basins, formation of aseismic ridges and oceanic plateaus, and mountain building processes. Prerequisites: B02, Math B17, and Physics A35-2.

423-C27-0 Chemical Processes in the Earth's Crust
Development of the fundamental principles of multiphase equilibria and solution chemistry necessary to understand fluid-rock interactions in the earth's crust; hydrothermal ore deposits, geothermal systems, metamorphism. Prerequisites: B01 and Chemistry A03 or A71.

423-C28-0 Geophysical Data Processing
Analysis techniques applied to seismic and other geophysical data. Sampling, windowing, discrete and fast Fourier transforms, z-transforms, deconvolution, filtering, and inverse methods. Prerequisite: Math B21.

423-C29-0 Tectonophysics
Quantitative description of the kinematics of distributed deformation within plate boundary zones of earth's gravity field

and geoid; principle of isostasy; flexure of the crust and lithosphere. Prerequisites: Math B21 and Physics A35-2 or consent of the instructor.

423-C50-0 Physics and Thermochemistry of the Earth's Interior
Finite strain theory, solid solution thermodynamics, phase transitions, subduction zone processes, seismic velocity structures.

423-C51-0 Geological Fluid Processes
Rheology of the crust and upper mantle; deformation mechanisms, textures, microstructures, and physical properties; interaction of metamorphism and deformation; fluid migration. Prerequisite: B01, Math B14-3, or consent of instructor.

423-C98-0 Undergraduate Seminar
Opportunity for advanced work through supervised reading, research, and discussion. Open only by invitation of the department.

423-C99-0 Independent Study
Special problems under direct supervision of one or more members of staff. Comprehensive report and examination required. Open with consent of department to juniors and seniors who have completed a field of concentration in the department.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

German Language and Literature

The Department of German Language and Literature offers courses in three separate tracks, giving students a choice in satisfying their educational needs or interests. Courses are designed to

- Offer students who select German to fulfill the college language requirement and those who wish to acquire a basic knowledge of the language an opportunity to read modern German prose and to express themselves in German
- Educate German majors, majors in German studies, and prospective teachers in all aspects of German language, literature, and culture with an emphasis on the "modern" period (from the 18th century to the present)
- Provide a basis for the understanding of the intellectual and cultural life of Germany for students who are not proficient in German

Honors in German

Superior students in the programs of German language and literature and German studies may qualify for departmental honors by completing one of the following options: (a) two quarters of C98 or C99, (b) two quarters of D-level courses, or (c) one quarter of C98 or C99 and one quarter of D-level. In addition, students will present a research paper at the end of their second quarter of honors study. Interested students should consult with the department's director of undergraduate studies.

Programs of Study for Departmental Majors

Courses indicated as a prerequisite for an advanced course may not be taken for credit after the advanced course. Students returning from a study abroad program in their junior year must enroll in three C-level quarter-courses in the department.

German Language and Literature

Required courses: Four quarter-courses in the German language, two from the B and two from the C level, chosen from B05, B08, C91; three quarters of B01; three quarters of C10; three quarters chosen from C29 and C32. German majors may take a C-level criticism course instead of one of the C-level literature and culture requirements.

Related courses (one of the following options):

- Five quarter-courses, at least two at the C level, in the humanities or social sciences in topics pertinent to German or to the study of language and literature in general
- Five quarter courses in another foreign language, including at least three on the B level or higher

Related courses must be approved by the director of undergraduate studies.

German Studies

The program offers students the opportunity to study German life and culture in the broadest sense, including language, geography, institutions, politics, economics, social and intellectual history, literature, and music. Since the program was designed to prepare the German studies student for a career in government service or for graduate study in international economics, management, trade, or law, a secondary concentration in economics, political science, history, or a combination thereof is recommended.

Required courses: Four quarter-courses in the German language, two from the B and two from the C level, chosen from B05, B08, B80, C80, C91; two quarters of B01; three quarters of C10; two quarters of C32. Students pursuing a second major in addition to German studies must select a concentration in an area distinct from that second major; for example, a double major in German studies and economics must select a German studies concentration in a field other than economics. Courses required for either major may be counted in one major only.

Related courses: Two quarter-courses from B33-2,3 or B50; History C38-1,2, C44-2,3, C49. Students selecting history for a secondary concentration must choose one of the related course options listed with the German language and literature major in a discipline other than history.

Courses for secondary concentration: Five quarter-courses, at least two at the C level, pertinent to German.

Related courses and courses for secondary concentration must be approved by the director of undergraduate studies.

The Teaching of German

CAS students pursuing a major in German who also wish to be certified for secondary teaching must be admitted to the program and complete all requirements as outlined in the School of Education and Social Policy section of this catalog. Students are urged to contact the Office of Student Affairs in the School of Education and Social Policy as early as possible in their academic careers.

Language Courses

425-A01-1,2,3 Elementary German
German language and culture. Understanding, speaking, reading, and writing of German.

425-A02-1,2,3 Intermediate German
German language and culture. Understanding, speaking, reading, and writing of German continued. Prerequisite: A01-3 or equivalent.

425-A05-0 German for Research (0)
Introduction to the translation of scholarly and scientific German texts. No prerequisites in the language.

425-B03-0 Intermediate Conversation
Practical training in communication skills with sole emphasis on listening comprehension and speaking. May be taken twice for credit with different materials. Prerequisite: A02-1 or equivalent.

425-B05-0 Intermediate Grammar and Composition
Practice in the writing of short essays; German grammar and structure. May be taken twice for credit with different materials. Prerequisite: A02 or equivalent.

425-B08-0 German through Reading News Periodicals
Articles of current interest in German newspapers, read and discussed in German. Biweekly compositions. May be taken three times for credit with different materials. Prerequisite: A02-3 or equivalent.

425-B80-0 German in Commerce and Industry
German language study oriented toward business and economics. Prerequisites: B-level courses in German or equivalent.

425-C80-0 Advanced German in Commerce and Industry
Advanced German language study oriented toward business and economics. May be taken twice for credit with different materials. Prerequisite: B80 or equivalent.

425-C91-0 Topics in Language
Special topics in German language. Samples: advanced grammar and composition; translation; advanced translation; stylistics; advanced conversation. Repetition with different topics for credit.

Courses in Literature and Culture with Prerequisite in German

425-B01-1,2,3,4 Introduction to German Literature
Works from the 18th century to the present. Readings, lectures, and discussions in German.

425-B15-0 Special Studies in German Literature and Culture
Studies of a major author, a prominent theme in German literature or culture, a movement, or a genre. Repetition with different topics for credit. Prerequisite: A02-3 or equivalent.

425-C10-1,2,3,4,5 Epochs of German Culture
The thought, literature, arts, and music of five epochs of German history in their sociopolitical contexts. **1.** Courtly golden age. **2.** Age of reason and revolution. **3.** Will to power. **4.** German literature and politics (1900–45). **5.** German literature and politics after 1945. Prerequisite: B-level courses in German or equivalent.

425-C29-0 Topics in Literature
Readings and discussions of topics in German literature, as announced annually. Repetition with different topics for credit.

425-C32-0 Topics in German Studies
In-depth study of pivotal periods in German culture, as announced annually. Repetition with different topics for credit.

425-C98-0 Undergraduate Seminar (1–3 units)
Advanced work through supervised reading, research, and discussion.

425-C99-0 Independent Study
Open to German majors with senior standing.

Courses with Reading and Discussion in English

No prerequisite in German required.

416-B06-0 European Fiction Since 1900
See Comparative Literary Studies.

425-B10-1,2,3 German Literature in Translation
These courses can be taken independently of one another. **1.** The novella. **2.** The drama. **3.** The novel.

425-B12-0 Introduction to German Culture and Literature
Topics vary. Samples: the fairy tale, Germanic mythology. Repetition with different topics for credit.

425-B20-0 The German Film
Topics vary. Samples: the pioneer film, "new" German cinema. Repetition with different topics for credit.

425-B33-1,2,3 German History and Culture
German cultural, political, and intellectual history, from its origins to the present. **1.** From the beginnings through the Reformation. **2.** Reformation to founding of the Empire. **3.** Imperial Germany to the present.

425-B35-0 Luther and the Philosophy of Faith
Luther's contribution to the intellectual and religious life of his time and his impact on modern Western civilization.

425-B40-0 The Theme of Faust throughout the Ages
The Faust theme in literature and music through shifting intellectual and social climates from the 16th century to the present.

425-B50-0 Introduction to Contemporary Germany
German political, social, and cultural scene after 1945. Repetition with different readings for credit.

425-B61-0 Turn-of-the-Century Vienna: In Search of New Values
The literature and thought of fin de siècle Vienna and its impact on the modern consciousness. Fiction, poetry, essays, plays by Freud, Schnitzler, Wittgenstein, Hofmannsthal, Musil, Karl Kraus, Schoenberg.

425-B62-0 Berlin: The Golden '20s
The literature, philosophy, fine arts, and architecture of the Weimar Republic (1918–33) as expressions of its intellectual debates and social upheavals. Remarque, Piscator, Mann, Spengler, the Bauhaus.

425-C14-0 German Contributions to World Literature
Topics vary. Samples: Rilke's poetry; Nietzsche's influence on literature: Thomas Mann; Hesse, the German novel, and the mystic tradition; modern German drama; German intellectual history. Repetition with different topics for credit.

Hispanic Studies

Spanish is spoken over a wider territory than the other Romance languages, in countries of all three worlds. In the United States, it constitutes the second language, particularly in large urban areas like Chicago and in the Southwest.

In addition to its obvious practical value, the study of Spanish is of cultural and aesthetic value. When Spain was the most important power in Europe, such authors as Cervantes and such painters as El Greco and Velázquez contributed to the treasury of human achievement on a par with Shakespeare and Michelangelo. Goya and Galdós in the 19th century and Picasso, García Lorca, Ortega y Gasset, and Unamuno in the 20th demonstrate that Spanish culture is still vital today. Spanish culture spread to the New World where, during the colonial and nationalization periods, literature vividly reflected Latin America's struggle to attain its rightful place under the sun. Today, with the appearance of the Nobel prize winners Miguel Angel Asturias, Gabriela Mistral, Pablo Neruda, García Márquez, and many others, Latin American literature has assumed an outstanding role in the development of more sophisticated and universal literary techniques.

With the belief that in this ever more enlightened and cosmopolitan world, all students should be familiar with another language and civilization, the department, by means of three optional programs of study, prepares majors to graduate with linguistic competence and a wide background in peninsular and Latin American literature. To achieve this goal, Spanish is offered on all levels: In the A-level courses emphasis is placed on reading, speaking, and understanding Spanish. The B-level courses are designed to solidify students' knowledge of the language and to introduce them to Spanish and Latin American literature. One series of C-level courses provides advanced training in the language; other C-level courses provide a more detailed analysis of cultural and literary movements, including all periods of both Spanish and Latin American literature and thought. Able undergraduates are eligible to take D-level (graduate) courses. Undergraduate majors are encouraged to enrich their work in Spanish by studying other languages and literatures and other fields in the humanities. The department regularly offers two years of work in Portuguese. All students who are competent in Spanish (not only majors) are encouraged to take part in the Northwestern/University of Seville Junior Year Program in Spain or in the summer program in Mexico sponsored by the Committee on Institutional Cooperation (CIC), the academic consortium of the Big Ten universities and the University of Chicago.

The department also offers a full program of graduate studies leading to the MA and PhD degrees.

Spanish

Programs of Study for Departmental Majors

Courses indicated as a prerequisite for an advanced course may not be taken for credit after the advanced course is completed.

Language and Literature

Prerequisites: three quarter-courses chosen from B01-1,2,3 and B02-1,2,3; one quarter of B03.

Major courses: C02 or C03; C23; C50 or C51; C80; and five C-level quarter-courses in Spanish or Latin American literature, including at least one course in each of the following areas: Spanish literature before 1700 (in addition to C23), modern Spanish literature, and Latin American literature. One C-level course in comparative literary studies, taught by a member of the department, may be substituted for one of the C-level requirements in Spanish or Latin American literature. Linguistics B07 is highly recommended.

Foreign study: all majors are encouraged to spend at least one quarter studying in a Spanish-speaking country.

Related courses: five quarter-courses, constituting a coherent pattern of study, chosen from other departments or programs with the approval of a department adviser. The study of another foreign language is encouraged.

Latin American Studies

Prerequisites: one quarter of B01, three quarters of B02, one quarter of B03.

Major courses: C02 or C03; C23; C40; C41; C43 or C44; C51; C99; and four quarter-courses relating specifically to

Latin America, chosen from history, linguistics, political science, or other departments or programs. A year of Portuguese is recommended.

Foreign study: all majors are encouraged to spend at least one quarter studying in a Latin American country.

Related courses: same as for language and literature. As alternatives, see Latin American and Caribbean Studies certificate program.

The Teaching of Spanish

CAS students pursuing a major in Spanish who also wish to be certified for secondary teaching must be admitted to the program and complete all requirements as outlined in the School of Education and Social Policy section of this catalog. Students are urged to contact the Office of Student Affairs in the School of Education and Social Policy as early as possible in their academic careers.

Honors in Hispanic Studies

Superior students in any major program in Hispanic studies qualify for departmental honors by completing a substantial research paper and by selecting either two quarters of C99 Independent Study or D07 plus one quarter of C99.

Four-Year BA/MA

The department offers a four-year BA/MA program in Spanish for outstanding undergraduate majors. Interested students should consult the department chair and should see Four-Year Master's Programs in the Undergraduate Education section of this catalog.

Courses Primarily for Undergraduates

463-A01-1,2,3 Elementary Spanish
Pronunciation, grammar, translation, and easy conversation. Five class meetings a week. Drill in language laboratory.

463-A02-1,2,3 Intermediate Spanish
Grammar review, conversation, composition, and readings in modern prose and drama. Four class meetings a week. Prerequisite: A01 or two units of Spanish.

463-A15-1,2 Accelerated First-Year Spanish
For students with some previous experience in Spanish. Pronunciation, grammar, and easy conversation. Four classes per week plus one hour in the language laboratory. Prerequisite: department placement.

463-A33/34-1,2,3 Intensive Spanish (2)
Alternative to A01 and A02 sequences. Concurrent enrollment in A33 and A34 required. Ten class hours per week.

463-B01-1,2,3 Introduction to the Literature and Civilization of Spain
Main currents of Spanish literature and culture. **1.** 19th and 20th centuries. **2.** 16th and 17th centuries. **3.** Middle Ages. Prerequisite: A02 or four units of Spanish.

463-B02-1,2,3 Introduction to the Literature and Civilization of Latin America
Main currents of Latin American literature and culture. **1.** From *modernismo* to the present. **2.** From the 17th century to 1888. **3.** Indigenous literatures of Latin America and from Columbus to Ercilla. Prerequisite: A02 or four units of Spanish.

463-B03-1,2,3 Intermediate Course in Conversation and Composition
Prerequisite: A02 or four units of Spanish.

Courses with Reading and Discussion in English

463-B10-0 The Literature of Spain
A study of major works of Spanish literature of significance to the European tradition: from the late Middle Ages to the present.

463-B11-0 Survey of Latin American Literature
Representative works of Latin American literature from Columbus to the present.

463-B23-0 Cervantes
Don Quixote and selected novels in translation.

463-B43-0 Contemporary Spanish-American Prose Fiction
Selected works in English translation of 20th-century Spanish-American authors.

463-C96-0 Topics in Spanish Culture and Civilization
Lectures, readings, discussions, and papers on specific topics in Spanish culture and civilization as announced annually.

463-C97-0 Topics in Latin American Culture and Civilization
Lectures, readings, discussions, and papers on specific topics in Latin American culture and civilization.

463-C98-0 Topics in Literature
Repetition with different topics for credit. Samples: single author (Borges, García-Márquez, Galdós, Lorca), the picaresque novel, voices of women in colonial Latin America.

Courses with Prerequisite in Spanish

Prerequisite for these courses is B01 or its equivalent.

463-C02-0 Advanced Grammar
Thorough study of grammar and syntax for majors and prospective teachers. Prerequisite: B03.

463-C03-0 Advanced Conversation
For advanced students and prospective teachers. Prerequisite: B03.

463-C04-1,2 Topics in Language
Advanced topics focus on teaching high school and college Spanish. **1.** Methodology. **2.** Grammar and syntax. Prerequisite: B03 or the equivalent.

463-C05-0 History of the Iberian Languages
Phonology, syntax, morphology, semantics of old Castilian as it

evolved from Latin. Portuguese and Catalan. Historical development of Spanish from the Middle Ages through the colonization of America.

463-C06-0 Introduction to Catalan Language and Literature
Pronunciation and grammar for reading knowledge of Catalan; readings in major works of Catalan literature.

463-C10-0 Medieval Literature
Masterpieces of Spanish literature from the *Poema de Mio Cid* to the *Celestina.*

463-C20-0 Golden Age Poetry and Prose, Excluding Cervantes
Development of the Italian school of poetry, mysticism, Gongorism, and the picaresque novel.

463-C21-0 Golden Age Drama
Antecedents and development of drama of the Golden Age.

463-C23-0 Cervantes
The works of Cervantes, especially *Don Quixote.*

463-C30-0 History of Ideas in Modern Spain
Spanish thought since the 18th century, in relation to main trends in the rest of Europe.

463-C31-0 The Romantic Movement
Origin and development of romanticism in Spain.

463-C32-0 The Novel of the 19th Century
Development of the novel from Férnan Caballero to Blasco Ibáñez.

463-C33-0 Literature and Society in 20th-Century Spain
How literature gives shape to the social institutions and historical events that circumscribe the reality of 20th-century Spain.

463-C34-0 Modern Poetry
Reading, analysis, discussion of major modern Spanish poets.

463-C35-0 Literature of Post–Civil War Spain
Trends and tendencies in contemporary Spanish literature. Prerequisite: B01 or equivalent.

463-C40-0 Latin American Literature and Civilization before 1888
The Colonial period and the 19th-century.

463-C41-0 The Modernist Movement in Latin American Literature
Spanish-American literature from 1888 to about 1920. The Modernist movement.

463-C42-0 Latin American Drama
Spanish-American drama of the 19th and 20th centuries.

463-C43-0 The Avant-Garde and Regionalism in Latin American Literature
Latin American literature from about 1915 to 1950.

463-C44-0 Contemporary Latin American Literature
Latin American literature from 1950 to the present.

463-C50-0 Spanish Culture and Civilization
Historical and social backgrounds of Spanish civilization.

463-C51-0 Latin American Culture and Civilization
Historical and social backgrounds of Latin American civilization.

463-C80-0 Critical Analysis
Detailed examination of representative selections from Hispanic writers. Critical analysis and discussion in Spanish.

463-C90-0 Undergraduate Seminar
Investigation of special problems; supervised readings and discussion. Open to qualified seniors. Offered in Spanish and English. Consult with department chair.

463-C95-0 Topics in Literature
Lectures, readings, discussions, and papers on specific topics in Spanish and Latin American literature as announced annually.

463-C99-0 Independent Study
Independent reading under supervision. Consult with department chair.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Portuguese

Courses

459-A01-1,2,3 Intensive Elementary Portuguese
Rapid audiolingual study of the Portuguese language followed by readings from Portuguese and Brazilian writers. No prerequisite in Portuguese.

459-C03-0 Advanced Portuguese
Development of competence in four areas of foreign language proficiency. Readings focus on Brazilian historical, cultural, and sociopolitical structures. Prerequisite: A01-3 or equivalent.

459-C05-0 Brazilian Literature
The intellectual and social climate of Brazil as a monarchy. Representative Brazilian authors from Independence to 1900. Prerequisite: A01-3 or equivalent.

459-C06-0 20th-Century Brazilian Literature
From *modernismo* to the present: nationalism, censorship, and current trends. Prerequisite: A01-3 or equivalent.

459-C97-0 Topics in Luso-Brazilian Culture and Civilization
Lectures, reading, and papers on specific topics in Luso-Brazilian culture and civilization. In English.

459-C99-0 Independent Study
Independent study under supervision.

History

The Department of History is distinguished by the breadth of its faculty's expertise. It includes nationally distinguished scholars in United States, European, Latin American, African, and Asian history. These faculty resources enable it to offer major fields of study in the history of the Americas, English/European history, African/Middle Eastern history, and Asian/Middle Eastern history. The department is particularly strong in social and intellectual history.

Most history courses are open to any undergraduate. Few have specific prerequisites, although freshmen are generally advised to try A- and B-level courses before attempting C-level. History majors have priority in registering for classes, but the majority of students enrolled in most history courses are majoring in other departments and schools. The history faculty welcomes this diversity of students.

In addition to the undergraduate major program, the department offers graduate instruction leading to the MA and PhD degrees. Graduate students may choose from five fields of concentration: African, European, and United States history; the history of science; and comparative history. Minor field work also may be done in these fields as well as in Latin American, Middle Eastern, and Asian history.

Program of Study for Departmental Majors

The purpose of the program is to acquaint students with historical materials and historical analysis. It does so by introducing students to patterns and problems in a variety of areas and time periods and by persuading them to search deeply into at least one area of concentration. Achievement of these goals depends heavily on effective use of faculty advice, and each student should see the adviser as soon as one is assigned. Thereafter, each history major should confer with the adviser at least once each quarter to insure smooth progress through the program of study.

Each student majoring in history selects an area of concentration. The department offers four such areas:

- History of the Americas
- English/European history
- African/Middle Eastern history
- Asian/Middle Eastern history

Students may arrange to emphasize certain special fields within the context of one of these four areas.

The program for majors consists of 11 graded quarter-courses in history and 5 graded quarter-courses in related subjects, none of which are to be substituted with advanced placement credits. These courses, chosen by the student in consultation with the adviser, are distributed as follows:

- Two introductory colloquia selected from A01, A02, and A03 without duplication of course number: e.g., students may not count two A01s. These colloquia normally are taken in the freshman year. When, because of transfer or late declaration of major, it is not possible for a student to register for the introductory colloquia, these courses must be replaced with C89, C92, or C93.
- Five B- and C-level quarter-courses in one of the four areas of concentration listed above.
- Four additional quarter-courses in history at the B and C levels. These lie outside the area of concentration and are distributed to provide both geographical and chronological variety.
- At least two of these nine B- and C-level quarter-courses must be in fields other than modern European or United States history. Such courses might be in the history of Europe before 1800 or in African, Asian, or Latin American history in any period.
- Five quarter-courses of related subjects at the B and C levels, at least two of which must be at the C level and must be chosen from at least two programs or departments in the social sciences and humanities. The courses should bear some coherent relationship to the student's major program. Students are encouraged to discuss their related courses with their adviser.

Superior students may qualify for departmental honors by enrolling in the honors seminar (C98-1,2,3) during their senior year and completing a senior thesis judged to be of honors quality.

As all courses listed below cannot be given in any one academic year and the quarters in which they are offered are subject to change, see the *Class Schedule* for actual offerings.

The Teaching of History

CAS students pursuing a major in history who also wish to be certified for secondary teaching must be admitted to the program and complete all requirements as outlined in the School of Education and Social Policy section of this catalog. Students are urged to contact the Office of Student Affairs in the School of Education and Social Policy as early as possible in their academic careers.

Introductory Colloquia

The following three courses are colloquia, each limited to 15 undergraduates, which introduce students to modes of historical analysis through the study of various topics in history. History majors are required to take two colloquia, each in a different geographical division (United States, Europe, non-Western). Specific subjects will be listed in the *Class Schedule*. Open to freshmen and sophomores only.

427-A01-0 Introduction to Historical Analysis: European History

427-A02-0 Introduction to Historical Analysis: American History

427-A03-0 Introduction to Historical Analysis: Non-Western History

United States

427-B10-1,2 History of the United States
Interpretative survey from the 17th century to the present. **1.** Colonial settlements to Civil War era. **2.** Reconstruction to present. Lectures, discussion sections.

427-B11-1,2 Problems in United States History
Survey of basic problems in United States history from the 17th to the 20th centuries. **1.** First European and African migrations to American Civil War. **2.** American Civil War to present. Designed for students with a strong secondary-school preparation or special motivation.

427-B91-0 Core Seminar in Latin American-Caribbean Studies
An option for the core seminar requirement in the Latin American-Caribbean Studies certificate program. Also open to other students, but a reading knowledge of Spanish or Portuguese is desirable. Prerequisite: consent of instructor.

427-C01-1,2,3 Survey of African-American History
1. Slavery: forms of oppression and resistance, 1700–1863. **2.** From reconstruction to the Harlem renaissance, 1863–1930. **3.** The civil rights movement, 1930–70.

427-C05-0 American Immigration
Origins, social characteristics, cultural values, and assimilation of immigrants in 19th and 20th centuries. Consequences of immigration in comparative and historical perspective.

427-C10-1,2 Early American History
1. Cultural and social development of England's mainland colonies from the reign of Queen Elizabeth to 1750. **2.** Creation of a new republic: from Revolution to the Constitutional Convention.

427-C14-0 The Civil War and Reconstruction
The "middle period" of American history, emphasizing the origins of the Civil War, its revolutionary nature, and its immediate and long-term consequences for the South and the nation.

427-C15-1,2,3 The United States in the 20th Century
America's domestic history and role in world affairs since 1900. **1.** 1900–1929. **2.** 1929–1960. **3.** 1960–present.

427-C17-1,2,3 American Cultural History
The changing values of the American people, how they have been transmitted, and how they have shaped American society, politics, and economy. **1.** 1607–1820. **2.** 1820–1890. **3.** 1890–present.

427-C18-1,2 Legal and Constitutional History of the United States
1. Development of legal institutions, constitutionalism, law and social change, law and economic development, colonial–1857. **2.** Law in industrial society: administration, race relations, corporations, environmental protection, civil liberties, 1857–present.

427-C19-1,2,3 History of American Foreign Relations
The study of American foreign relations in its broadest sense: the relationship of Americans, their culture, and their government with the rest of the world. Foreign, as well as American, perceptions of that interaction are emphasized. **1.** 1763–1900. **2.** 1900–1945. **3.** 1945–present.

427-C20-1,2 Environmental History of the United States
1. Preindustrial resource use and management; ecological impact of discovery and development to 1870. **2.** Industrial society and environment; scientific and political resource management, energy, post-Darwinian views of society and nature.

427-C21-1,2 A History of American Society
Organization and development of American society from the 18th century to the present. **1.** Problems of cultural diversity and social consolidation, 1760–1880. **2.** Problems of class and power, 1880–1970.

427-C22-1,2 Development of the Modern American City
Characteristics of urban society in America from the period of settlement to the present. **1.** To 1870. **2.** 1870–present. Prerequisite for C22-2: C22-1 or consent of instructor.

427-C23-0 Development of American Political Thought
Major strands of American political thought from the revolutions of the 17th and 18th centuries to the 20th century. Changing meaning of liberalism; relationship between political ideology and society.

Europe

427-B01-1,2 European Civilization
1. Culture and structure of preindustrial society, high Medieval through the mid-18th century. **2.** Impact of industrial and political change and the development of modern society to the present.

421-B40-0 Women in West European History
History of women from classical times through the French Revolution. Social, intellectual, and economic roles of women.

427-C32-1,2,3 The Development of Medieval Europe
1. Early Middle Ages. **2.** High Middle Ages. **3.** Late Middle Ages.

427-C33-0 The Age of the Renaissance
Decline and revival of European civilization, 1350–1530. Cultural, political, economic, and social developments.

427-C34-0 The Age of the Reformation
Europe in the 16th century, especially origins, evolution, and effects of changes in religion.

427-C38-1,2 Europe in the 20th Century
Growth of mass politics, Fascism, the home fronts, rise of the welfare state, loss of empire, economic resurgence and integration. **1.** 1900–1935. **2.** 1935–present.

427-C42-1,2,3 History of Modern France
1. The Old Regime and the French Revolution, 1715–1799. **2.** 19th-century France. **3.** 20th-century France.

427-C44-1,2,3 Modern Germany
German social, economic, political, and cultural developments since 1750. **1.** 1815–1918. **2.** 1918–45. **3.** 1945–present.

427-C45-1,2,3 History of Russia
1. Emergence of the Kievan and Muscovite states, ca. 800–1700. **2.** Russia from Peter to the Revolution, 1700–1917. **3.** The Soviet Union, 1917–present.

427-C47-1,2 Society and Politics in Modern European Jewry
The central trends in the history of European Jewry, from the onset of the process of formal emancipation in the 18th century to the reversal of that process and the subsequent destruction toward the middle of the 20th century. **1.** 1789–1881. **2.** 1881–1948.

427-C49-0 History of the Holocaust
An examination of the origins and development of the massacre of European Jewry during the Second World War.

427-C50-1,2,3,4 The Intellectual History of Europe
1. Heritage from antiquity and the Middle Ages. **2.** From the Renaissance to the end of the 18th century. **3.** 19th century. **4.** 20th century.

427-C51-1,2 History of Communism
Marx's Marxism and movements and regimes that have claimed to be Marxist. **1.** Movements, especially German and Russian Social Democrats, and Chinese, French, Italian Communists. **2.** Regimes, especially Soviet, Chinese, Yugoslav, Cuban.

Africa

427-B55-1,2,3 Background to African Civilization and Culture
Historical approach to society, economy, polity, and culture in Africa. **1.** Origins of humankind to the mid-18th century. **2.** Mid-18th century to 1900. **3.** 1900 to the present.

427-C55-1,2 Islam in Africa
The spread of Islam in Africa from the 7th century to the present: a thematic approach emphasizing African Muslim scholars and reformers.

427-C56-1,2 History of South Africa
1. From the African iron age to the establishment of the multinational gold mining industry, emphasizing the rise of African states and the contest for land with white settlers. **2.** Emphasis on the 20th century, the rise of African nationalism, and the clash with the apartheid state.

427-C57-1,2 East Africa
History of Kenya, Uganda, and Tanzania, concentrating on ancient coastal city-states, interior kingdoms, trade and colonial rule, postindependence problems.

427-C58-1,2,3 West Africa
Selected topics in West African history: economy, society, and government.

England

427-B60-1,2 History of England
1. Medieval and early modern England to 1559. **2.** England, 1559–present. National development and distinctive features and institutions.

427-C60-0 Tudor England (1485–1603)
Renaissance culture and the operation of Tudor social and political institutions.

427-C61-0 Stuart England (1603–1714)
The breakdown of the organic state; civil war; the reconstruction of English society.

427-C62-1,2,3 Modern British History
1. Social, political, and institutional history, 1688–1815. **2.** The age of industrialization and liberalism, 1780–1900. **3.** The welfare state, democracy, and total war, 1900–present.

427-C64-1,2 Social and Intellectual History of Modern Britain
1. Rise and fall of Victorian culture, 1780–1900. **2.** Main themes in 20th-century society and thought, 1900–present.

Latin America

427-C65-0 The Formation of Latin American Society
Development of Latin American socioeconomic structures, political institutions, and cultural tendencies from the pre-Columbian and Iberian backgrounds through the colonial period.

427-C66-0 Latin America in the Independence Era
18th-century background to Latin American independence and 19th-century aftermath. The process of achieving independence, changing social structures, and economic patterns and the problem of forming new nations.

427-C67-0 Politics and Development in Latin America
Political, economic, and social problems since 1880, with emphasis on the period since 1930. Interaction between economic change and politics of rapidly urbanizing societies.

427-C68-1,2 Revolution in 20th-Century Latin America
1. Mexico and its revolutions. Mexican history, from the modernizing regime of Diaz, through the revolutionary upheaval and the consolidation of a new regime, to contemporary problems. **2.** Comparative study of the origins and aftermaths of major 20th-century revolutions in Bolivia, Cuba, and Central America.

Middle East

427-B70-0 Islam in History
Influence of Islam on the components of Middle Eastern societies (nomads, agrarian and urban populations) from the inception of the faith (7th century A.D.) to the modern period.

427-B74-0 History of Ancient Egypt (3100–30 B.C.)
The Old Kingdom: centralized government, divine kingship. The Middle Kingdom: new monarchic principles in the after-

math of social disorder. The New Kingdom: imperialism in response to foreign aggression, religious revolution of Akhenaton.

427-C70-1,2,3 History of the Islamic Middle East
1. 600–1200: the classical Islamic community; Medieval Islamic civilization. **2.** 1200–1789: the great empires—Mamluks, Ottomans, and Safavids; cultural and economic decline. **3.** 1789–present: Jewish and Arab nationalism, oil diplomacy, Islam in the modern context.

427-C71-0 Islamic Institutions
Religious, legal, political, and socioeconomic institutions of traditional Muslim societies. Regional and cultural variations of principles and concepts common to all Muslims. Modernization and religious reform.

History of Science

427-C76-1,2 Science and Modern Society
1. Rise of science in early modern Europe and colonial America; relationship with philosophy, theology, and Enlightenment culture; science, society, and utopian thought. **2.** Science in Europe and America, 1800–present: physical sciences and the power to transform the world; biological and medical sciences and changing social values.

Asia

427-B81-0 Chinese Civilization
Chinese history from antiquity to the 18th century, emphasizing cultural and intellectual history.

427-B84-0 Japanese Civilization
Japanese history from antiquity to the 20th century. Integrates economic, political, intellectual, social, and cultural trends.

427-B85-0 Indian Civilization
History of Hindu culture from antiquity to the 20th century. Change and continuity in religious ideas, practices, and institutions, caste, and family life.

427-C81-1,2 Political History of Modern China
1. From 1644 to World War I. **2.** World War I to the present.

427-C84-1,2 History of Modern Japan
1. Japan: the modern state, 1860–1943. **2.** The history of postwar Japan, 1943–1980s.

427-C85-0 History of India
India since the mid-18th century. Focus on Hindu and Islamic cultural renovation movements, the politics of nation-building, and socioeconomic change.

427-C88-0 Southeast Asia
Mainland and island Southeast Asia in recent centuries, concentrating on Buddhist-Confucian Vietnam and Islamic Indonesia in the 20th century.

Courses Primarily for Majors in History

427-C91-0 Special Lectures
Lecture courses given on special topics not covered in regular course offerings. May be repeated by request, since content varies.

427-C92-0 Topics in History
Advanced work through reading, research, and discussion in area of special significance. Graduate students permitted in some courses. Prerequisite: consent of instructor.

427-C93-0 Seminar in Historical Writing
Advanced work in the research, organization, and writing of selected subjects. Prerequisite: consent of instructor.

401-C93-0 Chicago Field Study Internship
See General Studies.

427-C98-1,2,3 Undergraduate Seminar
Advanced work through supervised reading, research, and discussion. Admission by written application, to be reviewed by department. Grade of K given in C98-1 and C98-2.

427-C99-0 Independent Study
Reading and conferences on special subjects for advanced undergraduates. Open only with consent of student's adviser and instructor.

Undergraduate Leadership Program Course

427-B95-0 Leaders in History
Emphasis on the historical context within which leadership is exercised. Focus on a historical period or figure. Figures, periods, and cultures vary from year to year.

Related Courses in Other Departments

A history major may take no more than two quarter-courses listed below to satisfy the history requirement.

404-B14-1,2 History of Racial Minorities in North America
414-B20-1,2,3 The Ancient World
414-C21-1,2 Roman History
417-C15-0 Classical Problems in Economic History
417-C20-0 Rise of Industrial Society
417-C23-0 Economic History of the United States
417-C24-0 Western Economic History
418-B15-1,2 Humanistic Dimensions of Technological Change

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Integrated Arts Program

The interschool Integrated Arts Program offers courses, leading to a certificate, that explore the creative process from the perspective of the artist in the disciplines of theater, visual arts, music, dance, and media arts. (See Integrated Arts Program in the Other Undergraduate Programs section of this catalog.)

Integrated Science Program

The Integrated Science Program is a highly selective curriculum of natural sciences and mathematics presented predominantly in small classes at an accelerated pace. ISP courses emphasize the common base and interrelationships of the sciences, including the importance of mathematics and the development of first principles, leading to advanced topics at the forefront of science today. The goal is to provide students who are interested in careers in science and mathematics with a broad, quantitative background that will give them superior preparation for further work in graduate or professional school or for permanent employment. The curriculum is composed of 23 quarter-courses as well as a regular seminar series and the opportunity to pursue research. ISP may lead to a three-year bachelor of arts degree if by the end of the third year the student has completed 36 or more quarter-courses and satisfied all other college requirements.

Admission to ISP is by special application to the director of the Integrated Science Program. For more information on admission procedures, see the description of ISP under Academic Options at the front of this catalog. Also see the Admissions section for achievement tests required.

The ISP curriculum consists of specially designed courses taught by faculty members of the science and mathematics departments. Course descriptions are found with the appropriate departments in this catalog. Although listed in a three-year format, many students spread the program over four years, often to combine an ISP major with a second major in a traditional department. Specific second major requirements for ISP students can be found under the individual departments in this catalog.

Program of Study

- First year

ISP A01 Computing Applications
Mathematics B91-1,2,3 Accelerated Mathematics for ISP: First Year
Physics A25-1,2,3 General Physics for ISP
Chemistry A71 Accelerated General Inorganic Chemistry
Chemistry A72 Accelerated General Physical Chemistry
Biological Sciences C09 ISP Biochemistry and Cell Biology

- Second year

Mathematics C91-1 Accelerated Mathematics for ISP: Second Year
Mathematics C91-3 Complex Variables and Elements of Group Theory
Physics C39-1 Quantum Mechanics for ISP
Physics C39-2 Molecular and Solid State Physics for ISP
Chemistry B12-1 Organic Chemistry
Chemistry C48 Physical Chemistry for ISP
Geological Sciences C15 Physics of the Earth for ISP
Biological Sciences C10 ISP Quantitative Biochemistry and Molecular Biology
Biological Sciences C11 ISP Neurobiology

- Third year

Mathematics C91-2 Probability and Statistics for ISP
Physics C39-3 Nuclear and Particle Physics for ISP
Astronomy C31 Astrophysics for ISP
Biological Sciences C01 Biochemistry

ISP C98 may substitute for up to three of the following courses: Math C91-2, Math C91-3, Physics C39-3, Astro C31, Biological Sciences C01, and C10 ISP or C11 ISP.

Courses

481-A01-1,2,3 Computing Applications
Introduction to formulation and solution of scientific problems on the computer. One-third credit each quarter.

481-C98-0 Undergraduate Research
Advanced work for superior students through reading, research, and independent study. Consent of ISP director required.

International Studies Program

International studies, an undergraduate interschool adjunct major that is taken in conjunction with a traditional major, is open to CAS students. (See International Studies Program in the Other Undergraduate Programs section of this catalog.)

Italian

See French and Italian.

Jewish Studies Program

The Jewish Studies Program focuses on Judaism, not only in its narrow sense as a religious phenomenon but also in its broader sense as a phenomenon of culture and civilization. A good case can be made that the roots of Western culture lie in two places: Athens and Jerusalem. The traditional education of the humanist scholar recognized this by requiring not only the mastery of Greek and Latin but also of Hebrew. Thus

the study of Judaism in this program considers the many and varied dimensions of the phenomenon of Jewish civilization. A typical program of study includes, in addition to the religious dimension, the historical, sociological, linguistic, philosophic, and artistic dimensions.

Undergraduate Certificate in Jewish Studies

The Certificate in Jewish Studies requires the successful completion of seven courses in three general areas:

- Survey of Jewish history: A three-course sequence covering the sweep of Jewish history, providing a basis for advanced work and a unified view of the history of the Jews in the Western world. The first course is Religion B10 Introduction to Hebrew Bible. The second course must deal with the history or culture of the Jewish people in the Middle Ages (consent of director required). The third course is chosen from History C47-1 Society and Politics in Modern European Jewry 1789–1881, C47-2 Society and Politics in Modern European Jewry 1881–1948, or C49 History of the Holocaust.
- Two courses in Jewish literature: These may be chosen from, for example, Religion D32 Modern Jewish Literature, English courses studying Jewish themes in American literature, Slavic Languages and Literatures C72 Introduction to Eastern European Jewish Culture, and African and Asian Languages B03-1,2,3 Advanced Hebrew. Other courses, subject to approval by the Committee on Jewish Studies, can satisfy this requirement.
- Two courses chosen from Religion B24 Introduction to Judaism, B27 Introduction to Medieval Jewish Philosophy, C05 History of Judaism, C06 Judaism in the Modern World, C10 Main Themes in Hebrew Scriptures, C31 Recent Jewish Thought, C32 The Rise of Rabbinic Judaism, C34 Literary Expressions of Rabbinic Judaism, C35 The Art of Biblical Narrative, C52 Topics in Judaism, and D24 Studies in Judaism.

For students who also satisfactorily complete two years of language study in Hebrew, requirements for the certificate are the successful completion of five courses, three in the first area and one each in the second and third areas.

Students applying for CAS certificates must present records showing a minimum of five courses not double-counted in their majors.

Latin American and Caribbean Studies Program

The Program in Latin American and Caribbean Studies recognizes the importance of the Latin American and Caribbean regions to the foreign and domestic policies of the United States as well as the region's appeal to a variety of intellectual interests. This program allows a coherent interdisciplinary course of study with a particular emphasis on the social sciences in addition to history, languages, and literature. It also aims to create a community of students and faculty with common intellectual interests in the area. The program attempts to realize these goals through (1) core seminars required for all students wishing to enter the program, (2) a strong program of advising to give students a clear sense of direction while preserving flexibility toward individual interests, and (3) required senior research seminars.

Undergraduate Certificate in Latin American and Caribbean Studies

Nine quarter-courses are required for the certificate, including one core seminar, three core courses, one interdisciplinary senior research seminar, and four additional courses in Latin American and Caribbean studies. All students in the program are required to have an effective reading knowledge of Spanish or Portuguese. The program expects the level of proficiency required by the Department of Hispanic Studies for entry into its C-level courses or successful completion of a B-level course or equivalent. Students applying for CAS certificates must present records showing a minimum of five courses not double-counted in their majors.

Core seminars: A core seminar should be taken as early as possible after entry into the program. These are C96 seminars, offered in Hispanic studies, history, and political science.

Core courses: Three courses, one each in Hispanic studies, history, and political science, must be selected from the following list:

- Hispanic Studies B02-1,2, or 3
- History C65 or C66
- Political Science C53 or C64

Senior seminars: During the senior year, all students are required to take an interdisciplinary research seminar.

Electives: Four additional courses, not already taken to fulfill the core course requirement, may be drawn from the list of core courses or from the following list of related courses:

- Economics C25 Economic Development
- Hispanic Studies C03 Advanced Portuguese (Brazilian Culture)
- Hispanic Studies C05 Brazilian Literature
- Hispanic Studies C40 Latin American Literature and Civilization before 1888
- Hispanic Studies C41 The Modernist Movement in Latin American Literature
- Hispanic Studies C43 The Avant-Garde and Regionalism in Latin American Literature
- Hispanic Studies C44 Contemporary Latin American Literature
- Hispanic Studies C51 Latin American Culture and Civilization
- History C67 Politics and Development in Latin America
- History C68-1,2 Revolution in 20th-Century Latin America
- History C92 Topics in History (as they relate to Latin America or the Caribbean)

- Political Science C57 Politics of Underdeveloped Areas (when the content largely concerns Latin America or the Caribbean)
- Radio/Television/Film C51 National Cinema (when the content concerns Latin America or the Caribbean; Charles Kleinhans uses Cuba as his principal case)
- Sociology B03 Revolutions and Social Change

Advising

Regular contact between students and their adviser not only supports the sense of scholarly community but also offers students guidance in pursuing a course of study tailored to their particular needs and interests. Students must consult the director upon entering the program and also are required to discuss their plans with the program director at least once each quarter.

Linguistics

Linguistics is the scientific study of language. Since languages are systematic, linguistics, at its core, analyzes the structure of speech sounds (phonetics, phonology), the structure of words and sentences (morphology, syntax), and their meaning (semantics, pragmatics). In addition, linguistics is concerned with the social and psychological factors that affect language use and with language change.

The members of the faculty are especially interested in language planning, language and the professions, theoretical linguistics, and applying computational and experimental methods to the study of language structure and use.

Knowledge of the origins, nature, and functions of language is one of the best tools we can employ in seeking to understand our humanness. Holders of the BA who major in linguistics find employment in editorial work and technical writing and as legal, educational, and administrative assistants in business and government. The major is also an excellent preparation for professional studies such as law as well as for graduate work in linguistics, psycholinguistics, computational linguistics, and related disciplines. The PhD prepares individuals to teach at the college or university level or for a language-related position in business or government. At any level of preparation, the chances of securing attractive employment are greatly enhanced by interdisciplinary studies in language-related fields, education, social sciences, mathematics, or computer science.

Program of Study for Departmental Majors

Prerequisites: B06, B07

Core courses: C09 or C10; C02 or C17; select four from C05, C06, C16, C29, C71

Additional C-level courses: select four; only one may be C98 or C99

Related courses: select four in consultation with a linguistics adviser

Four-Year BA/MA Program

Students with a strong record in their major courses and an interest in pursuing linguistics at the graduate level are eligible to apply for the four-year BA/MA program in linguistics. Applications should be made no later than spring quarter of the junior year, after consulting with the department undergraduate adviser. To be considered for this program, students must demonstrate as part of their application that they will be able to complete by the end of their senior year all the CAS requirements for the BA degree plus the department's requirements for the MA degree (including Linguistics C05, C06, C16, D04-1,2, D05-1,2, two additional C- or D-level courses, and a satisfactory MA thesis). For further information, consult with the department undergraduate adviser.

Courses Primarily for Undergraduates

434-A10-0 Languages and Linguistics
The nature and structure of language. Methods of linguistic analysis. Language change, acquisition, and varieties. No supposition of previous work in linguistics.

434-B06-0 Syntax and Meaning in Human Language
Formal analysis, rules, and notation for syntax of languages; basic principles and concepts in the analysis of meaning in languages.

434-B07-0 Sound Patterns in Human Language
The formal analysis, rules, and notation of sound contrasts and sequences in various languages.

434-B09-0 Language and Society
Introduction to social structure and language use. Standard and nonstandard language; regional, social, and ethnic dialects; language functions, norms, and attitudes.

452-B10-0 Introduction to Cognitive Science: Language, Vision, and Memory
See Cognitive Science.

419-C02-0 History of the English Language
See English.

434-C02-0 Introduction to Comparative and Historical Linguistics
Principles of the comparative method and the method of internal reconstruction. Historical syntax. Quantitative methods in historical linguistics. Prerequisite: A10 or B07.

434-C04-0 Intonation
Description of intonation as an aspect of language sound structure and how intonation functions to convey information in spoken language. Issues in the design and interpretation of experiments.

419-C04-0 Practical Rhetoric
See English.

434-C05-0 Lexical Semantics
Introduction to lexical semantics; issues in the linguistic study of word meanings, including internal organization and interrelationships within the lexicon.

434-C06-0 Fundamentals of Syntax
Introduction to syntactic theory. Emphasis on linguistic argumentation and principles of syntactic analysis.

434-C07-0 Applied Linguistics: Methods of Foreign-Language Teaching
Current methods in foreign- and second-language teaching and their relationship to second-language acquisition theory.

434-C09-0 Psycholinguistics
Interrelationships of linguistic and psychological variables in human language use. Developmental and experimental psycholinguistics, the relationship between language and cognition.

620-C09-0 Culture, Language, and Learning
See Communication Sciences and Disorders, School of Speech.

434-C10-0 Sociolinguistics
Social factors in linguistic variation. Linguistic diversity; multidialectal and multilingual societies; diglossia. Prerequisite: B09 or consent of instructor.

434-C11-0 Child Language
How children acquire the forms and functions of their native language. Child bilingualism, the acquisition of literacy.

434-C12-0 Linguistics and English Composition
Recent trends in the study of the uses and forms of writing and the processes of written composition. The learning and teaching of written language.

434-C15-0 Bilingualism
Sociological, psychological, and linguistic factors affecting the simultaneous or sequential acquisition of two or more languages. Effects of bilingualism on phonology, syntax, the lexicon, cognition.

434-C16-0 Phonetics
Principles of articulatory and acoustic phonetics. Analysis of experimental evidence about language sound structure.

434-C17-0 Language Variation
Historical, geographical, social, and functional differences in language. Theories of variation and their relation to the concepts of competence and idealization. Prerequisite: B06, B07, or consent of instructor.

434-C19-0 Language Typology
Comparative overview of the classification and analysis of major grammatical structures found across languages of the world.

434-C20-0 Structure of Various Languages
Phonological, morphological, and syntactic structure of a particular language: one quarter. Repetition for credit with a different language. Recent offerings: African, Romance, Slavic, and Semitic languages; Navajo, Creoles.

434-C21-0 Field Procedures
Choosing informants, techniques of elicitation, and other problems encountered in field research; exercises in the collection and analysis of linguistic data.

434-C24-0 Language and Law
Survey of contemporary social science research on the interaction of language variables and our legal system; application of linguistics to the resolution of legal cases. Prerequisite: A10, B06, B09, or consent of instructor.

434-C25-0 Language and Medicine
Analysis of language patterns used in medical settings, including doctor-patient interaction and technical language use. Prerequisite: A- or B-level course or senior standing.

434-C29-0 Pragmatics
Introduction to linguistic pragmatics. The role of context in utterance production and interpretation. Reference, anaphora, implicature, presupposition, speech acts, functions of syntax.

434-C30-0 Topics in Language and Behavior
Topics in the relationship between language and human behavior. Topics vary. May be repeated for credit with different topic.

434-C46-0 Introduction to Computational Linguistics
Grammars; syntactic analysis of augmented transition networks; semantic analysis of sentences and larger texts. Implications for the design of natural language interfaces.

434-C51-0 The History of Linguistics
Linguistics from antiquity to the present.

434-C62-0 Second Language Acquisition
Major theories of second-language acquisition; current issues in the field. Cognitive, personality, and sociocultural variables affecting second-language learning.

434-C71-0 Morphology
Examination of the internal structure of words. Introduction to central problems facing a theory of morphology. The evolution of theories of morphology within generative grammar.

434-C80-0 English in the American University
English for speakers of other languages; conversational skills culturally appropriate for an American university. Optional lab and computer exercises.

434-C81-0 Advanced English in the American University
Advanced oral skills both inside and outside the classroom, for non-native speakers of English.

434-C98-0 Undergraduate Seminar in Linguistics
By invitation of the department. For students of superior ability, with choice of topic left to the group.

434-C99-0 Independent Study

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Mathematical Methods in the Social Sciences Program

A central feature of modern social, behavioral, managerial, and policy sciences is the use of mathematics, statistics, and computers, both as languages and as methods of abstraction and analysis. The Mathematical Methods in the Social Sciences Program was created to provide students an opportunity to acquire these skills and to become acquainted with modern analysis of social systems. This is accomplished through an accelerated program for high-ability students and through the offering of courses open to all undergraduates.

Program of Study

The Program in Mathematical Methods in the Social Sciences enables students to combine the study of social sciences with training in formal analytical methods. The program is intended for students with high mathematical aptitude and strong interest in social problems and issues, including their policy and research implications. It provides excellent preparation for graduate study in social or managerial sciences as well as for careers that require both quantitative skills and a solid background in the social sciences.

In each of their first two years in the program, students enroll in two coordinated three-quarter courses covering mathematical methods and their applications to the social sciences. In addition to this core curriculum, students participate in a senior seminar and complete a major in one of the social sciences—anthropology, economics, political science, psychology, or sociology. Students who satisfy all requirements for a social science major and for the program are granted a dual major.

Required courses:

- First year: MMSS B92, Math B92
- Second year: MMSS C92, Math C92
- Senior year: MMSS C98-1,2

Admission to the Program in Mathematical Methods in the Social Sciences is very selective; it is limited to entering freshmen and to Northwestern sophomores with superior academic records and a demonstrated strong aptitude in mathematics.

Prerequisite for admission consideration is a full-year course in calculus. High school students fulfilling this prerequisite are encouraged to enter the program as freshmen. Students lacking calculus but planning to enter the program as sophomores should complete at least two quarters of calculus (Mathematics B14-1 and 2) in their freshman year.

Students who wish to be considered as candidates for the Program in Mathematical Methods in the Social Sciences should request an application from the director, MMSS, 402 University Hall, Evanston, Illinois 60208-2250.

Courses

436-B92-1,2,3 Mathematical Methods in the Social Sciences: First Year
1. Introduction to social science models. 2. Introduction to computer language and systems. 3. Voting and social choice models. Prerequisite: first-year standing in MMSS.

435-B92-1,2,3 Accelerated Mathematics for MMSS: First Year
See Mathematics.

436-C92-1,2,3 Mathematical Methods in the Social Sciences: Second Year
1. Rational social behavior. 2. Decision making under uncertainty; game theory. 3. Capstone course: applications of mathematical social science. Prerequisite: second-year standing in MMSS.

435-C92-1,2,3 Accelerated Mathematics for MMSS: Second Year
See Mathematics.

436-C94-0 Special Topics
Advanced work for investigation of topics of current interest. Offered in different quarters. May be repeated for credit. Prerequisite: third-year standing in MMSS or consent of instructor.

436-C98-1,2,3 Senior Seminar
By invitation of the department.

Mathematics

Mathematics plays a central role in modern society. It has long been an important tool in science and engineering, and it is now increasingly being used in varied and sophisticated ways in the social sciences, the humanities, and business. Along with the expanding of applications, there has been a tremendous growth in many areas of mathematics itself, from pure to applied. At Northwestern, a variety of courses for nonmajors address these diverse applications of mathematics. The department offers two majors: the mathematics major and the applied mathematics major. The latter is intended to appeal to students whose primary interest is in applications of mathematics in the physical, biological, social, behavioral, management, or engineering sciences. Talented undergraduates have the possibility of taking some graduate courses to enrich their studies. Thus mathematics can be preparation either for employment or for further study in graduate school.

Programs of Study for Departmental Majors

A mathematics course that is a prerequisite for another mathematics course may not be taken for credit after the more advanced course has been completed. Consent of the department may be substituted for the prerequisite for any mathematics course.

Mathematics Major

Prerequisites (one of the following):

- B14-1,2,3; B15, B17
- B20-1,2,3
- B90-1,2,3
- Or the equivalent

Note: The four-quarter sequence B14-3, B15, B17, B21 and the three-quarter sequences B20-1,2,3, B90-1,2,3, B91-1,2,3, and B92-1,2,3 cover comparable material. Students who wish to combine courses from different sequences must obtain permission from the Department of Mathematics.

Required major courses: students must take a total of nine C-level courses in mathematics, of which at least three must be a complete sequence of either C10-1,2,3 or C30-1,2,3 or C37-1,2,3.

With the approval of the Department of Mathematics, students may substitute for as many as three of the remaining six courses a coherent set of the same number of C-level courses offered by other departments if these courses are deemed to be courses in serious applications of mathematics.

Mathematics majors are urged to take C08 at an early stage. Also recommended are B21 and a course in computer science.

Applied Mathematics Major

Prerequisites (one of the following):

- B14-1,2,3; B15; B17; B21
- B20-1,2,3
- B90-1,2,3
- Or the equivalent

Note: The four-quarter sequence B14-3, B15, B17, B21 and the three-quarter sequences B20-1,2,3, B90-1,2,3, B91-1,2,3, and B92-1,2,3 cover comparable material. Students who wish to combine courses from different sequences must obtain permission from the Department of Mathematics.

Required major courses:

- C11-1,2,3; C10-1,2,3; or C91-1,2,3
- C30-1,2,3 or C92-1,2,3
- C34 or C37-2,3
- At least four C-level courses, approved by the Mathematics Department Undergraduate Committee, in one of the following areas of application: biological sciences, chemistry, computer science, economics, engineering sciences, geological sciences, industrial engineering, physics, or statistics

The Teaching of Mathematics

CAS students pursuing a major in mathematics who also wish to be certified for secondary teaching must be admitted to the program and complete all requirements as outlined in the School of Education and Social Policy section of this catalog. Students are urged to contact the Office of Student Affairs in the School of Education and Social Policy as early as possible in their academic careers.

Integrated Science Program

The Integrated Science Program is a highly selective BA program within the College of Arts and Sciences (see Integrated Science Program). Students majoring in ISP who wish to complete a second major in mathematics should fulfill the following requirements instead of those listed above. They must take a full-year sequence, C10-1,2,3 or C37-1,2,3. It is recommended (but not required) that students planning graduate work in mathematics take both of these sequences. Students pursuing an ISP/math double major may not substitute ISP C98 for any mathematics course in the ISP curriculum.

Four-Year BA/MS

For a small number of mathematically talented and highly motivated students, the department offers a combined graduate-undergraduate program. In this four-year program, students ordinarily begin taking graduate courses in the junior year. As they complete work for a bachelor's degree, they also earn a master's degree. Interested students should consult with the department as early as possible in their college career and should see Four-Year Master's Programs in the Undergraduate Education section of this catalog.

Honors in Mathematics

Majors with outstanding records both overall and within the department may apply for graduation with departmental honors. Students seeking honors must complete both C10 and C37 or the equivalent. Students qualify for graduation with honors upon completion, with distinction, of either two quarters of Mathematics C99 leading to independent work on a research project or two D-level mathematics courses accompanied by a similar project.

Major Course Recommendations

Mathematics majors preparing to go to graduate school should take both C10 and C37 as early as possible; they should also take C28-1. Mathematics majors are strongly urged to take Math C08 as early as possible.

Mathematics majors or applied mathematics majors interested in probability and statistics should take C30 and some further courses in statistics (from Stat C50, C51, C52, C54). They should complete the requirements by taking additional courses from among real analysis (C10), computer science, and areas where probability and statistics are used.

Mathematics majors or applied mathematics majors interested in economics should take C10, C30, and Econ C80-1,2 or C81-1,2.

All majors are encouraged to discuss their programs with the department director of undergraduate studies.

General Course Recommendations

Students interested in mathematics, natural sciences, premed, engineering, or economics should take the standard calculus sequence B14-1,2,3.

Students who intend to major in behavioral science ordinarily should take B10-1,2 but may take the B14 sequence.

Students who desire an introduction to mathematics to fulfill the distribution requirement but who do not intend to do more advanced work in mathematics or related fields should consider A10, A11, or B10.

Students who have mastered the elements of single variable calculus in high school and desire an early introduction to theoretical mathematics should consider B90-1,2,3. They should take the CEEB advanced placement examination (preferably the BC exam), on the basis of which invitations are given. Students who wish to take B90 but have not received an invitation must obtain permission from the department.

Placement in Calculus

Students who have taken three years of high school mathematics, including some trigonometry, should in most cases be adequately prepared for the first quarter of calculus (B14-1).

Students who have a weak preparation in trigonometry and algebra and who want eventually to take calculus should take the Mathematics Diagnostic Examination during New Student Week of the first year. This exam is necessary for placement in precalculus (A13) and special five-days-a-week sections of B14-1.

Students who have taken calculus in high school are encouraged to begin their study of calculus at Northwestern in the most advanced course appropriate to their background. Students who have completed a year's course in calculus with good grades should ordinarily register for B14-3 or B20-1. To help determine the appropriate placement before registration, students should take the Self-Placement Examination available at the department office. Students who skip B14-1 and/or B14-2 may earn credit for the course(s) skipped by passing a credit examination, which is given in October and must be taken during the first year of enrollment at Northwestern. Credit earned by this examination may not duplicate AP credit or transfer credit earned at other colleges or universities. For CAS students, this credit counts as elective credit but does not count toward the distribution requirement. Engineering students should consult with their advisers about the necessity for this examination.

Courses Primarily for Undergraduates

435-A04-0 Games and Fallacies
Number puzzles and games; conceptualizing numbers; common fallacies. For nonscience students who may never have seen the charm of pure mathematical play or the spirit of mathematical applications.

435-A10-0 Survey of Modern Mathematics I
Introduction to modern mathematics: set theory, probability and statistics, matrices, number theory. Students may not take A10 for credit after having taken a C-level mathematics course. Prerequisite: high school mathematics.

435-A11-0 Survey of Modern Mathematics II
Continuation of A10. Prerequisite: high school mathematics.

435-A13-0 Precalculus Mathematics
Preparation for calculus. Basic algebra, functions, and graphs; exponential and logarithmic functions; trigonometry. Prerequisite: Math Diagnostic Examination and consent of department.

435-B10-1,2 Mathematics for the Behavioral Sciences
1. Elementary linear algebra and applications. Finite probability. Elementary statistics. **2.** Differential calculus. Integral calculus. Examples drawn from the behavioral and social sciences. Students may not receive credit for both B10-2 and B14-1. Prerequisite: three years of high school mathematics.

435-B13-0 Review of Calculus of One Variable
Elements of differential and integral calculus with an emphasis on problem solving, for entering students who have had calculus in high school. One unit each of course credit and placement credit given for successful completion. Students may not receive credit for B13 and any of the following: B10-2; B14-1,2. Students with advanced placement in B14-1,2 should take B14-3. Prerequisite: one year of high school calculus or consent of the department.

435-B14-1,2,3 Calculus
1,2. Elements of differential and integral calculus. **3.** Vector algebra, vector functions, partial derivatives. Students may not receive credit for both B14-1 and B10-2 or for both B14-3 and B90-1, B91-1, or B92-1. (See note under prerequisites for the major.) Prerequisite: three years of high school mathematics.

435-B15-0 Multiple Integration and Vector Calculus
Double and triple integrals. Line and surface integrals. Cylindrical and spherical coordinate systems. Change of variable in multiple integrals; Jacobians, gradient, divergence, and curl. Theorems of Green, Gauss, and Stokes. Prerequisite: B14-3.

435-B17-0 Sequences and Series, Linear Algebra
Sequences and series: convergence tests; power series; Taylor series. Linear algebra: vectors and matrices; Gaussian elimination; inverses; determinants; eigenvalues and eigenvectors; quadratic forms and diagonalization; application to quadric surfaces. Prerequisite: B14-3.

435-B20-1,2,3 Accelerated Calculus of Several Variables
Material of B14-3, B15, B17, and B21 covered in three quarters. Prerequisites: one year of high school calculus with good grades and good Math Achievement Test score.

435-B21-0 Elementary Differential Equations
Applications of calculus and linear algebra to the solution of ordinary differential equations. Students may not receive credit for both B21 and B90-2,3, B91-2,3, or B92-3. Prerequisite: B17, simultaneous registration in B17, or consent of department.

435-B90-1,2,3 Accelerated Mathematics: First Year
Linear algebra, multidimensional calculus, and other selected topics (including the material of B15 and B17). Emphasis on difficult problems. Prerequisite: one year of calculus (usually in high school) and permission of the department.

435-B91-1,2,3 Accelerated Mathematics for ISP: First Year
1. Vector differential calculus and multidimensional calculus. **2.** Vector integral calculus, differential equations, infinite series. **3.** Linear algebra, differential equations. Open only to students in ISP.

435-B92-1,2,3 Accelerated Mathematics for MMSS: First Year
1. Linear matrix algebra. **2.** Differential calculus. **3.** Integral calculus, infinite series, differential equations. Prerequisite: first-year standing in MMSS.

435-C03-0 Differential Equations
Intermediate course in differential equations. Topics chosen from the following: linear systems, nonsingular boundary value problems, theory of periodic solutions, stability theory, asymptotic expansions, special functions of mathematical physics, perturbation theory. Prerequisite: B21 or graduate standing.

435-C04-0 Game Theory
Selected topics in game theory: noncooperative games, matrix games, optimal strategies, cooperative games. For students in mathematics, probability, business, social sciences. Prerequisite: Mathematics B17 or consent of instructor.

435-C05-0 Complex Variables for Applications
Complex numbers, functions of a complex variable, theory of analytic functions, series development, analytic continuation, contour integration, conformal mapping. Students may not receive credit for both C05 and C11-3. Prerequisite: B21.

435-C08-0 Set Theory and Metric Spaces
Sets, cardinal numbers, well-ordering. Basic properties of metric spaces. Prerequisite: B17.

435-C10-1,2,3 Introduction to Real Analysis
Sets, functions, limits, properties of the real number system. Metric spaces. Foundations of differential and integral calculus, including the Riemann integral and infinite series. Lebesgue integration. Fourier series. Students may not receive credit for both C10 and C90. Prerequisites: B15 and B17 or consent of department.

435-C11-1,2,3 Introduction to Applied Mathematics
Functions of a real variable. Fourier series and boundary value problems. Ordinary differential equations, special functions, Laplace transforms. Functions of a complex variable. Students may not receive credit for both C11-2 and C16, C11-2 and C91-1, C11-3 and C91-3, or C11-3 and C05. Prerequisite: B21.

435-C13-1,2 Chaotic Dynamical Systems
1. Introduction to chaotic phenomena in deterministic discrete dynamical systems, primarily through iteration of functions of one variable. Existence and bifurcation of periodic points, including period-doubling, analysis through symbolic dynamics, and sensitive dependence on initial conditions. **2.** Iteration of functions of two and more variables, including the study of the horseshoe map, attractors, and the Henon map. Complex analytic dynamics, including the study of the Julia set and Mandelbrot set. Prerequisite: B17.

435-C16-0 Fourier Series and Boundary Value Problems
Expansion in orthogonal functions with emphasis on Fourier series. Applications to solution of partial differential equations arising in physics and engineering. Students may not receive credit for both C16 and C11-2 or C91-1. Prerequisite: B21 or consent of department.

435-C26-1,2 Geometry
Axiomatics for Euclidean geometry. Non-Euclidean geometry. Projective geometry. Introduction of coordinate system from the axioms. Quadrics. Erlangen program. Introduction to plane algebraic curves. Prerequisite: B14-3.

435-C28-1,2 Introduction to Topology
1. Point-set topology. **2.** Classification of surfaces. Prerequisite: C08, C10-1 (may be corequisite).

435-C29-1,2 Introduction to Differential Geometry
1. Curves and surfaces in three-dimensional space. **2.** Intrinsic geometry of abstract surfaces. Prerequisites: B15 and B17.

435-C30-1,2,3 Probability and Statistics
1. Discrete probability spaces. Random variables. Expected value. Combinatorial problems. Special distributions. Independence. Conditional probability. Introduction to continuous case. **2.** Integrating density functions. Convolutions. Law of large numbers. Central limit theorem. Random walk. Stochastic processes. **3.** Elementary decision theory. Estimation. Testing hypotheses. Bayes procedures. Linear models. Nonparametric procedures. Students may not receive credit for both C30 and C92. Prerequisites: B15 and B17.

435-C34-0 Linear Algebra for Applications
Solution of linear equations, number of independent solutions. Vector spaces. Eigenvalues and eigenvectors, diagonalization of a matrix, minima for quadratic forms. Symmetric, orthogonal, hermitian, and unitary matrices. Inner products. Least squares. Applications to science, engineering, and economics. Prerequisite: B17, B20-3, or equivalent.

435-C35-1,2 Introduction to the Theory of Numbers
1. Divisibility and primes, congruences, quadratic reciprocity, diophantine problems. **2.** Additional topics in analytic and algebraic number theory. Prerequisite: B14-3 or B10-2.

435-C37-1,2,3 Introduction to Modern Algebra
1. Elementary theory of groups, rings, and fields, with applications to the ring of integers and polynomial rings. **2,3.** Linear algebra done abstractly, including vector spaces, bilinear forms, canonical forms, modules. Prerequisite: B17 or consent of the department.

435-C75-0 Mathematical Logic
Mathematical formulation and rigorous discussion of logical systems, particularly the propositional calculus and the functional calculi of first and second order. Well-formed formulae, formal languages, proofs, tautologies, effective procedures, deduction theorems, axiom schemata. Prerequisite: consent of instructor.

435-C76-0 Theory of Computability and Turing Machines
Algorithms, computability, decidability, enumerability; formal replacements and Church's thesis. Turing machines, primitive recursive functions, mu-recursive functions, recursive functions. Undecidable predicates; the undecidability and incompleteness of arithmetic. Prerequisite: consent of instructor.

435-C91-1,2,3 Accelerated Mathematics for ISP: Second Year
1. Fourier series and boundary value problems. **2.** Probability and statistics. **3.** Complex analysis, elements of group theory. Students may not receive credit for both C91-1 and C16 or for C91-3 and C05. Ordinarily taken only by students in ISP. Prerequisites: B91-1,2,3 and Physics A25-1,2,3.

435-C92-1,2,3 Accelerated Mathematics for MMSS: Second Year
1. Probability theory. **2.** Stochastic processes. **3.** Estimation and hypothesis testing. Students may not receive credit for both C92 and C30. Prerequisite: second-year standing in MMSS.

435-C95-0 Undergraduate Seminar
(1–4units) Topics of modern mathematics and relationships among different branches of mathematics. Open only to superior students by permission of department.

435-C99-0 Independent Study
Open on approval of department to undergraduates who are qualified to do independent study and who have a definite plan of study. Students who wish to enroll in C99 must file a plan of study with the Department of Mathematics before registration.

D-Level Courses
Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Neurobiology and Physiology
The Department of Neurobiology and Physiology does not offer a major to incoming students. See Biological Sciences, Undergraduate Program in, for a description of the major in biological sciences.

Neuroscience Program
The Neuroscience Program provides an opportunity for undergraduates to do specialized work, including independent research during the regular year and Summer Session, on theoretical and practical approaches to the study of brain function.

On the recommendation of the director of the program, students who complete the approved course of study may apply for an ad hoc major in neuroscience. Participation in the program does not require election of the ad hoc major in neuroscience. Students might instead follow the curriculum and, by the addition of appropriate courses, complete one of the regular major programs in biological sciences.

Program of Study
- First year
  Chemistry A01 General Chemistry
  Chemistry A02 General Inorganic Chemistry
  Chemistry A03 General Physical Chemistry
  Psychology A12 Introduction to Neuroscience
  Psychology B01 Statistical Methods in Psychology
  Mathematics B14-1,2,3 Calculus
- Second year
  Biological Sciences B10-1,2,3 Biology
  Chemistry B10-1,2 Organic Chemistry
  Psychology C12-1,2 Neurobiology and Behavior
- Third year
  Biological Sciences C02 Fundamentals of Neurobiology
  Biological Sciences C03 Molecular Neurobiology
  Biological Sciences C04 Developmental Neurobiology
  Biological Sciences C51 Membranes and Cell Surfaces
  Biological Sciences C90 Molecular Biology I
  Physics A35-1,2,3 General Physics
- Fourth year
  Biological Sciences C24 Biological Clocks
  Biological Sciences C77 Sensory Neurobiology
  Biological Sciences C91 Molecular Biology II
  Psychology C95 Psychobiology Research Seminar

Philosophy
Perhaps the most notable feature of the Department of Philosophy is its pluralism—its commitment to exposing students to a broad range of philosophical traditions and philosophical issues. The department, long recognized as a leader in contemporary continental philosophy, also offers a strong array of courses in ancient, medieval, and modern philosophy as well as in other contemporary philosophies. All the major systematic areas of philosophy are taught, many of them from different perspectives in different courses. The research inter-

ests of members of the department show a similar breadth. The value of this pluralism to students is that it enables them to see philosophy's application to all areas of life and to appreciate the diversity of approaches possible in philosophy.

Program of Study for Departmental Majors

Because the study of philosophy involves the critical discussion of the most fundamental questions asked by human beings, it helps develop breadth of understanding and clarity of thought. This character of philosophical inquiry makes a double major attractive to many students. Moreover, with appropriate supporting courses, a philosophy major can be a sound preparation for many careers, whether or not they involve further study.

The core of our program is a firm grounding in the history of philosophy. Against this background, students can tailor a program that meets most fully their particular interests. Full descriptions of the courses offered each quarter are available in the department office two weeks before advanced registration.

The program for majors consists of 12 quarter-courses. The following courses are required:

- Logic: A50
- History of philosophy: B10-1, B10-2, B10-3, C10

Students should complete these required courses, especially the B10 sequence, as early as possible, since material covered is a prerequisite to more advanced work.

- Of the remaining seven courses, at least four must be at the C level and none may be at the A level. We strongly encourage our students to take at least one C95 Junior-Senior Colloquium, a seminar open only to majors in their junior or senior years.

Honors in Philosophy

To be admitted to honors, a student must have a 3.3 grade point average in the philosophy major and must declare candidacy during the spring quarter of the junior year. Declaration of candidacy requires securing an adviser and approval of a project proposal. The honors candidate will then take C98 Senior Tutorial in three successive quarters and will present a long paper. Recommendation for honors will depend on performance in C98.

Courses Primarily for Freshmen and Sophomores

Beginning students of philosophy should take A10, A11, or A50 during their first year. Students with an informed interest in philosophy, especially those intending to choose philosophy as a major, should begin with the B10 sequence in their first year.

439-A09-6 Introductory Seminar in Philosophy
Introduction to philosophy: special topics or a general survey. Offered in a number of small, discussion-oriented classes.

439-A10-0 Introduction to Philosophy
Fundamental problems and methods of philosophy.

439-A11-0 Introduction to Contemporary Philosophy
Major problems and types of contemporary philosophy. Representative writings of the 20th century.

439-A15-0 Society and the Individual
Traditional and contemporary moral problems concerning the relation of the individual to society: the rule of law, punishment, abortion, euthanasia, personal liberty, war, and revolution.

439-A50-0 Elementary Logic I
Study of argument through the use of elementary formal systems of deductive inference. Informal fallacies and nondeductive modes of inference. First quarter of A50-B50-C50 sequence.

439-B05-0 Introduction to Oriental Philosophy
Philosophic conceptions developed in the Orient. Comparison with Western thought.

439-B09-0 Introduction to Existentialism
The principal sources of existential philosophy: Kierkegaard, Jaspers, Marcel, Nietzsche, Sartre, Heidegger, Merleau-Ponty, and others.

439-B10-1,2,3 The History of Philosophy
1. Ancient philosophy. **2.** Medieval philosophy. **3.** Early modern philosophy.

439-B50-0 Elementary Logic II
Formal systems of deductive inference and their properties. Translation from ordinary language to formal languages, including first order quantification and identity and related philosophical problems. Prerequisite: A50.

439-B54-0 Scientific Method in the Natural Sciences
Philosophical and methodological issues in the natural sciences, such as the discovery and testing of hypotheses, explanation, theory selection, the nature of scientific laws, causality, space and time, determinism. Prerequisite: one course in the natural sciences.

439-B55-0 Theory of Knowledge
The basic philosophical questions about human knowledge, focusing on skepticism; competing theories of knowledge.

439-B60-0 Ethics
Theories of human conduct and character, dealing with such issues as the nature of the good, duty, happiness, virtue, freedom, and moral responsibility.

439-B63-0 Social and Political Philosophy
Issues such as the rationale for existing in society, the justification and proper limits of political power, and the most desirable form of government.

439-B65-0 Introduction to the Philosophy of Law
Ethical and conceptual issues arising in connection with the law, such as the nature of law, the nature of liberty and of justice, and the theory of punishment.

Courses Primarily for Juniors, Seniors, and Graduates

439-C03-0 The Philosophy of Education
Educational theories of representative philosophers as related to their culture and the problems of their times.

439-C04-0 Philosophy and Modern Literature
Issues involving philosophy and literature and their relationship.

439-C07-0 Studies in French Philosophy
One or more figures in French philosophy. The figures may vary, but the primary readings will be in French.

439-C10-0 Kant's *Critique of Pure Reason*
A close examination of Kant's *Critique of Pure Reason.*

425-C14-0 German Contributions to World Literature
When course is on Nietzsche; see German.

439-C20-0 Studies in Ancient Philosophy
The work of one important philosopher or philosophical movement before 500 A.D. Subject varies. Barring duplication of subject, credit for repetition. Prerequisite: B10.

439-C21-0 Studies in Medieval Philosophy
The work of one important philosopher or philosophical school between 500 and 1000 A.D. Barring duplication of subject, credit for repetition. Prerequisite: B10.

439-C22-0 Studies in Modern Philosophy
The work of one important philosopher or philosophical movement between 1500 and 1800. Subject varies. Barring duplication of subject, credit for repetition. Prerequisite: B10.

439-C23-0 Studies in Contemporary Philosophy
The work of one important philosopher or philosophical movement of the 19th and/or 20th centuries. Subject varies. Barring duplication of subject, credit for repetition. Prerequisite: B10.

439-C24-0 Phenomenology
Major works contributing to the phenomenological movement: texts by Husserl, Heidegger, Sartre, and Merleau-Ponty. Questions of methodology, together with problems in theory of knowledge and ontology.

439-C25-0 Philosophy of Mind
Selected topics in the philosophy of mind: mind-body problem, problem of other minds, self-knowledge, personal identity, philosophical psychology.

439-C27-0 Philosophy of Psychology
Problems such as the nature of psychological explanation, experimentation and the testing of psychological claims, the standing of psychology as a science, reductionism, the unconscious, and conceptualizing the psyche and its processes.

439-C29-0 On Being a Scientist
Investigation of science as a profession, its standards of conduct, strategies for surviving in the profession, and special problems that arise. Prerequisite: a major in an area of science.

439-C50-0 Systematic Logic
Formal systems of deductive inference. Metatheory, formal semantics, completeness, and set theory. Third quarter in a one-year sequence in logic, including A50 and B50. Prerequisite: B50.

439-C51-0 Advanced Topics in Philosophical Logic
Methods of modern formal logic applied to traditional philosophical questions, e.g., modal logic, deontic logic, epistemic logic, many-valued logic, tense logic. Prerequisite: B50.

439-C52-0 Philosophy of Mathematics
Traditional philosophical issues, such as the nature of mathematical entities and of mathematical truth, in the light of modern developments in the foundations of mathematics.

439-C53-0 Philosophy of Language
The nature and uses of language as presenting philosophical problems, e.g., theory of reference, the modes of meaning, definition, metaphor, problems of syntax, and semantics.

439-C54-0 Advanced Topics in the Philosophy of Natural Science
Discovery, conceptual change and the growth of scientific knowledge, explanation, relation of theory to observation, confirmation theory, space and time, causality, and philosophical implications of relativistic and quantum mechanics. Prerequisite: B50 or consent of instructor.

439-C55-0 Scientific Method in Social Sciences
Analysis of the philosophical foundations of social inquiry with reference to selected problems, thinkers, and schools, both classical and modern.

439-C60-0 Ethical Theory
A systematic analysis of the nature of moral value judgments and their validity.

439-C61-0 Advanced Studies Ethics
Philosophical study of a central problem, school of thought, or historical period or figure (e.g., Aristotle) in moral philosophy. Topic varies. May be repeated for credit with change in topic.

439-C64-0 Principles of Political Philosophy
Political power and authority; the notion of law; relations between society and the state; concepts of rights, liberty, equality, and justice. The problem of peace. Prerequisite: B63.

439-C65-0 Advanced Studies in the Philosophy of Law
Normative and conceptual issues arising in legal contexts.

439-C66-0 Advanced Studies in Philosophy of Religion
Central problems in the philosophy of religion.

439-C67-0 Philosophical Issues Concerning Technology
Normative issues raised by technology, such as whether technology has intrinsic values and whether it is possible to make technology serve humane ends. Prerequisite: consent of instructor.

439-C68-0 Problems in Social and Political Philosophy
Philosophical analysis of the social and political thought of a school, an individual philosopher, or an epoch. Problem varies.

439-C90-0 Undergraduate Seminar in Topical Philosophical Issues
Philosophical issues underlying current social interests, such as feminism, homosexuality, pornography, ecology, pacifism, civil disobedience, racism, and depersonalization.

439-C95-0 Junior-Senior Seminar
Open only to majors in their junior or senior year.

439-C98-1,2,3 Senior Tutorial
Undergraduate honors thesis. Grade of K given in C98-1 and C98-2. Prerequisite: C95 or approval of the chair.

439-C99-0 Independent Study
Open to properly qualified students with consent of department.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Physics and Astronomy

The study of physics provides a scientific foundation appropriate to any field. Physics seeks to understand the fundamental properties of matter, ranging from the astronomically large (stars and galaxies) to the smallest particles (atoms and their constituents). A major in physics furnishes a basis for almost any career in our science-oriented society: physics, science, engineering, medicine, law, business, teaching, and others.

The study of astronomy opens the path to understanding the current exploration of the solar system, the implications of alternative cosmologies, and the continuing debate about investment in space research. A major in astronomy establishes credentials for a career in space science, teaching, or astrophysics.

The Department of Physics and Astronomy offers programs for physics and/or astronomy majors, for other scientists and engineers who want to comprehend physics at a deeper level, and for nontechnical students who wish to understand the physical ideas that underlie modern philosophy, economic development, and even the arts.

Students in the College of Arts and Sciences may complete their basic science requirement by taking any of the following courses: general physics A30-1,2 (noncalculus), A35-1,2 (calculus-based), A90-1,2 (for majors); A03 Ideas of Physics; or the astronomy courses for nonspecialists A01 Modern Cosmology, A02 Milky Way Galaxy, and A20 Highlights of Astronomy. A01, A02, A03, and A20 allow students to explore major ideas in the physical sciences with only high school mathematics.

Students majoring in physics or astronomy begin to study physics in their freshman year, taking A90-1,2,3. (Other science and mathematics majors may also register for this sequence.) These students study mathematics concurrently, beginning with Mathematics B14-1, B14-2, or B14-3, whichever is appropriate to their high school background. A good preparation in algebra and trigonometry is necessary, but calculus is not a prerequisite.

All other science and engineering students begin to study the general physics sequence after they complete differential and integral calculus. Freshmen should register for Mathematics B14-1,2,3 unless equivalent work was completed in high school. Students who obtain advanced placement in mathematics into B14-3 should begin their physics study in the fall of their freshman year. As soon as students complete Mathematics B14-2 or its equivalent, they may begin an A-level physics series. The series selected depends on the student's interest and the following guidelines: A25-1,2,3 is tailored for students in the Integrated Science Program; A35-1,2,3 is the basic introduction to general physics, appropriate for engineering and science majors; A90-1,2,3 is the general physics course for science or mathematics majors who prefer a more analytical approach to basic physics and have a strong mathematics background; A30-1,2,3, given only in the Summer Session, covers the topics included in the other three-quarter sequences, but without calculus.

Advanced Placement

Freshmen who have had a calculus-level physics course in high school may waive parts of the introductory physics sequence if they satisfy either of two conditions: (1) obtaining a 4 or 5 on the College Board Advanced Placement Physics C examination allows students to be exempt from A35-1 or 2 or its equivalent; a grade of 5 also gives students credit for the course exempted; (2) passing the departmental examination based on previous course finals during New Student Week allows students to waive any or all parts of the sequence. Students who obtain advanced placement in mathematics into B14-3 should begin their physics study in the fall of their freshman year.

Program of Study for Physics Majors

The undergraduate major program is directed toward helping students acquire a broad and varied background in physics. Upon graduation, a physics major is equipped for either a career or further studies: (1) graduate work in physics or another science or in engineering, (2) medical school, law school, or business school, (3) education courses leading to a teaching certificate.

Freshmen are strongly encouraged to take the A90-1,2,3 sequence in parallel with mathematics at a level appropriate to their high school background. This sequence begins with Mathematics B14-1,2,3. Students may also take any other A-level general physics sequence. These other sequences have

a two-quarter calculus prerequisite. After completing the B14 sequence, students should register for three more mathematics courses: B15, B17, and B21 or B20-1,2,3. Students intending to go to graduate school in physics or another science should also take Mathematics C11-1,2,3 or Mathematics C05, C16, and C34.

Required courses for physics majors:

- Introductory physics: A25-1,2,3; A35-1,2,3; or A90-1,2,3
- Classical physics: four courses selected from C30-1,2; C31; C32; C33-1,2; C34
- Modern physics: C36-1,2; C37 or C38
- Advanced laboratory: C59-1,2,3

Three ways to schedule the required physics courses are shown in the accompanying table, Three Possible Physics Major Sequences. Aside from the C59 laboratory, these requirements are usually fulfilled in three years. Thus a student can have most of the senior year available for taking advantage of departmental options. Seniors can undertake C99, individual study of a subject of interest under the direction of a faculty member. Beginning graduate courses may be taken by advanced undergraduates to get an early start on a graduate program. Students might spend part of the junior year and/or the entire senior year studying another discipline, such as astronomy, biological sciences, chemistry, economics, engineering, geological sciences, mathematics, or philosophy, in an attempt to link two disciplines together. Appropriate choices should be planned by student and adviser early in the junior year.

To suit specific needs, students may wish to arrange their individual major programs in consultation with their advisers. In all cases, students are urged to consult an adviser in the department at the earliest possible time, even before formally entering as a freshman. Transfer students, from either other departments or other universities, should consult their adviser to see whether any of the requirements may be waived or reduced because of work done elsewhere.

Program of Study for Astronomy Majors

The astronomy major program is designed to give students a foundation in astronomy and ample opportunity to pursue related work. Students will obtain an excellent foundation in physics as well as both observational astronomy and theoretical astrophysics. Students may combine the study of astronomy with the study of other natural sciences, such as physics, geology, and biology, or with a less traditional choice, such as economics, history, or philosophy. The national space program employs many people with astronomy and computer skills or astronomy and engineering know-how. Students are urged strongly to consult with an adviser early in their academic career to make the most of the options available through careful structuring of courses. Calculus and general physics should be completed as early as possible.

Required courses for astronomy majors:

- Introductory physics: A25-1,2,3; A35-1,2,3; or A90-1,2,3
- Classical physics: four courses selected from C30-1,2; C31; C32; C33-1,2; C34
- Modern physics: C36-1,2; C37 or C38
- Astronomy: B10-1,2; any two of C25, C28, and C29
- Astronomical observing: C61

The Teaching of Physics

CAS students pursuing a major in physics who also wish to be certified for secondary teaching must be admitted to the program and complete all requirements as outlined in the School of Education and Social Policy section of this catalog. Students are urged to contact the Office of Student Affairs in the School of Education and Social Policy as early as possible in their academic careers.

Honors in Physics, Astronomy, or Physics and Astronomy

Qualified students who plan to develop a research career or to combine teaching and research in physics are urged to participate in departmental honors. Overall course performance is the first criterion for consideration. To qualify for honors, students may follow any A-level general physics sequence, although A90-1,2,3 is preferred. Two classical C-level physics or astronomy courses in addition to the four required classical physics courses and two independent study courses are required. (Occasionally, D-level courses may be substituted for independent study.) Evidence of independent work and recommendation from an adviser are necessary. Consult the department for details.

Integrated Science Program

The Integrated Science Program is a highly selective BA program within the College of Arts and Sciences that includes Physics A25-1,2,3 and C39-1,2,3 and Astronomy C31 as part of its curriculum (see Integrated Science Program).

Required courses for ISP students who wish to complete a major in physics:

- 447-C59-1,2,3
- Three one-quarter courses from 447-C30-1,2; 447-C32; 447-C33-1,2; 447-C34

Students pursuing an ISP/physics double major may not substitute ISP C98 for any physics course in the ISP curriculum.

Required courses for ISP students who wish to complete a major in astronomy:

- 407-C38 or 407-C39
- 407-C61
- Three one-quarter courses from 447-C30-1,2; 447-C32; 447-C33-1,2; 447-C34

Students pursuing an ISP/astronomy double major may not substitute ISP C98 for any physics or astronomy course in the ISP curriculum.

Three Possible Physics Major Sequences

Sequence one is strongly recommended and must be taken by students who study physics and calculus concurrently. Sequences two and three are for students who take two quarters of calculus before starting physics. Only physics courses are shown. The A courses are introductory physics sequences: A25-1,2,3; A35-1,2,3; or A90-1,2,3. Students should try to arrange their mathematics courses so that they have had B15, B17, and B21 (or B20-1,2,3) before taking physics courses C32 and higher. They also should have had Mathematics C11-1,2,3 or Mathematics C05, C16, and C34 if they plan to do graduate work in physics.

	Sequence one		Sequence two		Sequence three	
First year	A-1					
	A-2					
	A-3		A-1			
Second year	C31		A-2	C31	A-1	
	C30-1	C33-1	A-3	C30-1	A-2	C30-1
	C30-2	C33-2		C30-2	A-3	C30-2
Third year	C36-1	C32	C32		C31	
	C36-2	C34	C33-1		C33-1	
	C38		C33-2		C33-2	
Fourth year	C59-1	C37	C36-1	C59-1	C36-1	C59-1
	C59-2		C36-2	C59-2	C36-2	C59-2
	C59-3		C38	C59-3	C38	C59-3

Distribution/Elective Courses

Nonscience Majors

A03 Ideas of Physics is a series of independent one-quarter courses on interesting topics in modern and/or applied physics. Courses during any given year vary with the interest of faculty and students; recent offerings have included energy, relativity, and the relationship between physics and music. Requiring only high school mathematics, they are specifically designed for nonscience majors.

All A-level astronomy courses are open to people without technical backgrounds. Most of them include opportunities to observe through the telescopes at Dearborn Observatory and the Lindheimer Astronomical Research Center.

Science and Engineering Majors

Science or engineering students who have completed just the first course of any A-level physics sequence may enroll in C31 Thermodynamics and C30-1,2 Advanced Mechanics. Students who have completed the three courses in the A-level sequence and Mathematics B15, B17, and B21 may enroll in C33-1,2 Advanced Electricity and Magnetism. Students who have completed C30-1 and C33-1 may enroll in C36-1. Students who have completed C36-2 may enroll in C37 Introduction to Solid State Physics or C38 Introduction to Nuclear and Particle Physics.

Physics

Courses Primarily for Undergraduates

447-A03-0 Ideas of Physics
Independent one-quarter courses on selected topics in physics and on relations between physics and other disciplines, requiring only high school mathematics. Samples: relativity; physics and music; physics and energy; physics and modern society; introduction to elementary particle physics; history of physics in the 20th century. Consult the *Class Schedule* for current topics.

447-A25-1,2,3 General Physics
Primarily for students in ISP. Similar to A35 but at a somewhat deeper level, with an introduction to special relativity. Three lectures, discussion, lab. Prerequisite: first-year standing in ISP or consent of instructor.

447-A30-1,2,3 Introductory College Physics
Concentrated program similar to A35 but at a noncalculus level. Lectures plus lab. Summer Session only; see the Summer Session catalog for details.

447-A35-1,2,3 General Physics
Primarily for science majors, engineering majors, and premedical students. **1.** Mechanics. **2.** Electricity and magnetism. **3.** Wave phenomena, optics, quantum physics, and selected special topics. Three lectures, discussion, lab. Prerequisites

for A35-1: Math B14-1,2 or equivalent. Prerequisites for A35-2: A35-1 and Math B14-1,2,3 or equivalent. Prerequisites for A35-3: A35-1,2 and Math B14-1,2,3 or equivalent.

447-A90-1,2,3 General Physics
Primarily for students who wish to major in physics or astronomy but also open to other interested science and mathematics students. Similar to A35 but at a somewhat deeper level, with an introduction to special relativity. Three lectures, discussion, lab. In this sequence, physics and mathematics are taught in parallel. Depending on high school background, students should register for Math B14-1, 2, or 3. Prerequisite: excellent high school background in algebra and trigonometry.

447-C30-1,2 Advanced Mechanics
Static equilibrium, relative motion, systems of particles, central forces, rigid bodies, oscillations, waves on a string, generalized coordinates, Lagrange's equations, relativity. Four lectures. Prerequisites: A25-1, A35-1, or A90-1 and Math B14-1,2,3 or the equivalent.

447-C31-0 Thermodynamics
Equations of state, first and second laws of thermodynamics, entropy, phase changes, third law of thermodynamics, applications. Four lectures. Prerequisite: A25-1, A35-1, or A90-1 and Math B14-1,2,3 or the equivalent.

447-C32-0 Kinetic Theory and Statistical Mechanics
Ideal gas, Boltzmann distribution, transport phenomena of classical systems, Bose-Einstein and Fermi-Dirac statistics, applications, fluctuation theory. Four lectures. Prerequisites: C30-1,2 and C31; Math B15, B17, and B21.

447-C33-1,2 Advanced Electricity and Magnetism
1. Vector calculus, electrostatics and magnetostatics, solutions to boundary value problems by images, inversion, Green's functions. **2.** Maxwell's equations, wave equations, radiation, waves in cavities and matter, diffraction. Four lectures. Prerequisites: A25-1,2,3 or A35-1,2,3 or A90-1,2,3 or equivalent; Math B15, B17, and B21.

447-C34-0 Introduction to Relativity: Special and General
Time dilation, length contraction, the Lorentz transformation, equivalence of mass and energy, relativistic momentum, space-time and some simple metrics, geodesics, classic tests of general relativity, black holes. Four lectures. Prerequisites: A25-1,2,3 or A35-1,2,3 or A90-1,2,3 and C30-1,2; Math B15, B17, and B21.

447-C35-0 Modern Physics for Nonmajors
Survey of modern physics for nonmajors with a technical background. Relativity and quantum physics; their application to nuclear, atomic, molecular, and electrical problems. Does not fulfill C-level requirement for majors. Prerequisites: A35-1,2,3.

447-C36-1,2 Introduction to Quantum Mechanics
Nonrelativistic quantum theory and wave mechanics. Fundamental axioms, wave-particle duality and uncertainty relations, Schroedinger equation, solutions for simple systems. Model systems include one-dimensional potential wells, barrier penetration and scattering, harmonic oscillators, Coulomb potential, and hydrogenic atoms. Prerequisites: C30-1 and C33-1.

447-C37-0 Introduction to Solid State Physics
Part of the physics major requirement but open to anyone. Electrons in periodic lattices, phonons, electrical, optical, and magnetic properties of metals and semiconductors. Superconductivity. Prerequisite: C36-2.

447-C38-0 Introduction to Nuclear and Particle Physics
Nuclei and their constituents, nuclear models, alpha and beta decay, nuclear reactions, nuclear fission and fusion. Strong, electromagnetic, and weak interactions, the fundamental particles and particle-schemes. Prerequisite: C36-2.

447-C39-1,2,3 Quantum Mechanics, Nuclear and Particle Physics
For students in ISP. Similar to C36-1,2 and C38 but at a more advanced level and with more detailed discussion. Prerequisite: second-year standing in ISP.

447-C59-1,2,3 Modern Physics Laboratory
1. Introduction to modern electronics, construction of elementary analog and digital circuits. **2.** Introduction to microprocessors, hardware construction, interfacing to external devices, assembly language programming. **3.** Classic experiments in atomic, nuclear, and solid state physics using modern electronics and microcomputers. Emphasizes independent work. Two lectures and two labs.

447-C98-0 Honors Independent Study
Individual study under the direction of a faculty member. Open only to advanced students pursuing departmental honors. Separate quarters of this course may be taken independently.

447-C99-0 Independent Study
Opportunity to study independently an advanced subject of interest under the individual direction of a faculty member. Open to all advanced students. Consent of instructor required. Separate quarters of this course may be taken independently.

D-Level Courses
Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Astronomy

Courses Primarily for Undergraduates

407-A01-0 Modern Cosmology for Nonspecialists
Modern views on the structure of the universe, its past, present, and future. Primarily for nonscience majors; no science or mathematics background required. Limited enrollment.

407-A02-0 Milky Way Galaxy
Structure of the galaxy, star formation, interstellar clouds and dust, star clusters, neutron stars and black holes, the galactic center, the future evolution of the sun and our solar system. Limited enrollment.

407-A20-0 Highlights of Astronomy
Main results attained in study of solar system, stars, Milky Way galaxy, and systems beyond. For those who desire an acquaintance with descriptive astronomy. Some telescopic observation included.

407-B10-1,2 General Astronomy
Fundamental facts, principles, and methods of modern astronomy. 1. Solar system. 2. Stars and galaxies. Evening telescopic observations once per week included. Concurrent registration in Physics A35-2 or A35-3. Prerequisites: Math B14-3 and Physics A35-1 or equivalent. B10-2 may be taken without B10-1.

407-C25-0 Stellar Structure and Evolution
Physical conditions in stellar interiors. Comparison of theory and observations in stellar evolution. White dwarfs, neutron stars, and black holes. Offered alternate years. Prerequisites: B10-1,2 and Physics A35-1,2,3.

407-C28-0 Interstellar Matter
Mathematical and statistical treatment of interstellar matter: physics of gas and dust clouds. Offered alternate years. Prerequisites: B10-1,2 and Physics A35-1,2,3.

407-C29-0 Galactic Structure
Mathematical and statistical treatment of galactic structure: kinematics of stars and star clusters. Offered alternate years. Prerequisites: B10-1,2 and Physics A35-1,2,3.

407-C31-0 Astrophysics
Stellar structure and evolution: basic equilibrium equations, physical conditions in the stellar interior, stellar energy sources, evolution of stars, nucleosynthesis, supernova phenomena, white dwarfs, neutron stars, and black holes. Prerequisite: Physics C38 or C39-3. Enrollment limited to ISP students.

407-C61-0 Astronomical Observing Methods: Photometry
Theory and application of astronomical radiation measurement techniques. Characteristics of photometric systems. Effects of bandwidths on photometric measurements. Characteristics and merits of various radiation detectors. Modern techniques in photometry and spectrophotometry. Offered alternate years. Prerequisites: B10-1,2 and Physics A35-1,2,3.

407-C99-0 Independent Study (1 or 2 units)

D-Level Courses
Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Political Science
A knowledge of political science is central to any occupation or profession that needs an understanding of human behavior; to the relationships between people and governments, whether their own or foreign; or to the analysis and communication of information about public problems. A background in political science is virtually indispensable for people in politics and government, whether at the state, local, or national levels; lawyers; journalists; scientists; business managers; or medical people. Such professionals are in constant need of information on and understanding of the political, legal, governmental, and public implications of their fields. The Department of Political Science is internationally recognized for excellence at both the undergraduate and graduate levels.

The department is especially strong in American politics and government; the politics of foreign countries, especially in Europe, Latin America, South Asia, and the Middle East; international studies; law and politics; political economy; and political theory. Much of the department's work is associated closely with the activities of the Law and Social Science Program, Program of African Studies, International Studies Program, and Center for Urban Affairs and Policy Research, all of which are outstanding in their respective specialties in the United States.

Program of Study for Departmental Majors
The department offers not only an undergraduate major, but also graduate programs leading to the MA and PhD degrees in political science.

Prerequisites: any three of the following "gateway" courses in political science: B01, B20, B21, B30, B40, B50, B70.

Major courses: seven quarter-courses in political science, one of which must be C10, C11, or C12 and another must be C95. The remaining five are to be chosen from B10, B15, and all C-level courses.

Related courses: five quarter-courses in anthropology, economics, history, philosophy, psychology, or sociology, of which at least two must be at the C level and no more than one at the A level.

The Teaching of Political Science
CAS students pursuing a major in political science who also wish to be certified for secondary teaching must be admitted to the program and complete all requirements as outlined in the School of Education and Social Policy section of this catalog. Students are urged to contact the Office of Student Affairs in the School of Education and Social Policy as early as possible in their academic careers.

Advisers and Course Elections
As soon as students have declared a major in political science, a department adviser can be assigned to consult regularly with them about the program of study. Students planning

to major in political science should try to complete the B-level prerequisites by the end of the sophomore year.

Preparation for Research

The required C95 Political Research Seminar normally is taken in the junior year. Students should take at least one of the following before taking C95: C10 Elementary Statistics for Political Research, C11 Methods of Political Research, or C12 Logic of Political Inquiry. All majors also are urged to acquire a working knowledge of a foreign language.

Honors in Political Science

Majors with outstanding records both overall and within the department may apply for graduation with departmental honors. The primary route to earning the departmental recommendation for honors involves enrolling in C98 Honors Tutorial, a two-quarter course that requires writing a senior thesis that receives an A grade. Students interested in exploring an alternate route to honors should meet with the director of undergraduate studies in the junior year. Either way, departmental honors requires outstanding work in connection with a research project.

Four-Year BA/MA

The department offers a four-year BA/MA program in political science for outstanding undergraduate majors. Interested students should contact the director of undergraduate studies no later than the winter quarter of the junior year and should see Four-Year Master's Programs in the Undergraduate Education section of this catalog.

Courses Primarily for Undergraduates

Political Theory

These courses examine the ideas that inform the thinking of today's citizens, representatives, and political scientists. They are organized by historical periods and conceptual similarity.

449-B01-0 Introduction to Political Theory
Ideas like power, freedom, justice, and rationality in the work of major political theorists. How political thought influences political institutions and behavior.

449-C01-0 Classical Political Theory
Contributions of classical political theorists, such as Plato, Aristotle, and Cicero, and their modern applications. Modern concepts of scope and method of political science.

449-C02-0 Modern Political Thought
The nation-state, modern science, and the industrial revolution as context for a revolution in political ideals. Machiavelli, Hobbes, Locke, Rousseau, Marx. Relation of ideas to social movements and political institutions.

449-C03-0 Concepts in Democratic Theory
Contemporary analyses of the meanings of liberty, equality, representation, and other key concepts in the theory and practice of democracy.

Research Methodology

Courses in this field prepare students to do original research on the causes and consequences of political phenomena. The methodological techniques are often transferable to research problems in government and business.

449-B10-0 Social Experimentation: The Logic and Practice of Experimental Social Science
Application of experimental methods to social settings. Experiments in voting, conflict resolution, public health, and crime control. Ethical and practical constraints on experimentation.

449-B15-0 Introduction to Formal Models of Political and Social Behavior
Formal models for studying political and social behavior. Elementary game theory, electoral competition, political power, arms races, utility theory, world systems, probability models. Only high school algebra assumed as background.

449-C10-0 Elementary Statistics for Political Research
Measuring political data, summarizing observations, analyzing contingency tables. Parametric and nonparametric tests of hypotheses. Basics of multiple regression. SPSS computer usage.

449-C11-0 Methods of Political Research
Introduction to methods and techniques of political research: research design, experimentation, comparative inquiry, measurement, data collection, and data analysis. Application of these methods to political phenomena.

449-C12-0 Logic of Political Inquiry
Political science as "science." Identity sources, construction, functions, and validation of social science theory and explanation from varied perspectives. Not open to students who have taken Sociology C26.

449-C13-0 Computer Methods for Political Science
File management, on-line editing, information retrieval systems, statistical packages, interactive computing, text processing, simulation. Topics may vary with instructor. Prerequisite: C10.

449-C15-0 Formal Models of Political Behavior
Techniques of formal modeling employed in the analysis of politics. Arms races, deterrence, bargaining and coalitions, rational choice, social choice and Arrow's paradox, voting, game theory. Prerequisite: C10.

American Politics

These courses deal with the dynamics of behavior within and between domestic political institutions. Although focusing on American politics, the courses usually involve comparisons with behavior and institutions in foreign countries.

449-B20-0 American Government and Politics
The structure and process of American politics from competing perspectives. Analysis of representation, voting, interest groups, parties, leadership, and policy-making institutions. The gateway course for the American Politics subfield.

449-B21-0 Urban Politics and Policies
Structure of local and regional political power and its relation to social and economic structure of community.

449-C20-0 The Presidency
Contemporary presidency in terms of recruitment, presidential character, public opinion, institutional constraints, and foreign versus domestic policy making. Prerequisite: B20 or equivalent.

449-C21-0 Community Political Processes
Selected problems of mobilizing and exercising political power in local and regional jurisdictional units. Relationships between political structure and community needs and demands. Prerequisite: B21.

449-C22-0 Federalism and Intergovernmental Relations
Political and economic integration of federal systems. Relationships formulating and implementing policies. Politics of metropolitan areas with overlapping jurisdictions. Fiscal federalism, revenue sharing. Prerequisite: B20 or equivalent.

449-C23-0 Public Opinion and Voting Behavior
Who votes and for whom. Social, psychological, economic, and political factors influencing election choices. Sources of opinions. Focus on American presidential elections but some comparative and nonpresidential material. Prerequisite: B20 or equivalent.

449-C24-0 Political Parties and Elections
Role of political parties in a democratic society. Topics include nomination, national conventions, political funding, campaigns, party organization, and national, state, and local parties.

449-C25-0 The Legislative Process
Organization of legislatures to make public policy; legislative-executive relations; impact of interest groups and other forms of citizen activity on legislative decision making. Emphasis on United States Congress. Prerequisite: B20 or equivalent.

449-C26-0 Political Campaigning
Students combine fieldwork in an actual campaign with class work on political parties, elections, and campaigning and receive academic credit for their efforts. Registration limited to those with a suitable background in political parties and elections. Prerequisites: C23, C24.

449-C27-0 Black American Politics in the United States
Historical survey of black politics and relationship of blacks to the government. Relevance of both reformist and revolutionary strategies in the struggle for black liberation.

Law and Politics

These courses study the role of the judiciary at the national, local, and emerging levels of government. They also investigate issues in jurisprudence and the administration of justice.

449-B30-0 Introduction to Law in the Political Arena
Roles of law in society and politics—how disputes are resolved, organization of the bar, why people litigate, the consequences of litigation. Compares common law, civil code, and other legal traditions.

449-C30-0 The Politics of Local Justice
Local justice systems, with emphasis on trial courts, civil and criminal litigation, and the political consequences of the involvement of the law in social conflicts.

449-C31-0 Appellate Processes
Operation of appellate courts, with emphasis on the United States Supreme Court. Decision making by appellate courts and the development of public policy.

449-C32-0 Constitutional Law I
Introduction to interpretation of the United States Constitution by the Supreme Court. Judicial review, federalism, separation of powers, economic and religious liberty, and personal privacy. Prerequisite: B20 or B30.

449-C33-0 Constitutional Law II: Civil and Political Rights
Consideration of decisions of the United States Supreme Court dealing with civil and political rights, including equality, freedom of expression, and criminal procedures. Prerequisite: B20 or B30.

International Politics

This field includes the study of major actors and arenas in the world scene, major processes through which cooperation and conflict are managed in the international system, and ways in which change occurs and resources become allocated in the global system.

449-B40-0 Introduction to International Relations
Surveys basic concepts and processes in international and transnational relations, including major actors, management of conflict and cooperation, and systemic changes at the global level. The gateway course to International Politics.

449-C40-0 Global Society
Survey of human problems of global dimensions, such as population, poverty, human rights, and war. Evaluation of the adequacy of existing institutions for handling these problems. Alternative forms of global organization.

449-C41-0 American Foreign Policy in a Global Context
Economic, military, and diplomatic dimensions of policy; internal and external influences on policy; theories of foreign policy decision making in the United States and other nations.

449-C42-0 International Organizations
Role of international organizations in international relations. Similarities and differences between international and other political institutions. Comparison of different types of international organization.

449-C44-0 Advanced Studies in International Relations
Integrated analysis of collaborative and conflict processes in international politics, with intensive work on substantive topics of special interest to each student. Prerequisite: B40 and/or C40; C41 and/or C42 desirable.

449-C45-0 National Security
Problems of maintaining national security in the military and economic spheres; deterrence theory, nuclear weapons, arms control, and defense policy among the major powers.

Comparative Politics

This field analyzes political behavior and institutions in foreign countries and areas of the world. Some courses concentrate on understanding the politics of specific national systems, while others focus on certain types of political phenomena and make cross-national comparisons.

449-B50-0 Comparative Political Systems
The emphasis may be on industrialized and/or developing states; socialist and/or capitalist states. Major issues include regime-society relations, revolution, and policy making.

449-C50-0 Conflicts and Politics
Causes, processes, and consequences of revolutionary movements. Theories and case studies, including victorious and unsuccessful, urban and rural-based movements.

449-C51-0 Peasant Politics
Characteristics of agrarian economic structures, social organizations, and peasant politics, movements, and revolutions; elite responses to, interactions with, rural society through public policy, clientelist mobilization, etc.

449-C52-0 Comparative Communism
Comparison of politics, economics, and history in Eastern Europe, the former Soviet Union, and China. Major issues include revolution and regime-society relations.

449-C53-0 Politics in Latin America
Patterns of socioeconomic development and regime forms in Latin America. Interaction of internal and international economic and political structures and processes.

449-C54-0 Politics of South Asia
Comparative politics of the South Asian subcontinent (India, Pakistan, Sri Lanka, Bangladesh, etc.), stressing the impact of colonial residues, economic planning and development.

449-C55-0 Soviet Politics
Overview of the politics, history, and economics of the former Soviet Union since the 1917 revolution. Particular emphasis on domestic arena and contemporary issues.

449-C57-0 Politics of Underdeveloped Areas
Problems and political behavior in underdeveloped areas in regard to their internal affairs and international relations. Interplay between economic conditions and political patterns.

449-C58-0 Nationalism
Social, linguistic, religious, and political bases of the rise of modern nationalism in Europe, Asia, and Africa; wars of national liberation in relation to imperialism and colonialism.

449-C59-0 African Political Systems
Political structures and relation of cultural factors to political stability and change; development of modern political systems.

449-C60-0 Politics of the Far East
Political systems of northeast Asia. Historical, economic, and sociocultural factors in their transformation into major international powers.

449-C61-0 Chinese Politics
Fundamental conflicts in Chinese politics: party-mass relations, class, the urban-rural split, and debates over ideology, democracy, and development strategy.

449-C62-0 Politics of Western Europe
Historical development, mass behavior, interest groups and parties, policy making, and social and economic policy.

449-C63-0 Middle East Politics
The rise of the nation-state in the Middle East and the modernization of the Islamic political system. Ideological regional political movements; regional conflict and Great Powers rivalry.

Public Policy and Political Economy

The consequences of governmental action on political, social, and economic activity are analyzed in these courses. Other courses concerned with public policy and political economy are listed under Law and Politics and International Politics.

449-B70-0 Introduction to Public Policy
Government decision making and policy making: which problems; what solutions; the implementation and evaluation of policies. Special attention to issues of inequality.

449-C70-0 Public Policy
Analysis of policy fields such as education, welfare, health, and crime control. Materials emphasize United States, Western Europe, and other political systems.

449-C71-0 Environmental Politics
Political problems associated with human impact on natural environment; pollution, natural resources, public lands, land use, energy, and population.

449-C72-0 The Politics of the Global Economy
Interactions of politics and economies in the relations between nations and among subnational groups. Theories of imperialism, dependency, and the evolution of the global system; international policy and institution reform.

449-C73-0 Political Economy of Underdevelopment
Major analytical perspectives of modern political economy through examination of concrete problems of development and underdevelopment in the third world. Economics B01 and B02 strongly recommended.

Seminars, Independent Study, and Special Opportunities

C95 is required of all political science majors, who will be notified of scheduling arrangements in advance. C95 is ordinarily taken in the spring quarter of the junior year or the fall quarter of the senior year. With permission of the department,

students may receive full credit for more than one quarter of C95 provided that, if C98 and C99 are also taken, C95 with C98 and C99 do not exceed a total of four course credits.

449-C90-0 Special Topics in Political Science
Designed for investigation of topics that are of current interest to students and faculty but are not adequately covered by other course offerings. No prerequisites. Offered in different quarters as announced.

449-C91-0 Computers for Qualitative Research
Senior capstone course. Computer methods of information processing. Qualitative research encouraging students to undertake computer analysis of textual material.

401-C93-0 Chicago Field Studies Internship
See General Studies.

449-C94-0 Senior Linkage Seminar
Topics vary. Open only to senior majors and nonmajors.

449-C95-0 Political Research Seminar
Led by different members of the department, small seminars in research topics, providing students the chance to conduct research.

449-C98-1,2 Honors Tutorial
For seniors with excellent records, by department invitation. First quarter taken fall or winter for K grade, final grades given to research paper at end of second quarter. Two consecutive quarters. Prerequisite: C95.

449-C99-0 Independent Study
Study and research programs for unusual needs of political science majors. A written proposal, signed by the professor with whom the student will study, to be submitted to the department.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Portuguese

See Hispanic Studies.

Psychology

The study of psychology covers a wide range of topics in the natural and social sciences. It provides students a unique opportunity to increase their understanding of themselves and other people as developing individuals, biological organisms, and participants in society. Because of the strong research orientation of the Department of Psychology, it also provides an understanding of how research is done and an opportunity to participate directly in research.

Majors in psychology can lead in various directions after graduation. Graduate study can prepare students for a career as an academic, clinical, industrial, or other kind of psychologist. Psychology is a useful major for students planning careers in medicine, law, or management, as the department has strength in cognitive science, psychobiology, psychopathology, the psychology of law, and social psychology. Whether students continue their education beyond the bachelor's degree, they will find that the psychology major provides knowledge about human behavior and methods of research and data analysis that is valuable in business, the helping fields, and other occupations.

At the graduate level, the department recognizes several specialties with programs leading to the PhD. Though opportunities for study and research are available to undergraduates in all these areas, there is only one undergraduate psychology major. Its requirements are designed to give every student a mastery of the basic methods and a balanced exposure to different aspects of psychology. Beyond that, students are encouraged to follow their interests in regular courses and in independent study. Extensive laboratory facilities, including a number of microcomputers, are available.

Program of Study for Departmental Majors

Prerequisite: A10 or A12.

Major courses: B01, B05, and seven additional courses beyond the A level (except B06), subject to the following restrictions:

- No more than two courses from among B07, B10, and B11 may count toward the seven
- At least one of the seven must be selected from among the laboratory courses C01, C11, C16, C21, and C33 (the same course may count toward this category and one of the two categories following)
- At least two of the seven must be selected from the cognitive and physiological category of C11, C12-1, C12-2, C21, C22-1, C22-2, C24, C27-1, C27-2, C28, C33, C34, C35, and C60
- At least two of the seven must be selected from the personality/clinical, developmental, and social courses B04, C01, C03, C10, C15, C16, C26, and C40
- Not more than one quarter of C99 may be used toward the requirement

Related courses:

- Three quarter-courses at the B level or higher in mathematics (one or two courses in computer programming, if approved by the director of undergraduate studies, may substitute for mathematics courses)
- Two quarter-courses from among biological sciences, chemistry, and physics

Honors in Psychology

Each spring quarter a few students with superior records in psychology are invited into C98 Undergraduate Seminar for the following academic year. Those who accept carry out a yearlong research project that, if completed, commonly leads to departmental honors in psychology. Honors in psychology

may also be achieved by carrying out a major research project through two or more quarters of C99 Independent Study.

Integrated Science Program

The Integrated Science Program is a highly selective BA program within the College of Arts and Sciences (see Integrated Science Program). Students in the ISP who also wish to complete a major in psychology should consult with the director of the Integrated Science Program and the director of undergraduate studies in psychology as early as possible to determine their specific additional major requirements.

Courses Primarily for Freshmen and Sophomores

451-A10-0 Introduction to Psychology
Basic psychological facts and principles of normal behavior. Laboratory.

451-A12-0 Introduction to Neuroscience
Brain processes in relation to behavior, including memory, perception, and motivation. The scientific study of mind and of brain mechanisms that control behavior. Dissection, histology, and surgery for brain stimulation. Prerequisite: one college or advanced high school course in biology recommended.

451-B01-0 Statistical Methods in Psychology
Measurement scales. Descriptive statistics. Introduction to probability theory and sampling distributions. Inferential statistics: one-sample, two-sample tests for means and proportions; analysis of variance; correlation and regression. Prerequisite: A10 or A12; some college mathematics recommended.

451-B04-0 Social Psychology
Psychological processes in social behavior. Prerequisite: A10 or A12.

451-B05-0 General Experimental Psychology
Execution and interpretation of experiments using the classical experimental designs. Prerequisite: B01.

451-B06-0 Computer Programming in Psychology
Introduction to computer programming methods with emphasis and examples appropriate for applications in psychology.

452-B07-0 Introduction to Cognitive Modeling
See Cognitive Science.

452-B10-0 Introduction to Cognitive Science: Language, Vision, and Memory
See Cognitive Science.

452-B11-0 Introduction to Cognitive Science: Learning, Representation, and Reasoning
See Cognitive Science.

Courses Primarily for Juniors, Seniors, and Graduates

451-C01-0 Personality Research
Current research in personality, with emphasis on experimental approaches and methods. Basic concepts of test reliability and validity. Lecture and laboratory. Prerequisite: B05.

451-C03-0 Psychopathology
Deviations in psychological processes as they occur in psychopathology. Prerequisite: A10 or A12.

451-C10-0 Developmental Psychology
Development of cognitive, social, and other psychological functions. Prerequisite: A10 or A12.

451-C11-0 Human Learning and Memory
The nature of human learning and memory with an emphasis on research methodology and report writing. Lecture and laboratory. Prerequisites: B05 and C28.

451-C12-1,2 Neurobiology and Behavior
1. Neurophysiology, neuroanatomy, sensory processes, examples of electrophysiological substrates of behavior. Prerequisites: A10 or A12 and one course in biology.
2. Neuroanatomical, electrophysiological, and biochemical substrates of learning, memory, attention, arousal, pleasure, pain, and biofeedback. Prerequisite: C12-1 or equivalent. B05 recommended.

451-C14-0 Special Problems
Topic to be announced. Prerequisite: consent of instructor. May be repeated for credit with change in topic.

451-C15-0 Psychology of Personality
Nature of personality and its development. Modern theoretical interpretations. Prerequisite: A10 or A12.

451-C16-0 Experimental Social Psychology
Theory and mechanics of social psychological experimentation (laboratory experiments, field experiments, quasi-experiments), with students conducting a group experiment and/or original research. Prerequisites: B04 and B05.

451-C21-0 Neuroscience and Behavior Laboratory
Classical exercises in the physiological psychology laboratory, including brain-wave recording and electrophysiology. Prerequisite: C12-2.

451-C22-1,2 Learning and Motivation
1. Principles of nonverbal learning; interrelations of learning and motivation; data from research with animals.
2. Applications to more complex aspects of learning, primarily in humans. Prerequisite for C22-1: A10 or A12. Prerequisite for C22-2: C22-1.

451-C24-0 Perception
Human perception, particularly vision. Also hearing, taste, smell, and touch. Biological foundations, development, and disorders of perception. The role of the senses in everyday life.

451-C26-0 Personality Development
Research methods, theories, and facts relating to the development and modification of children's attitudes and behavior. Prerequisite: consent of instructor.

451-C27-1,2 Formal Models of Cognition
1. Practical aspects of mathematical modeling in psychology. Curve fitting, distribution theory, reaction-time models, semantic and neural network models. 2. Introduction to mathematically expressed models of human choice and decision making. Descriptive models of complex qualitative data; multidimensional scaling. Prerequisites: Math B14-3 or equivalent and consent of instructor.

451-C28-0 Cognitive Psychology
Introduction to the empirical and theoretical research conducted by psychologists studying mental processes such as perception, memory, reasoning, problem solving, and decision making. Prerequisite: A10 or A12. B05 is recommended.

451-C33-0 Psychology of Thinking
Research methods and recent experimental findings for simple types of human thinking. Lecture and laboratory. Prerequisites: B05 and C28.

451-C34-0 Psychology of Language
Seminar in psycholinguistics for upper-level undergraduates and graduate students. Exposure to original research and journal articles and experience in methodological and theoretical criticism. Prerequisite: C28 or consent of instructor.

451-C35-0 Heuristic Decision Processes
Human decision making from both descriptive and prescriptive perspectives. Computer algorithms that simulate human performance provide a focus for examining traditional psychological models. Computer programming assignments. Prerequisite: computer literacy.

451-C40-0 Psychology of Law
Psychological theories and research related to the law. Topics may include socialization, attitudes toward government and law, law-related behavior, attribution of responsibility, negotiation, equity and fairness, trials and jury decision making, eyewitness testimony, civil commitment, prisons and evidence law. Prerequisite: A10 or A12.

451-C60-0 Human Memory and Cognition
In-depth survey of recent work in human memory and cognition. Prerequisite: C28 or consent of instructor.

451-C95-0 Psychobiology Research Seminar
Research methods and advanced topics related to brain function. Limited enrollment. Prerequisite: consent of instructor.

451-C98-1,2,3 Undergraduate Seminar (1–4 units)
Senior honors research. Open only by invitation of the faculty.

451-C99-0 Independent Study
Consent of instructor required.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Religion

Because religion is a multifaceted phenomenon, the academic study of religion and the religious is a multidisciplinary field. The undergraduate major in religion is designed to develop an understanding of several major religions through study of their historical development, sacred literature, and social manifestations. The faculty's training and the course offerings concentrate on the traditions of Hinduism, Buddhism, Judaism, Christianity, and Islam, though courses in other areas are presented occasionally. Study of the interaction of two or more traditions constitutes a regular part of the curriculum and the extracurricular seminars, lectures, and discussions. Undergraduate majors enjoy a wide range of extracurricular events and daily association with the faculty, staff, and graduate students.

Students, in consultation with the department adviser, may organize highly individual major programs of study that include courses from this department and other departments in the University. To ensure coherence and balance with the individuality of each program, students submit their proposed program for approval to both the department director of undergraduate studies and the department chair.

Program of Study for Departmental Majors

The program for majors in religion consists of ten courses in the department and four courses in related subjects.

The ten courses in the Department of Religion are designated as follows:

- A10 Religion in Human Experience
- C95 Theories of Religion
- Eight courses beyond the A level, at least five at the C or D level, including two in Eastern religions and two in Western religions
- Four courses in related subjects

These courses should be chosen in consultation with the department's undergraduate adviser, who is ready to assist students in organizing a major course program that concentrates in such options as religion and politics or that accommodates students' premedical or other preprofessional program of study.

Honors in Religion

Superior students in the department become eligible for departmental honors by writing a senior thesis. This is usually accomplished by enrolling in two quarters of C96 Senior Seminar during the fall and winter quarters of their senior year.

Students who intend to qualify for honors should notify the undergraduate adviser in writing by the end of the spring quarter of the junior year.

Courses Primarily for Freshmen and Sophomores

429-A10-0 Religion in Human Experience
Religion as it has appeared in the past and as humans continue to express it in their personal and social life.

429-A11-0 Varieties of Religious Tradition
The way religions originate, grow by internal development and by accretion, and interpret themselves.

429-B10-0 Introduction to Hebrew Bible
Major genres of Old Testament literature. Basic theological views and the social-political history of ancient Israel.

429-B11-0 New Testament Origins
The beginning, development, and content of the New Testament. Its Jewish and Hellenistic environment.

429-B20-0 Introduction to Hinduism
Unity and diversity of Hindu mythology, beliefs, and practices from ancient times to the present.

429-B22-0 Introduction to Buddhism
The Buddha's life and teachings, the traditions that developed from this teaching, and the systems of meditation, rituals, and ethics.

429-B23-0 Religion in China
Historical development of religious traditions in China from ancient to modern times; Confucianism, Taoism, and Buddhism.

429-B24-0 Introduction to Judaism
Main concepts in the theology of Judaism, main rituals and customs, and main institutions.

429-B25-0 Religion in Japan
Introduction to the religions in Japan from ancient to modern times, including Shinto, Confucianism, Taoism, and Buddhism.

429-B26-0 Introduction to Christianity
Christian doctrine, worship, and institutions in the various branches of Christianity.

429-B27-0 Introduction to Medieval Jewish Philosophy
Philosophic tradition of medieval Judaism, focusing on the history of Judaism more than on the history of philosophy, through study of the thought of the most important Jewish medieval philosopher, Moses Maimonides (1138–1204).

429-B28-0 Introduction to Islam
Principal beliefs and practices of Muslims set against the historic development of the faith.

Courses Primarily for Juniors, Seniors, and Graduates

Buddhism

429-C23-0 Buddhist Scriptures
Origins, development, and content of Buddhist sacred literature.

429-C24-0 Buddhism in the Modern World: Traditional and Reform
Buddhism's reinterpretation of its thought and practice in response to postcolonial modernizations.

429-C25-0 Theravada Buddhism and Culture
Theravada Buddhism in interaction with its culture.

429-C38-0 Central Ideas of Mahayana Buddhist Thought
Mahayana philosophy of life, its concept of reality, notion of individual existence, and view of the world.

429-C44-0 Nagarjuna's Madhyamika Philosophy

429-C46-0 Contemporary Buddhist Philosophy

429-C48-0 Zen Buddhism
Historical development of Zen Buddhist theory and practice.

429-C49-0 Shinran
Shinran's thought and the new religious movement it initiated in Japanese Buddhism.

429-C55-0 Topics in Buddhism
Barring duplication of subject, may be repeated for credit.

Judaism

429-C05-0 History of Judaism
Survey of the religious history of Judaism from the post-Biblical period to the emancipation.

429-C06-0 Judaism in the Modern World
Examination of the impact of emancipation and modernity upon Judaism. The fundamental problems that emancipation and modernity precipitate and the radical changes they bring to the religious expression of Judaism.

429-C10-0 Main Themes in Hebrew Scriptures
Distinctive religious ideas in Hebrew scripture.

429-C13-0 Varieties in Ancient Judaism
Introduction to the Judaisms that flourished from the 5th century B.C.E. to the 3rd century C.E.

429-C31-0 Recent Jewish Thought
Distinctive themes in the main 20th-century Jewish philosophers.

429-C32-0 The Rise of Rabbinic Judaism
Investigation of how Judaism was recreated after the destruction of the Temple in 70 C.E.

429-C34-0 Literary Expressions of Rabbinic Judaism
An examination of the forms of expression of Rabbinic Judaism: legal, mystical, philosophical, and poetic.

429-C35-0 The Art of Biblical Narrative
Ways in which the religious imagination of ancient Israel expresses itself through literary artistry.

429-C52-0 Topics in Judaism
Barring duplication of subject, may be repeated for credit.

Christianity

429-C02-0 Christian Ethics
Content and role of ethics in Jesus' formation of Christian teaching and in the theology of some recent Christian thinkers.

429-C12-0 Modern Study of Jesus
Recent approaches to the study of Jesus.

429-C50-0 Topics in Religion
Barring duplication of subject, may be repeated for credit.

429-C51-0 Topics in Christianity
Barring duplication of subject, may be repeated for credit.

429-C60-1,2,3 History of Christianity
Christian thought and institutions: general periods and major figures. **1.** c. 100–500 A.D. **2.** c. 500–1500 A.D. **3.** c. 1500–1900 A.D. Any unit may be taken independently.

429-C61-1,2 Foundations of Christian Thought
Survey of the development of Christian thought. **1.** Early or traditional Christianity. **2.** Christian thought since the Reformation.

429-C62-0 Recent Protestant Thought
Basic themes in 20th-century Protestant liberalism, neo-orthodoxy, and evangelicalism.

429-C63-0 Recent Roman Catholic Thought
Basic themes in Roman Catholic thought, especially since Vatican II.

429-C64-0 The Idea of Sainthood in Christianity
Historical and contemporary conceptions of sanctity, especially in Roman Catholicism and Eastern Orthodoxy.

429-C65-0 The Christian Mystical Tradition
Writings of mystics (e.g., Meister Eckhart, *Cloud of Unknowing,* Julian of Norwich, Teresa of Avila) in their cultural context.

429-C69-0 Topics in Medieval Christianity
Selected themes in the history of Christianity during the Middle Ages. May be repeated for credit.

Islam

427-C55-1,2 Islam in Africa
See History.

429-C57-0 Topics in Islam
Selected topics in Islamic history and thought. Barring duplication of subject, may be repeated for credit.

429-C75-1,2 History of Islam
1. Development of Islamic dogma, mysticism, and law against the background of political and social history of the Muslim peoples in the first six centuries of Islam. **2.** Developments in Islamic thought and institutions from the 13th century to the present; emphasis on 19th and 20th centuries.

429-C77-0 Trends in Islamic Thought
Quranic, Medieval, and modern approaches to problems in faith and social action.

Courses in Method and Comparative Study

429-C07-0 Judaism in Contemporary Christian Theology
Judaism in the theologies of Barth, Bultmann, Tillich, Niebuhr, Danielou, et al.

429-C08-0 The Understanding of Christianity in Modern Jewish Thought
The way Jewish thinkers in the 19th and 20th centuries perceived Christianity in relation to Judaism, e.g., Formstecher, Hess, Rosenzweig, Buber, Baeck.

429-C90-0 Comparative Study of Religions
History and present use of the comparative method of studying religions.

429-C95-0 Theories of Religion
Ways of analyzing critically religious experience and its meaning. Phenomenology of religion, history of religions, comparative religions.

429-C96-1,2 Senior Seminar

429-C99-0 Independent Study
For advanced students, reading and conferences on special subjects. Consent of instructor required.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Russian

See Slavic Languages and Literatures.

Science in Human Culture Program

The certificate program in science in human culture is designed to confront the fragmentation of modern culture that has attended the rise of science. The goal is to discover what the sciences have in common and to see how the scientific enterprise fits with other parts of human culture. Professors from many different disciplines, who educate each other in weekly seminars, bring undergraduates into this adventure.

Undergraduate Certificate in Science in Human Culture

Students who wish to earn a certificate in the program must select a coherent set of six courses from the following lists and must also take the senior seminar in the program. The critical issue in a student's program is coherence, and individual counseling is essential to the search for coherence. In consultation with a member of the faculty committee in charge of the program, students work out their own sets of courses, according to their curiosities and puzzlements. They must justify the coherence of their six-course set in a brief statement, to be approved by the faculty committee and filed in the CAS Office of Studies no later than the fall quarter of their senior year. No more than two of the six courses may be within the student's major department.

Interested students should pick the member of the faculty committee with interests closest to their own and arrange to have a chat. The list of committee members and some suggestions about how students with various interests might use the program are included in a brochure available from the Office of Studies. Committee members can provide a copy of the program's application form.

Students applying for CAS certificates must present records showing a minimum of five courses not double-counted in their majors.

Courses

485-B20-0 Science in Human Culture
Interaction between science and other parts of human culture. Three case studies, one in each of the following: science and worldview, science and technology, science and social relations. Emphasis on critical thinking about controversial issues.

485-C20-0 Science and Public Policy
Interaction between applied science and public policy. Barring duplication of subject, maybe repeated for credit.

485-C90-0 Seminar on Science in Human Culture
Advanced topics dealing with the place of science in human culture. Topic varies. May be taken for credit more than once. Prerequisite: senior standing or consent of instructor; preference to students in the program.

Related Courses

Anthropology C70 Anthropology in Historical Perspective
Geological Sciences B88 Earth and Life in Science and Art
History C50-1,2,3,4 The Intellectual History of Europe
History C64-1 Social and Intellectual History of Modern Britain: 1780–1900
History C76-1,2 Science and Modern Society
Philosophy B54 Scientific Method in the Natural Sciences
Philosophy C25 Philosophy of Mind
Philosophy C27 Philosophy of Psychology
Philosophy C52 Philosophy of Mathematics
Philosophy C54 Advanced Topics in the Philosophy of Natural Science
Philosophy C55 Scientific Method in Social Sciences
Philosophy C67 Philosophical Issues Concerning Technology
Physics C34 Introduction to Relativity
Physics C36-1,2 Introduction to Quantum Mechanics
Sociology C12 Social Basis of Environmental Change
Sociology C19 Sociology of Science
Sociology C26 The Logic of Social Inquiry
Sociology C55 Medical Sociology

In addition to these courses, other occasional offerings are eligible (e.g., History C91 Special Lectures, when offered on such topics as women in science or history of biomedical sciences). For up-to-date information, check with a member of the faculty committee.

Slavic Languages and Literatures

The department offers a full program of study in Russian language and literature and a range of other courses on the languages, culture, and history of Eastern Europe. Russian study encompasses a broad discipline that touches on many others. The rich heritage of Russia includes much that is fundamental to Western culture. For example, Turgenev, Dostoevsky, Tolstoy, and Chekhov probe philosophical, social, political, and psychological issues that are central to the 20th-century experience. Courses in Russian literature open up the artistry and ideas of this intellectual tradition. Russian language study can also serve as an entree into other Slavic languages; with a foundation in Russian, one can branch off into the related Slavic traditions. At this time, of course, Russian study has obvious practical significance as well.

Nonmajors as well as prospective specialists are served by the department's courses. Many courses offering a general acquaintance with some facet of Slavic studies have no prerequisite. All periods of Russian literature are represented, with emphasis on the 19th and 20th centuries. Russian language at all levels is taught by American and native speakers.

Students major in Russian language and literature for a variety of reasons. Some want the rigorous intellectual training and the breadth of cultural exposure. Some students are primarily interested in acquiring language skills for use in government service, international law or trade, journalism, or scientific research. Others use the major as a foundation for graduate work in comparative literature, linguistics, history, or political science. A number of students combine the major in Russian with a second major in one of these fields. Northwestern's library is an excellent resource for undergraduate and graduate study in Russian literature. Qualified advanced students have the opportunity to spend a quarter in Russia through a Northwestern study abroad program.

Programs of Study for Departmental Majors

Prerequisite for all majors: A02 or equivalent

Electives: 14 additional courses in Slavic and related fields

Honors: 2 additional courses

Plan A: No Study Abroad

Basic electives (7): B03-1,2,3; 4 courses chosen from B10-1,2,3, B11-1,2, B55

Advanced electives (7): C60 or C61; 5 C-level Slavic courses not already required or any D-level courses (students planning graduate study in Slavic should take C03-1,2,3 and 1 course in a related field determined with the undergraduate adviser)

Plan B: Study in Russia

Basic electives (7): B03-1,2,3; 4 courses chosen from B10-1,2,3, B11-1,2, B55

Study abroad: 3 credits toward the major

Advanced electives (5): junior tutorial; C60 or C61; 3 C-level Slavic courses not already required (except C03) or any D-level courses

Honors in Slavic Languages and Literatures

In addition to one of the major programs, students seeking honors in Slavic must complete C98 (1 credit) and C99 or a D-level seminar (1 credit).

Courses in Language and Linguistics

467-A01-1,2,3 Elementary Russian
1. A largely oral approach to the basic grammar and vocabulary necessary for reading, speaking, and writing simple Russian. **2,3.** Graded readings, conversation, writing.

467-A02-1,2,3 Intermediate Russian
The language of conversation, literature, and today's posters and newspapers. Weekly language lab; unabridged poetry and fiction; tapes and films. Prerequisite: A01-3 or equivalent.

467-B03-1,2,3 Russian Language and Culture
With C03, comprises a two-year sequence of advanced language study. Conversational and written skills using modern Russian culture as basis for study. Values, concerns, popular and high culture.

467-C03-1,2,3 Advanced Russian Language and Culture
Effective self-expression in Russian, using contemporary issues as basis for discussion and writing. Newspapers, films, written reports. **1.** How Russians see America. **2.** Women in Russia. **3.** Russia in the 1980s. Prerequisite: B03-3 or equivalent.

467-C20-0 Structure of Various Languages
Phonological and syntactic structure of a particular Slavic language (Czech, Polish, Serbo-Croatian). May be followed with C45 for further work in same language. Languages alternate; consult *Class Schedule.*

467-C40-0 History of the Russian Language
Russian phonology, morphology, and syntax from Proto-Indo-European to contemporary Russian. Effects of the changes on the contemporary language.

Courses with Reading and Discussion in English

467-B10-1,2,3 Introduction to Russian Literature
Comprehensive overview of the central prose works and literary movements in 19th-century Russia. **1.** Thematic and formal study of major works by Pushkin, Gogol, Lermontov, Turgenev. **2.** Tolstoy, Dostoevsky. **3.** Turgenev, Leskov, the late Tolstoy, Chekhov, Bunin, Gorky.

467-B11-1,2 Introduction to 20th-Century Russian Literature
Major trends in Russian literature from the turn of the century through the rise of Socialist Realism to the present. Interaction of literature with broader social, ideological, and political contexts. **1.** Bely, Blok, Babel, Olesha, Mayakovsky, Pasternak, Platonov. **2.** Kataev, Tertz, Bulgakov, Solzhenitsyn, Erofeev, Trifonov, Voinovich.

467-B55-0 Slavic Civilization
History, literature, and culture of the Slavs (Bulgarians, Macedonians, Serbs, Croats, Russians, Ukrainians, Byelorussians, Poles, Czechs, Slovaks) from antiquity through the 13th century.

467-B57-0 Introduction to the Soviet Union and Successor States
Broad survey of Russian cultural, social, political, and economic life in the 20th century. Focus on the Soviet period and its aftermath in light of Russia's historical background.

467-C10-0 Tolstoy
Tolstoy's artistic-intellectual development through his major fiction.

467-C11-0 Dostoevsky
Dostoevsky's artistic and intellectual position in Russian literature as revealed in the major novels, shorter fiction, and diaries.

467-C18-0 19th-Century Russian Comedy and Satire
The nature of comedy, the types of satire, and the functions of laughter in the works of Gogol and Chekhov.

467-C30-0 Old Russian Literature
Russian literature from the 11th through 17th centuries as represented by the literatures of Kiev and Novgorod, the literature of the provinces, and Muscovite literature.

467-C35-0 18th-Century Russian Literature
Russian poetry in the classical and preromantic periods, metrical systems and literary language; aesthetic and cultural developments, interactions with the West: Lomonosov, Sumarokov, Muravyov, Derzhavin, Karamzin.

467-C68-0 Russian Drama
Survey of the rich Russian dramatic and theatrical tradition from the early 19th century to the present. Pushkin, Gogol, Ostrovsky, Blok, Mayakovsky, Bulgakov, Petrushevskaya.

467-C69-0 20th-Century Russian Drama and Theater
Modernist dramatic and theatrical traditions of Russia from the rise of the Moscow Art Theater to the advent of Socialist Realism. Dramas by Chekhov, Blok, Khlebnikov, Mayakovsky; productions of Stanislavsky, Diaghilev, Meierkhold; design innovations of Tatlin, Malevich, Exter.

467-C90-0 Literature and Politics in Russia
More than in any other European tradition, Russian literature has played a central role in defining the nation's political agenda. The interaction of literature with Russian cultural and political history.

Courses in Literature with Prerequisite in Russian

Unless otherwise indicated, the prerequisite for C-level courses is B03-3 or equivalent.

467-B01-0 Readings in Russian Literature
Reading and discussion of selections from the works of the Russian masters, with some attention to biographical and cultural background. Prerequisite: A02-3.

467-C60 Survey of 19th-Century Russian Poetry
Introduction to the wealth of Russian 19th-century lyric poetry and to basic techniques for its study: Pushkin, Baratynsky, Lermontov, Tyutchev, Fet.

467-C61-0 Survey of 20th-Century Russian Poetry
Introduction to the major currents of Russian 20th-century lyric poetry and to basic techniques for its study: Blok, Mayakovsky, Khlebnikov, Akhmatova, Tsvetaeva, Mandelshtam, Pasternak, Brodsky.

467-C98-0 Senior Honors Seminar
Topics vary yearly.

467-C99-0 Independent Study
For Russian majors selected by the department as candidates for departmental honors and for other advanced students with consent of instructor.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Sociology

The Department of Sociology offers preparation for students who want to pursue careers in social research, social policy applications, and teaching. It provides an excellent background for all professions involved in the major structures of modern society, such as business, public administration, law, medicine, journalism, planning, and many more. The department also emphasizes the sociological perspective as a fundamental part of a liberal education and a discipline for developing a humane understanding of the world.

The department is particularly strong in the areas of urban studies, comparative historical sociology, the sociology of art and culture, deviance and social control, organizations, and the sociology of law, education, and science. Unusually good opportunities are available for independent study, field internships, and the use of qualitative historical and comparative methods of research. In addition to the courses listed below, the department offers quarterly seminars on special topics of interest. The department offers a wide variety of approaches to fundamental issues of social inequality, its origins and consequences, including class and economic domination, race, ethnicity, and gender.

Program of Study for Departmental Majors

Major courses: one sociology quarter-course at the A or B level (except A01 and B26) and nine additional quarter-courses, distributed as follows:

- Three courses in methods of social research: B26, C03, and C29 or C69 (B26 should be taken in the freshman or sophomore year and the C-level methods courses in the junior year)
- C06 Sociological Theory (junior or senior year)
- C98-1,2 Senior Research Seminar (fall and winter quarters of the senior year)
- Four additional C-level sociology courses; only one unit each of C76, C99, and General Studies C93 may be used to fulfill this requirement

In certain cases, students who are combining a major in sociology with a major in another field that also requires a senior research seminar may arrange to fulfill their seminar requirement in a combined project.

Related courses: four C-level quarter-courses in African-American studies, anthropology, economics, history, linguistics, political science, philosophy, psychology, or women's studies selected with the approval of the adviser.

The Teaching of Sociology

CAS students pursuing a major in sociology who also wish to be certified for secondary teaching must be admitted to the program and complete all requirements as outlined in the School of Education and Social Policy section of this catalog. Students are urged to contact the Office of Student Affairs in the School of Education and Social Policy as early as possible in their academic careers.

Honors in Sociology

Students who complete all requirements for the major, maintain the requisite grade point average in their major, and complete an outstanding senior research project in C98-1,2 or its equivalent will be nominated for honors in sociology to the College Committee on Superior Students and Honors, which has final authority to grant the honors degree.

Four-Year BA/MA

In rare instances, superior students may petition the department to complete BA and MA degrees in the normal four-year period required for the BA. Only unusually gifted and motivated students are accepted into this rigorous program. Interested students should consult with the undergraduate advisers early in their school careers.

Students under Former Requirements

Students who entered the departmental major before the present requirements and course changes went into effect may follow the regulations in force at the time they entered the department. Students should consult their advisers about the interim arrangements.

Courses Primarily for Undergraduates

471-A10-0 Introduction to Sociology
Essential characteristics of group life. Interrelations of society, culture, and personality. Basic institutions and processes.

471-B01-0 Social Inequality: Race, Class, and Power
Origins and functions of stratification. Class, prestige, and esteem. Interaction of racial and cultural groups in various settings. Black-white relationships in the United States.

471-B02-0 Social Problems: Norms and Deviance
How social norms and issues of concern emerge. Rules, rule enforcers, rule breakers; advocates, opponents, and victims of problems. Organization of blame, help, and entitlement. Current problems and systemic contradictions.

471-B03-0 Revolutions and Social Change
Causes and outcomes of large-scale social change. Role of violence and revolution in the development of the modern world.

471-B04-0 Social Interaction: The Individual and Society
Development of individual attitudes and behavior patterns through social interaction. Relation to students' everyday life and problems.

471-B05-0 American Society
How American society works as a whole. How major institutions relate and affect each other; how the different segments and strata of society experience such institutional processes. Tensions associated with differential experience of common and shared institutions.

471-B06-0 Law and Society
Introduction to role of law in American society. Relationship of law, inequality, and social change. Patterns of change in major legal institutions: the courts, the legal profession, and legal services for the poor.

471-B07-0 Problems of Contemporary American Cities
Problems of American urban communities and possible solutions. Spatial, economic, and political trends; private and public decision making; class, race, and family needs. Consequences for adequate public services.

471-B15-0 Economy and Society
Introduction to sociological approaches to economic life. Property rights, informal and illegal markets, money, consumption, economic inequalities, direct sales organizations, boycotts, and other issues.

471-B16-0 Sociology of Sex Roles
Social determination of gender appropriate behavior. Origins, values, and effects of sex-role stereotypes. How stereotypes fit social reality. Socialization (childhood and adult), values, economic opportunities in the United States, historically and currently.

471-B26-0 Sociological Analysis
Logic and methods of social research, qualitative and quantitative analysis of social data, ethical issues in social research, relation between social science and public policy. Provides foundation for further work in social research and for understanding reports of social scientific research.

471-C01-0 The City: Urbanization and Urbanism
Historical roots and theories of urbanization. United States urban structure in relation to economics and politics. Methods for studying the city and its neighborhoods. Urban reform policies. Prerequisite: A10 or B07.

471-C02-0 Sociology of Organizations
Structure and function of formal organizations, especially in business and government. Stratification, social control, and conflict. Discretion, rules, and information in achieving goals. Modes of participation. Development of informal norms. Prerequisite: A- or B-level sociology course.

471-C03-0 Analysis and Interpretation of Social Data
Introduction to quantitative methodology, emphasizing the interpretation of descriptive statistics (e.g., graphs) and relationships between variables (e.g., percentage differences, cross-tabulations, correlations). How to construct and read tables; how to use data to construct social science arguments. Prerequisite: B26.

471-C05-0 Demography and Population Problems
Population and social structure. Fertility, mortality, migration. Age-sex structure, spatial distributions, and socioeconomic composition. Problems of growth, distribution, population control, and scarce resources, in developed and underdeveloped societies. Prerequisite: A- or B-level sociology course.

471-C06-0 Sociological Theory
Sociological perspective as developed by classic theorists. Elucidation and testing of sociological principles in contemporary research. Primarily for sociology majors. Open to others with consent of instructor. Prerequisite: B26.

471-C07-0 School and Society
Reciprocal influences between formal institutions of education and the broader society from different theoretical perspectives. Internal organization of schools. Relationship between education and inequality and to problems of contemporary urban education. Prerequisite: A- or B-level sociology course.

471-C08-0 Sociology of Deviance and Crime
The social organization of crime and other misdeeds, explanations of crime and deviance, creating criminal law, policing, detection and investigation, prosecution, plea bargaining, the courts, sentencing, punishment, prisons, and alternatives to criminal law. Prerequisite: A10 or B02.

471-C09-0 Political Sociology
Selected topics in political economy and sociology: revolutions, the development of the modern state, third world development, international conflict. Prerequisite: A- or B-level sociology course.

471-C10-0 The Family and Social Learning
Historical and modern relationships of families to major social institutions. Variations in marriage, divorce, and remarriage patterns under changing social and economic conditions. Role pressures in modern family systems, with changing social values and familial resources. Prerequisite: A- or B-level sociology course.

471-C12-0 Social Basis of Environmental Change
Relationship of the social organization of production and consumption to environmental degradation. Evaluation of social forces supporting and opposing environmental reform. Social welfare consideration in alternative models of reform. Prerequisite: A- or B-level sociology course.

471-C14-0 Sociology of Religion and Ideology
Relation of belief systems to social structure. Generation, maintenance, and decline of organizational commitment. Production of ideas. Religion, art, science, political ideology, and folk-knowledge as social products. Prerequisite: A- or B-level sociology course.

471-C15-0 Industrialism and Industrialization
Structure and culture of modern industry; consequences for status and class organization. Labor force, formal and informal organization of management and labor. Union-management interaction. Factors affecting industrial morale. Prerequisite: A- or B-level sociology course.

471-C18-0 Sociology of Law
Organization of the legal order—institutions of adjudication and dispute settlement and of law enforcement. Courts, administrative agencies, police, and legal professionals. Patterning and control of discretion. Dynamics of legal participation. Prerequisite: A10 or B06.

471-C19-0 Sociology of Science
Science as a social system. Personality, social class, and cultural factors in scientific development, creativity, choice of role, simultaneous invention, and priority disputes. Social effects on objectivity and bias.

471-C21-0 Armed Forces and Society
Contemporary military instructions and sociological theory. Changing social organization of the military. Civil-military relations, military recruitment and socialization, modern warfare, and the role of the military in developing nations. Prerequisite: A- or B-level sociology course.

471-C23-0 American Subcultures and Ethnic Groups
Differentiation, organization, and stratification by ethnicity, race, life-style, and other traits. Maintenance of subgroup boundaries and distinctiveness. Development and continuity of American society as a system of subgroups. Consequences of difference: identity, political and economic participation, group solidarity. Prerequisite: A- or B-level sociology course.

471-C24-0 Social Structure in African-American Communities
Institutional variation and social change. Black populations in local settings, urban and rural, contemporary and historical. Some attention to different eras and regions in United States and other New World societies. Prerequisite: A- or B-level sociology course.

471-C25-0 Social Stratification
Bases of social stratification. Effects on life conditions and social organization. Theoretical, methodological, and empirical dimensions. Emphasis on advanced industrial societies. Prerequisite: B26.

471-C26-0 The Logic of Social Inquiry
Tensions between methodological rules and researcher judgments in the practice of social inquiry. Trade-off in various research designs. Social contexts and their resources for or restraints on social researchers. Impact of research context on forms of observation and reporting of inferences. Prerequisite: B26.

471-C27-0 Youth and Society
The ways that persons between the ages of about 10 and 15 interact with various institutions (families, schools, employers, welfare agencies, etc.), influencing these institutions and being influenced by them. Ethnic and class differences in these interactions. Prerequisite: A- or B-level sociology course.

471-C29-0 Field Research and Methods of Data Collection
Practicum in data collection that addresses common issues in observation, structured and unstructured interviewing, and surveys. Special attention to problems of reactivity and issues of reliability and validity. Prerequisite: B26.

471-C30-0 Basic Statistics for Social Research
First course of an advanced sequence in social statistics. For advanced undergraduates and beginning graduate students not previously exposed to quantitative methods. Prerequisite: consent of instructor.

471-C31-0 Markets, Hierarchies, and Democracies
The forms and social structures for making economic decisions in modern societies. Theories of what different forms are good for, the conditions under which they tend to occur, and what sorts of outcomes they tend to produce. Prerequisite: A- or B-level sociology course.

471-C32-0 Work and Occupation in Modern, Industrialized Societies
Work in modern society and its place in the moral order: workers in selection, recruitment, socialization, and stages

of practice throughout their careers; the relationship of work and other responsibilities to family and the larger society. Prerequisite: A- or B-level sociology course.

471-C39-0 Comparative and Historical Sociology
Theoretical and methodological issues in the comparison of whole societies and other macrosocial units. Contrast approaches that emphasize variables with those that emphasize cases (e.g., countries) and their histories. Prerequisite: A- or B-level sociology course.

471-C45-0 Class and Culture
The role that culture plays in the formation and reproduction of social classes. Class socialization, culture and class boundaries, class identities and class consciousness, culture and class action. Prerequisite: A- or B-level sociology course.

471-C50-0 Sociology of the Arts
Art as collective activity. Conventions in artistic activities and in aesthetic responses. Training of professionals and audiences. Relation of artistic works to other aspects of culture. Prerequisite: A- or B-level sociology course.

471-C55-0 Medical Sociology
Response to illness in various cultures and societies. Identification, distribution, and treatment of illness. Care systems, careers, practices. The sick role, sickness as deviant behavior. Politics of health care delivery. Prerequisite: A- or B-level sociology course.

471-C69-0 Field Research and Methods of Data Collection
Fifteen-week, 1.5 credit version of C29.

471-C76-0 Topics in Sociological Analysis
Advanced work on special topics in sociological study.

471-C80-7 Junior Year Tutorial
Small seminar group in conjunction with various scheduled C-level classes.

401-C93-0 Chicago Field Studies Internship
See General Studies.

471-C98-1,2 Senior Research Seminar
Majors prepare an independent project/thesis under faculty direction. Occasionally students may collaborate on a common research topic. Prerequisite: C03 or C29.

471-C99-0 Independent Study (1 or 2 units)
Open with consent of department. Registration extension to more than one quarter.

D-Level Courses
Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Spanish
See Hispanic Studies.

Statistics
Statistics is the scientific discipline that deals with the organization, analysis, collection, and interpretation of numerical data. Statistical methods are widely used to design and analyze experiments, sample surveys, censuses, and other observational programs. Such analysis involves both description of the properties of groups of observations and problems of drawing inferences from such data. Applications to the biological, social, and physical sciences are widespread, and statistical analyses are increasingly required in actuarial work, accounting, finance, engineering, medicine, and law.

Program of Study for Departmental Majors
Prerequisites: (a) Math B14-1,2,3; B15; and B17; (b) Math B20-1,2,3; (c) Math B90-1,2,3; or (d) the equivalent.

Major course requirements: Math C30-1 or IE/MS C02; Stat C20-1,2; Stat C50; Stat C98; and three of the following courses: Math C30-2; IE/MS C15; Stat C25; Stat C51; Stat C52; Stat C55; Stat C59; IE/MS C05. Of these three courses, one must be either Stat C25 or Stat C51. Students may not apply both Math C30-2 and IE/MS C15 to the major requirement.

Honors in Statistics
Departmental majors with outstanding records both overall and within the department may apply for graduation with departmental honors. A departmental recommendation for honors requires that two quarters of C98 Undergraduate Seminar be used to submit a research paper.

Courses Primarily for Undergraduates
473-B02-0 Introduction to Statistics
Data collection and summarization, random variables, correlation, regression, probability, sampling, estimation, tests of significance, and two-sample comparisons. Does not require calculus and makes minimal use of mathematics.

473-B03-0 Statistics and Public Policy
Basic statistical concepts and techniques introduced through a series of case studies of interesting public policy issues. The cases illustrate various kinds of data collection methods with their own strengths and weaknesses.

473-B10-0 Introductory Statistics for the Social Sciences
Introduction to basic concepts and methods of statistics and probability. Methods of data collection; descriptive statistics; probability, distributions, moments; normal distributions; association and correlation; regression; estimation; sampling distributions; confidence intervals; hypothesis testing. Examples from various social sciences; see CTEC description for current emphasis.

473-C02-0 Elementary Statistical Methods
Tabular and graphical presentation of data, statistical distributions, hypothesis tests, confidence intervals, comparisons of

means and proportions, regression and correlation, use of computers in statistical analysis. Prerequisite: Math B14-2 or equivalent.

473-C03-0 Concepts in Statistics with Public Policy Applications
Public policy case studies introduce basic statistical concepts and techniques. The cases illustrate various data collection methods and their strengths and weaknesses. Emphasis on concepts.

473-C20-1,2 Statistical Methods
1. Distribution functions, densities, measurement of location and scale, random sampling, random variables, sampling statistics, hypothesis tests, confidence intervals, parameter estimation, and nonparametric methods. 2. Correlation and regression, contingency tables, analysis of variance, design and analysis of experiments. Prerequisites: Math C30-1 or Industrial Engineering C02.

473-C25-0 Survey Sampling
Probability sampling, simple random sampling, error estimation, determination of sample size, stratification, systematic sampling, replication methods, ratio estimation and regression estimation, pseudo replication method, cluster sampling, multiphase sampling, nonsampling errors. Prerequisites: two quarters of statistics or consent of instructor.

473-C50-0 Regression Analysis
Simple linear regression and correlation, multiple regression, residual analysis, stepwise regression, and other methods of selecting subsets of variables, multicollinearity and shrinkage estimation, nonlinear regression. Prerequisite: C20-2 or equivalent.

473-C51-0 Design and Analysis of Experiments
Methods of designing experiments and analyzing data obtained from them: one-way and two-way layouts, incomplete block designs, Latin squares, Youden squares, factorial and fractional factorial designs, random-effects and mixed-effects models, split-plot and nested designs. Prerequisite: C20-2 or equivalent.

473-C52-0 Nonparametric Statistical Methods
Survey of nonparametric methods, with emphasis on understanding their application. Sign test, Wilcoxon signed-rank test, Mann-Whitney test, Kolmogorov-Smirnov test, Friedman test, Kruskal-Wallis test, nonparametric confidence intervals, nonparametric regression, and rank correlation. Prerequisite: C20-2 or equivalent.

473-C55-0 Analysis of Qualitative Data
Introduction to the analysis of qualitative data. Measures of association, log-linear models, logits, and probits. Prerequisite: C20-2 or equivalent.

473-C59-0 Topics in Statistics
Topics in theoretical and applied statistics to be chosen by instructor. Prerequisite: consent of instructor.

473-C91-0 Statistics and Probability for ISP
Introduction to basic statistical and probability theory and applications in the natural sciences. Ordinarily taken only by students in ISP. Prerequisites: Math B91-1,2,3 and C91-1; Physics A25-1,2,3.

Related Courses in Other Departments
(Department in parentheses.)

435-C30-1,2,3 Probability and Statistics (Mathematics)

738-C02-0 Probability (IE/MS)

738-C05-0 Statistical Methods for Quality Improvement (IE/MS)

738-C15-0 Stochastic Models and Simulation (IE/MS)

D-Level Courses
Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Undergraduate Leadership Program
The Undergraduate Leadership Program, a certificate program open to all undergraduates, helps students understand the nature of leadership and prepares them to become leaders. (See Undergraduate Leadership Program in the Other Undergraduate Programs section of this catalog.)

Urban Studies Program
The Program in Urban Studies enables students majoring in anthropology, economics, history, political science, or sociology to master their disciplinary major and to complement it with a second major in urban studies. With special permission of the director of the program, students with other majors in the College of Arts and Sciences also may elect urban studies as a second major. The purpose of the program is to introduce students to an interdisciplinary perspective on the city and its problems, bringing together faculty and students who share common interests but have different academic backgrounds. In addition to the following requirements, it is recommended that students who major in urban studies complete a methods or statistics course in one of the social science departments and participate in the Chicago field study program.

Program of Study for Majors in Urban Studies
- Fulfillment of the major requirements in any one of the following undergraduate departments: anthropology, economics, political science, sociology, history; or with consent of the director of the Program in Urban Studies, fulfillment of the major requirements in another department of the College of Arts and Sciences. No more than two courses may be double-counted toward urban studies and the student's other major; one course may be used to satisfy the core requirement, the other as an elective.

- Completion of four courses from an urban studies core consisting of Economics C53, C54; History C22-1,2; Political Science B21, C21; Sociology B07, C01; Civil Engineering C73.
- Completion of three additional courses chosen from the following list, no more than two from the same department and no more than one from urban field studies or internships: Anthropology C92; Art History C79; African-American Studies B36-2; Civil Engineering C71, C73, C74; Economics C37, C53, C54, C55; History C22-1,2; Political Science B21, C21, C22, C27, C30; Sociology B07, C01, C17, C24; any approved unit of urban field studies in any relevant department.
- Completion of the two-unit Urban Studies Seminar during the fall and winter or winter and spring quarters of the student's senior year. Check *Class Schedule* for quarters this seminar is offered.

Course

475-C98-1,2 Urban Studies Seminar
Open to senior majors in urban studies. Interdisciplinary approach to urban studies entailing design and execution of a research project over two quarters. Grade of K given in C98-1 changed to letter grade after completion of C98-2.

Women's Studies Program

The Women's Studies Program coordinates an interdisciplinary program of courses focused on new scholarly research on women and issues of concern to women, especially in the humanities and social sciences. These interdisciplinary courses are supplemented by a variety of courses on women offered through the regular academic departments. Women's studies courses at Northwestern offer information about and analyses of women's contributions to human culture, women's experiences examined historically and cross-culturally, and the social and political issues raised by contemporary changes in women's lives. Major themes addressed in the women's studies curriculum include women's roles in the economy, in the family, and in the public world; the social, political, and psychological impact of gender stratification; women's distinctive experiences, rituals, language, and consciousness; women's writing; and new social relationships between men and women. Consistently emphasized in this curriculum are the ways in which attention to women's lives and experiences has encouraged scholars to alter their preconceptions and research methods.

Undergraduate Certificate in Women's Studies

Students who wish to focus their interest in women's studies may earn a certificate in women's studies while simultaneously pursuing a departmental major in any undergraduate school. This certificate program offers students an opportunity to integrate required courses in their major with electives in related fields as the basis for an independent research project in the senior year.

Students qualify for the certificate in women's studies by satisfactorily completing the nine quarter-courses listed below. The electives in women's studies may be in their major. The women's studies faculty committee publishes each quarter a list of all electives approved for the certificate. Students are encouraged to enroll in freshman seminars with a focus on women, which may count as basic introductory courses. Students applying for CAS certificates must present records showing a minimum of five courses not double-counted in their majors.

Certificate requirements:

- Two quarters of basic introductory courses in the social and behavioral sciences, historical studies, or the humanities, chosen in consultation with a women's studies adviser. These courses need not focus on women.
- B30, B31 Introduction to Women's Studies. Prerequisite: one quarter of the required courses listed above.
- Electives: three one-quarter courses, at least two above the B level, focusing on women, offered through the academic departments, and chosen from the list of courses approved for the certificate in women's studies.
- C98-1,2 Research Seminar in Women's Studies or two C-level courses chosen from women's studies course list or approved by women's studies adviser.

Related courses: various departments and programs, such as anthropology, comparative literary studies, English, history, linguistics, philosophy, and sociology, regularly offer courses that fulfill the elective requirement. Examples of applicable courses include, but are not limited to, the following:

- Anthropology C54 Gender and Anthropology
- Comparative Literary Studies B71-4 Japanese Literature in Translation: Introduction to Modern Japanese Women Writers
- English C24 Studies in Medieval Literature: Women in Medieval Literature
- History B40 Women in West European History
- Linguistics C30 Topics in Language and Behavior: Language and Gender
- Philosophy C23 Studies in Contemporary Philosophy: Theory of Feminism
- Sociology B16 Sociology of Sex Roles

Students should check quarterly updates of approved courses.

Courses

480-B30-0 Introduction to Women's Studies I
New scholarship on women in the humanities and social sciences and cross-disciplinary problems and concepts of women's studies. Gender roles, the family, sexuality.

480-B31-0 Introduction to Women's Studies II
New scholarship on women. Work, education, feminism, the women's movement.

480-B91-0 Women in Culture and Society: Topics
Changing role and image of women in society. The "female world" in the cultural and socioeconomic milieu of one or several cultural and/or national traditions. Topics vary; may be repeated with change of topic.

480-C75-0 Internship in Women's Services
Field research and practical work experience in women's organizations; biweekly meeting with the instructor and other interns for discussions of common readings and their internship experiences. Consent of instructor.

480-C92-0 Topics in Women's Studies
Seminar in a specialized and interdisciplinary topic in women's studies. Samples: women and science; women in the labor force. Prerequisite: at least one course in women's studies, preferably B30-1 or B30-2.

480-C98-1,2 Research Seminar in Women's Studies
Extended individual research; regular class meetings for presentations of research designs, preliminary results, and the final paper. Open to juniors and seniors with consent of instructor.

480-C99-0 Independent Study
Individual tutorial or research projects. Prerequisite: consent of instructor and of a women's studies adviser.

Writing Program

The Writing Program was established in 1977 as part of an effort to give renewed emphasis to the teaching of writing at Northwestern. The program was created to administer the CAS writing proficiency requirement, offer courses in expository writing, and establish a core faculty of writing instructors. The Writing Program continues to serve these functions but has expanded in scope to serve students from across the University. Although it focuses its courses and tutoring particularly in the College of Arts and Sciences, the Writing Program now seeks to help all Northwestern undergraduates learn to write clearly, precisely, and persuasively.

As an independent program, the Writing Program collaborates with the Department of English and other departments and programs, but it maintains its administrative autonomy and thus preserves its sharply defined sense of purpose. A core faculty of experienced instructors is responsible for teaching the program's main sequence of basic, intermediate, and advanced composition courses. These are listed as English A05, B05, and C05. Writing courses are limited to 15 students, allowing instructors to comment extensively on each student's writing and to meet frequently with students in individual conferences. The Writing Program also operates the Writing Place, a center that offers free composition tutoring and advice to all Northwestern students. In addition to offering several sections of its standard courses each quarter and maintaining the Writing Place, the Writing Program occasionally teaches specialized courses and workshops. In recent years, these offerings have included courses in technical writing, a residential college tutorial on management communication, and a course in the Women's Studies Program, Writing Women's Lives. In all its offerings, the Writing Program concentrates on helping the individual student develop skill, confidence, and insight as a writer.

Students interested in a writing major should see the English Major in Writing section under English.

Courses

419-A05-0 Basic Composition
See English.

419-B05-0 Intermediate Composition
See English.

419-C05-0 Advanced Composition
See English.

School of Education and Social Policy

The mission of the School of Education and Social Policy is to aid both students and the society at large in the development of the capacities that improve lives. To achieve this mission, the school seeks to improve the experiences of individuals of all ages in schools as well as other settings. The school accomplishes this mission through scholarship; the training of professionals and scholars; and the provision of help, research findings, and recommendations to those who are engaged in promoting these improvements.

At the undergraduate level, the school provides professional and preprofessional training for students in the application of the social and behavioral sciences to an understanding of education. It offers programs for undergraduates enrolled in the school leading to the degree of bachelor of science in education and social policy in one of four programs: Social Policy, Psychological Services, Organizational Studies, or Secondary Teaching. Additionally, students enrolled in other schools of the University who qualify for admission to and complete all programmatic requirements of the Secondary Teaching Program also may qualify for secondary certification.

Applicants who hold a baccalaureate degree may make application to the school's master of science program and be considered for admission to study leading to entitlement for elementary or secondary teaching certification in the state of Illinois.

Academic Policies

Requirements for the Degree of Bachelor of Science in Education and Social Policy

The following requirements concerning residence and grade point average apply to all students seeking the degree of bachelor of science in education and social policy.

1. A minimum of 45 course units is required for graduation from the School of Education and Social Policy.

2. Students are required to maintain a minimum grade point average of 2.0 in all work presented for the degree. To qualify for teacher certification, students must earn a grade of A, B, or C for an overall average of 2.5 in all required core courses and all courses used to complete their teaching major. Students in the Social Policy, Psychological Services, and Organizational Studies programs must earn a grade of A, B, or C in all their core and program courses.

3. Full-time students in the School of Education and Social Policy may elect to enroll in some courses with the understanding that they will not receive a regular letter grade but that they will receive the notation P (pass) or N (no credit). They may elect one course per quarter under this option and may not elect this option in any course in their core, program, or teaching major.

4. Not more than one-fifth of the grades in courses taken at Northwestern and presented for graduation may be a combination of P's and D's. This requirement applies to students matriculating or transferring into the School of Education and Social Policy in fall 1987 and thereafter.

5. Any work taken at universities other than Northwestern that is to be counted toward fulfillment of Northwestern requirements must be approved in advance by the student's adviser and the associate dean.

6. Every candidate for a degree must file an application for the degree, along with a Planning and Advising Schedule, in the Office of Student Affairs a year in advance of the date of graduation (see Academic Calendar). That office will forward the application, when approved, to the Registrar's Office.

7. Students who wish to transfer into the School of Education and Social Policy Secondary Teaching Program may not be able to meet the requirements unless they plan carefully throughout their undergraduate program.

8. Transfer students must meet the following conditions:

- In most cases, applicants should apply to transfer not later than the beginning of their sophomore year
- Applicants must meet all program requirements expected of students in the School of Education and Social Policy
- Applicants must present evidence of acceptable academic performance at Northwestern

9. Students transferring from another university are required to complete the last 23 course units at Northwestern University.

In addition to and independent of the requirements set by the School of Education and Social Policy, all students must satisfy the University Enrollment Requirement (see Financial Regulations).

Honors

Students who maintain records of academic distinction may qualify for the Honors Program. Following completion of the junior year, any student who has attained an overall cumulative grade point average of 3.5 or above is eligible for the program. Students selected for the program work with a faculty adviser on an honors project during the senior year. The three-quarter program begins with registration for 205-C99 Independent Study with the honors project adviser. If progress is satisfactory, students are then eligible to register for 205-C98 Honors Thesis during winter and spring quarters of the senior year. Grades are based on performance throughout the project and on readers' evaluations of the project report. Additional information about the Honors Program is available from the Office of Student Affairs.

Probation

In addition to the University regulations regarding academic probation, an undergraduate student in the School of Education and Social Policy is ordinarily placed on academic probation when, in any one quarter, that student does not receive at least three final grades of A, B, C, or P or the cumulative grade point average falls below 2.0.

Academic Advisers

Each undergraduate student is assigned to an adviser in the Office of Student Affairs. This adviser is responsible for helping students plan their programs to meet the requirements for graduation and for completion of the major or program. Students consult with faculty about area interests and career planning.

For the advising system to work effectively, students must accept responsibility for taking all academic questions to their adviser in the Office of Student Affairs.

Students are required to obtain their adviser's permission to register for the first two quarters of the freshman year. Thereafter, such permission is not required unless the student is on probation or is instructed to do so by an adviser.

Petitions

Students must petition the faculty if they wish to be exempted from any of the regular degree requirements of the School of Education and Social Policy. Petition forms may be obtained from the School of Education and Social Policy Office of Student Affairs. No petition is considered unless it is signed by a member of the advisory staff of the Office of Student Affairs.

Placement Service

A complete range of services is provided at the Northwestern University Placement Center in Scott Hall.

All students should register with the Placement Center by securing the necessary forms as early in their final year as possible. When the forms are completed, students should attend an orientation session. Students may also receive individual attention in resume preparation as well as in career search and interviewing.

Students should also establish a reference file in the Placement Center to assemble credentials and confidential recommendations for future job or graduate school applications. Students who wish to register for on-campus job interviews should become familiar with the Placement Center's procedures early in the final year.

Academic Programs

Social Policy, Psychological Services, and Organizational Studies Programs

Students in the Social Policy, Psychological Services, and Organizational Studies programs receive a bachelor of science in education and social policy; 45 units are required for the degree.

Preprofessional Preparation

These three programs offer students an opportunity to prepare for a number of career options. Students in these programs have a wide variety of academic and career goals. Some intend to go immediately to graduate and professional schools, while others plan to enter a profession upon graduation. They are encouraged to design their programs with career objectives and/or graduate and professional school admission policies in mind. The programs are especially appropriate for those seeking careers in psychological services such as clinical psychology, social work, and counseling and in law, public service, management, and health professions.

Students interested in public service and in law will normally choose to follow the requirements of the Social Policy Program, where they can combine the policy-related course work of that program with courses in political science, communication studies, economics, urban affairs, and sociology to prepare either for graduate work in law or public policy or for policy positions in public and private agencies. Students in the Social Policy Program are encouraged to use their program electives to build specialties in such areas as juvenile justice, advocacy programs, or policy analysis and to develop the oral and written communication skills important to success in law school and in public policy positions.

Students interested in such fields as social work, clinical psychology, health, and counseling normally enter the Psychological Services Program. The core course work in human development and psychological counseling in this program, combined with other courses in psychology, sociology, and interpersonal communication, is particularly important for students considering such careers. Students with these interests are encouraged to use the program to complete the prerequisites in psychology and quantitative methods needed for graduate work in psychology and in the human service professions.

The Organizational Studies Program is well suited to students who plan careers in management. Within that program, students can combine the core course work in organization studies, public and social policy, psychology, and sociology with the necessary work in economics, quantitative methods, and interpersonal communication that will prepare them for positions in administration and business and for graduate work in management.

In all three programs, students focus on the interdisciplinary study of human behavior as it is shaped by social institutions, on understanding the behaviors that people bring to various institutional contexts, on identifying and analyzing the behavior shaping that takes place in these environments, and on establishing criteria by which to evaluate the purposes and effectiveness of institutional activities.

To work toward these goals, students register for a one-quarter practicum in off-campus settings such as governmental entities, community agencies, hospitals, juvenile homes, industry, law firms, and corporations where they can observe and participate in the activities of a socializing institution. During this quarter, students meet together in a weekly practicum analysis seminar. This seminar helps students integrate their past learning from course work with their observations of human behavior within an organizational setting.

Distribution Requirements (10 course units)

All students must complete at least two courses in each of the following distributional areas:

I. Natural sciences
II. Formal studies
III. Historical studies
IV. Values
V. Literature and fine arts

Distribution requirements for the School of Education and Social Policy follow the pattern approved by the College of Arts and Sciences. Courses approved by the College of Arts and Sciences can be used to meet

School of Education and Social Policy distribution requirements. In addition, selected courses in the School of Education and Social Policy or other professional schools can be used with the consent of the student's adviser.

Professional Core (8 course units)

All students must complete the two components of the professional core. One component provides students with a basic understanding of human development across the life span (225-C01 Human Development: Childhood and Adolescence; 225-C02 Human Development: Adulthood and Aging). Students also must demonstrate theoretical and practical mastery of quantitative and conceptual analysis through completion of two research methods courses (205-B10 Introduction to Statistics and Research Methodology; 205-C72 Methods of Observing Human Behavior). Students must complete 205-C72 before undertaking the practicum component of the professional core.

In the practicum component, all students complete a supervised practicum experience during the course of their program of study. The practicum involves a one-quarter, unpaid internship in an off-campus setting related to the student's program. Concurrent with the internship, students attend a weekly seminar on campus that integrates their experiential knowledge with the theoretical training in their course work.

Students must contact the practicum director in the undergraduate program at least two quarters before the beginning of the quarter in which the practicum will be taken. The practicum director advises students about procedures and application materials for a practicum placement.

Individually Planned Programs (16 course units)

Students in the Social Policy, Psychological Services, and Organizational Studies programs must prepare a program contract that includes a rationale for the configuration of courses chosen for their program of study. During the winter quarter of the junior year, the program contract must be submitted to the Program Contract Review Committee for approval.

Social Policy

The Social Policy Program is designed to encourage students to explore in depth the way in which policy decisions and social institutions influence the course of human lives.

Required courses are 225-B01 Introduction to Social Policy, 225-C11 The Political Economy of Social Policy, and 205-C02 Social Policy and the Human Services.

The remaining 13 units will be composed of individually planned combinations of courses related to some aspect of social policy, chosen from an approved list of courses offered by the School of Education and Social Policy and other departments (anthropology, political science, psychology, sociology). The Office of Student Affairs maintains the approved list from which students must select these courses. At least 8 of the 16 program courses must be at the C level.

Psychological Services

The Psychological Services Program is designed to encourage students to explore in depth the complexity of the contributions of institutions such as the family, the educational system, government, religious organizations, and the workplace to human development.

Required courses are 230-C01 Introduction to Counseling, 230-C11 Group Dynamics, and 205-C02 Social Policy and the Human Services.

The remaining 13 units will be composed of individually planned combinations of courses related to some aspect of human services, chosen from an approved list of courses offered by the School of Education and Social Policy and other departments (anthropology, communication studies, linguistics, psychology, sociology). The Office of Student Affairs maintains the approved list from which students must select these courses. At least 8 of the 16 program courses must be at the C level.

Organizational Studies

The Organizational Studies Program is designed to encourage students to explore in depth the structure of organizations—schools, corporations, political parties, hospitals, etc.—in modern society and the way in which individuals interact with organizations to influence the goals and achievements of the organizations

and to enhance their own goals. Students must take courses in several areas chosen from lists of specified courses available in the Office of Student Affairs.

In the area of organizations and their social context, students must take 205-B11 Introduction to Organization Theory and Practice, 205-C06 Studies in Organizational Change, 225-B01 Introduction to Social Policy, and two electives.

In the area of individuals and their social context, students must take either Psychology B04 Social Psychology or Sociology B04 Social Interaction: The Individual and Society and three electives.

The remaining 7 units will be composed of individually planned combinations of courses approved by the adviser that address the student's academic goals and improve the student's mastery of concepts and skills related to understanding organizations. Students planning to do graduate work in business or management are encouraged to take at least 3 courses in economics, including Economics C11 Microeconomics. At least 8 of the 16 program courses must be at the C level.

Electives (11 course units)

Eleven units of elective course work must be taken to complete the 45-unit degree requirement.

Secondary Teaching Program

Students enrolled in the School of Education and Social Policy or elsewhere in the University who wish to pursue a secondary teaching major and recommendation for certification through entitlement must apply for formal admission to the Secondary Teaching Program as early as possible after arriving at Northwestern and no later than the beginning of the sophomore year. To be recommended for certification through entitlement for secondary teaching (grades 6–12), students must be admitted to and complete the Secondary Teaching Program. Students completing degree requirements within the School of Education and Social Policy receive the degree of bachelor of science in education and social policy; 45 units are required for the degree. Students in other undergraduate schools also must fulfill degree requirements of their school.

Preparation for Professional Work in Middle and Secondary Schools

Individuals interested in the undergraduate Secondary Teaching Program should contact the Office of Student Affairs, School of Education and Social Policy. The Secondary Teaching Program is approved by the Illinois State Teacher Certification Board; those completing the program therefore qualify for secondary certification in Illinois through entitlement. Students who plan carefully may qualify for provisional certification in another state.

Major features of the Secondary Teaching Program:

- A solid academic foundation in the liberal arts, in the teaching content areas, and in human development
- A series of clinical experiences leading to a full-time student teaching internship

Students in this program will take course work in the liberal arts and complete a major in the academic subject they expect to teach. The clinical experiences include the observation of a wide variety of educational settings, co-teaching experiences, subject-oriented tutorials, and full-time student teaching internships.

Distribution Requirements (20 course units)

Distribution requirements must be planned to meet Illinois State Board of Education requirements for teacher certification. Distribution requirements for the Secondary Teaching Program follow the approved general education requirements of the Illinois State Board of Education.

All students must complete the following course work:

I. Biological and physical sciences (4 courses, 1 with lab)

- At least one biological sciences course
- At least one course chosen from astronomy, chemistry, geological sciences, and physics

II. Mathematics (2 courses)

III. Social and behavioral sciences (4 courses)

- Political Science 449-B20 American Government and Politics (The U.S. Constitution examination requirement is met by receiving a grade of C or higher in 449-B20.)

- Three additional courses chosen from anthropology, economics, psychology, political science, sociology, African-American studies, cultural and political geography, history, and psychology

IV. Humanities (6 courses)

- U.S. history (Can be used to fulfill social and behavioral sciences or humanities requirement.)
- English
- Non-Western or third-world course, including Asian, African, and Central and South American cultures (Can be used to fulfill social and behavioral sciences or humanities requirement.)
- Three additional courses chosen from history, the arts, the study of languages, literature, and philosophy

V. Communications (4 courses)

- Two courses in written composition
- One course in oral communication
- One additional course in speech or composition

VI. Health and physical development

- Three noncredit health and physical development courses

Additional Requirements for Certification

- United States citizenship or evidence of permanent resident status
- Illinois State Teacher Certification Examination (Basic Skills and Content Area tests)

Information about the required Illinois State Teacher Certification Examination is available in the Office of Student Affairs.

Professional Core (9 course units)

- 225-C01 Human Development: Childhood and Adolescence
- 205-C03 Problems in the Philosophy of Education or 205-C04 History of Education in the United States
- 205-C27 Problems of the Exceptional Child or 624-C36 The Field of Special Education
- 205-B41 Methods and Techniques of Teaching at the Secondary Level
- 205-C54–59 Tutorial in Education: Co-teaching
- 205-C81 Tutorial in Education: Student Teaching (4 units)

Teaching Major Requirements

Majors are as listed below under specific teaching major fields, which are designed to meet statutory and regulatory requirements of the Illinois State Board of Education. Teaching major requirements may differ from those of a departmental major, and departmental course offerings change frequently. Teacher certification candidates are required to meet regularly with the advising staff of the Office of Student Affairs to ensure that certification requirements are met.

Art

12 course units:

- Introductory courses: 406-A20; A24; A25
- Studio courses: 406-B22; B25; one course chosen from B20 or C20; one course chosen from B40, C40, or C42; one course chosen from C31, C32, C33; one additional art elective
- History and criticism courses: two courses chosen from 405-B01-1,2, or 3; one course chosen from B70 or B72

Related courses: six courses related to art in one CAS department

Biological and Physical Sciences

Biological Sciences

12 course units:

- Core courses: 409-B10-1,2,3; C01
- Botany: three courses chosen from 409-A03, A22, A66, A71, C15, C51, C52, C65, or C90
- Zoology: three courses chosen from 409-C02, C03, C04, C06, C12, C20, C21, C24, C25, C45, C50, C55, C56, or C92
- Laboratory: one course chosen from 409-C05, C08, C45, or C54
- Elective: one C-level course

Related courses: 411-A01, A02, A03, B10-1,2; 435-B14-1,2,3; 447-A35-1,2,3

Chemistry

12 course units:

- General: 411-A01, A02, A03; or A71, A72
- Organic: 411-B10-1,2 or B12-1,2
- Physical: 411-C42-1,2
- Advanced: 411-C29; C33
- Laboratory: one course chosen from 409-C01, 411-B15, C35, C45, or C61

- Electives: two or three B- or C-level chemistry courses to bring total to 12 units

Related courses: 435-B14-1,2,3 and 447-A35-1,2,3

Physics

13 course units:

- Introductory: 447-A35-1,2,3 or 447-A90-1,2,3
- Classical: four courses chosen from 447-C30-1, 2; C31; C32; C33-1, 2; C34
- Modern: 447-C36-1,2; C37; C38; C59-1,2,3

Related courses: 435-B14-1,2,3; B15; B17; B21

Students must also complete course work to qualify for a second teaching area.

English

14 course units:

- Prerequisites: one B-level introductory course; B98
- Composition: 419-B05; one other B- or C-level composition course
- Major courses: one literature criticism and theory course and one course from each of the following areas: 419-C20s, C30s, C40s, C50s, C60s, C70s
- Linguistics: one course chosen from 434-B03, B06, B08, C03, C05, or C12
- Reading and language acquisition: 205-C23
- Non-Western/third-world literature: one course in Asian, African, or Central or South American literature

Foreign Languages

French

12 course units:

- Language: 455-B02; B03; C02-1,2; C03; C05
- Literature: 455-B10; C15-2,3
- Other: 455-C80-1,2; one C-level course chosen from 455-C80, C91, or C92

Related courses: eight courses strongly recommended

German

12 course units:

- Language: 425-B03; B05; B08; C91
- Literature: three courses chosen from 425-B01-1,2,3,4
- Other: three courses chosen from 425-C10-1,2,3,4,5; two C-level courses

Related courses: eight courses strongly recommended

Latin

12 course units:

- Language: 413-A01-1,2,3
- Literature: 413-B01-1,2,3; C10
- Other: five B- or C-level courses

Related courses: eight courses strongly recommended

Russian

12 course units:

- Language: 467-B03-1,2,3; C03-1,2,3
- Literature: 467-B01-1,2,3; B10-1,2
- Other: one C-level course

Related courses: eight courses strongly recommended

Spanish

12 course units:

- Language and composition: 463-B03-1,2,3; C02; C03
- Literature: 463-B01-1,2,3 or B02-1,2,3; C23; one C-level Latin American or Spanish literature course; 463-C80
- Culture and civilization: 463-C50 or C51

Related courses: eight courses strongly recommended

Mathematics

12 course units:

- Calculus/analysis: five courses chosen from 435-B14-1,2,3; B15; B20-1,2,3; B21; C03; C05; C10-1,2,3; C11-1,2,3
- Geometry: two courses chosen from 435-C08; C26-1,2; C28-1,2; C29-1,2
- Algebra: two courses chosen from 435-B17; C34; C37-1,2,3
- Other: one probability and statistics course chosen from 435-C30, 473-B02, C02, or C20; one computer science course; one additional C-level mathematics course

Related courses: four related courses taken in one department other than mathematics

Social Sciences

History

12 course units:

- Analysis: two courses chosen from 427-A01; A02; A03; C89; C92; C93
- Concentration: five B- or C-level courses in one area of concentration
- Other history: five courses outside the area of concentration, one of which must be non-Western/third world

Related courses: five courses in other social sciences or humanities

Economics with History

16 course units:

- Prerequisites: 417-B01; B02; B10; B81

- Major courses: 417-C10-1; C11-1; four B- or C-level economics courses
- U.S. history: three courses
- World history: three courses

Political Science with History
16 course units:

- Prerequisites: 449-B20; two courses chosen from 449-B01, B21, B30, B40, B50, or B70
- Methods courses: 449-C95; one course chosen from 449-C10, C11, or C12
- Five courses chosen from 449-B10, B15, all 449 C-level courses
- U.S. history: three courses
- World history: three courses

Sociology with History
16 course units:

- Introductory: one A- or B-level sociology course
- Theory and methods courses: 471-B26; C03; C06; one course chosen from C29 or C69
- Five C-level sociology courses
- U.S. history: three courses
- World history: three courses

Electives

Additional units of elective course work must be taken to complete the 45-unit degree requirement.

Clinical Experiences

All requests for co-teaching and student teaching placements must be submitted to the Office of Field Experience by the fourth week of the quarter preceding the field experience.

Students admitted to the Secondary Teaching Program must complete a preliminary contract for their co-teaching experience (205-C54, 205-C55, 205-C56, 205-C57, 205-C58, and 205-C59) and for their student teaching experience (205-C81) during the first two weeks of each quarter in the field. To be placed as a student teacher, students must do the following:

- Complete appropriate core courses: 225-C01; 205-C03 or C04; 205-C27 or 624-C36; the general (B41) and specialized (C54, C55, C56, C57, C58, or C59) methods courses (methods courses that are taken simultaneously); and at least nine course units in the teaching subject major
- Present a 2.5 average and grades of A, B, or C in all courses used to complete the teaching subject major and in all required professional education courses
- Complete necessary forms

Teacher Certification at Northwestern

Students successfully completing approved teacher training programs at Northwestern qualify to receive, on application, Illinois certification through entitlement (i.e., certification by virtue of graduation from a teacher training program that has been reviewed and officially approved by the Illinois State Teacher Certification Board and that is offered by a college or university officially recognized by the Illinois State Certification Board).

Although legal requirements for certification vary from state to state, each teacher training program offered at Northwestern is sufficiently flexible to permit a student who plans carefully to complete provisional requirements of most states. Information concerning these requirements is available in the Office of Student Affairs of the School of Education and Social Policy.

Northwestern will recommend a student for a teaching certificate only when (1) the student has successfully completed an approved teacher preparation program and (2) the dean of the school or college in which the student is enrolled has attested in writing, to the University's designated certifying official, that the student's record indicates the student is "of good character" and "in good health" in accordance with the requirements of Section 21.1 of the School Code of Illinois.

A student who qualifies for certification as described above must apply to the University's designated certifying official for a recommendation for certification. Students in the Schools of Music and Speech should apply through their schools. All other students should apply through the Office of Student Affairs of the School of Education and Social Policy. Applications must be submitted early in the quarter preceding the final quarter of study at Northwestern.

The Illinois Constitution Examination is required for renewal of certification. This exam is offered three times during the school year for current students at the

School of Education and Social Policy. (For dates, see the *Class Schedule* issued each quarter.)

Graduates of a teacher training program at Northwestern who do not apply for certification upon graduation may not be eligible for licensure. The University will make every effort to assist its graduates in obtaining teaching certification at any time, but the rapidity with which certification requirements change makes it impossible to guarantee certification through entitlement at a later date.

International Studies Program

Any Northwestern undergraduate student may enroll in international studies, an undergraduate interschool adjunct major that is taken in conjunction with a traditional major. (See International Studies Program in the Other Undergraduate Programs section of this catalog.)

Undergraduate Leadership Program

The Undergraduate Leadership Program, an interschool certificate program open to all undergraduates, helps students understand the nature of leadership and prepares them to become leaders. (See Undergraduate Leadership Program in the Other Undergraduate Programs section of this catalog.)

Courses

Courses Primarily for Freshmen and Sophomores

205-B10-0 Introduction to Probability, Statistics, and Research Methodology
Definitions and classifications of terms used under the general heading of quantitative methods; measures of typical and maximum performance, reliability, and validity checks on all measures; reporting and displaying data; and interpreting results.

205-B11-0 Introduction to Organization Theory and Practice
Major theories and research explaining organizational structure and processes and individual behavior in organizational settings—such as corporations, schools, political parties, and hospitals. Motivation, socialization, leadership, goal setting, role processes, communication, group decision making, power, authority, control, and conflict within organizations.

205-B98-0 Student Organized Seminar
Students wishing to study topics not covered in the school's courses may initiate their own courses under the supervision of sponsoring faculty members. In consultation with the faculty sponsor, student organizers must prepare a plan for the seminar and submit it to the associate dean for student affairs before the middle of the quarter preceding the quarter in which the seminar is held. The plan must include a topic description, a reading list, specification of the examinable products such as term papers and written examinations, prerequisites, and the meeting schedule. All proposals must be formally reviewed and approved before a seminar may be offered. A student may enroll in only one Student Organized Seminar per quarter, and enrollment must be on the pass/no credit basis. Consult the associate dean for student affairs for further details.

225-B01-0 Introduction to Social Policy
Exploration of social policy formulation. Examination of substance of major American social policies and discussion of manner in which American political system shapes social policy in this country.

Courses Primarily for Juniors, Seniors, and Graduates

205-B41-0 Methods and Techniques of Teaching at the Secondary Level
Current instructional theory, research, and practice. Definition of instructional goals, implementation of goals through curricular design, measurement of relevant outcomes. Minimum of 50 hours of observation in selected schools. Open only to teacher certification candidates. Concurrent registration with co-teaching required. Prerequisite: consent of Office of Student Affairs.

205-C02-0 Social Policy and the Human Services
Development of social policy for human services in the United States. Human service policies for education, mental health, physical health, income, and aging.

205-C03-0 Problems in the Philosophy of Education
Problems in the philosophy of education. Topics vary.

205-C04-0 History of Education in the United States
Education and social change in the United States since 1789. Development of the American commitment to commonality in education; the changing relation between school and community since 1899; and the rise of the professional educator.

205-C06-0 Studies in Organizational Change
Case studies illuminating the process of change in complex organizations. Development of change strategies and measurement of change effectiveness. Emphasis on the ecology of organization—how external social and policy changes influence the internal processes of the organization. Prerequisite: 205-B11.

205-C11-0 Legal Aspects of Education
Structure of school governance; decision making; relevant state and federal legislation affecting public schooling.

205-C23-0 Foundations of Reading and Language Acquisition
Trends in the teaching of reading and language. Methods of instruction and their assumptions about the reading-language process and about the learner.

205-C26-0 Mathematics in the Elementary School
Selective mathematical topics taught in the elementary school. Relevant teaching strategies and instructional materials. Mathematical and psychological aspects of the concepts studied.

205-C27-0 Problems of the Exceptional Child
Handicapping conditions, including learning disabilities, resulting from human development and/or accidents; understanding and application of approved emergency, educational, and rehabilitative activities; interrelationships with medical, health, and educational personnel.

205-C28-0 Instructional Design
Perspectives on the planning of teaching and learning experiences. Attention to both print and nonprint media. Evaluation of instructional materials.

205-C52-0 Topics in Curriculum and Instruction
Recent innovations in instructional practices; technology of instruction, diversity in methodology, individualization of learning.

205-C54, C55, C56, C57, C58, C59 Tutorial in Education
The following six courses (1) provide an analysis of teaching content and development of learning experiences, methods, and educational techniques appropriate to the student's grade level and teaching field and (2) cover the literature, research, and scholarly content of teaching methodology. In preparation for the co-teaching experience, each student will develop a contract for that experience with the co-teaching professor, a teacher or administrator in the teacher training school where the internship is to be done, and the Office of Field Experience. Those seeking the secondary certificate must select either 205-C54, C55, C56, C57, C58, or C59. Taken simultaneously with 205-B41. Prerequisites: an approved contract for the co-teaching experience; consent of the Office of Field Experience.

205-C54-0 Tutorial in Education: Co-teaching in Art

205-C55-0 Tutorial in Education: Co-teaching in Foreign Languages

205-C56-0 Tutorial in Education: Co-teaching in English

205-C57-0 Tutorial in Education: Co-teaching in Secondary Mathematics

205-C58-0 Tutorial in Education: Co-teaching in the Sciences

205-C59-0 Tutorial in Education: Co-teaching in the Social Sciences

205-C72-0 Methods of Observing Human Behavior
Guided practice in systematic and participant observation of human behavior. Observer bias, field notes, unobtrusive measures. Prerequisite for 225-C83, 225-C85.

205-C81-0 Tutorial in Education: Student Teaching (4 units)
Further development of teaching methodologies by intensive clinical experience and teaching under the supervision of master teachers in the teacher training schools. Increasingly sophisticated teaching responsibilities and finally, primary responsibility for teaching a group or a class over a period of 10 weeks. Prerequisites: successful completion of the co-teaching experience and an approved tentative contract for the C81 internship experience; consent of the Office of Field Experience.

205-C83-0 Undergraduate Internship in Education
Opportunity for advanced undergraduates to gain field experience in practical and theoretical aspects of education. No more than two units may be taken in any one quarter. Prerequisite: consent of instructor directing the field study and of associate dean. (Students wishing to register must first complete the Request for Independent Study/Internship in Education form available from the Office of Student Affairs.)

205-C98-0 Honors Thesis
Following the completion of the junior year, any student who has attained an overall cumulative grade point average of 3.5 is eligible. Prerequisites: consent of instructor directing the honors thesis and of associate dean.

205-C99-0 Independent Study
Opportunity for students to pursue, under the direction of faculty members, special topics in education not covered by regular courses. Prerequisites: consent of instructor directing the study and of associate dean. (Students wishing to register in C99 must first complete the Request for Independent Study/Internship in Education form available from the Office of Student Affairs.)

225-C01-0 Human Development: Childhood and Adolescence
Personal, social, and cognitive development, birth through adolescence. Interplay of biological and experiential factors on ego, personality, linguistic, and conceptual development.

225-C02-0 Human Development: Adulthood and Aging
Psychological, sociological, and biological factors influencing socialization and development from young and middle adulthood through old age. Influences of family, school, and work on the individual.

225-C11-0 The Political Economy of Social Policy
American social policy from a cross-national comparative perspective. Examines the historical development of social policy in the Western world; assesses three competing perspectives on the "crisis" of the welfare state.

225-C13-0 Development of Black Children and Families: Research and Social Policy
Educational and human service policy concerns of black Americans; contemporary social policies affecting children and families; associated developmental, educational, and sociopsychological research.

225-C14-0 Role of Play in the Development of the Child
Structure of play behavior and the psychological development of the child. Function in the motor, cognitive, social, and emotional development of the child.

225-C16-0 Moral Values and Human Development: An Introduction
Examines moral development of the individual. Explores topic of moral values from several perspectives: age-developmental differences, cross-cultural and gender differences, relationship between moral reasoning and moral behavior.

225-C83-0 Practicum(2 units)
Internship *only* for students in the Organizational Studies, Psychological Services, and Social Policy programs. Intensive, supervised participant observation of (1) interpersonal relationships, especially those of professional and client, and (2) the effects of institutional structure and policy on both professionals and clients. Prerequisites: 205-C72 and consent of program director.

225-C85-0 Practicum Analysis Seminar (2 units)
Small-group meetings *only* for students in the Organizational Studies, Psychological Services, and Social Policy programs to analyze C83 practicum experiences, organize their perceptions of their own internships, and share them with other class members. To be taken concurrently with 225-C83. Prerequisite: 205-C72.

230-C01-0 Introduction to Counseling
Overview of counseling theories, techniques, client systems, and service settings.

230-C11-0 Group Dynamics
Theory and research in the social psychology of groups and social systems. Small- and large-group dynamics; intergroup relations. Participation in a weekend group relations conference.

230-C32-0 Career Development: Theory and Counseling
Process of career development and its relation to the world of work. Discussion of career development theories. Focus on self-assessment; decision-making skills; educational, occupational, and community information; and job-seeking skills.

434-C09-0 Psycholinguistics
See Linguistics.

451-C10-0 Developmental Psychology
See Psychology.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Robert R. McCormick School of Engineering and Applied Science

The McCormick School of Engineering and Applied Science is committed to providing leadership for the technological foundation of our society, economy, environment, and culture. The school's mission is two-fold: the personal and professional development of its students and faculty and the development and application of new technology, which is increasingly of an interdisciplinary nature.

McCormick is dedicated to a high standard of excellence in

- Teaching fundamentals of science and engineering disciplines and stimulating students to become innovative thinkers and leaders able to cope with complex issues in a changing environment
- Preparing undergraduate and graduate students for professional engineering careers in a competitive world, capable of understanding, applying, and contributing to technology in whatever areas or careers they subsequently pursue

Undergraduate students in McCormick may follow a curriculum leading to a bachelor of science degree in any of the following fields:

Applied mathematics
Biomedical engineering
Chemical engineering
Civil engineering
Computer engineering
Computer science
Electrical engineering
Environmental engineering
Industrial engineering
Manufacturing engineering
Materials science and engineering
Mechanical engineering

With proper use and combination of requirements, options, and electives, students may prepare themselves for graduate work in engineering and also for graduate studies in medicine, law, business, or other areas. Bachelor of science degrees are awarded also in approved ad hoc combined studies programs.

Graduate programs of study are available in all the above fields as well as in theoretical and applied mechanics, manufacturing management, and engineering management. These programs leading to degrees at the master's and doctoral levels are described completely in the Graduate School catalog or in publications on engineering graduate programs.

Excellence in research is a distinguishing characteristic of the engineering faculty. A faculty such as this, working at the frontiers of knowledge, is in the best position to maintain courses and curricula in a state of currency and to develop an atmosphere inspiring scholarship and originality among students.

The McCormick School has a student body of approximately 1,300 undergraduates and 950 graduate students. The school is housed in the Technological Institute, which contains more than 750,000 square feet of floor area and provides excellent educational and research facilities.

The Seeley G. Mudd Library for Science and Engineering, adjoining the Technological Institute, is an integrated and centralized collection serving engineering, applied mathematics, astronomy, biology, biochemistry, chemistry, and physics.

Academic Policies

Requirements for the Degree of Bachelor of Science

Students must successfully complete all 48 courses of the curriculum or demonstrate equivalent experience. Students who interrupt their programs of study for an

extended time during which degree requirements are changed will normally be held to the new requirements. Students who encounter curricular changes during their period of enrollment may choose to follow any curriculum during that period but must meet the requirements completely.

Students must earn a grade average of not less than C for all courses presented for the degree.

The grade point average of the 16 major program courses presented for the degree must be at least 2.00. Further, no more than two of these courses may carry grades of D.

Students must complete the last 23 quarter-courses while enrolled as an undergraduate in Northwestern University and must be enrolled in the McCormick School during the last three quarters of study.

Every candidate for a degree must file an application for the degree a year in advance of the date of graduation (see Academic Calendar).

In addition to and independent of the requirements set by the McCormick School, all students must satisfy the University Enrollment Requirement. (See Financial Regulations for details.)

Pass/No Credit Option

Undergraduates in the McCormick School may take a maximum of eight quarter-courses under the pass/no credit (P/N) option for use toward the degree. During the freshman and sophomore years, however, only one course per quarter may be taken under the P/N option.

The P/N option may be used in the following areas:

- Basic program: in any course taken as a social sciences/humanities selection or in any unrestricted elective. Although the number of C-level courses is not restricted (to the limit of eight as above), only four A- or B-level courses may be taken under the P/N option and used to satisfy the nine-course requirement in the social sciences/humanities area. This option may not be used in mathematics, basic sciences, and basic engineering courses.
- Departmental program: consult the department office or the McCormick School Records Office regarding the regulations for use of P/N in each departmental program.

Advanced Placement

Advanced placement and college credit may be granted on the basis of the College Entrance Examination Board (CEEB) advanced placement tests. Placement or exemption may be granted on the basis of the CEEB tests or special examinations in subject areas or by appropriate analysis of high school background. Any placement (verified by a grade of C or better in a subsequent course) in approved sequential work will reduce the course requirements for the BS by the number of courses preceding the placement. If students receive a grade of D or F in any course that is used to verify advanced placement, the course must be retaken. These stipulations regarding placement and exemption and degree requirements may differ from those of other schools of the University.

Personal Computers

The McCormick School emphasizes computing throughout the engineering curriculum. Entering students are expected to have timely access to a personal computer. While microcomputer laboratories are available to students at the Technological Institute building and elsewhere on campus, incoming students should consider carefully the merits of owning their own microcomputers for use throughout their undergraduate programs at Northwestern and thereafter.

Academic Options

Cooperative Program

The Walter P. Murphy Cooperative Engineering Education Program alternates periods of industrial experience and classroom work for full-time students in all departments of engineering and applied science. During 18 months of industrial employment, students can apply theory while gaining practical experience. This perspective enables them to develop an understanding of the responsibilities of their future professional careers.

Freshmen are invited to participate in workshops to prepare them for the co-op program. Sophomores in good academic standing begin applying for co-op positions as early as the fall quarter. The co-op coordinator

makes every effort to secure interviews for the students, so that cooperative work assignments are related to their professional objectives.

Generally, the first work experience for sophomore co-op students occurs the summer before their junior year. Co-op experience for junior and transfer students and others may begin in the spring of their junior year. If necessary, with the help of the academic advisers, special schedules can be worked out that will enable students to observe individual academic as well as co-op requirements.

Students register for their work quarters, but no tuition or fee is charged. The registration keeps co-op students enrolled at Northwestern during work periods. While no academic credit is given for co-op, special BS/MS programs may use co-op experience as the basis for undergraduate projects and master's theses.

Although emphasis is on the experience gained from cooperative work rather than on the income, students in the cooperative program may earn at least a portion of their educational expenses. Salaries range from $1,000 to $2,700 per month.

The following table shows the college-industry schedule for the full five years of undergraduate education:

College-Industry Schedule

	Summer	Fall	Winter	Spring
Freshman		1	2	3
Sophomore	vacation	4	5	6
Junior	work	7	8	work
Presenior	work	9	work	10
Senior	work	work	11	12

Students may be enrolled simultaneously in the co-op program and the Naval Reserve Officers Training Corps.

Students who complete their co-op plan receive tuition rebates during their final academic quarters to assure that they will not pay higher total tuition than other students in the same entering class.

In addition to the academic degree, the faculty of the McCormick School awards co-op students a certificate in recognition of successful completion of the Murphy Cooperative Engineering Education Program. Students must successfully complete at least four approved co-op quarters to be recognized as co-op students upon graduation from the McCormick School.

In several states, co-op experience is credited for up to one year of the usual four years of engineering experience required for the Professional Engineer's License.

Employers of co-op students include government and service institutions as well as industry. Northwestern coordinators visit participating employers periodically to discuss the students' abilities, attitudes, and progress on the job. At the end of each work period employers are asked to evaluate the students' performance and progress. It is important to note that neither students nor cooperative employers obligate themselves to permanent employment by virtue of the co-op status, even though most students do get impressive permanent job offers as a result of the co-op experience.

Undergraduate Honors Program

Students with good scholastic records may be admitted to the Undergraduate Honors Program any time during their junior or presenior year. At the time of admission, they must have a cumulative grade point average of 3.5 or better. Students who become eligible will be notified by the dean.

Honors students participating in the program must (a) complete at least three units of approved advanced study (including courses normally accepted at the graduate level) with an average grade of B or better and (b) complete an extended independent study project (at least two quarters on the same topic) leading to an acceptable report.

Successful completion of the Honors Program will be noted on the student's transcript. Recognition also will be given in the commencement program. If a student's individually evaluated performance is not judged to meet the standards of success, the student will receive course grades and credits as earned.

Undergraduate Research

Opportunities for undergraduate research are made available and encouraged in several ways. Each major field of study offers a C99 Projects for research enrollment on an elective basis. The Undergraduate Honors Program incorporates a required research component.

The McCormick School Undergraduate Research Board, composed of student leaders, administers a program that funds individual research projects from the Sara Boley Undergraduate Research Fund. The board helps select the winner of the Harold Benedict Gotaas Award, presented to the senior engineering student who submits the best original research paper.

Undergraduate research projects normally are performed under faculty direction, with faculty who are doing research in their department or in a University or McCormick School research center, laboratory, or council. Engineering faculty may be associated with a variety of research centers, including the NSF Center for Advanced Cement-Based Materials and the NSF Center for High-Temperature Superconductivity; the University's Materials Research Center, Center for Catalysis and Surface Science, Steel Resource Center, and Institute for the Learning Sciences; as well as McCormick School Centers for Engineering Tribology, Information Technology, Manufacturing Engineering, and Quality Engineering and Failure Prevention. Important research is also carried out by faculty working in the Applied Optics Laboratory, Quantum Devices Laboratory, and Council on Theoretical and Applied Mechanics.

Students admitted as freshmen to the Honors Program in Undergraduate Research will have the opportunity to be involved in faculty-guided research in all four years of study.

Two BS Degrees

Students with wide-ranging interests may work toward two bachelor of science degrees in the McCormick School. The work in both areas need not be completed at the same time, but the full requirements for each degree must be approved by each department (program) no later than two academic quarters before the completion of work for the second degree yet no earlier than the junior year. The full requirements for each degree must be satisfied. At least 54 courses or equivalents must be presented before the awarding of a second degree.

Second Field of Specialization

The elective opportunities in the McCormick School curriculum may be used toward a departmental program in another school of the University. Satisfactory completion of the requirements for the second program, verified by the appropriate department, will be noted on the student's transcript. Carefully planned electives will normally enable students to obtain a second field of specialization within the 48-course requirement for the BS degree.

Concurrent BS/MS

During their senior year, qualified undergraduate students in the McCormick School may work simultaneously toward the bachelor of science and master of science degrees in engineering. Integrated planning of course work involves the possibility of taking graduate-level courses during the third and fourth years. Also provided are early assurance of graduate admission and early planning of project or research work.

It is possible for some students to finish the work for an MS in a combined program in less than the normal five years. In the McCormick School, any advanced placement, exemption, or demonstrated proficiency will reduce the course work requirement.

The course requirements remain unchanged for the two degrees. In the McCormick School, the requirement for the BS is 48 courses, and the requirement for the MS is specified by the individual department (9–12 courses). No course used for the MS requirement may be used for the BS requirement.

Application for admission to concurrent BS/MS study may be made any time during the seventh through the ninth quarters, in accordance with departmental advice. However, upon beginning graduate study, students may have no more than four courses to complete toward the undergraduate degree. The graduate application must be accompanied by a full plan of BS/MS studies and must be approved by the appropriate department and the Graduate School. A department may require that students do additional work preliminary to a concurrent BS/MS program at any level.

Five-Year BA/BS

The McCormick School encourages breadth of interest and to this end supports combined degree programs in engineering and liberal arts. One approach is the 3-2 program, in which students attend a liberal arts college for the first three years with a course of studies that develops a basic understanding of science and

mathematics and a strong component in the social sciences and humanities. Following the three years of basic studies and on recommendation of the liberal arts college, students transfer to Northwestern. When they complete the requirements of a field of engineering in two years, a BS in engineering is awarded by Northwestern and a BA by the original college. Any student enrolled in an accredited liberal arts college program may apply for transfer admission to follow a 3-2 plan.

Another approach to combining liberal arts and engineering is a parallel arrangement of studies at Northwestern, in which a fifth year results in a BA with a major in the College of Arts and Sciences and a BS in a particular field of engineering. A petition outlining this dual plan of study should be filed before the fourth year; it must be approved by the departments and schools administering the degree work. The stated requirements of both schools and expected majors must be completed.

Engineering and Journalism

A combined program between the McCormick School and the Medill School of Journalism is designed for students who have strong interests in science, applied science, and engineering and in effective communication in these areas. For students in engineering, at least five journalism courses could form a "theme" and at least three science and/or mathematics courses could be used jointly to fulfill the science/mathematics requirement in journalism and some basic science and mathematics requirements in engineering. Students in this combined program, which normally takes five years to complete, must fulfill all course requirements for a degree in engineering as well as in journalism.

Students can apply for admission to this program during the regular undergraduate admission process through the Office of Admission. Students already enrolled at Northwestern may apply to the joint program, but not later than the beginning of their sophomore year. This later admission requires concurrent approval of the Medill School and the McCormick School.

Engineering and Music

For highly capable students who have a strong interest in and commitment to both engineering and music, a five-year program that will lead to bachelor's degrees in both fields is available. In engineering, any field of study may be chosen, resulting in a bachelor of science in the chosen field. In music, the bachelor of music or bachelor of arts in music is awarded. Admission to the program, which can be entered no later than the beginning of the sophomore year, requires concurrent approval of both the School of Music and the McCormick School.

International Education

Engineering students are encouraged to make choices within the curriculum to develop the background for international participation, a situation in which many engineers will find themselves engaged in the future. The thematic suggestions in the social science/humanities distribution call attention to international themes and suggest appropriate sequences of course work, including language study.

International studies, an undergraduate interschool adjunct major that is taken in conjunction with a traditional major, is open to McCormick students. (See International Studies Program in the Other Undergraduate Programs section of this catalog.)

Study abroad provides students with the opportunity to experience a different culture and sharpen their proficiency in a foreign language. Most study abroad programs in which engineering students participate are different from the traditional junior year abroad and are often shorter than an academic year. Students must consider their individual backgrounds, goals, and needs when looking for an appropriate program.

In addition to providing similar language and cultural experiences as a study abroad program, an engineering internship abroad also allows work in a technical setting. Students enrolled in the Murphy Cooperative Engineering Education Program can schedule meaningful work opportunities abroad (see Cooperative Program). Other students may locate summer work abroad through the International Association for Exchange of Students for Technical Experiences (IAESTE).

Honors Program in Undergraduate Research

The Honors Program in Undergraduate Research in the McCormick School provides an unusual opportunity for high school students with superior motivation and scholastic credentials (high school rank and board

scores) to be admitted to work with an engineering faculty mentor/adviser in a challenging research project. This research project participation could begin in the first year and continue through all the undergraduate years, allowing close association with a faculty researcher probing the frontiers of knowledge in engineering or engineering science.

This unique opportunity for experiencing the excitement of original research and the associated approach to learning provides the students with not only encouragement but also excellent preparation for graduate study. If students in the Honors Program in Undergraduate Research achieve advanced placement as well as satisfactory performance in the research project and accompanying course work, they will be considered for admission to the Graduate School and for award of financial aid during their third year of undergraduate study.

Honors Program in Engineering and Management

Students are eligible to participate in a joint program between the McCormick School and the J. L. Kellogg Graduate School of Management. Under this program, high school students with superior scholastic credentials and strong motivation for study beyond the bachelor's degree may be admitted to undergraduate engineering in McCormick and also granted deferred admission to the master of management program in Kellogg.

The program entails eight years, consisting of a combination of undergraduate and graduate study interspersed with related work experience. The initial studies are in a chosen field of engineering with a schedule of school and work in industry in accordance with the McCormick School's Murphy Cooperative Education Program. Normally this requires five years, four academic years and 1½ years of industrial work carried out in periods alternating with academic work during the last three years.

Students in the joint program may reduce the time in undergraduate work by using advanced placement and/or through heavier than average course loads. After these five years or equivalent, participants receive a bachelor of science degree in the chosen engineering field and are admitted to the Kellogg Graduate School of Management. The condition of this admission requires at least a B average in undergraduate course work and one further year of full-time work experience in industry before the two years of full-time study leading to the master of management degree.

Honors Program in Medical Education

The Honors Program in Medical Education (HPME) is designed for unusually gifted high school students who seek a career in medicine or medical science. It provides a plan whereby students entering Northwestern are admitted simultaneously to the McCormick School, College of Arts and Sciences, or School of Speech and to the Medical School. HPME students then participate in a challenging program, with the first three years in undergraduate study and the last four years in the Medical School, thus reducing the period of formal training by at least one year.

Students who meet the entrance requirements of the McCormick School may pursue a program leading to the bachelor of science in biomedical engineering degree after four years and the doctor of medicine degree after seven years.

Combined BS/DDS

A combined BS/DDS program is offered to qualified students in the biomedical engineering curriculum. Application is made for admission to Northwestern University Dental School after three years in the undergraduate program. Upon completion of the first year in Dental School, credits earned are accepted as electives and the BS is awarded by the McCormick School, provided all the requirements for that degree have been met. A number of places in each entering class at the Dental School are reserved for students who qualify for this program.

Undergraduate Leadership Program

The Undergraduate Leadership Program, an interschool certificate program open to all undergraduates, helps students understand the nature of leadership and prepares them to become leaders. (See Undergraduate Leadership Program in the Other Undergraduate Programs section of this catalog.)

Student Resources

Tutorial Program

The McCormick School conducts a program of guided study and tutorial help for freshmen and sophomores in all the required courses in mathematics, chemistry, physics, and engineering. This program encourages out-of-class work and good study habits and helps provide a full understanding of the early courses that are the foundation for much that is to follow. The aim is not to displace students in their learning efforts but to provide explanations to bridge the uncertain or unknown and lead to depth of understanding.

Faculty Advisers

During the first year, students are assigned a special freshman adviser. At the beginning of the sophomore year, most students will have selected a major field of study and will be reassigned an adviser in that area. The adviser assists in planning the program of study, but students retain the responsibility of meeting overall graduation requirements.

Counseling Office

The McCormick School employs professional counselors available to give students educational, vocational, academic, and personal counseling. Students can arrange to have interest testing through the Counseling Office. Vocational materials relating to engineering are available.

Organizations for Engineering Students

The McCormick Student Association is composed of representatives from each class in engineering and from approved McCormick organizations. It is the recognized representative body of undergraduate engineering students and as such serves as a link between the students and faculty and administration. It encourages and coordinates the activities of engineering students and student groups.

The McCormick Undergraduate Research Board is organized to stimulate undergraduate research and to provide financial support for projects begun by individual students.

Student branches of the following professional societies have been established on the campus:

American Institute of Chemical Engineers
American Institute of Industrial Engineers
American Society of Civil Engineers
American Society of Mechanical Engineers
ASM International
Institute of Electrical and Electronics Engineers
Institute of Electrical and Electronics Engineers (computer subchapter)
Biomedical Engineering Society
Materials Research Society
National Society of Black Engineers
Society of Automotive Professional Engineers
Society of Hispanic Professional Engineers
Society of Women Engineers

The following honorary societies recognize high achieving McCormick undergraduates:

Eta Kappa Nu: open to upperclass students in electrical engineering who demonstrate superior scholarship and ability.

Omega Chi Epsilon: for upperclass students in chemical engineering who demonstrate superior scholarship and leadership ability.

Phi Eta Sigma: for freshmen who make a scholastic average equivalent to a grade of A.

Phi Lambda Upsilon: open to upperclass students in chemistry and chemical engineering who demonstrate superior scholarship and academic ability.

Pi Tau Sigma: for upperclass students in mechanical engineering who demonstrate superior scholarship and leadership ability.

Sigma Xi Society: seniors who excel in scholarship in at least two departments are eligible for associate membership.

Tau Beta Pi: for upperclass students who have shown superiority in scholarship and ability in engineering work.

Undergraduate Programs of Study

McCormick School Curriculum Requirements

All curricula leading to the bachelor of science in engineering or applied science must have the same basic components—mathematics, basic sciences, basic engineering, social sciences/humanities, communications, computer programming, unrestricted electives, and major program. The specific requirements in each area are listed below.

Mathematics (6 courses)

Five calculus courses are required:
Math B14-1,2,3 Calculus
Math B15 Multiple Integration and Vector Calculus
Math B17 Sequences and Series, Linear Algebra
or IE C11 Linear Algebra for Operations Research
The sixth course is specified by the department.

Basic Sciences (5 courses)

Five courses in at least two of the four areas below, but not more than three in one area and not more than two from earth sciences/astronomy.

- Physics
  Phys A35-1,2,3 General Physics
- Biological Sciences
  Biol B10-1,2,3 Biology
- Chemistry
  Chem A01 General Chemistry
  Chem A02 General Inorganic Chemistry
  Chem A03 General Physical Chemistry
  Chem A71 Accelerated General Inorganic Chemistry
  Chem A72 Accelerated General Physical Chemistry
  Chem B10-1,2 Organic Chemistry
- Earth Sciences/Astronomy
  Astron B10-1,2 General Astronomy
  Geol B01 The Skin of the Earth
  Geol B02 The Body of the Earth

Basic Engineering (6 courses)

Six courses from at least five of the following eight areas:

- Mechanics
  CE B12 or ME B02 Mechanics
- Thermodynamics
  Chem C42-1 Thermodynamics
  May be taken alone or as prerequisite to ChE B11
  ChE B11 Thermodynamics
  Chem C42-1 is prerequisite
  ME B20 Thermodynamics I
  May not be taken with Chem C42-1 or ChE B11
  ME C25 Kinetic Theory and Statistical Thermodynamics
  ME C70 Thermodynamics II
  MSc C21 Applications of Thermodynamics
- Fluids and Solids
  ChE C21 Fluid Mechanics
  CE B16 Mechanics of Materials I
  CE B19 Continuum Mechanics I
  ME B41 Fluid Mechanics I
- Materials Science
  MSc B01 Principles of Properties of Materials
  or MSc C01 Chemical Aspects of Engineering Materials
  or MSc B03 Microstructure and Engineering Properties of Materials
- Electrical Science
  EECS B41 Circuits I
  EECS B42 Circuits II
  EECS B70 Applications of Electronic Devices
  EECS C01 Fundamentals of Electromagnetics
- Systems Engineering and Analysis
  ChE B10 Analysis of Chemical Process Systems
  IE C19 Operations Research
  IE C26 Economics for Engineering I
  IE C33 Systems Engineering and Analysis
- Computer Sciences
  EECS B01 Fundamentals of Computer Organization
  EECS B05 Fundamentals of Computer System Software
  EECS B11 Fundamentals of Computer Programming II
  EECS B30 Introduction to Software Engineering
  EECS C16 Mini/Microcomputers and Real-Time Applications
  EECS C17 Data Management and Information Processing
  EECS C28 Numerical Methods for Engineers
- Probability, Statistics, and Quality Control
  ChE C12 Process Models by Statistical Methods
  CE C06 Uncertainty Analysis in Civil Engineering
  EECS C02 Probabilistic Systems and Random Signals
  IE B03 Probability and Statistics for Engineering
  IE C03 Statistics I
  ME C59 Reliability Engineering

Social Sciences/Humanities (7 courses)

Seven courses, which must be approved in advance by the McCormick Humanities Panel, chosen according to one of two options in the following three areas:
Social and behavioral sciences (SBS)
Historical studies and values (HSV)
Fine arts, language, and literature (FAL)

- Option A: at least two courses must be chosen in each area. Of the seven courses, only three may be A-level introductory courses and three courses must be thematically related to provide depth.
- Option B: five of the seven courses must be clearly thematically related. For breadth, no more than five courses may come from a single area.

Communications (2 courses)

One course required in each writing and speech from the following:

- Writing

Eng A05 Basic Composition
Eng B05 Intermediate Composition
Eng C05 Advanced Composition
Edit B01 Basic Writing

- Speaking

Speech A01 Interpersonal Communication
Speech A02 Public Speaking
Speech A03 Analysis and Performance of Literature

Higher-level courses may satisfy this requirement, approved on an individual basis.

Computer Programming (1 course)

One of the following:
EECS A01 Introduction to Scientific Programming and FORTRAN
EECS A10 Introduction to Computer Programming
EECS A11 Fundamentals of Computer Programming

Passing the computer exemption examination before matriculation provides one unit of credit.

Unrestricted Electives (5 courses)

Students may take any credit course in the University. Course choices are open to students to enable technical or nontechnical exploration or extension.

Major Program (16 courses)

Any program of study finds its depth or concentration in the 16 courses given to the major program of the curriculum. Each engineering curriculum provides considerable elective opportunity within these courses. The intent is to provide opportunity for individualization, but there is the necessity for coherence in the selection of these elective courses. In accredited programs, the understanding is that certain criteria will be met and guidance to this end is necessary. Accordingly, it is required that a plan of study be submitted with intended selections listed by the end of the eighth quarter of study (winter quarter of junior year) for approval.

Most curricula offer suggested areas of specialization or options that provide excellent guidance in use of electives. These course plans are available in the department or program offices or the McCormick Records Office and can be the basis for course planning. Self-designed plans may alternately be submitted, but they should be worked out in consultation with a faculty adviser.

Departmental Curricula

Students must meet not only the McCormick School curriculum requirement but also the specific requirement for the departmental curriculum being pursued. The following listings of these curricula present additional information or specifics to be used with the basic curriculum.

Some of the listed curricula contain specializations or options within the curriculum. These are for advice and serve the purpose of guidance for elective course choice. For further details about the options/specializations within a particular program, consult with the department coordinator sponsoring that curriculum or check with the McCormick Records Office.

Applied Mathematics Curriculum

Total Requirement—48 courses

Mathematics—6 courses
Math B14-1,2,3; B15
Math B17 Sequences and Series, Linear Algebra
Math B21 Elementary Differential Equations

Basic Sciences—5 courses
Phys A35-1,2,3; two courses in chemistry, biological sciences, and/or earth sciences/astronomy

Basic Engineering—6 courses
Six courses from at least five of the following areas: systems engineering and analysis, mechanics, thermodynamics, fluids and solids, materials science, electrical science, computer science

Computer Programming—1 course

Social Sciences/Humanities—7 courses

Communications—2 courses

Unrestricted Electives—5 courses

Major Program—16 courses

- Required courses—6 courses

ESc C11-1,2,3 Methods of Applied Mathematics
ESc C21-1,2,3 Models in Applied Mathematics

- Additional courses—4 courses from and including at least one in each of the following three areas (suggested courses are given in parentheses):

Linear algebra (Math C34 or IE C11)
Numerical analysis ((EECS C28, D70, D71; ESc D46-1,2))
Probability (IE C02, IE C03 or Math C30-1,2,3; EECS C02)

- Engineering or the sciences—4 courses leading to an in-depth understanding of an area of application
- Technical electives—2 courses

Must be C-level or above in engineering, science, or mathematics

Biomedical Engineering Curriculum

Total Requirements—48 courses

Mathematics—6 courses
Math B14-1,2,3; B15
Math B17 Sequences and Series, Linear Algebra
Math B21 Elementary Differential Equations

Basic Sciences—5 courses
Phys A35-1,2; Chem A01, A02, A03 or A71, A72

Basic Engineering—6 courses
- Mechanics: CE B12 or ME B02
- Thermodynamics: Chem C42-1 or ME B20
- Fluids and Solids: CE B16 or ME B41 or ChE C21
- Materials Science: MSc B01 or C01
- Electrical Science: EECS B41 or B70
- Computer Sciences: EECS B01 or C16 or C28 or C29-1

Computer Programming—1 course
EECS A01 or A10

Social Sciences/Humanities—7 courses

Communications—2 courses

Unrestricted Electives—5 courses

Major Program—16 courses B level or higher
- Core—7 courses
  Chem B10-1,2 Organic Chemistry
  Biol B10-2 Biology or Biol C01 Biochemistry
  BME C01,C02,C03 Systems Physiology (2 quarters) or physiology (2 quarters) in the Medical School or Dental School
  BME C08 Biomedical Engineering Laboratory
  BME C90 Biomedical Engineering Design
- Areas of specialization—9 courses
  Each student in the biomedical engineering program completes a course of study either by selecting one of the five areas of specialization listed below or by developing an alternate set of courses with his or her adviser that is subsequently approved by the BME Undergraduate Committee. The area of specialization part of the departmental program is intended to provide students with depth in one area of biomedical engineering. Full details on the specific course requirements for an area of specialization are provided to students when they enter the department. They may also be obtained from the department office.
  Biomedical Instrumentation
  Biomechanics
  Biotransport Processes
  Biotechnology
  Imaging

Chemical Engineering Curriculum

Total Requirements—48 courses

Mathematics—6 courses
Math B14-1,2,3; B15
Math B17 Sequences and Series, Linear Algebra
Math B21 Elementary Differential Equations

Basic Sciences—5 courses
Phys A35-1,2,3; Chem A02, A03 or A71, A72
Chem A01, the prerequisite for Chem A02, must be taken as an unrestricted elective.

Basic Engineering—6 courses
- Mechanics: CE B12
- Thermodynamics: Chem C42-1, ChE B11
- Fluids and Solids: ChE C21
- Materials Science: MSc C01
- Systems Engineering Analysis: ChE B10

Computer Programming—1 course
EECS A01 recommended

Social Sciences/Humanities—7 courses

Communications—2 courses

Unrestricted Electives—5 courses

Major Program—16 courses
- Required courses—12 courses
  Chem B10-1,2 Organic Chemistry I, II
  Chem C43 Kinetics and Spectroscopy
  ChE B12 Equilibrium Separations
  ChE C07 Kinetics
  ChE C22 Heat Transfer
  ChE C23 Mass Transfer
  ChE C41 Process Dynamics and Control
  ChE C42 Chemical Engineering Laboratory
  ChE C51 Chemical Engineering Design I
  ChE C52 Chemical Engineering Design II
  Substitute ChE C71 for ChE C52 in the biomedical engineering area of specialization
  ChE C61 Introduction to Polymers
  or one approved B- or C-level chemistry, physics, biological sciences, or materials science course
- Areas of specialization—4 courses
  The remaining four courses are chosen from advanced engineering, mathematics, or science courses. They should be selected to fulfill one of the six areas of specialization offered by the Department of Chemical Engineering. Students may select one of these programs or may petition the chemical engineering faculty for approval of other course selection in accord with the overall departmental major program.
  Chemical Process Engineering
  Biomedical Engineering
  Biotechnology
  Environmental Engineering
  Polymer Science and Engineering
  Process Control and Simulation

Civil Engineering Curriculum

Total Requirements—48 courses

Mathematics—6 courses
Math B14-1,2,3; B15
Math B17 Sequences and Series, Linear Algebra
Math B21 Elementary Differential Equations

Basic Sciences—5 courses, including
Phys A35-1,2; Chem A01, A02

Basic Engineering—6 courses
- Mechanics: CE B12
- Fluids and Solids: CE B16 and ME B41
- Thermodynamics: 1 course
- Electrical Science: 1 course

MSc B03 or one other course from systems engineering and analysis, computer sciences, or materials science.

Computer Programming—1 course

Social Sciences/Humanities—7 courses

Communications—2 courses

Unrestricted Electives—5 courses

Major Program—16 courses
Ten courses must be CE courses.
- Basic Civil Engineering—6 courses

CE B21 Theory of Structures I
CE B22 Structural Steel Design
CE B50 Introductory Soil Mechanics
CE C64 Sanitary Engineering
CE C71 Introduction to Transportation Planning and Analysis

- Mathematical Techniques—2 courses
- Technical Electives—8 courses in mathematics, science, engineering, or other area supporting student's specialty. Any 2 of the 8 must be from an approved list of design and synthesis courses; an additional 1.5 units of design credits must be accumulated from the remaining 6 technical electives.

Areas of Specialization

Listed below are samples of some traditional areas of specialization, but students are encouraged with the help of their advisers to design a program that meets their own particular interests.

Applied Mechanics
Structural Engineering
Geotechnical Engineering
Environmental Engineering
Transportation Systems
Construction

Computer Engineering Curriculum

Total Requirements—48 courses

Mathematics—6 courses
Math B14-1,2,3; B15
Math B17 Sequences and Series, Linear Algebra
Math B21 Elementary Differential Equations

Basic Sciences—5 courses
Phys A35-1,2,3
Two chemistry courses

Basic Engineering—6 courses, including
- Electrical Science: EECS B41
- Computer Sciences: EECS B01, B05

Computer Programming—1 course
EECS A10 or A11

Social Sciences/Humanities—7 courses

Communications—2 courses

Unrestricted Electives—5 courses

Major Program—16 courses
- Required Courses—10 courses

EECS B30 Introduction to Software Engineering
or EECS B11 Fundamentals of Computer Programming II
EECS B42 Circuits II
EECS B43 Signals and Systems
EECS B50 Physical Electronics
EECS C02 Probabilistic Systems and Random Signals
EECS C06 Electronic Circuits
EECS C11 Data Structures and Data Management
EECS C43-1 Operating Systems I
EECS C53 Digital Electronic Circuits and Systems
EECS C55 Computer Architecture I

- Design Requirement—1 course

EECS C41 Design of Real-Time Digital Systems
EECS C46 Microprocessor System Design
EECS C56 Computer Architecture II
EECS C43-2 Operating Systems II
EECS C91 VLSI Systems Design
EECS C94-2 Software Project Management and Development II
EECS C99 Projects, when C99 is a design program

- Technical Electives—5 courses

EECS C32 Introduction to Computer Vision
EECS C36 Design and Analysis of Algorithms
EECS C39 Introduction to Database Systems
EECS C47 Digital Electronic Systems Design
EECS C51 Introduction to Computer Graphics
EECS C57 Design Automation in VLSI
EECS C60 Introduction to Feedback Systems
EECS C74 Introduction to Digital Controls
EECS C77 Biomedical Computing
EECS C90 Introduction to Robotics
EECS C94-1 Software Project Management and Development I
Any courses listed for the design requirement and not used to satisfy the design requirement

Computer Science Curriculum

Total Requirements—48 courses

Mathematics—6 courses
Math B14-1,2,3
Math B17 Sequences and Series, Linear Algebra
Two courses from Computer Science Mathematics List

Basic Sciences—5 courses, including
Phys A35-1,2

Basic Engineering—6 courses, including:
- Computer Sciences: EECS B01, B05, B11

- Probability, Statistics and Quality Control: IE C02 *or* EECS C02 *or* equivalent

Two other courses chosen from the basic engineering list, excluding computer science courses.

Computer Programming—1 course
EECS A11

Social Sciences/Humanities—7 courses

Communications—2 courses

Unrestricted Electives—5 courses

Major Program—16 courses

- Required Courses —8 courses

Fundamentals—4 courses
EECS C10 Mathematical Foundations of Computer Science
EECS C11 Data Structure and Data Management
EECS C20 Formal Languages and Automata Theory
EECS C36 Design and Analysis of Algorithms

Systems—2 courses
EECS C22-1 Compiler Construction I
EECS C43-1 Operating Systems I
EECS C55 Computer Architecture I

Applications—2 courses
EECS C28 Numerical Methods for Engineers
EECS C39 Introduction to Database Systems
EECS C48 Introduction to Artificial Intelligence
EECS C51 Introduction to Computer Graphics

- Technical Electives—8 courses

Of the eight technical electives required, four must be from the advanced computer science course list; two courses must be from any of the three lists below, including the advanced computer science course list; and the remaining two are unrestricted, subject to the approval of the student's department adviser.

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. EECS A10 may be used as a technical elective for those students who need additional preparation for EECS A11 or who are transferring from other majors. Courses used as technical electives may not be counted toward satisfying other requirements.

Computer Science Mathematics List
EECS C52 Applied Combinatorics
Math B15 Multiple Integration and Vector Calculus
Math B21 Elementary Differential Equations
Math C08 Set Theory and Metric Spaces
Math C10 Introduction to Real Analysis
Math C37 Introduction to Modern Algebra

Computer Science External Technical Elective List
Math C11-1,2,3 Introduction to Applied Mathematics
Math C13 Chaotic Dynamical Systems
IE C13 Deterministic Models and Optimization
IE C15 Stochastic Models and Simulation
IE C19 Operations Research
IE C28 Location Analysis and Spatial Planning
IE C33 Systems Engineering and Analysis
IE C35 Systems Simulation
Stat C20-1,2 Statistical Methods
ESc C11-1,2,3 Methods of Applied Mathematics

Advanced Computer Science List
EECS C22-C57; C90; C91; C94-1,2; C95, C99

Electrical Engineering Curriculum

Total Requirements—48 courses

Mathematics—6 courses
Math B14-1,2,3; B15
Math B17 Sequences and Series, Linear Algebra
Math B21 Elementary Differential Equations

Basic Sciences—5 courses
Phys A35-1,2,3
Two chemistry courses

Basic Engineering—6 courses

- Mechanics: CE B12
- Thermodynamics: ME B20
- Fluids and Solids: CE B19 or ME B41 or CE B16
- Electrical Science: EECS B41 and C01

(Grade of C or better in EECS B41 required for registration in EECS B42 or EECS B50)

- Computer Sciences: EECS B01

Computer Programming—1 course

Social Sciences/Humanities—7 courses

Communications—2 courses

Unrestricted Electives—5 courses

Major Program—16 courses

- Required courses—10 courses

EECS B42 Circuits II
(Grade of C or better required for registration in EECS C06, C60, C65, C66)
EECS B43 Signals and Systems
EECS B50 Physical Electronics
EECS C02 Probabilistic Systems and Random Signals
EECS C06 Electronic Circuits
EECS C07 Communications
EECS C08 Applications of Electromagnetic Fields
EECS C53 Digital Electronic Circuits and Systems
EECS C60 Introduction to Feedback Systems
EECS C81 Electrical Materials: Properties and Applications

- Technical Electives—5 courses

A technical elective is any C-level science, mathematics, computer science, or engineering course. The B-level courses EECS B05 and Chem B10-1 are also accepted as technical electives. The distribution of such courses must constitute a viable and educationally sound program for electrical engineering. At least three of the five technical electives must be

taken in the EECS Department. All students must take at least one of the following design courses: EECS C41, C47, C67, C91, C98, C99 (when C99 is a design project).

- Electrical Engineering Design Requirement—1 course
  All senior students who have not elected to take one of EECS C41, C47, C67, C91, or C99 (when C99 is a design project) will take EECS C98-0 Electrical Engineering Design. Students electing to take C98 will select from a group of design problems structured by the faculty to represent distinct technical areas in electrical engineering.

Environmental Engineering Curriculum

Total Requirements—48 courses

Mathematics—6 courses
Math B14-1,2,3; B15
Math B17 Sequences and Series, Linear Algebra
Math B21 Elementary Differential Equations

Basic Sciences—5 courses
Phys A35-1,2; Chem A01, A02, A03

Basic Engineering—6 courses
- Mechanics: CE B12 or ME B02
- Thermodynamics: Chem C42-1 and ChE B11
- Fluids and Solids: ME B41
- Electrical Science or Materials Science
- Systems Engineering and Analysis or Computer Sciences

Computer Programming—1 course

Social Sciences/Humanities—7 courses

Communications—2 courses

Unrestricted Electives—5 courses

Major Program—16 courses
- Core—8 courses
  CE C60 Environmental Impact Evaluation
  CE C61 Public Health Engineering
  CE C63 Community Air Pollution
  CE C64 Sanitary Engineering
  CE C65-1 Radiation Health
  CE C66 Environmental Biology
  CE C67 Chemistry of the Aquatic Environment
  Plus one course from the following engineering design courses:
    CE C65-3 Radiation Health Engineering
    CE C68 Industrial Hygiene and Environmental Control
    CE C70 Environmental Engineering Design
- Required Supporting Courses—4 courses
  Chem B10-1 Organic Chemistry I
  Chem C43 Kinetics and Spectroscopy
  IE C26 Economics for Engineering I
  Plus one course from the following applied statistics courses:
    CE C06 Uncertainty Analysis in Civil Engineering
    ChE C12 Process Models by Statistical Methods
    IE B03 Probability and Statistics for Engineers
- Technical Electives—4 courses
  The selected electives must include the equivalent of one additional course unit in design, planning, and/or environmental systems. A list of the design/systems electives commonly selected by environmental engineering students is available from the faculty advisers.

Industrial Engineering Curriculum

Total Requirements—48 courses

Mathematics—6 courses
Math B14-1,2,3; B15
IE C11 (preferred) or Math B17 or Math B19
Math B21 Elementary Differential Equations

Basic Sciences—5 courses, including
Phys A35-1,2 General Physics
Plus three courses that satisfy the McCormick School requirement

Basic Engineering—6 courses, including
- Computer Sciences: EECS C17 (preferred) or EECS C28
- Five courses, one from each of the following areas: mechanics, thermodynamics, fluids and solids, materials science, electrical science

Computer Programming—1 course
EECS A10

Social Sciences/Humanities—7 courses

Communications—2 courses

Unrestricted Electives—5 courses

Major Program—16 courses
- Probability, statistics, and simulation—4 courses
  IE C02 Probability
  IE C03 Statistics I
  Two courses from IE C04, C05, C06, C35
- Operations research—2 courses
  IE C13 Deterministic Models and Optimization
  IE C15 Stochastic Models and Simulation
- Production and economics—3 courses
  IE C26 Economics for Engineering I
  Two courses from
    IE C27 Economics for Engineering II
    IE C28 Location Analysis and Spatial Planning
    IE C29 Production Planning and Scheduling
- Applied behavioral science—2 courses
  IE C22 Industrial Psychology
  IE C40 Field Project Methods
- Senior design project—2 courses
  IE C34-1,2 Systems Project Management I, II
  or IE C36-1,2 Industrial Engineering Design Project I, II
- Technical electives—3 courses
  B-level or above engineering courses with a few exceptions (selected according to the rules in effect at the time the courses are taken).

Manufacturing Engineering Curriculum

Total Requirements—48 courses

Mathematics—6 courses
Math B14-1,2,3; B15
Math B17 Sequences and Series, Linear Algebra
or Math B19 *or* IE C11
Math B21 Elementary Differential Equations

Basic Sciences—5 courses, including
Phys A35-1,2; Chem A01, A02

Basic Engineering—6 courses
- Mechanics: CE B12 recommended
- Thermodynamics: ME B20 recommended
- Materials Science: MSc B01 recommended
- Electrical Science: EECS B70 recommended
- Systems Analysis: IE C19 and IE C26

Computer Programming—1 course

Social Sciences/Humanities—7 courses

Communications—2 courses

Unrestricted Electives—5 courses

Major Program—16 courses
- Core—10 courses
  CE B16 Mechanics of Materials I
  IE C05 Statistical Methods for Quality Improvement
  IE C29 Production Planning and Scheduling
  EECS C16 Mini/Micro Computers and Real-Time Applications
  or EECS C17 Data Management and Information Processing
  MSc C17 Materials in Manufacturing
  ME B40 Introduction to Mechanical Design and Manufacturing
  ME C40-1,2 Computer-Integrated Manufacturing
  Senior Design Project—2 courses
  Both courses must be taken from a single engineering department. The following are preapproved options; others available by petition.
  ChE C51, C52
  2 courses from EECS C41, C47, C91, C98
  IE C34-1,2 or C36-1,2
  ME C98, C99
  2 units of MSc C96
- Probability and Statistics—1 course
  IE B03 Probability and Statistics for Engineers
- Technical electives—5 courses
  Courses to be taken from approved list; approved list will be updated annually by the MfE Curriculum Committee and the IEMS Department.

Materials Science and Engineering Curriculum

Total Requirements—48 courses

Mathematics—6 courses
Math B14-1,2,3; B15
Math B17 Sequences and Series, Linear Algebra
Math B21 Elementary Differential Equations

Basic Sciences—5 courses
Phys A35-1,2,3; Chem A02, A03 or A71, A72

Basic Engineering—6 courses, including
- Mechanics: CE B12 recommended
- Thermodynamics: Chem C42-1 and MSc C21
- Materials Science: MSc B01
- Electives: selected from fluids and solids (CE B19 recommended), electrical science, systems engineering and analysis, and computer science.

Computer Programming—1 course
EECS A10 recommended

Social Sciences/Humanities—7 courses

Communications—2 courses

Unrestricted Electives—5 courses
MSc A90 recommended

Major Program—16 courses
- Required Courses—9 courses
  MSc C16-1,2 Science of Engineering Materials I, II
  MSc C31 Physical Properties of Polymers
  MSc C32 Mechanical Behavior of Solids
  MSc C51-1,2 Introductory Physics of Materials I, II
  MSc C61 Crystallography and Diffraction
  MSc C96-1,2 Senior Project I, II
- Technical Electives—7 courses
  Each student must choose the remaining courses in a consistent manner to fulfill an area of concentration. These courses may be in engineering, natural sciences (usually chemistry or physics), and mathematics. At least 2 of the 7 technical electives must be from materials science and engineering. No more than 2 of the 7 courses may be B-level courses. Advanced mathematics courses such as the following are strongly recommended:
  Math C05 Complex Variables
  ESc C11-1,2,3 Methods of Applied Mathematics
  Areas of Concentration
  Examples of partial programs for concentrations in electronic materials, metals and ceramics, polymeric materials, and surface science are described in a departmental manual for majors.

Mechanical Engineering Curriculum

Total Requirements—48 courses

Mathematics—6 courses
Math B14-1,2,3; B15
Math B17 Sequences and Series, Linear Algebra
Math B21 Elementary Differential Equations

Basic Sciences—5 courses
Phys A35-1,2, 3; Chem A01, A02

Basic Engineering—6 courses
- Mechanics: ME B02
- Thermodynamics: ME B20
- Fluids and Solids: CE B16, ME B41

- Materials Science: MSc B01
- Electrical Science: EECS B70

Students planning to take advanced EECS courses as electives may substitute EECS B41 Circuits

Computer Programming—1 course
EECS A01 recommended

Social Sciences/Humanities—7 courses

Communications—2 courses

Unrestricted Electives—5 courses

Major Program—16 courses

- Required Courses—10 courses

ME B01 Mechanics I
ME B24 Experimental Engineering I
ME B40 Introduction to Mechanical Design and Manufacturing
ME C14 Theory of Machines—Dynamics
ME C15 Theory of Machines—Design of Elements
ME C70 Thermodynamics II
ME C73 Engineering Fluid Mechanics
ME C77 Heat Transfer
ME C90 Introduction to Dynamic Systems
ME C91 Fundamentals of Control Systems I

- Options—6 courses

General option:
Two C-level mechanical engineering courses
One design course from the following:
ME C40-2 Computer Integrated Manufacturing
ME C66 Computer-Aided Engineering II—Design
ME C98 Engineering Design

Four other options are available: biomedical engineering, energy, intelligent mechanical systems, and manufacturing. The six courses comprising each of these options are contained in a listing that may be obtained from the department office.

Combined Studies Program

For students whose particular interests and goals cannot be satisfied by one of the regular programs of study in engineering or applied science, the Combined Studies Program provides an alternative. Under this program, an ad hoc curriculum, guided and endorsed by three faculty members and approved by the McCormick School Curriculum Committee, may be pursued and upon completion will lead to the granting of the bachelor of science degree.

Available courses may be combined in a variety of interdisciplinary plans as long as the all-school specification of seven basic components is met. Some examples of combined studies programs entered into in recent years include such titles as public health, engineering physics, biomedical engineering and molecular biology, and computers and mechanical design.

Students interested in the Combined Studies Program should consult with the associate dean for undergraduate affairs.

Accreditation

The engineering programs, including biomedical engineering, chemical engineering, civil engineering, electrical engineering, environmental engineering, industrial engineering, materials science and engineering, and mechanical engineering are accredited by the Accreditation Board for Engineering and Technology. ABET accreditation, which is administered on a national basis, is important in professional engineering fields. Additional information concerning professional accreditation may be obtained from the office of the associate dean for undergraduate affairs.

General Engineering Courses

703-A90-0 Engineering Freshman Seminar
Subjects of current interest in broad engineering or interdisciplinary areas.

703-B20-0 Analytic and Computer Graphics
Microcomputer-aided drawing (CAD) for graphical, three-dimensional problem solving and presentation. Orthogonal, auxiliary, and pictorial view representation. Systematic study of points, lines, planes, objects, and graphical databases. Lectures, laboratory.

703-C65-0 History of Engineering
Development of engineering from ancient times to about 1930. Influence of techniques and achievements set against environment and social order. Engineering advances as a factor among social and economic changes following the Industrial Revolution. This is a history course and may not be used as a technical elective.

Biomedical Engineering

Biomedical engineers solve problems in the life sciences and clinical medicine by applying engineering and mathematical techniques. This approach has been fruitful in studying those complex systems involved in transport, regulation, and information processing in the body where a descriptive approach is no longer adequate. Equally important has been the development of devices used inside or outside the body to replace or supplement physiological functions and to enhance the quality of medical diagnosis and care. Thus biomedical engineering refers to the application of engineering techniques to problems in medicine and biology.

The interplay among the physical sciences, engineering, biology, and the medical sciences takes many forms. The traditional study of complex systems, whether for power transmission, communications, or the operation and control of industrial processes, has provided engineers with a number of concepts and techniques that proved valuable in analysis and design. These principles expressed in mathematical form are applicable to a wide range of phenomena, including those in biological processes. Information theory, statistics, and computer technology have opened new areas for exploration

of sensory and central nervous activity as well as patient handling and diagnosis. Theories for feedback controls, transport processes, materials science, and mechanics provide new insight into homeostatic physiological processes. Analysis of heat transfer, fluid flow, and chemical-process control in living organisms requires competence in both engineering and life sciences. Current studies help provide understanding of many physiological processes. This understanding, in turn, leads to improvements in clinical practice, diagnosis, and patient care.

Undergraduate Program

Northwestern was among the first schools to recognize the value of a biomedical engineering background, and today the Department of Biomedical Engineering offers, at both the undergraduate and graduate levels, one of the largest and broadest programs in the country. The primary path interested students may follow is the biomedical engineering program administered by the biomedical engineering department. Alternative curricula are the biomedical options in other engineering departments.

The biomedical engineering program provides biomedical training that is quantitative, emphasizes problem solving, and treats phenomena with a systems approach. This curriculum prepares students for careers in dentistry, medicine, and/or research or with corporations in the health-care industry. Required courses in mathematics, engineering, and science establish a strong foundation on which to build a biomedical framework. In addition, each student selects one sequence of courses with which to develop an *area of specialization.*

Areas of Specialization

All areas are suitable for students planning to enter medical school, continue their biomedical engineering education in graduate school, or pursue careers in the biomedical industry or hospitals.

Biomedical Instrumentation

Electronic and optical instruments are used widely in the diagnosis and treatment of disease and in the study of normal physiological function. Students in this area learn the fundamentals of electronic, computer (hardware and software), and optical instrumentation.

Biomechanics

Solid (e.g., musculoskeletal) and fluid (e.g., cardiovascular, pulmonary) mechanics are applied to human physiology in the design and manufacture of limb prostheses or artificial organs. Students in this area learn the fundamental engineering principles needed for this work.

Biotransport Processes

The study of transport processes in living tissue is important in understanding blood flow, lung ventilation, and oxygen transport to and from red blood cells to various tissue beds. Students in this area learn the fundamental chemical engineering principles that relate to these processes.

Biotechnology

Biochemical engineering, biochemistry, molecular biology, and biosensors are components of the broad field that goes under the name biotechnology. Students in this area learn the various aspects of biotechnology from the engineer's perspective.

Imaging

The application of imaging, signal processing, and signal analysis to biomedical problems has become a most important part of medicine. MRI, CT-imaging, PET, EKG, and EEG are all examples of physiological signals. Students in this area learn the physiology that underlies these signals and the engineering that underlies their recording and analysis.

Curriculum

Students seeking admission to dental or medical schools should be familiar with the entrance requirements of those schools to which they intend to apply. In addition to the specifically required courses of the biomedical engineering program, many professional schools also require additional courses in physics, organic and/or physical chemistry, and laboratory biology. These requirements can be satisfied by judicious use of electives.

Courses Primarily for Undergraduates

765-A70-0 Introduction to Biomedical Engineering
Emphasis on areas of medicine and physiology where engineering techniques are particularly useful or where a clear need exists for an engineering approach.

765-C01-0 Systems Physiology
Neurophysiology. Basic functional/structural aspects of the mammalian nervous system, including terminology. Experimental aspects emphasized. Prerequisites: Phys A35-2; at least junior standing or consent of instructor.

765-C02-0 Systems Physiology
Cardiovascular and respiratory physiology. Human physiology from a quantitative, systems viewpoint. Anatomy and pathology where appropriate. Prerequisite: Math B14-3.

765-C03-0 Systems Physiology
Renal, digestive, endocrine, and metabolic physiology from a systems viewpoint. Fluid, electrolyte, and renal physiology. Energy balance and metabolism. Prerequisites: junior standing or consent of instructor; background in basic biology, chemistry, and mathematics. Biochemistry course recommended.

765-C08-0 Biomedical Engineering Laboratory
Laboratory experiments and associated lecture concerning quantitative physiology, testing and evaluation of biomedical

apparatus, and evaluation of devices for replacement or assist of physiological function. Prerequisites: C01, C02, and C03 (at least two); EECS B41 or B70. Preference given to seniors in BME.

765-C15-0 Application of Genetic Engineering to Immunochemistry
Recent developments in genetic engineering as applied to the rapidly developing field of immunochemistry. Gene splicing, genetic rearrangements, production of antibodies and related proteins.

765-C20-0 Introduction to Biomedical Signal Analysis
Deterministic and stochastic signals. Analog and digital analysis. Sampling. Convolution, auto- and cross-correlation. Spectral analysis techniques. Specific examples using biomedical signals. Prerequisites: Math B21, Physics A35-2.

765-C22-0 Mathematical Modeling of Physiological Systems
Analysis and modeling of physiological systems. Problem of system identification in physiology. Traditional approaches to physiological system identification. White noise method. Prerequisites: C01, C02, or C03; and C20 or consent of instructor.

765-C23-0 Models of Vision
Introduction to visual sciences. Models in spatial vision (i.e., processing of visual images, spatial sampling and interpolation, feature extraction, pattern and object analysis), visual adaptation, motion perception and texture perception. Prerequisite: senior standing with engineering or physical science background.

765-C25-0 Introduction to Medical Imaging
Diagnostic X-rays; X-ray film and radiographic image; computed tomography; ultrasound. Prerequisite: Physics A35-3 or equivalent.

765-C26-0 Physiological Imaging
Medical images applied to physiological measurement, especially radionuclide imaging and design of measurement methods based on digital gamma camera images. Tomographic reconstruction (X-ray CT, radionuclide SPECT and PET). Related digital angiography techniques. Includes computer exercises in image manipulation.

765-C27-0 Magnetic Resonance Imaging
Nuclear magnetic resonance; two-dimensional Fourier transform, spin-echo and spin-wrap image pulse sequences; gradient echo imaging. Prerequisite: Physics A35-3.

765-C30-0 Optics in Biomedical Sciences
Introduction to biomedical optics, optometry, microscopy, endoscopy, spectroscopy, interferometry, and speckle methods as well as other optical methods relevant to the field. Prerequisite: Physics A35-3.

765-C32-0 Introduction to Optical Holography
Theory, types of holograms, lasers for holography, recording media for holograms. Applications of holography in science, medicine, and industry. Prerequisites: Math B14-3; Physics A35-3.

765-C33-0 Hologram Interferometry and Nondestructive Testing
Requirements for high-quality holography. Materials for hologram interferometry. Methods of time-average, double exposure, sandwich, double pulse and real-time studies. Prerequisite: C32.

765-C38-0 Interaction of Laser Radiation with Tissue
Propagation, scattering, and absorption of light in biological materials. Modeling of diagnostic and therapeutic uses of light. Engineering evaluation of laser-based clinical systems. Prerequisite: senior standing or consent of instructor.

765-C40-0 Introduction to Biomaterials
Biological materials fundamentals, including thermodynamic, informational, and structural properties. Implant materials. Interface between tissues and materials. Prerequisite: MSc B01.

765-C43-0 Biomaterials and Medical Devices
Structure-property relationships for biomaterials. Metal, ceramic, and polymeric implant materials and their implant applications. Interactions of materials with the body. Prerequisite: senior standing.

765-C44-0 Biological Performance of Materials
Structure-property relationships of materials, physical chemistry of surfaces and interfaces, materials-tissue interactions, applications to the selection and design of materials for medical implants and devices. Prerequisites: C43 or MSc C12-1,2.

765-C62-0 Musculoskeletal Biomechanics
An introductory class presenting the fundamentals of orthopaedic biomechanics. Topics include mechanical properties of bone, cartilage, ligament, tendon, and muscle. Prerequisite: CE B12.

765-C65-0 Control of Human Limbs and Their Artificial Replacements
Human movement, biomechanics of skeletal and muscular anatomy, comparative anatomy, muscle physiology, and locomotion. Artificial limb replacement. Multidisciplinary design concepts and engineering problems where the design constraints are extremely stringent. Prerequisite: senior standing with engineering or physical science background.

765-C66-0 Biomechanics of Movement
Engineering mechanics applied to analyze human movement, including models of muscle and tendon, kinematics of joints, and dynamics of multijoint movement. Applications of biomechanics in sports, rehabilitation, and orthopaedics demonstrated. Prerequisites: ME B02 or consent of instructor.

765-C71-0 Mechanics of Biological Tissues
Stress and strain for small and large deformations. Mechanics of membranes. Nonlinear elastic, viscoelastic, pseudoelastic, and biphasic models of biological tissue. Rheological properties of bone, cartilage, blood vessels, lung, muscle, and cells. Prerequisite: CE B16 or equivalent.

765-C72-0 Cardiovascular Mechanics
Mechanical aspects of the human circulation system. Its geometry, kinematics, mean pressures. The cardiac cycle. Blood and blood vessel rheology. Pressures and flows in the arterial system. Cardiac muscle mechanics. Prerequisites: ME B41; BME C02 or D02 or permission of instructor.

765-C73-0 Cardiac Mechanics
Mechanical characteristics of isolated muscle fibers. Mechanical behavior of isolated left ventricle. Centricular wall stresses. Right heart, lung, left heart interactions. Heart, systemic system, and venous system interactions. Prerequisite: CE B16 or consent of instructor.

765-C75-0 Pulmonary Mechanics
Basic physiology of lung function and its mechanical aspects, including tissue viscoelasticity, airway instability, mucus transport, interfacial phenomena, gas exchange, air flow and its limitation. Prerequisites: ME B41, Math B21.

765-C77-0 Intermediate Fluid Mechanics in Engineering and Biology
Fundamental concepts of fluid dynamics treated with applications to engineering and biological flows. Dimensional analysis, approximation methods, kinematics in Lagrangian and Eulerian reference frames, mass and momentum balance, constitutive equations, kinematic and stress boundary conditions, surface tension phenomena and inviscid flow. Prerequisite: ME B41 or consent of instructor.

765-C80-0 Biomedical Transducers and Instrumentation
Transducers and instrumentation used to quantify temperature, displacement, force, pressure, sound, and flow. Optical spectroscopy, electrodes for biopotentials and chemical measurements, mass spectroscopy. Prerequisite: senior standing in engineering.

765-C83-0 Cardiovascular Instrumentation
Theory, design and application of instrumentation used for diagnosis, monitoring, treatment, and research investigation of cardiac and cardiovascular diseases. Examples taken from the current literature. Prerequisites: EECS B41 or EECS B70 or equivalent or consent of instructor.

765-C90-0 Biomedical Engineering Design
Design strategy and concepts, including planning, CAD, reliability, safety, economic analysis, and marketing. Laboratory projects to develop instrumentation, patient monitoring algorithms, and computer simulations for biomedical engineering applications. Prerequisite: senior standing in BME.

765-C95-0 Special Topics in Biomedical Engineering

765-C99-0 Projects

Biomedical Courses in Other Departments

710-C71-0 Transport Phenomena in Living Systems

727-C69-0 Theory of Measurement Systems

727-C73-0 Feedback in Biological Systems

727-C77-0 Biomedical Computing

760-C81-0 Models in Biochemistry and Molecular Biology

Chemical Engineering

Chemical engineering is concerned primarily with the principles and processes involved in the conversion of raw materials into products vital to modern civilization. The products of the chemical and process industries range from antibiotics to zirconium, from petroleum to plutonium, from agricultural chemicals to plastics and synthetic rubber. The rapid introduction of new products by the chemical process industries gives chemical engineering its characteristic concern with the management and development of innovation. Preparation for careers in chemical engineering requires a comprehension of physical, chemical, and engineering principles. The program aims at developing people who can plan, design, and operate new processes and who may have potential for managerial responsibility in highly technical industrial enterprises.

The Department of Chemical Engineering has a curriculum that provides this broad fundamental training and prepares the graduate for any of the chemical and process industries or for advanced study. The first two years are devoted largely to the principles of mathematics, physics, and chemistry. After this, the fundamentals of chemical engineering fall into two sequences: the chemical process principles, with emphasis on thermodynamics and kinetics of chemical change, and the transport processes, with emphasis on the transfer of mass, momentum, and thermal energy in the physical handling of substances, their heating, cooling, separation, and purification. Theoretical principles and practical applications are then integrated in courses in systems design and control. Supporting courses in allied fields of engineering and the sciences broaden the technical proficiency of chemical engineers, while the election of courses in the social sciences, humanities, and arts deepens their background in the common hopes and problems of humanity.

Areas of Specialization

The curriculum permits students to select an area of specialization and to develop background for further study at the graduate level or for application to specific industries. Students are encouraged to select one of the six areas listed below or to plan an alternate program with an adviser. There are numerous electives in the basic program, and students are urged to give early consideration to planning for effective use of these opportunities.

Chemical Process Engineering

The chemical process engineering option is designed to prepare students for many areas, including design, operations, research, and management. Recommended for students who want a broad background in chemical engineering, it provides

preparation for employment in many fields, including the chemical process industry and the petroleum industry. It is also good preparation for graduate work in chemical engineering or other areas, both technical and nontechnical.

Biomedical Engineering

Increasing numbers of chemical engineers enter medical school and work in related areas such as pharmaceutical production, biomedical materials, and artificial organs. The biomedical engineering option satisfies the needs of these students by adding courses in biology, biochemistry, and biomedical engineering to the foundation in chemical engineering. Students can therefore prepare for careers in medicine or biomedical engineering as they obtain a degree in chemical engineering.

Biotechnology

Biotechnology is the industrial exploitation of biological systems or processes. Microorganisms are employed for production of food, beverages, antibiotics, and solvents as well as for waste treatment. Advances in genetic engineering have led to the production (in animal cells, yeast, and bacteria) of a wide range of enzymes, growth factors, hormones, immunoregulators, and monoclonal antibodies for use in disease diagnosis and therapy. Animal cells and microorganisms produce chemicals via a complex network of tightly regulated chemical reactions, making biotechnology a natural extension of chemical engineering. The biotechnology option provides the background necessary to apply chemical engineering skills in biological systems, especially for process optimization, control, scale-up, and product recovery.

Environmental Engineering

Means for improving the quality of our environment, disposing of wastes, and devising waste-free processes often involve chemical processing. The development, construction, and operation of these processes increasingly involves chemical engineers in a leading role. The next decade will see the replacement of many present industrial processes by new ones designed to eliminate or minimize waste products, requiring imaginative engineering. The environmental engineering specialization offers students a way to add special competence in environmental and civil engineering concerns to a chemical engineering degree and to prepare for attacking environmental problems.

Polymer Science and Engineering

Synthetic polymers are large molecular substances that now provide the basis for the plastics, fiber, and rubber industries. Synthetic polymers are used in fields as diverse as the automotive industry, pollution abatement, low-cost housing, biomedical engineering, and indeed wherever needs exist for new materials with unique properties. The polymer field requires a knowledge of chemistry and some background in materials science in combination with expertise in chemical engineering, especially in transport processes. The option in polymer science and engineering provides training to undergraduates considering working in the field or going to graduate school.

Process Control and Simulation

The chemical process industries have long been concerned with the optimal design and control of large-scale systems. In recent years, chemical engineers have played a significant role in the continued evolution of control systems theory and applications and have been instrumental in the use of modern computing methods for such tasks. The process control and simulation specialty provides background for immediate applications or graduate study.

Laboratories

The Undergraduate Chemical Engineering Laboratory provides facilities for exploring firsthand the quantitative experimental implications of fundamental laws in their application to practical problems of heat transfer, gas absorption, distillation, and other basic operations. Process dynamics and automatic control principles are studied in the Process Dynamics Laboratory, furnished with typical control equipment plus a number of Zenith microcomputers, supplemented by the digital computer facility at Academic Computing and Network Services. A computing laboratory also is used in a variety of courses, and chemical laboratory experience is a part of the polymer course.

Courses Primarily for Undergraduates

710-A90-0 Survey of Chemical Engineering Concepts and Opportunities
Application of chemical engineering principles illustrated by examples from the chemical, petroleum, food processing, pharmaceutical, electronics, and other industries. Impact of economics, ethics, and other nontechnical constraints.

710-B10-0 Analysis of Chemical Process Systems
Introduction to process systems. Material balances and stoichiometry. Analysis of process system flow sheets. Introduction to departmental computing facilities. Basic numerical analysis. Prerequisites: Chem A03, EECS A01, and Math B21; Math B21 may be taken concurrently.

710-B11-0 Thermodynamics
The first and second laws of thermodynamics. Entropy and equilibrium. Material and energy balances. Equations of state and properties of fluids. Solutions, phase equilibria, and chemical reactions. Prerequisites: B10 and Chem C42-1.

710-B12-0 Equilibrium Separations
Design and analysis of chemical separation processes such as distillation, absorption, extraction, and leaching. Plant equipment and operations. Prerequisite: B11.

710-C07-0 Kinetics
Chemical reaction kinetics with application to the design of chemical reactors. Prerequisite: B10 and Chem C43.

710-C12-0 Process Models by Statistical Methods
Statistical methods necessary for building mathematical models of chemical engineering processes, including linear and nonlinear regression analysis, analysis of variance, experimental design, and response surface methods.

710-C21-0 Fluid Mechanics
Derivation and applications of continuity and Navier-Stokes equations. Macroscopic mass, momentum, and energy balance. Dimensional analysis: friction factors in pipes and packed beds; drag coefficients. Prerequisites: CE B12 and Math B21.

710-C22-0 Heat Transfer
The differential equations of energy transport. Solutions for various applications. Prerequisite: junior standing.

710-C23-0 Mass Transfer
Diffusion and rate concepts; application to distillation, extraction, absorption, humidification, drying. Prerequisites: C21 and C22.

710-C41-0 Process Dynamics and Control
Dynamic behavior of chemical process components. Feedback control principles. Prerequisite: senior standing; C07 recommended.

710-C42-0 Chemical Engineering Laboratory
Operation and control of process equipment for the determination of operating data. Analysis and written presentation of results. Prerequisites: C07 and C23.

710-C45-0 Process Optimization
Modern techniques and application to the design and operation of chemical process systems. Steady-state and dynamic methods. Experimental search for the optimum. Prerequisite: senior standing.

710-C49-0 Advanced Process Control
Digital sampling; sampled data models; digital controllers; hierarchical, distributed, and advanced regulatory control concepts; plant data and control system tuning; model-based control algorithms; nonlinear consideration; multivariable and noninteracting control systems. Prerequisite: C41.

710-C51-0 Chemical Engineering Design I
Preliminary design of industrial processes for the production of chemical and allied products by the application of the engineering sciences and economics. Prerequisites: C07 and C23.

710-C52-0 Chemical Engineering Design II
Design of chemical and process plants applying the principles of unit operations, thermodynamics, reaction kinetics, and economics. Mechanical design and selection of chemical process equipment. Prerequisite: C51.

710-C61-0 Introduction to Polymers
Polymerization mechanisms and their relation to molecular structure, polymerization processes, and the mechanical properties of polymers, especially flow behavior. Prerequisites: Chem B10-1 and Chem C42-1.

710-C67-0 Fabrication of Microelectronic Devices
Application of chemical engineering fundamentals to the analysis and design of basic operations in microelectronics manufacturing, including thin film preparation, lithography, and electronic packaging. Prerequisite: C07.

710-C71-0 Transport Phenomena in Living Systems
Application of transport theory, principally diffusion, to movement of molecules in biological systems, including the blood, cornea, microcirculation, and lung. Prerequisites: C22 and Math B21 or consent of instructor; C21 and C23 recommended.

710-C75-0 Biochemical Engineering
Fast-paced first exposure to modern biochemical engineering. Introduction to the life sciences: microbiology, biochemistry, and molecular genetics. Metabolic stoichiometry, energetics, growth kinetics, transport phenomena in bioreactors, and product recovery. Prerequisites: C07, C23, or consent of instructor.

710-C95-0 Special Topics in Chemical Engineering
Topics to be suggested by students or faculty but approved by the Department of Chemical Engineering.

710-C99-0 Projects
Supervised investigation of a chemical engineering problem with submission of a final report.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Civil Engineering

Civil engineers plan systems such as transportation networks or procedures for water control and supply, and they design structures such as buildings, bridges, dams, and sewage disposal plants. They work together with ecologists, sociologists, economists, lawyers, and others to plan how to use wisely the human and natural resources of large areas such as river basins and how to redevelop cities. With few exceptions, each planning or design job is one of a kind, as contrasted with more routine solutions to other engineering problems.

Planning, of course, requires abundant data of all sorts—topography, geology, soils, vegetation, weather and climate, streamflow and lake currents, traffic routes and patterns, pollution, population, cultural background and preferences,

skills and ambitions. Many civil engineers collect, analyze, and present the data, developing and improving measuring instruments as part of their job. Others apply probability and statistical methods to the data to forecast such things as population growth, demand for water and transportation, maximum winds and precipitation, height of floods, and air and water quality.

Designing systems and structures requires the planning forecasts plus accurate data on the mechanical properties of materials such as steel, concrete, soils, rocks, and plastics and on the behavior of structural components made from them. Some civil engineers test materials and physical models to obtain these data. Many more, however, use known physical properties and the laws of mechanics—energy, momentum, and conservation of mass—to design structures, foundations, pavements, pipe networks, and treatment plants that will do the job safely and economically.

Civil engineers who design water and waste treatment facilities or set up programs to reduce air and water pollution need to understand certain chemical reactions and biological processes as well as the usual fluid and solid mechanics. Engineers who help to plan and design a system understand how and why it works and what may go wrong with it. Hence, civil engineers may operate treatment facilities or systems of flood control reservoirs or set up and administer traffic control plans. Civil engineers may become city engineers.

Engineers who design structures and know soil mechanics learn the practical difficulties of providing a foundation and erecting the structure. Thus they become partly qualified to operate construction companies, and some civil engineers enter the construction business. Administrative and business activities require them also to learn something about accounting, personnel management, and contracts.

Since civil engineering students have such a wide range of career options, the Department of Civil Engineering prescribes a minimum of required courses and required subjects. Students elect the remainder freely or from specified broad categories. The breakdown, which may be deviated from by honor students with permission, is as follows:

Courses specified by name and number	18
Courses specified by subject	8
Courses required to fit into broad categories	17
Free electives	5
Total	48

For details see the civil engineering curriculum.

Areas of Specialization

Civil engineering students may select a program that fits their needs by choosing courses judiciously. The 5 free electives, the 17 courses required to fit into broad categories, and most of the 8 courses specified by subject only (such as mathematical techniques or electrical engineering science or chemistry) allow students to construct diverse specialized curricula, broadly based study programs, or intermediate combinations. Students are encouraged to discuss with faculty any proposed program that meets a well-defined goal. Examples of courses selected in the areas of specialization most often pursued by students are listed in the civil engineering curriculum.

Laboratories

Environmental Engineering

Facilities are provided for instruction and research in environmental biology and chemistry, industrial hygiene, radiological health, and the unit operations of water and waste treatment. Specialized apparatus and instrumentation are available for studies in each area.

Geotechnical Engineering

This facility has a variety of conventional and special equipment for the testing and evaluation of rocks, soils, and soil-foundation systems under both static and dynamic loadings, for undergraduate study, graduate study, and research. The laboratory contains many specialized instruments, including consolidation devices and triaxial compression units equipped for computer-controlled stress, strain, and cyclic loading.

Structural Engineering and Structural Mechanics

The department has a large first-class modern laboratory for testing structural materials, especially cement-based materials and composites. The laboratory is equipped with several closed-loop computer-controlled or servo-controlled testing machines capable of static and dynamic loading as well as advanced instrumentation for electron and optical microscopy studies with facilities for image analysis and holographic capabilities, creep testing in programmed environmental chambers, multiaxial or torsional loading, impact testing, acoustic defect detection, and other nondestructive test methods. Basic facilities, including a perforated testing floor, are available also for static and dynamic testing of structural models and structural components. Students conduct experiments using electrical and mechanical strain gauges, structural models, and photoelastic models. A fully equipped shop and technical assistance are available for the design and construction of special loading devices.

Computer Graphics

More than 100 department computers are linked via an ethernet, of which some 50 are located in the department's four computer laboratories. The computer graphics undergraduate laboratory contains specialized RISC workstations and input-output devices to support computer aided design, geographical information systems, facility management, and scientific visualization software.

Courses Primarily for Undergraduates

720-A90-0 Microcomputer Applications in Civil Engineering
Introduction to microcomputer use in civil engineering. Problems from various areas of civil engineering that involve the use of software such as spreadsheets, databases, and word processing for solution.

720-B02-0 Planning and Managing Our Environment
Contemporary environmental problems and the framework in which societal and public agency decisions are made: air and water resources and pollution control; solid and hazardous wastes; impacts of energy sources.

750-B03-0 Microstructure and Engineering Properties of Materials
See Materials Science and Engineering.

720-B06-0 Environmental Literacy
Simple concepts from the sciences and engineering applied to specific environmental problems, including the concepts of risk. Understanding of and quantitative facility in multidisciplinary aspects of environmental decisions.

720-B12-0 Mechanics
Force systems, equivalence of force systems, and resultants. Equilibrium of a rigid body and systems. Kinematics and dynamics of a rigid body in plane motion. Work and energy relations for a rigid body in plane motion. Prerequisites: Phys A35-1, registration in Math B15.

720-B16-0 Mechanics of Materials I
Analytical and experimental study of stresses and deformations and their application to the design of machine and structural elements subjected to static, dynamic, and repeated loads. Prerequisite: B12 or ME B01.

720-B19-0 Continuum Mechanics I
Introductory concepts of mechanics of continua. Analysis of deformation and stress and the equations of motion, with special emphasis on the elastic solid and Newtonian fluid. Prerequisites: Phys A35-1 and Math B17 or B19.

720-B21-0 Theory of Structures I
Deflections of structures, energy concepts, idealization of structures, truss analysis, column stability, and influence lines. Introduction to indeterminate truss and frame analyses, slope-deflection analysis, and moment distribution. Portal method. Prerequisite: B16.

720-B22-0 Structural Steel Design
Rational basis of structural design. Design approach for structural steel components of a building system. Prerequisite: B21.

740-B41-0 Fluid Mechanics I
See Mechanical Engineering (formerly 720-B41).

720-B50-0 Introductory Soil Mechanics
Fundamental properties and behavior of soils as engineering materials. Origin of soils through the properties of soil components to the strength, permeability, and deformation of soil masses. Prerequisite: B16.

720-C02-0 Engineering Law
Relationship between social, political, and economic problems in engineering; the U.S. legal system, contracts, preparation and criticism of contract documents and specifications; methods of contracting for construction; government contracts; competitive bidding; the engineer's role in management and administration; engineer's, contractor's, and product liability; liability and other insurance; lawsuits; arbitration; legal implications of environmental laws; professional societies; ethics. Prerequisite: junior standing.

720-C06-0 Uncertainty Analysis in Civil Engineering
Development and applications of the analysis of uncertainty, including basic probability, statistics, and decision theory, in the civil engineering areas of soil mechanics, structures, transportation, and water resources.

720-C07-0 Microstructure of Cement-Based Materials
Chemistry of the principal silicate and aluminate cements used in building and civil engineering. Emphasis on underlying science rather than on practical application. Experimental and theoretical aspects of cement chemistry; relationships between processing, microstructure, and properties.

720-C08-0 Construction Management
The construction industry and construction project management. The operation and organization of a large construction management company. Prerequisite: junior standing or consent of instructor.

720-C13-0 Experimental Stress Analysis
Study and use of experimental techniques in measuring stress and strain. Strain gauge, photoelastic, brittle coating, and moire techniques studied and applied with selected laboratory experiments. Prerequisite: B16.

720-C16-0 Plates and Shells
Methods of calculating stresses and deformations in plates and shells used in engineering structures. Bending of circular and rectangular plates under various conditions. Membrane and flexural analysis of shells of revolution with applications in the design of domes, containers, and pressure vessels. Elastic stability. Prerequisite: senior standing.

720-C17-0 Mechanics of Continua I
Introduction to the mechanics of continuous media. Cartesian tensors; kinematics of deformable media; stress; balance laws; constitutive relations for selected solids and fluids. Prerequisites: B12 and Math B17 or B19 or equivalent.

720-C18-0 Mechanics of Fracture
Stress concentration: analysis of the stress field near a crack tip; fracture modes; brittle and ductile fracture; fracture toughness; fracture criteria; fracture-mechanics design; fatigue; dynamic effects. Prerequisites: course in mechanics of materials and Math B17.

720-C19-0 Theory of Structures II
Shear center, biaxial bending, and torsion for beams. Approximate methods of analysis, moment distribution and Muller-Breslau principle. Introduction to limit analysis, plate and shell problems. Computer applications. Prerequisite: B21.

720-C20-0 Structural Analysis
Analysis of deflection and indeterminate structures by the interchange concept. Continuous beams and frames having nonprismatic members. Analysis of vibration characteristics of structures, response of buildings to dynamic loads.

720-C21-0 Properties of Concrete
Concrete as a composite material; relationship between constitutive laws and microstructure; failure theories, fracture; fatigue; strain rate effects; destructive and nondestructive testing; creep and shrinkage; chemistry of cement hydration; admixtures; aggregates; proportioning; new materials.

720-C22-0 Structural Design
Design criteria; planning and design aspects of structural systems for gravity and lateral loads; an integral part of the class is a total design project involving the analysis and design of a structure. Prerequisite: B22 or equivalent.

720-C24-0 Dynamics of Structures
Analysis of systems with one and several degrees of freedom. Problems involving nonlinear force-displacement relation and damping. Determination of natural frequencies of structures. Longitudinal vibrations of bars and stress waves. Vibrations of flexural members. Prerequisites: B21 and Math B21.

720-C25-0 Reinforced Concrete
Fundamentals of reinforced concrete theory and design. Analysis and design of beams, slabs, and columns. Introduction to ultimate strength design and prestressed concrete. Concurrent familiarization with current building codes, specifications, and practices. Prerequisite: B21.

720-C26-0 Matrix Analysis of Structures
The use of matrix methods in analysis of structural systems. Application of flexibility and stiffness methods to trusses, frames, and plate structures. The approximate solution of plane stress problems. Application of digital computers to structural analysis. Prerequisite: B21.

720-C27-0 Finite Element Methods in Mechanics
Development of elements from variational principles and application to static continuum problems. Introduction to techniques for dynamics and generalized field problems. Computer implementation of finite element techniques.

720-C28-0 Prestressed Concrete
Principles of prestressed concrete. Prestressing systems, end anchorage, and loss of prestress. Analysis and design of sections for flexure, shear, bond, bearing, and deflection. Continuous beams, slab, tension, and compression members. Circular prestressing.

720-C46-0 Meteorology and Hydrology
Weather instruments and observations. Mechanics of the atmosphere. Precipitation, runoff, groundwater flow. Methods of analyzing rainfall and stream-flow records for power generation, flood control, and water supply. Prerequisite: ME B41.

720-C51-0 Engineering Properties of Soils
Determination, interpretation, significance, application of index and engineering properties of soils. Laboratory testing procedures, sample handling, reliability of results, methods of evaluation and control. Prerequisite: B50.

720-C52-0 Foundation Engineering
Application of soil mechanics to analysis and design. Settlement of structures, bearing capacities of shallow and deep foundations, earth pressures on retaining structures and slope stability. Prerequisite: B50.

720-C55-0 Engineering Aspects of Groundwater Flow
Applied aspects of groundwater flow and seepage. Permeability determination, flow net construction, filter design, construction dewatering, slope stabilization, road and airfield drainage. Prerequisite: presenior or senior standing.

720-C56-0 Transport Processes in Porous Media
Transport processes in porous media, including unsaturated flow, flow in deformable porous media, convective transport of solutes with hydrodynamic dispersion effects and coupled flow phenomena with particular emphasis on electrokinetics.

720-C58-0 Airphoto Interpretation
Principles and practice of using aerial photographs to obtain information about natural features of the earth's surface, with emphasis on earth materials. Landforms, geological processes, rocks, and soils. Stereoscopic photographs, elements of photogrammetry. Prerequisite: junior standing or consent of instructor.

720-C59-0 Hazardous Waste Management
Identification and classification of hazardous wastes. Regulatory framework. Risk assessment. Control and disposal technologies. Environmental audits. Site assessment and remediation. Prerequisite: upperclass standing in engineering or science or consent of instructor.

720-C60-0 Environmental Impact Evaluation
Methods for evaluating impacts of engineering projects on environmental quality; environmental legislation; environmental quality indices. Participation in a multidisciplinary group project; preparation of impact report. Prerequisite: junior standing.

720-C61-0 Public Health Engineering
Evaluation of the disease status of a community; elements of vital statistics and epidemiology; etiology of infectious and noninfectious diseases; control of environmentally based health hazards.

720-C62-0 Separations and Resource Recovery
Strategy of physical, biological, and chemical separations and resource recovery for environmental, chemical, and mineral engineers; low-grade feed streams and selective physical separations from heterogeneous mixtures; solid waste recovery, coal and mineral beneficiation, and liquid waste stream treatment. Design and system analysis of separation process trains.

720-C63-0 Community Air Pollution
Nature and control of community air pollution. Sources, physical and chemical properties, and effects of major air pollutants; analytical measurements and monitoring of air pollutants; engineering and legislative control. Prerequisite: junior standing.

720-C64-0 Sanitary Engineering
Engineering elements of water supply and water pollution abatement. Water quality standards, water and wastewater treatment processes, and the management of receiving waters to control pollution. Prerequisite: ME B41 (C40 desirable).

720-C65-1,2,3 Radiation Health, Radiation Safety Evaluation, and Radiation Health Engineering
1. Radiation health: survey of the principles of health physics: sources of radiation, physics of radioactivity and ionizing radiation, interaction of radiation and radiation dosimetry, biological effects of radiation, radiation safety standards, principles of radiation protection. 2. Radiation safety evaluation: interaction of radiation with matter. Bragg-Gray principle and external dosimetry, MIRD method for internal dosimetry, population dose, application of radiation safety standards. 3. Radiation health engineering: shielding design, criticality control, contamination control, waste management, legal controls, administrative procedures.

720-C66-0 Environmental Biology
Terrestrial, freshwater, marine, and estuarine ecosystems; interactions of biota with the physical and chemical environment; ecosystem considerations in engineering problems and solutions. Prerequisite: junior standing in engineering or science.

720-C67-0 Chemistry of the Aquatic Environment
Physical chemistry of the aqueous environment; solution and heterogeneous equilibria; reactions at solid-solution interface. Water and wastewater analyses. Lecture, laboratory. Prerequisite: Chem A03.

720-C68-0 Industrial Hygiene and Environmental Control
Application of industrial hygiene principles and practice; measurement and control of atmospheric contaminants. Design and evaluation of industrial ventilation systems. Prerequisite: junior standing.

720-C69-0 Principles of Industrial Hygiene
Recognition, evaluation, and control of health hazards in the working environment. Principles of industrial toxicology, occupational diseases, and occupational health standards. Environmental sampling and analysis. Lecture, laboratory.

720-C70-0 Environmental Engineering Design
Decision making in selection and implementation of environmental control measures. Water supply and wastewater management: quantities to be handled, transportation systems, treatment processes, solid wastes management. Prerequisite: C64.

720-C71-0 Introduction to Transportation Planning and Analysis
Analysis and design of solutions to transportation problems; introduction to selected operations research and statistical analysis techniques; extensive use of case studies in urban transportation, intercity passenger transport, and freight movements. Prerequisite: junior standing or consent of instructor.

720-C72-0 Transportation System Design and Analysis
Integrative design and analysis experience; physical and programmatic problems, including operations, terminals, and management; fundamental concepts of transportation; systematic approaches to creative problem solving.

720-C76-0 Transportation System Operations
Characteristics of roadway travel; vehicle and human factors, intersection performance and control; management and control of arterial streets and networks; neighborhood traffic restraint, urban transit operations. Operations concepts and theories applied to actual problems through laboratory practice.

720-C95-0 Special Topics in Civil Engineering
Topics to be suggested by students or faculty but approved by the Department of Civil Engineering.

720-C99-0 Projects
Special studies under faculty direction. Credit to be arranged.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Electrical Engineering and Computer Science

The Department of Electrical Engineering and Computer Science has three distinct curricula—electrical engineering, computer engineering, and computer science—each of which offers a broad range of programs leading to the BS degree. In addition, MS and PhD degrees can be pursued in electrical engineering and computer science. Electrical engineering is concerned with the theory, design, implementation, and applications, both actual and potential, of various devices and systems based on electrical phenomena and properties. Computer engineering is a synthesis of electrical engineering and computer science designed to provide students with the skills to apply engineering principles to computer design as well as to effectively use computers in engineering applications. Computer science is concerned with the theory, design, implementation, and applications of modern computers, both actual and potential.

Because the disciplines of electrical engineering, computer engineering, and computer science are very broad, their curricula are designed to appeal to students with various

educational and professional goals. By properly selecting elective courses, students can specialize in one or two areas in the department or in an interdisciplinary program. Detailed information on degree requirements and elective courses leading to these areas of specialization is given in the electrical engineering and computer science undergraduate bulletin, available in the department office.

Areas of Specialization

Communication Systems

A communication system involves the generation of an electrical signal representing information to be transmitted, its encoding in some form for efficient transmission, actual transmission, decoding at the receiving end of the system, and the reconversion of the electrical signal into something intelligible to the user. The thorough study of communications system theory requires knowledge of a broad range of mathematical methods and of the capabilities and limitations of electronic circuits. This subject also covers the design and analysis of communication networks for the transmission of audio, video, and data among many users.

Control Systems

The study of control systems deals with the analysis and design of automatic regulators, guidance systems, numerical control of machines, robotics, and computer control of industrial processes. In the study of these systems, students are concerned with their identification and such topics as systems stability, system performance criteria, and optimization. These concepts find application in other fields of engineering and in the development of better understanding of biological, energy, economic, and social systems.

Electronic Circuits

This area of study is concerned with the analysis and design of circuits that employ electronic devices such as integrated circuits, transistors, diodes, light-emitting diodes, data storage elements, image-forming devices, and cathode ray tubes. Important applications include AM and FM radio, television, digital computers, and electronic control and instrumentation systems.

Electromagnetic Waves and Devices

This area of study is concerned with the analysis and synthesis of electromagnetic devices, structures, and systems. Transmission lines, waveguides, antennas, resonant structures, diffracting and scattering elements, Impatt and Gunn diodes, and gyrations are examples of devices and structures that are electromagnetic in nature. Applications include radar, radio astronomy, microwave radio relaying, satellite relaying for transoceanic communication, space communication, radio and television broadcasting, optical imaging and devices, and diagnosis/treatment of human disease, including cancer.

Optoelectronics

This area includes geometric and wave optics, interference, polarization, diffraction, Fourier transformation by lenses, and holography. Laser sources with appropriate modulation techniques are fabricated and studied. Optical communication systems are analyzed with an emphasis on signal transmission through optical fibers. Other important topics include microelectronics techniques in device fabrication, fiber-optic imaging, integrated and nonlinear optics, solar energy conversion, LED, liquid crystal, and other electro-optic display devices.

Solid State Electronics

This area is concerned with the design, physical principles, and applications of solid-state devices both as discrete units and integrated circuit systems. In addition to the various diode, transistor, and FET devices fabricated from silicon technology, other devices developed from gallium arsenide-type materials are reviewed. Both analog and digital circuit applications are stressed. Another important topic is the behavior of conductors in the superconducting state with a stress on applications.

Biomedical Engineering

This area provides electrical engineering training combined with a strong background in the life sciences, which allows students to apply quantitative techniques to the study of living systems. The program offers training in premedical studies, biomedical instrumentation, health care engineering, bioacoustics, and biosciences. Medical schools consider undergraduate biomedical engineering an excellent premedical background, filling a strong need for MD students with good mathematics, science, and engineering preparation. Other graduates may find rewarding careers with hospitals, industry, and research centers in such diverse fields as hospital and research laboratory instrumentation, patient monitoring, and computerized patient diagnosis.

Computer Architecture

This area, a computer engineering specialization, focuses on the design of computer system hardware. Topics include processor design, computer arithmetic, controller design, instruction set design, memory subsystems, and pipelining. Computer-aided design tools are used for the various levels of the design hierarchy.

Embedded Systems Design

This area, a computer engineering specialization, focuses on the use of digital hardware to monitor and control physical systems. Topics include discrete-dynamic systems, digital controllers, analog-to-digital converters, microprocessor-based design, and the study of the economic trade-offs of different software and hardware systems.

Robotics
This area, a computer engineering specialization, focuses on computer vision and robotics. Emphasis is on the software and hardware aspects of robotic design. Topics include robotic control, kinematics, differential relations, dynamic motion, and homogeneous transformations.

Computer Systems Design
This area deals with the structure and design of computers and systems incorporating computers. Introductory courses deal with the organization of computers—arithmetic and logic unit, control unit, memory, and input/output. More advanced courses deal with digital circuits, computer interfaces, microprocessor-based systems, controller design, microprogramming, graphics, computer architecture, computer networks, multiprocessors, reliability and fault-tolerance, and switching theory. Students interested in specializing in this area may major in electrical engineering, computer engineering, or computer science.

Software Engineering
This area is concerned with a systematic approach to developing reliable and maintainable large-scale software. Topics include software requirements, specification, systems design, detailed design, verification and validation, documentation, and maintenance. Also included are performance evaluation, development of error-resistant software, and management of large-scale software development projects. Students have the opportunity to participate in group projects for developing practical software systems. Students interested in specializing in this area may major in computer engineering or computer science.

Systems Programming and Operating Systems
General problems of the efficient use of computing systems are addressed here. Elementary concerns are assembly language programming and machine characteristics. From there the problems of assembly, macroprocessing, linkage, and loading are considered. Advanced topics in operating systems include surveys of operating system architectures, control of concurrent processes, resource sharing, protection, memory management, scheduling, deadlocks, and others. Also considered are problems inherent in real-time information processing. Students interested in specializing in this area may major in computer engineering or computer science.

Database Management and Information Retrieval
This area is concerned with the organization of large amounts of data for efficient processing and retrieval. Structures for organizing data are studied and relative merits compared for storing, sorting, and processing large data files. File creation and maintenance are studied. The principles, design, and implementation of various information management systems are classified and studied. Students interested in specializing in this area may major in computer science or computer engineering.

Programming Languages and Language Processing
This area is concerned with the definition of languages in general and the definition and implementation of programming languages for computers in particular. Topics include the design of programming languages; the translation of higher-level language features like expressions, block structure, and recursion to machine language; the semantics of programming languages; the relation of language features to automata theory; recursive function theory, including decidable/undecidable problems; mathematical logic; and the development of other theories to understand practical computer science problems.

Foundations of Computer Science
This area is concerned with formal language theory, design and analysis of algorithms, computational complexity, automata theory, recursive function theory including decidable/undecidable problems, mathematical logic, and the development of other theories to understand/study practical computer science problems.

Numerical Methods
This area is concerned with the techniques for solving linear and nonlinear systems of equations numerically on high-speed computers. Topics include numerical differential evaluation, development of error-resistant software, and management of large-scale software development projects. Students have the opportunity to participate in group projects for developing practical software systems.

Artificial Intelligence
This area is concerned with methods for programming computers to perform activities generally associated with "intelligent" behavior, such as planning, learning, and natural language processing. Other important topics include automated reasoning, computer vision, and models of human cognition.

Laboratory Facilities
The Department of Electrical Engineering and Computer Science has well-equipped instructional and research laboratories for electronic circuits; digital circuits; solid-state electronics; fabrication of solid-state lasers and other quantum electronic/photonic devices; thin-film device development; biomedical electronics; microwave techniques; control systems; robotics; holography and coherent light optics; biological control systems; digital and analog computation; digital systems design; microprocessor systems; microprogramming;

computer networking; computer graphics; computer-aided design; database and information management systems; operating systems; programming languages; computer communications networks; signal, image, and speech processing; compiler design; and hardware-software interaction.

The department has major research facilities for work in software engineering, distributed computing systems, database systems, expert systems, computer vision, robotics, solid-state devices, fiber optics, lasers, computational electromagnetics, electronic materials, and biomedical engineering. The department also uses the facilities of the Rehabilitation Center and the Materials Research Center. The department's Computer Science and Engineering Laboratory has a number of networked workstations and appropriate software to support class work and projects. These machines are connected to external networks, allowing off-site computing as well.

Courses Primarily for Undergraduates

Courses in the department are numbered in the following groups: A01–A20, B01–B30, C10–C57, and C90–C95 are courses or seminars in computer science and engineering; B41–B70, C01–C08, C60–C89, C97, and C98 are courses or seminars in electrical engineering. A40 is an overview course designed for all engineering freshmen who may be interested in electrical engineering, computer engineering, or computer science.

727-A01-0 Introduction to Scientific Programming and FORTRAN
Introduction to the FORTRAN programming language and methodology for the computer solution of engineering problems. Numerical methods such as root finding and numerical integration techniques. Pre/corequisite: Math B14-2 or equivalent.

727-A02-0 Algorithmic Thinking
Introduction to artificial intelligence and cognitive science from a nontechnical perspective. Fundamental questions about thinking, beliefs, language understanding, education, and creativity. Students write a short essay on each week's topic. No programming required.

727-A10-0 Introduction to Computer Programming
Introduction to programming practice using a modern programming language. Analysis and formulation of problems for computer solution. Systematic design, construction, and testing of programs. Substantial programming assignments.

727-A11-0 Fundamentals of Computer Programming
Introduction to principles of programming and procedural thinking. Procedural abstraction, data abstraction, modularity, object-oriented programming. Uses computer facilities and the Scheme programming language. Substantial programming assignments, including numerical and symbolic programs. Required for computer science majors.

727-A20-0 Introduction to Computers and Information Technology
Basic concepts of computer systems. Considerable hands-on experience with applications such as word processors, databases, and spreadsheets. Some ways in which information technology is making an impact on today's society. No previous experience with computers needed. Not for engineering, computer science, or computer studies majors; not open to students who have taken A01, A10, or A11.

727-A40-0 Introduction to Electrical Engineering and Computer Science
The breadth of the discipline of electrical engineering and computer science and its applications to our modern technological society. Application of principles illustrated by examples from the computer industry, telecommunications and controls, electronic and optical devices, software development and maintenance, and artificial intelligence. Open only to freshmen.

727-B01-0 Fundamentals of Computer Organization
Principles of hardware design. Number system and Boolean algebra. Logic gates. Design of combinational circuits and simplification. Encoders, multiplexors, adders and other MSI circuits, timing diagrams. Memory elements and flip-flops. Sequential logic. Excitation tables. Registers, counters, and design of their digital circuits. Basic computer organization.

727-B05-0 Fundamentals of Computer System Software
Basics of assembly language programming modes. Macros. System stack and procedure calls. Asynchronous traps and calling system services. Techniques for writing assembler, linkers, and loaders. Recursive reentrant and position independent code. Prerequisites: B01 or equivalent, A10 or A11 or equivalent programming experience.

727-B11-0 Fundamentals of Computer Programming II
Continuation of A11. Key concepts in software design and systems programming. Object-oriented programming (in C++), design of interpreters and compilers, and register machines. Required for computer science majors. Prerequisite: A11.

727-B30-0 Introduction to Software Engineering
Advanced program design and debugging. Methodologies for design and implementation of larger programs. Object-oriented concepts and programming in C++. Prerequisites: A01, A10, A11, or any introduction to programming or passing grade in McCormick programming proficiency exam.

727-B41-0 Circuits I
Circuit analysis using Kirchoff's laws, nodal and mesh methods, and network theorems. Resistance network, transient circuit, and sinusoidal analysis. Students must receive a grade of C− or better to register for B42 and B50. Prerequisites: Phys A35-2 and concurrent registration in Math B21.

727-B42-0 Circuits II
Complex frequency, frequency response, parallel and series resonance, Bode diagrams, coupled circuits, two-port

networks, Fourier analysis. Students must receive a grade of C− or better to register for B43, C06, C60, C65, C66. Prerequisite: B41 (C− or better).

727-B43-0 Signals and Systems
Comprehensive introduction to the basic tools for analysis of signals in linear systems. Background in fundamentals of AC circuits and differential equations assumed. Convolution integral and linear time-invariant systems, frequency domain analysis using Fourier and Laplace transform techniques, and elements of discrete-time signal and system analysis. Prerequisite: B42 (C− or better).

727-B50-0 Physical Electronics
Electronic conduction in semiconductors; physical principles of p-n junctions; diodes and transistors; device characteristics and models; elementary diode circuits and amplifiers. Prerequisites: Phys A35-2 and concurrent registration in B42.

727-B70-0 Applications of Electronic Devices
DC and AC networks, rectifiers, transistor amplifiers, feedback and operational amplifiers, digital electronics, and microprocessors. Not open to electrical engineering majors. Prerequisites: Math B14-2 and Phys A35-2 or equivalents.

727-C01-0 Fundamentals of Electromagnetics
Concepts of flux, potential, gradient, divergence, curl, and field intensity. Boundary conditions and solutions to Laplace and Poisson equations. Capacitance and inductance calculations for practical structures. Conductors, insulators, and magnetic materials and their polarization and magnetization. Solutions of magnetic circuits problems. Application of Maxwell's equations. Prerequisites: Phys A35-1,2,3 and Math B21.

727-C02-0 Probabilistic Systems and Random Signals
Basic concepts of probability theory, random variables, moments; introduction to random processes, correlation function and power spectra, Poisson processes. Prerequisite: Math B15 or B42.

727-C04-0 Electrical Machinery
Direct current, polyphase, and single-phase induction machines with emphasis on their characteristics as elements of larger systems. Semiconductor controlled drives. Prerequisite: B41.

727-C06-0 Electronic Circuits
Single-stage FET and BJT amplifier configurations; multistage amplifiers and feedback; frequency response of amplifiers; differential amplifiers and active loads; elementary operational amplifier circuits. Prerequisites: B42 (C− or better) and B50.

727-C07-0 Communications
Analysis of analog communications systems, including modulation, transmission, and demodulation of AM, FM, and TV systems. Design issues, channel distortion and loss, bandwidth limitations, and additive noise. Prerequisite: B43 and C02.

727-C08-0 Applications of Electromagnetic Fields
Maxwell's equations. Transmission lines. Wave equations, plane waves, and Poynting theorem. Solution of Maxwell's equations for rectangular and circular waveguides, applications to microwave networks, antennas, radar, and communications. Prerequisites: C01, Phys A35-1,2,3, and Math B21.

727-C10-0 Mathematical Foundations of Computer Science
Basic concepts of finite and structural mathematics. Emphasis on applications in computer sciences. Sets, axiomatic systems, propositional and predicate calculi. Prerequisites: A10, A11, or equivalent and Math B14-3.

727-C11-0 Data Structures and Data Management
Data structure and data processing applications, searching, sorting, file creation, file maintenance. Data storage techniques. Data processing algorithms. Design of file and data management systems. Prerequisites: B11 or B30 and Math B14-3.

727-C13-0 Introduction to Telecommunication Science
Signals and bandwidth concepts, spectra, basics of electronics, information and coding, modulation, multiplexing, transmission systems, transmission media, analog versus digital communications, computer networks, switching techniques. Not open to EECS majors.

727-C14-0 Applied Artificial Intelligence
Applications that include intelligent capability for relieving the user of routine aspects of problem solving. Computer-aided design, intelligent interfaces, decision support systems.

727-C16-0 Mini/Microcomputers and Real-Time Applications
Basic computer architecture. Low-level program development tools, mini/micro organization, and software development. Laboratory experience to reinforce classroom topics. Not open to computer science or computer studies majors. Prerequisite: A10 or equivalent.

727-C17-0 Data Management and Information Processing
Data representation, file and record organization, linear and linked lists, and scatter storage techniques. Sorting and searching algorithms. Practical techniques to solve problems involving large databases. Not open to computer science or computer studies majors. Prerequisite: A10 or equivalent.

727-C20-0 Formal Languages and Automata Theory
Regular languages, deterministic and nondeterministic finite automata, context-free grammars and push-down automata, Turing machines and unsolvability. Prerequisite: C10.

727-C22-1,2 Compiler Construction
Overview of compilers and context-free languages, top-down parsing, LL(1) parser construction, translation grammars, implementation of lexical analyzer, parser and translator, compiler optimization, error handling, and recovery. Prerequisites: C11 and concurrent registration in C20.

727-C25-1,2 Artificial Intelligence Programming
1. Introduction to LISP and the basic elements of artificial intelligence programming, including semantic networks, frames, and partial matching. **2.** Advanced artificial intelligence programming techniques, including rule-based reasoning (deductive systems and production systems) and case-based reasoning (frames, discrimination trees). Prerequisite for C25-1: A10, A11, or programming experience. Prerequisite for C25-2: A11, C25-1, or LISP programming experience.

727-C27-0 Intelligent Information Management Systems
Principles for simplifying human interactions with complex information management systems. Methods from artificial intelligence applied to the design of interfaces and the redesign of systems to improve performance and simplify training in the use of these systems. Prerequisites: at least junior standing and permission of instructor.

727-C28-0 Numerical Methods for Engineers
Introduction to numerical methods; numerical differentiation, numerical integration, solution of ordinary and partial differential equations. Programs written using methods presented in class. Students are expected to write programs in FORTRAN, C, or PASCAL. Corequisite: Math B21.

727-C32-0 Introduction to Computer Vision
Introduction to computer and biological vision systems, image formation, edge detection, image segmentation, texture, representation and analysis of two-dimensional geometric structures, and representation and analysis of three-dimensional structures. Prerequisites: C11 or equivalent, Math B17, and IEMS C01.

727-C33-0 Introduction to Communication Networks
Network architectures, models, protocols, routing, flow control, and services. Queueing models for network performance analysis. Prerequisite: basic probability theory—C02, IEMS C02, Math C30, or equivalent, or consent of instructor.

727-C36-0 Design and Analysis of Algorithms
Analysis techniques: solving recurrence equations. Classes of algorithm design techniques: divide and conquer, the greedy method, backtracking, branch-and-bound, dynamic programming. Sorting and selection algorithms, order statistics, heaps, priority queues. Prerequisites: C10 and C11.

727-C37-0 Natural Language Processing
Semantics-oriented introduction to natural language processing, broadly construed. Representation of meaning and knowledge, inference in story understanding, script/frame theory, plans and plan recognition, counterplanning, thematic structures. Prerequisite: C48 or consent of instructor.

727-C39-0 Introduction to Database Systems
Data models and database design. Modeling the real world: structures, constraints, and operations. Entity-relationship model and logical database design. Various approaches to data modeling (network, hierarchical, and object-oriented); relational model emphasized. Use of existing database systems for implementation of information systems. Prerequisite: C11.

727-C41-0 Design of Real-Time Digital Systems
Design of digital systems for automatic control and automatic manufacturing. Numerical control, microprocessor-based control, robotics. Algorithms for control strategies; optimization techniques. Prerequisites: (B01 and C53) or C46.

727-C43-1,2 Operating Systems
Fundamental overview of operating systems. **1.** Operating system structures, processes, process synchronization, deadlocks, CPU scheduling, and memory management. **2.** File systems, secondary storage management, protection and system security, issues in distributed systems, case studies, and special topics. Substantial programming projects. Prerequisites: B05 and C11.

727-C44-0 Design of Computer Problem Solvers
Principles and practice of organizing and building artificial intelligence reasoning systems. Pattern-directed rule systems, truth-maintenance systems, and constraint languages. Prerequisites: C25-1 or equivalent LISP experience and C48.

727-C46-0 Microprocessor System Design
Design of digital systems using microprocessors as controlling elements. Comparison of microprocessor architecture. Software/hardware and economic trade-offs examined. Example design of typical systems. Designing for flexibility, ease of maintenance, and economy of development. Prerequisite: C55 or (B01 and C53).

727-C47-0 Digital Electronic Systems Design Projects
Laboratory project experience in design of electronic systems, with appropriate lectures and discussions. Provides practical experience to supplement C46. Prerequisite: C46.

727-C48-0 Introduction to Artificial Intelligence
Core techniques and applications of artificial intelligence. Representing, retrieving, and applying knowledge for problem solving. Hypothesis exploration. Theorem proving. Vision and neural networks. Prerequisite: Lisp programming course (C25-1 or A11).

727-C49-0 Introduction to Theorem Proving
First-order logic and normal forms. The resolution principle. Unification. Completeness. Implementation issues. Applications to mathematics, logic and databases, program verification and generation. Prerequisite: C48.

727-C51-0 Introduction to Computer Graphics
Mathematical, software, and hardware requirements for computer graphics systems. Data structures and programming languages. Random and raster displays. Graphic applications and introduction to current research. Prerequisite: C11.

727-C52-0 Applied Combinatorics
Fundamental problems in combinatorics, including selection, arrangements, counting methods, generating functions, and graph theory, focusing on applications to science and engineering. Prerequisite: C10.

727-C53-0 Digital Electronic Circuits and Systems
Digital electronic logic families, comparators, analog-to-digital converters, digital-to-analog converters, combinational systems, sequential systems, solid-state memory, large-scale integrated circuits, and design of electronic systems. Experimental project included. Prerequisite: C06.

727-C55-0 Computer Architecture I
Fundamentals of the basic building blocks of a computer, including arithmetic logic unit, registers, control unit, memory subsystem, and input-output. Introduction to computer-aided design tools. Prerequisite: B05.

727-C56-0 Computer Architecture II
Fundamentals of computer design, including instruction set design, data-path design, memory system, addressing, and pipelining. Computer design project. Prerequisite: C55.

727-C57-0 Design Automation in VLSI
VLSI chip design, including logic design, architectural design, and packaging. Develop CAD tools for VLSI physical design. Prerequisites: B01 and C11 or consent or instructor.

727-C59-0 Digital Signal Processing
Discrete-time signals and systems, the z-transform, discrete Fourier transform, discrete random processes, effects of finite register length, homomorphic signal processing. Prerequisite: B43.

727-C60-0 Introduction to Feedback Systems
Linear feedback control systems, their physical behavior, dynamical analysis, and stability. Laplace transform, frequency spectrum, and root locus methods. Introduction to system design and compensation. Prerequisites: B42 (C− or better) and Math B21.

727-C61-0 Electrical Power Transmission
Analysis of power systems with symmetrical components, relaying, lightning protection, frequency and load control, economical dispatching, use of computers in power system problems. Prerequisite: B41.

727-C63-0 Digital Filtering
Recursive and nonrecursive digital filters, decimation and interpolation, A/D and D/A conversion as digital filtering problems. Implementation of nonrecursive filters via fast Fourier transforms, quantization problems, e.g., companding and limit cycles. Prerequisite: C59.

727-C65-0 Communication Filters
Analytical approximations in the design of analog filters. Matched filters and their implementation with surface-acoustic-wave and charge-coupled devices. Prerequisites: B42 (C− or better) and C07.

727-C66-0 Communication Circuits
Advanced treatment stressing methods of analysis and design. Coupling network and narrowband filters. Active device modeling. Oscillator and r-f amplifier design. Amplitude and frequency modulators and demodulators. Prerequisites: B42 (C− or better), C06, and C07.

727-C67-0 Linear Integrated Circuits
Theory and practice of linear integrated circuits in the instrumentation and communication fields. Prerequisite: C06.

727-C70-0 Ultrasonic Engineering
Theory of ultrasonics; application to engineering and biological systems. Prerequisites: C06 and C07.

727-C71-0 Information, Modulation, and Coding
Problems in obtaining and processing data from physical and biological systems. Introduction to probability, statistics, system capacity, and signal to noise theory. Methods of coding information for storage and retrieval. Prerequisites: C06 and C07.

727-C74-0 Introduction to Digital Control
Discrete dynamics systems; discrete models of continuous systems feedback and digital controllers; analog-digital conversion; numerical control with microcomputers. Prerequisite: C60 (C or better).

727-C75-0 Nonlinear Problems in Engineering
Analysis of nonlinear circuits and mechanical systems using phase-plane and analytical methods; singularities, stability of equilibrium, periodic solutions and limit cycles, switched circuits, perturbation theory, and numerical solutions.

727-C77-0 Biomedical Computing
Principles of physiological data-acquisition and signal processing. Laboratory computer system design; application in instrumentation, patient monitoring and diagnosis. Laboratory to emphasize programming applications. Guided system design project. Prerequisites: B01 and C06 or equivalent.

727-C78-0 Digital Communications
Sample and time-division multiplexing baseband digital signals and systems. Coded pulse modulation, error control coding, digital modulation systems, information measure and source encoding, introduction to spread spectrum communications. Prerequisites: C02 and C07.

727-C80-0 Radiation and Wave Propagation
Elementary theory of wave propagation; ground wave, sky wave, and ionosphere characteristics. Principles of antennas at low, HF, and microwave frequencies; introduction to diffraction, scattering, and radar fundamentals. Prerequisite: C08.

727-C81-0 Electronic Materials: Properties and Applications
Introduction to the quantum physics of the solid state; energy bands and semiconductors; electronic transport in metals and semiconductors; superconductivity; optoelectronic properties; analysis of various metal and semiconductor interfaces. Prerequisite: C08 or consent of instructor.

727-C82-0 Introduction to Applied Optics
Wave equation; dipole radiation; reflection, refraction. Lenses, stops, mirrors, prisms. Polarized light, retardation plates. Interferometers, thin films. Prerequisite: C08 or consent of instructor.

727-C83-0 Lasers and Coherent Optics
Fundamental principles of operation of lasers. Characteristics of coherent and incoherent radiation. Fresnel and Fraunhofer diffraction theory. Fourier transforming properties of lenses. Spatial filtering and optical information processing. Prerequisite: C08.

727-C84-0 Physical Principles of Semiconductor Devices
Physical mechanisms and the fabrication processes that influence device behavior. Analysis of p-n junctions and MOS structures and characteristics of unipolar and bipolar devices and integrated circuits. Prerequisite: C06 or consent of instructor.

727-C85-0 Optoelectronics
Devices for optical communications, coherent and incoherent sources, semiconductor diode lasers, internal and electro-optic modulation, coherent and incoherent detection, optical fibers, fiber interconnects, integrated optics, and optical communication systems. Prerequisite: C81.

727-C86-0 Computational Electromagnetics
Numerical approaches for modeling the interaction of electromagnetic waves with complex structures, differential equation formulation, time-domain solution, integral equation formulation, method of moments, 2-D and 3-D problems. Prerequisites: C08 and C28.

727-C87-0 Microwave Theory and Techniques
Application of Maxwell's equations to propagation in waveguides containing isotropic and inhomogeneous media. Use of microwaves for the determination of properties of material. Prerequisite: C08.

727-C88-0 Microelectronic Technology
Physics and fabrication of photonic and electronic devices. Physics of semiconductors: heterojunctions, quantum wells, and superlattices; bulk and epitaxial growth of III-V semiconductor crystals; optical, electrical and structural characterization techniques; device processing techniques: diffusion oxidation, ion implantation, annealing, etching and photolithography; optical and electrical devices. Prerequisite: concurrent registration in C81 or consent of instructor.

727-C89-0 Introduction to Superconductivity and Its Applications
Metals and alloys in the superconducting state, the London, Ginzburg-Landau, and BCS theories, types I and II superconductors. Applications in power generation and transmission, computers, magnetic field controlled systems, and Josephson junctions. Prerequisite: C81 or consent of instructor.

727-C90-0 Introduction to Robotics
Introduction to the basic mathematics of robotic control. Homogeneous transformation, kinematics and kinematic solutions, differential relationships, dynamic motion trajectory, robotic control system and programming. Prerequisites: vector and matrix operations and high-level language (C or PASCAL).

727-C91-0 VLSI Systems Design
Design of digital integrated circuits concentrating on architectural and topological issues. CMOS digital circuits. Top-down and bottom-up design. Layout design rules. Timing issues. Computer simulation of circuit performance. VLSI architectures. Systolic arrays, trade-offs in custom design, standard cells, gate arrays. Use of VLSI design tools on a small project. Prerequisite: B01.

727-C94-1,2 Software Project Management and Development
Software development methodologies. Object-oriented analysis and design, CASE tools, software life cycle. Project management tools, programming teams. Executable specifications, automatic test generation. Prerequisites: C43-1 or equivalent programming experience.

727-C95-0 Special Topics in Computer Science
Topics to be suggested by students or faculty but approved by the department.

727-C97-0 Special Topics in Electrical Engineering
Topics to be suggested by students or faculty but approved by the department.

727-C98-0 Electrical Engineering Design
Design of electrical and electronic devices, circuits, and systems by the application of the engineering sciences, economics, and IEEE or other national standards. Prerequisite: senior standing.

727-C99-0 Projects
Seminar and projects for advanced undergraduates on subjects of current interest in electrical engineering, computer engineering, and computer science.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Engineering Sciences and Applied Mathematics

The Engineering Sciences and Applied Mathematics Department offers course work in applied mathematics and administers an undergraduate program leading to a BS in applied mathematics and a graduate program in applied mathematics.

The applied mathematics program is intended to provide the knowledge necessary for applying mathematical ideas and techniques to the problems that arise in engineering or science. It is expected that a student receiving a BS in applied mathematics would have the background for suitable employment in industry or for graduate study in either mathematics (pure or applied) or an engineering field, including computer science and operations research. To achieve these goals, the applied mathematics program is designed to be flexible and

allow the student to concentrate a substantial part of the course work either in mathematics or one or more areas of application.

Courses Primarily for Undergraduates

760-B52-1,2,3 Honors Calculus for Engineers
Yearlong sequence; alternative to standard calculus in Math B14-3, B15, and B17. For engineering freshmen with a strong mathematical background to better prepare them for the mathematical needs of an engineering curriculum. Examples from various science and engineering disciplines to illustrate the applications and utility of calculus. Admission by invitation or consent of department.

760-C11-1,2 Methods of Applied Mathematics
Ordinary differential equations; Sturm-Liouville theory, properties of special functions, solution methods, including Laplace transforms. Fourier series: eigenvalue problems and expansions in orthogonal functions. Partial differential equations: classification, separation of variables, solution by series and transform methods. Prerequisite: Math B21.

760-C11-3 Methods of Applied Mathematics: Complex Variables
Imaginary numbers and complex variables, analytic functions, calculus of complex functions, contour integration with application to transform inversion, conformal mapping. May be taken independently of C11-1,2. Prerequisite: Math B21.

760-C21-1,2,3 Models in Applied Mathematics
Applications to illustrate typical problems and methods of applied mathematics. Mathematical formulation of models for phenomena in science and engineering, solution of the mathematical problem, and physical interpretation of results. Examples from solid and fluid mechanics, combustion, diffusion phenomena, chemical and nuclear reactors, biological processes, etc. Prerequisites: C11-1,2,3 and Phys A35-1,2,3 or consent of instructor.

760-C81-0 Models in Biochemistry and Molecular Biology
Mathematical modeling of biochemical and molecular biological problems, e.g., allosteric enzymes, bacterial transduction, X-ray diffraction, study of DNA fibers. Prerequisite: consent of instructor.

760-C99-0 Projects
Special studies to be carried out under faculty direction. Credit to be arranged.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Environmental Engineering

Environmental engineering is concerned with the interactions of man and environment, applications of scientific knowledge to the understanding and analyses of these interactions, and the improvement of the quality of our environment. The undergraduate interdisciplinary program provides an engineering and scientific basis for the understanding of contemporary environmental problems and approaches to their solutions, an understanding of the natural systems with which human activities must be compatible, and the development of a grasp of engineering analysis and design for environmental control systems planning and design.

Faculty members of the McCormick School are engaged in research on physical, chemical, and biological processes for water supply, waste treatment, pollution control, and resource recovery; water resources; toxicology; the establishment of quantitative relationships between radiation exposure and biological damage; environmental systems planning and design; chemistry and treatment of industrial wastes; land reclamation and contaminant effects on ecosystems.

Completion of the undergraduate interdisciplinary program in environmental engineering will permit students to acquire a level of competence appropriate to the practice of engineering at the entry level or to continue their education at the graduate level. The interdisciplinary program serves as preparation for the Engineering-in-Training (EIT) and, with adequate experience, the Professional Engineer (PE) examinations.

Industrial Engineering and Management Sciences

The Department of Industrial Engineering and Management Sciences offers two undergraduate degrees, one in industrial engineering and management sciences and the other in manufacturing engineering.

The IE/MS degree provides students with the knowledge, principles, and techniques for analysis, design, and installation of complex systems involving people, materials, and modern technology. Graduates find employment in the private sector; in manufacturing and service firms; in the public sector as professional engineers, technical specialists, and analysts; and in general management. Many students use the IE/MS degree as the basis for graduate study of law, business, engineering, management science, mathematics, social sciences, and medicine.

The manufacturing engineering degree prepares students for careers as specialists in manufacturing firms. It also provides a solid technical foundation for a career in manufacturing management.

Course work in industrial engineering and management sciences is divided into five core areas: probability, statistics, and simulation; operations research; production and economics; applied behavioral science; and systems analysis and

design. Course work in manufacturing engineering is organized into three areas: probability and statistics, the manufacturing core, and technical electives.

Courses Primarily for Undergraduates

738-B01-1,2 Introduction to Industrial Engineering
Introduction to the various aspects of industrial engineering with emphasis on applications in industry and the public sector. Presentations by IE faculty and lectures by outside experts. Practical exercises to familiarize students with the problems and tools of industrial engineering. Two quarters registration to receive one credit.

738-B03-0 Probability and Statistics for Engineers
Elementary probability; standard probability distribution models; descriptive statistics; inferential statistics, including confidence intervals and hypotheses tests; regression and correlation; applications to engineering problems, especially quality control and reliability. Not open to IE majors.

738-C01-0 Introduction to Statistics
Collecting data; summarizing and displaying data; drawing conclusions from data; probability background, confidence intervals, hypotheses tests, regression, correlation. Not open to IE majors.

738-C02-0 Probability
Fundamentals of probability theory with applications. Probability spaces, random variables, distribution and density functions, expectations. Binomial, Poisson, Gaussian distributions. Prerequisite: Math B15.

738-C03-0 Statistics I
Descriptive statistics; observational and experimental studies; confidence interval estimation; hypothesis testing; categorical data; simple linear regression and correlation. Prerequisite: C02 or equivalent.

738-C04-0 Statistics II
Multiple regression; analysis of variance; design and analysis of single factor and multifactor experiments; nonparametric methods. Prerequisite: C03 or equivalent.

738-C05-0 Statistical Methods for Quality Improvement
Control charts and process capability studies; other graphical methods. Acceptance sampling plans. Industrial experimentation: multifactor experiments, screening experiments, quality engineering using robust designs. Reliability and life testing. Prerequisite: C03 or equivalent.

738-C06-0 Decision Analysis and Behavioral Decision Theory
Theory of optimal decisions and psychology of human decision making. Probability, utility, risk and uncertainty, rare events, group decision making, probability revision, interpersonal conflict. Background in probability desirable. Prerequisite: C02 or equivalent.

738-C11-0 Linear Algebra for Operations Research
Linear spaces, linear transformations, matrices. Systems of linear equations: properties; solution by elimination. Orthogonality; the linear least-squares problem. Eigenvalues, eigenvectors, powers of matrices, dynamic equations. Prerequisite: Math B15.

738-C13-0 Deterministic Models and Optimization
Formulation and solution of applicable optimization models, including linear programs, network problems, integer programs, dynamic programs, and nonlinear programs. Algorithmic methods and efficient use of computers. Prerequisite: C11 or equivalent course in linear algebra.

738-C15-0 Stochastic Models and Simulation
Modeling and analysis of systems under uncertainty. Integrated approach of stochastic analysis and simulation. Elementary queueing systems and networks. Discrete event simulation, choice of distributions, output analysis, animation. Prerequisites: C02, C03, EECS A10.

738-C19-0 Operations Research
One-quarter survey of operations research techniques for nonmajors. Linear programming, decision theory, stochastic processes, game theory. Not open to IE majors.

738-C21-0 Human Factors Engineering
System development, human functions in systems, human capabilities and equipment design, personnel selection and training, human performance assessment and system evaluation. Man-machine systems design.

738-C22-0 Industrial Psychology
For managers in industry and nonprofit organizations, human resources (HR) processes that affect productivity, quality of work life, and legal obligations. HR planning, job analysis, recruitment, selection, placement, appraisal, compensation, training, and development. Prerequisite for nonmajors: consent of instructor.

738-C24-1,2 Engineering Management I, II
Two-course introduction to the fundamentals of accounting, finance, and marketing for managers of engineering and other technology-based functions of an organization. May not be taken P/N. Prerequisites: IE senior standing; C24-1 prerequisite for C24-2.

738-C26-0 Economics for Engineering I
Utility theory and demand analysis, production functions and cost analysis, objectives of the firm, introduction to welfare considerations, input/output models, activity analysis, market structures. Prerequisite: Math B15.

738-C27-0 Economics for Engineering II
Continuation of C26 to include plant and facility location decisions: present value calculations and their justifications, cost of capital, cost-benefit concepts, theory of production and investment, mathematical programming investment models under certainty and risk. Prerequisite: C26 or equivalent.

738-C28-0 Location Analysis and Spatial Planning
Plant layout problems and their solutions. Increasingly complex models of plant location problems. Case studies. Prerequisite: C13 or C19.

738-C29-0 Production Planning and Scheduling
Production planning and scheduling under various demand environments. Application of operations research methods to practical problems of production and inventory control. Prerequisites: C02 and C13 or C19.

738-C33-0 Systems Engineering and Analysis
Real-world projects to develop the art of analyzing and designing complex systems. Consulting, system design, PERT, simulation, value engineering, proposals, PPBS, contracting, systems management. Not open to IE majors.

738-C34-1,2 Systems Project Management I, II
1. Introduction to systems problems and methods, including problem definition, analysis, design, evaluation, proposals, and related areas; preliminary exploration of potential team systems projects. 2. Project management methods applied to the analysis and design of a complex, real-world system. Initiation and planning; organizing and staffing; performance, schedule, and cost control; evaluation, proposals, and implementation. Prerequisites: C22, C40, and IE senior standing.

738-C35-0 Systems Simulation
Discrete event simulation using microcomputers. Generating and testing random deviates, analyzing simulation output, simulating complex systems, and reviewing commonly used simulation languages. Modeling and programming exercises. Prerequisites: C03, C15, and EECS A10.

738-C36-1,2 Industrial Engineering Design Project I, II
1. Case studies and small-scale projects involving application of operations research techniques to complex decisions problems. Mathematical modeling, optimization, and policy analysis in public and private sector systems. Written and oral presentations of analyses. 2. Large-scale, open-ended team projects from selected fields of industrial engineering. Systems approach requiring establishment of objectives and criteria, analysis and synthesis of alternatives, feasibility, trade-offs, testing, and evaluation. Written and oral presentations of reports. Prerequisites: C13, C15, and IE senior standing.

738-C40-0 Field Project Methods
Bases for theories and practices in organizational behavior and complex systems problem solving. Methods of identifying and defining problems, choosing among methods of data collection and analysis, and designing and carrying out inquiries and related projects. Prerequisite for nonmajors: consent of instructor.

738-C41-0 Introduction to Organizational Design
Design of operating organizations or their components. Work in planned change and a field project in an operating organization. Prerequisite: C40 or D10 and D11.

738-C95-0 Special Topics in Industrial Engineering
Topics to be suggested by students or faculty but approved by department.

738-C99-0 Seminar and Project
Comprehensive study by each student of a selected topic. Engineering literature, experiments, field studies, computer programming. Credit to be arranged. Departmental form required before registration.

D-Level Courses
Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Materials Science and Engineering
Materials science and engineering is a new discipline that has expanded rapidly in response to growing needs for improved use of existing resources and the development of new, specialized materials for future technologies. The program at Northwestern is broad-based, encompassing solid-state physics, polymer science, ceramics, metallurgy, geophysics, surface science, and electronic materials. Engineers, scientists, and technologists who work on different materials for our modern technology all apply basically the same scientific principles governing the interrelation of processing, structure, properties, and material performance. A key theme of the Northwestern program is the integration of these principles in the systematic design of new materials, exploiting the controlled evolution of multilevel structure.

The Department of Materials Science and Engineering offers an undergraduate program leading to the BS degree as well as programs for the MS and PhD degrees. Preparation for a career in materials science and engineering is founded on engineering principles as well as on thermodynamics and kinetics, chemistry, physics, and mathematics. Students who complete one of the programs described below will be well prepared for professional work or graduate studies in materials science and engineering, applied to metals, ceramics, or polymers for structural or electronic applications.

An essential component of the undergraduate program is the senior project, in which each student works with a faculty member on a development or research project. The curriculum provides a fundamental education that prepares students for careers in application, production, processing, or research and development of materials. A student's educational experience is broadened by provision of adequate time for courses in the humanities, arts and sciences, and other areas of engineering.

Areas of Concentration
The undergraduate program at Northwestern offers a close relationship between students and faculty. Every effort is made to tailor specific programs to the student's needs and interests. Several broad areas of concentration are described below. Students are encouraged to create other areas that fit particular interests.

Electronic Materials

As microelectronics enters the era of very large-scale integration, the materials scientist faces new challenges in developing materials and processes used in making integrated circuits with components of micrometer dimensions. New scientific principles, materials fabrication techniques, and improved instrumentation will be needed to exploit electronic-level structure/property relations in these devices and their components. New electronic materials must be developed to meet ever-increasing requirements such as the exciting new area of high Tc superconductivity.

Metals and Ceramics

With the greater use of ceramics in structural application, the materials scientist has seen an increase in the number of principles evolved for metals and alloys carried over to ceramic materials. The development of heat-treatable and toughened ceramics exploits advanced knowledge of solid-state phase transformations and reactions. Exciting developments are taking place in high-performance metal alloys, tough ceramics, and composite combinations of these and other materials.

Polymeric Materials

Synthetic polymers offer the engineering community an ever-expanding array of materials having properties that are tailored by chemical and physical processing. New developments are opening up applications for polymers as high-strength, low-weight materials, optoelectronic components, and key materials in other revolutionary areas. The basic understanding of engineering properties in terms of multilevel microstructure is essential for the full utilization of polymers.

Surface Science

A solid communicates with the outside world through its surface. Wear, corrosion, and passivation are well-known surface processes. Mechanical properties of materials depend critically on composition at grain boundaries (internal surfaces), surface treatments, and the environment. The surface scientist must not only be able to determine the properties of surfaces or interfaces but also be able to control them.

Laboratories and Facilities

Materials science and engineering demands sophisticated experimental techniques for the preparation and characterization of advanced materials The undergraduate program makes heavy use of state-of-the-art laboratory facilities in core courses, technical electives, and senior projects.

Materials preparation and processing equipment is available for all classes of materials, including an advanced crystal growth facility in a clean room environment for preparing single crystals of metals, oxides, alkali halides, and semiconductors. Investigation of complex microstructures employs a wide array of microscopy, diffraction, and microanalysis techniques. This features a unique combination of instruments (cold field-emission transmission electron microscope, atom-probe field-ion microscopes, scanning tunneling microscopes), providing atomic resolution imaging and chemical analysis, complemented by an extensive surface analytical laboratory. Characterization of material properties employs an advanced mechanical testing facility featuring static and dynamic loading under controlled temperature and environment, and there are specialized facilities to measure electrical, spectroscopic, magnetic, and photonic properties. Computer laboratories address thermodynamic modeling and simulation of microstructural evolution, with application in materials design.

Courses Primarily for Undergraduates

750-A90-0 Materials Science and Engineering Freshman Projects
Laboratory-oriented, with research projects emphasizing use of the scanning electron microscope and other modern apparatus; correlation of structure with other properties of materials. Lecture and laboratory. Prerequisite: consent of instructor.

750-B01-0 Principles of the Properties of Materials
Introduction to atomic and molecular organization in solids, with emphasis on structure-property relations in ceramics, electronic materials, metals, and polymers. Single-phase and multiphase materials. Elastic properties, plasticity, fracture, conductivity, phase equilibria. Prerequisites: Chem A02 and Phys A35-1.

750-B03-0 Microstructure and Engineering Properties of Materials
Processing, microstructure, and properties of engineering materials with emphasis on structural materials such as concrete, steel, wood, glass, and ceramics. Prerequisites: Chem A02 and Math B14-3.

750-C01-0 Chemical Aspects of Engineering Materials
Thermodynamics and bonding in matter. Equilibrium and nonequilibrium development of microstructures. Mechanical behavior of metals, ceramics, and polymers. Corrosion and stability of engineering materials. Materials processing. Nature of heterogeneous catalyst materials. Not usable in MSc program. Prerequisite: Chem C42-1 or ChE B11.

750-C16-1,2 Science of Engineering Materials
Principles underlying the development of microstructures and relationships between structure and properties. Phase equilibria, diffusion, phase transformations, nucleation and growth, thermal and mechanical treatment of materials. Lectures, laboratory. Prerequisite: C21 or equivalent.

750-C17-0 Materials in Manufacturing
Ways in which structure-property relationships of engineering materials determine and are affected by the processes employed in their manufacture. Not open to MSc majors. Prerequisite: B01 or equivalent.

750-C21-0 Applications of Thermodynamics
Classical thermodynamics; entropy and energy functions in liquid and solid solutions and their applications to phase equilibria. Lectures, problem solving. Prerequisite: Chem C42-1 or equivalent.

750-C22-0 Kinetics of Heterogeneous Reactions
Rates and mechanisms of heterogeneous gas-solid, liquid-solid, and solid-solid reactions such as carburization, reduction, oxidation, corrosion, stress-corrosion, and heterogeneous structural transformations. Role of microscopic and macroscopic defects; application to statistical behavior.

750-C31-0 Physical Properties of Polymers
Different kinds of polymeric materials. Relationships between structure and physical properties; rubber elasticity, the glassy state, crystallinity in polymers. Experiments on microstructure, thermal properties, processing characteristics, and mechanical behavior. Lectures, laboratory. Prerequisites: B01 or equivalent and Chem C42-1.

750-C32-0 Mechanical Behavior of Solids
Plastic deformation and fracture of metals, ceramics, and polymeric materials; role of crystal plasticity. Role of imperfections, state of stress, temperatures, strain-rate. Lectures, laboratory. Prerequisites: C16-1,2.

750-C33-0 Composite Materials
Introduction to ceramic-, metal-, polymer-matrix composites for structural applications. Emphasis on structure (reinforcements, architecture), properties (elasticity, strength, toughness, creep), processing, role of interface.

750-C40-0 Ceramic Processing
Steps in production of fired ceramic articles. Methods of powder preparation and characterization, compact formation by die and isostatic processing, slip casting, extrusion and injection molding; firing; chemical and physical changes during liquid-phase and solid-state sintering. Lectures, laboratory. Prerequisite: C16-1 or equivalent.

750-C41-0 Introduction to Modern Ceramics
Conventional and high technology applications of ceramic materials, with emphasis on structure (bond, crystal, glass, defect, micro-); properties (thermal, electrical, optical, magnetic, mechanical); and processing (powders, forming, densification). Prerequisites: C16-1,2 or permission of instructor.

750-C51-1,2 Introductory Physics of Materials
Introduction to quantum mechanics with applications to materials and engineering. Brillouin zones, band structures of materials, nature of the cohesive energy of the various types of materials. Thermal behavior. Electrical conduction. Semiconductors. Magnetic behavior of materials. Liquid crystals. Lectures, problem solving. Prerequisites: Math B21 and Phys A35-1,2,3.

750-C55-0 Electronic Materials
Principles, models, and characterization of semiconductor materials. Crystal growth and doping. Diffusion, epitaxy, and monolithic processes. Current transport, nonequilibrium processes, thin films, low-mobility materials, electronic properties of interfaces. Prerequisite: C51-1, EECS C81, or consent of instructor.

750-C60-0 Introduction to Electron Microscopy
Theories and practice in application of scanning electron microscopy and transmission electron microscopy in materials. Lectures, laboratory. Prerequisites: B01 and Phys A35-1,2,3 or equivalent.

750-C61-0 Crystallography and Diffraction
Elementary crystallography. Basic knowledge of diffraction theory; reciprocal space. Applications to structure analysis, preferred orientation. Film and counter techniques. Lectures, laboratory. Prerequisites: Math B21 and Phys A35-1,2,3.

750-C62-0 Point, Line, and Planar Imperfections
Introduction to point defects, dislocations, and internal interfaces in crystalline solids. Interactions among point, line, and planar imperfections. Examples from metals, ionic solids, semiconductors. Prerequisite: C21.

750-C80-0 Introduction to Surface Science and Spectroscopy
Surface spectroscopy, including Auger spectroscopy, photoemission, and LEED. Surface dynamics and thermodynamics. Electronic properties of surfaces and interfaces. Gas-surface interactions. Lectures, demonstrations. Prerequisite: C51-1 or equivalent.

750-C85-0 Stereology
Quantitative analysis of microstructures occurring in ceramic, metallic, petrographic, and other materials, from measurements on two-dimensional sections, transmission micrographs, and scanning electron micrographs.

750-C90-0 Materials Design
Analysis and control of microstructures. Quantitative process/structure/property/performance relations with case studies. Computer lab for modeling multicomponent thermodynamics and transformation kinetics. Prerequisites: C21 and C16-1,2 or consent of instructor.

750-C94-0 Honors Project in Materials Science
Independent study and/or research linked to C96. Comprehensive report on a specific area of modern materials science and engineering. Prerequisite: registration in departmental honors program.

750-C95-0 Special Topics in Materials Science and Engineering
Topics to be suggested by students or faculty and approved by the department.

750-C96-1,2 Senior Project in Materials Science and Engineering
To be taken in two consecutive quarters. Independent basic or applied research project, conceived and performed under the direction of a department faculty member. Interim report at the end of first quarter and final written report at the end of second quarter. Prerequisite: senior standing in MSc.

750-C98-0 Introduction to Plasma Science and Processing Technology
Plasma production, plasma properties (microscopic and macroscopic); plasma characterization, transport phenomena, plasma processing of powders and advanced materials.

750-C99-0 Special Problems in Materials Science
Individual problems including library and design work; comprehensive report on a specific phase of modern materials science. Credit to be arranged.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Mechanical Engineering

The Department of Mechanical Engineering offers a broad range of programs leading to the bachelor of science degree in mechanical engineering.

Mechanical engineering has always meant engines and machinery, but the character of modern engines and machinery has changed enormously because of the ever-increasing demands of performance, compactness, reliability, and productivity. The early devices were built by ingenious mechanics, men of ideas possessed with the know-how to reduce these ideas to practice. Today, traditional know-how and creative ability are as necessary as ever but no longer sufficient in the highly competitive world. It has become necessary also to know why things occur and thus to be able to exert the proper guidance at the earliest stages of planning. Furthermore, in a world of finite resources and in a society increasingly aware of its environment, mechanical engineers must cope with not only the traditional concerns of efficiency and safety but also the undesirable effects of pollution. Clearly, the tools that future mechanical engineers need to possess must be more sophisticated to allow the important but ever-subtle effects to be recognized and controlled.

Mechanical engineering plays a dominant role in a wide spectrum of industries, among them the transportation industry (automotive, rail, air, and marine), the field of heavy machinery (machines producing other machines), the power industry, the environmental industry (heating, ventilation, and air conditioning), robotics, the light precision-machine enterprises (optical, prosthetic devices, mechanical instruments, and the like), and numerous commercial product industries. Preparation for a career in mechanical engineering requires a basic understanding of mathematical, physical, and engineering principles essential to the development of an individual able to plan, design, and manufacture new equipment, combined with a potential for managerial responsibility in a technological society.

The curriculum in mechanical engineering provides a broad, fundamental education preparing a student for direct entry into industry as well as further professional study. The first part of the curriculum is devoted to mathematics, physics, and chemistry. With this background, fundamental mechanical engineering subjects are studied. These include dynamics, solid mechanics, fluid mechanics, and thermodynamics followed by specialized subjects such as vibration, heat transfer, and automatic control. During the final two years, design courses, laboratory courses, and project courses allow students to acquire a taste for the complex task of designing, analyzing, and building a piece of "hardware." In particular, students become aware of the coupling between conceptual design, subsequent analysis (mathematical modeling), manufacturing, systematic experimentation, and final testing. Supporting courses in allied fields of science and engineering broaden the technical proficiency of mechanical engineering, while the elective courses in social sciences, fine arts, history, and philosophy enlarge their background in the problems of humanity.

Areas of Specialization

The program in mechanical engineering is designed to appeal to students with a wide variety of interests and professional goals. By an appropriate choice of elective courses, students can develop a highly personalized curriculum.

Some areas of specialization are computer-aided design/computer-aided manufacturing, systems and control, robotics, tribology, aerodynamics, combustion engines, and environmental control. In addition, there are special options—energy, intelligent mechanical systems, biomedical, and manufacturing. The energy option emphasizes the mechanical aspects of energy conversion and management. The intelligent mechanical systems option focuses on the design of devices featuring mechanical hardware interfaces to electronic hardware and software. The biomedical option is open to students interested in the biological and medical applications of mechanical engineering procedures. Students in this option can also satisfy the entrance requirements of medical schools. The manufacturing engineering option is directed toward planning and selecting manufacturing methods, the design for manufacture, computer-aided flexible automation and robotics, and increasing the efficiency and productivity of current and emerging manufacturing technologies.

Facilities

A detailed description of ME facilities in the newly reconstructed mechanical engineering laboratories may be obtained from the ME department office.

Courses Primarily for Undergraduates

740-B01-0 Mechanics I
Equivalent force systems. Equilibrium of rigid bodies. Distributed forces and centers of gravity. Kinematics of rigid bodies in planar motion. Prerequisites: Phys A35-1, concurrent registration in Math B15.

740-B02-0 Mechanics II
Kinetics of rigid bodies in planar motion. Moments of inertia. Energy and momentum methods. Principle of virtual work. Prerequisite: B01.

740-B20-0 Thermodynamics I
Basic definitions; Zeroth Law and the meaning of temperature; the First Law applied to flow and nonflow processes; the Second Law and its applications; properties of pure substances; equations of state, the Third Law of Thermodynamics, and introduction to cycles. Prerequisites: Phys A35- 1, concurrent registration in Math B15.

740-B24-0 Experimental Engineering I
Modern electronics; construction of elementary analog and digital circuits, such as optodevices, clocks, function generators, counters, analog to digital conversion, digital to analog conversion. Modern data acquisition involving temperature measurements, control of stepper motors, transient heat transfer, fluid mechanics, deformation of beams. Prerequisites: B20, B41, CE B16.

740-B40-0 Introduction to Mechanical Design and Manufacturing
Introduction to strategy and methods of designing, manufacturing, and testing of mechanical products. Material properties and selection methodology, engineering drawing and CAD, and simple manufacturing processes. Prerequisite: concurrent registration in CE B16.

740-B41-0 Fluid Mechanics I
Fundamentals of fluid mechanics. Properties and statics of fluids. Kinematics and dynamics of fluid motion—continuity, momentum, and energy equations. Dimensional analysis, flow in closed conduits. Prerequisites: CE B12 and Math B17 or B19 or equivalents.

740-C14-0 Theory of Machines—Dynamics
Three-dimensional kinematics: rotation axes and mechanism analysis, rotation matrices and Euler's angles for rigid bodies. Three-dimensional kinetics: dynamics of particles, central force problems, dynamics of rigid bodies, rotational inertia matrices and principal axes, dynamics of mechanisms, the gyroscope and other torque-free problems. Prerequisite: B02.

740-C15-0 Theory of Machines—Design of Elements
Factors influencing the proportioning of machine elements—stresses, deformations, and failure criteria as applied to shafts, springs, belts, bearings, gears. Lectures, laboratory. Prerequisite: CE B16.

740-C25-0 Kinetic Theory and Statistical Thermodynamics
Kinetic theory of ideal gas; temperature; Maxwell velocity distribution; transport phenomena, Maxwell-Boltzmann statistics; Bose-Einstein and Fermi-Dirac statistics; partition functions and thermodynamics. Prerequisite: B20 or equivalent.

720-C27-0 Finite Element Methods in Mechanics
See Civil Engineering.

740-C40-1,2 Computer-Integrated Manufacturing
Use of computers to improve productivity and reduce costs in the manufacture of discrete parts and assemblies. **1.** Geometric modeling, dimensioning systems, tolerances, design for manufacture, programming of machine tools. Prerequisites: B40 and CE B16 or consent of instructor. **2.** Metrology, machine tool control, forming processes, parts feeding, assembly, robotics, factory control, communications. Prerequisite: C40-1 or consent of instructor.

740-C46-0 Introduction to Tribology
Fundamentals of surface contact: surface topography hardness, asperity contact. Friction theories and wear mechanisms. Temperatures in sliding contacts. Hydrodynamic, hydrostatic, elastohydrodynamic, and boundary lubrication.

740-C50-0 Introduction to Nuclear Engineering
Energy sources and needs and the interrelationship of nuclear power and the environment. Nuclear physics as it relates to radiation protection and nuclear fission and fusion reactions; nuclear designs, economic and environmental considerations; nuclear reactor types and characteristics. Prerequisites: Phys A35-1,2,3 and Math B21.

740-C58-0 Experimental Engineering II
Optical systems; high-speed photography and laser light sources; schlieren and interferometric flow visualization. Thermometry and thermoelectricity; radiation and spectroscopy. Data analysis; curve-fitting; error analysis. Analogic techniques. Aerothermochemistry; shock tubes; magnetohydrodynamic power generation. Mechanical vibrations; accelerometers; frequency analysis. Lectures, laboratory. Prerequisite: B24.

740-C59-0 Reliability Engineering
Probability concepts and random variables. Failure rates and reliability testing. Wear-in, wear-out, random failures. Probabilistic treatment of loads, capacity, safety factors. Reliability of redundant and maintained systems. Fault tree analysis. Prerequisite: Math B21.

740-C60-1,2 Advanced Machine Design
Lectures and student-selected design and synthesis projects involving significant analytical problems in the following areas: gear, belt, or screw power; transmission; cam, crank, or spring actuation; pneumatic or hydraulic systems; journal or antifriction bearings; lubrication; dynamic or impact loads and deflection or stress; balancing, vibration, or critical speeds; dynamic response or control. Prerequisite: C15.

740-C62-0 Stress Analysis
Theory of elasticity: stress, strain, material response, field equations of linear elasticity, plane stress, and plane strain problems. Bernoulli-Euler beam theory; beams on elastic foundations. Elastic stability: buckling of columns. Energy methods: principle of minimum potential energy; Rayleigh-Ritz methods applied to problems involving rods, beams, columns, plates. Prerequisite: CE B16 or equivalent.

740-C63-0 Mechanical Vibrations
Analysis of vibrations in single- and multidegree-of-freedom systems. Free and forced vibrations with various types of damping. Response to steady-state and transient excitations. Applications to vibration measurement and control systems. Prerequisites: B02 and Math B21.

740-C65-0 Computer-Aided Engineering I—Analysis
Application of computer-based modeling techniques to analysis of mechanical systems; databases; computer graphics and their use in analysis. Prerequisites: Math B15, CE B16, and computer programming.

740-C66-0 Computer-Aided Engineering II—Design
Numerical methods for interaction and optimal CAD. Terminology; fully stressed design; design sensitivity analysis and descent methods; optimality criteria to automated design; gradient projection methods in nonlinear programming and computer implementations. Prerequisites: senior standing and C65 or consent of instructor.

740-C68-0 Aerodynamics
Behavior of lifting surfaces in ideal fluid flows. Two-dimensional airfoil theory; Joukowski transformation. Finite wing theory; the Prandtl lifting line. Prerequisite: B41.

740-C70-0 Thermodynamics II
Elementary classical thermodynamics, application of first and second laws of thermodynamics to power and refrigeration cycles, mixtures and solution, thermodynamic relations, chemical reactions, phase and chemical equilibrium. Prerequisite: B20.

740-C71-0 Combustion Engines
Theoretical and actual cycles, combustion, detonation, carburetion, fuels; performance characteristics, fuel-cell power. Prerequisite: B20.

740-C72-0 Introduction to Turbomachinery
Application of fluid dynamics and thermodynamics to the analysis and design of steady flow machinery, such as pump, compressor, and turbine. Introduction to aircraft engines. Prerequisites: C70 and C73.

740-C73-0 Engineering Fluid Mechanics
Laminar and turbulent duct flows. Boundary layers and potential flows. Lift and drag forces. Thermodynamics and mechanics of compressible flow. Nozzle flows and choking. Wave motion and shock waves. Applications to fluid machinery. Prerequisite: B20, B41, or equivalent.

740-C75-0 Air Conditioning and Refrigeration
Heating and cooling requirements for buildings and various technical processes; thermodynamic analysis; heating and refrigeration systems; system design. Prerequisite: B20.

740-C77-0 Heat Transfer
Fundamentals of heat transfer by conduction, convection, and radiation. Steady and transient heat conduction in solids. Forced and free convection in fluids. Properties of thermal radiation. Radiation heat transfer between solids. Solar radiation. Prerequisite: C73.

740-C79-0 Elements of Combustion Engineering
Introduction to combustion processes, providing an understanding of flame processes as they relate to efficiency and pollution due to propulsion and power generating systems. Diffusion and premixed flames, problems of ignition, quenching, flammability limits, and detonation. Prerequisite: senior standing in ME or consent of instructor.

740-C90-0 Introduction to Dynamic Systems
Modeling the dynamic behavior of physical systems. Concepts of causality, dependent and independent storages, and state. Introduction to bond graphs. Generation of state equations; analytical and computer simulation of system behavior. Application to problems of engineering interest. Prerequisite: Math B21.

740-C91-0 Fundamentals of Control Systems I
Mathematical modeling of automatic control systems. Open loop and closed loop control. Laplace transform techniques and transfer functions. Stability. Root locus technique, Bode plots, Nyquist criterion. Approaches to control system design, including PID and lead-lag compensation. Prerequisites: C90 or consent of instructor.

740-C92-0 Fundamentals of Control Systems II
State space analysis and design of control systems. Eigenvectors, eigen values, dyadic decomposition. Cayley-Hamilton theorem. Concepts of controllability and observability. State feedback, pole placement, model-based observers, the linear quadratic regulator. Prerequisite: C91.

740-C95-0 Special Topics in Mechanical Engineering
Topics to be suggested by students or faculty but approved by the department.

740-C98-0 Engineering Design
Product or system design projects carried out by small student groups. Project definition, conceptual and detailed design, evaluation, and documentation. Prerequisite: senior standing.

740-C99-0 Projects
Special studies to be done under faculty direction. Credit to be arranged.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Medill School of Journalism

Journalists perform a vital function in a democracy whose existence depends on an informed electorate and in a world that depends on effective communication. The Medill School of Journalism seeks to develop professional writers and editors who are broadly educated in the liberal arts and sciences; who are technically skilled; who understand the historical underpinnings of a free press in America; and who appreciate the social, legal, and ethical issues of the news media in modern-day society.

The core journalism courses—which make up 25 percent of the undergraduate curriculum—are designed to prepare students for careers in the mass media, with emphases on writing, reporting, and editing. During the junior year, students participate in the Teaching Newspaper, Teaching Magazine, or Teaching Television program, receiving course credit for an academic internship at 1 of about 50 newspapers located in 25 states or at various magazines or television stations. The curriculum also allows students to take specialized journalism courses during their senior year.

The nonjournalism courses—about 75 percent of the undergraduate curriculum over four years—include a wide selection of social and natural sciences, arts, and humanities classes, so that students will have the background to understand and communicate the world's events.

Many undergraduates find media jobs in print or broadcast journalism, public relations, or allied fields directly after graduation. Others pursue a Medill master's degree. The graduate program in editorial journalism offers concentrated study in reporting and writing, newspaper management, broadcast journalism, and magazine publishing. The school also has another graduate program in integrated marketing communications, with specialized concentrations in advertising, corporate public relations, direct marketing, and interdisciplinary studies. Students are admitted to a graduate program only if their undergraduate course work indicates the aptitude necessary for rigorous, specialized education.

Through the Accelerated Master's Program, Medill allows a few students each year to earn both the bachelor's and master's degrees in editorial journalism in less than five years. Students apply to this program in their junior year; those accepted into the highly selective program must show academic excellence and the promise of success in journalism.

Medill has awarded about 11,000 degrees since its founding in 1921; the school's graduates stand among the leaders of the profession. Medill's 900 students—600 undergraduates and 300 graduate students representing nearly every state in the Union—take pride in the school's ranking as one of the country's preeminent journalism centers.

Academic Policies

Program of Study for the Degree of Bachelor of Science in Journalism

Undergraduates must complete 45 course units, with at least 33 of those in areas other than journalism. Students must complete one or more courses in economics, history, literature, math/science, and political science. In addition, students must have a 6-unit concentration in a social science discipline and an elective 6-unit concentration.

Students take just 1 of the 11 required journalism course units during their freshman year (Basic Writing) and 2 during their sophomore year (Newswriting and History of Mass Communications). During their junior year, students take Editing I and participate in the Teaching Newspaper, Teaching Magazine, or Teaching Television program, where they take reporting and editing courses at newspapers, magazines, or television

stations throughout the United States. These internships offer a professional laboratory in which students study under the supervision and guidance of editor-instructors, monitored and supervised by Medill faculty. Students who encounter financial hardship while on these programs may apply to the school's Benjamin H. Baldwin Fund for additional support.

In their senior year, students usually take 4 courses: Law and Ethics and 3 others chosen from a pool, including courses in newspaper, magazine, or broadcast journalism, advertising, and other journalism electives. Certain journalism electives may be taken before the senior year.

Requirements for the Degree of Bachelor of Science in Journalism

In addition to and independent of the requirements set by the School of Journalism, all students must satisfy the University Enrollment Requirement (see Financial Regulations).

1. A minimum of 45 units of work must be completed on the college level.

2. The final 23 units (of 45 required for graduation) must be taken at Northwestern, and the last three quarters of work must be completed while the student is enrolled at Medill.

3. At least 11 but no more than 12 units in journalism may be counted toward the 45 required for graduation. If the student has more than 45 units, additional journalism units may be taken.

4. Required journalism courses:

B01-0 Basic Writing
C02-0 History of Mass Communications
C20-1 Newswriting
C20-2 Reporting (2 units of credit)
or C60-2 Broadcast News (2 units of credit)
C21-1 Editing I
C21-2 Editing II
or C62-2 TV News Editing II
C26-0 Law and Ethics of Journalism

In addition to C26 Law and Ethics of Journalism, seniors take three journalism courses. Of these three units, at least one must be chosen from the following:
C25-0 Newspaper Reporting and Writing
C60-1 Broadcast Writing
C80-0 Magazine Article Writing
C81-0 Magazine Editing

The remaining two courses may be taken from either the above list or the following list:
B03-0 Advertising
B04-0 Direct Marketing
B10-0 Communication and American Democracy (open to freshmen only)
C24-0 News Media and Social Reform
C61-0 Broadcast Reporting
C62-1 TV News Editing I
C99-0 Independent Study

Students may take both B03 and B04 only if 1 of these courses is a 12th journalism unit. Of the 11 journalism units required for the BSJ degree, 10 must be editorial courses.

5. Students are required to take three units of literature taught by any department in the University dealing with literature, either in English or in a foreign language. Courses in European Thought and Culture will fulfill literature requirements.

6. A student is required to take three units of science and/or mathematics:

- At least one of the required math/science courses must be taken from the following core subjects: astronomy, biological sciences, chemistry, computer science (EECS), geological sciences, mathematics, and physics. In addition, Civil Engineering B02 Planning and Managing Our Environment and B06 Environmental Literacy are considered in this category and will satisfy this requirement.
- At least one of the required math/science courses must be taken from this list: Anthropology C62-1,2,3 Quantitative Methods of Analysis; Educational Processes B10 Introduction to Probability, Statistics, and Research Methodology; Mathematics B10-1,2 Mathematics for the Behavioral Sciences; Political Science B15 Introduction to Formal Models of Political and Social Behavior, C10 Elementary Statistics for Political Research, C11 Methods of Political Research, C12 Logic of Political Inquiry, C13 Computer Methods for Political Science, and C15 Formal Models of Political Behavior; Psychology B01 Statistical Methods in Psychology; Sociology C03

Analysis and Interpretation of Social Data and C30 Basic Statistics for Social Research; and any course in the Department of Statistics.

- The third required math/science course may be from the two preceding categories or may be Geography B10 The Natural Environment or Geography B11 World Biogeography, which are the only geography courses that count toward this requirement.

7. Students are required to take three units of history taught by the Department of History or European Thought and Culture. Courses may be taken in any combination.

8. Students are required to take one American government course in the Department of Political Science. Acceptable courses include the following: B20 American Government and Politics; B21 Urban Politics and Policies; B30 Introduction to Law in the Political Arena; C20 The Presidency; C21 Community Political Processes; C22 Federalism and Intergovernmental Relations; C23 Public Opinion and Voting Behavior; C24 Political Parties and Elections; C25 The Legislative Process; C27 Black American Politics in the United States; C32 Constitutional Law I; and C33 Constitutional Law II: Civil and Political Rights.

9. Students are required to take one unit of economics.

10. A social science "major" (concentration) is required. It may take one of several forms:

- Students may take six units of any one of the following subjects: anthropology, economics, history, political science, psychology, or sociology. If, for example, the student selects history or political science, the six units taken to fulfill the social science major must be in addition to those required of all Medill students (see 7 and 8). At least two of the six units must be at the C level. Students may apply no more than one A-level course toward the social science major. International Studies B01-1,2,3 Introduction to the World System may be used in partial fulfillment of the six-unit social science major in political science.
- Students may take a nine-unit social psychology major. This requires a minimum of two units each in sociology, psychology, and anthropology. The remaining three units may be selected from any of the three subjects, in any combination. Three A-level courses, the introductory courses in the three disciplines, are permitted. At least two of the six remaining units must be at the C level.
- Students may select a nine-unit social science major in urban studies. The general requirements for this major are described in the Medill Undergraduate Handbook.
- For field study units in social science: (1) students may not apply more than two units from any single field study toward any social science major; (2) students may not apply more than three credits from field study or C99 Independent Study in social sciences toward any six-unit social science major. For social psychology majors the limit is four, and for urban studies majors the limit is one. Requests for credit must be approved by the Academic Standards Committee or its designee.

11. An elective "major" (concentration) or two elective "minors" (concentrations) are required. The options are

- For an elective major, a student must select at least six units in a department in the College of Arts and Sciences. However, the units cannot be in the same subject selected for the social science major (although, of course, they can be in a second social science subject). For any elective major except those in astronomy, biological sciences, chemistry, geological sciences, mathematics, physics, or a foreign language, students may apply no more than one A-level course and must take at least two C-level courses.
- If a student prefers, two elective minors, each consisting of three units, may be selected in place of the elective major. One set of units must be in a College of Arts and Sciences department. The other may be taken in any department of any school of the University outside of journalism. (Naval ROTC students may use courses offered for University credit in the Naval Science Program for one of the elective minors.) However, the units cannot be in the same subject selected for the social science "major" (although, of course, they can be in a second social science subject). If a student has selected the social psychology or urban affairs major as a social science major, only one elective minor of three units is required.

- Students taking a social psychology or urban studies major may not take an elective minor in any department in which they have earned more than three units as part of their interdisciplinary major.
- For elective minors: students may not apply more than one unit from any single field study or C99 course toward their elective minors.
- For any elective minor except those in astronomy, biological sciences, chemistry, geological sciences, mathematics, physics, or a foreign language, students may not apply more than one A-level course toward the requirement and must take at least one C-level course in the department.

12. No course may count toward more than one requirement.

13. Exceptions to any degree requirements must be approved by the Academic Standards Committee. Petitions and the committee's rules for filing petitions are available in the Medill Student Records Office.

Grade Requirements

1. Students must achieve the following: a 2.00 minimum grade average in all nonjournalism courses taken for a letter grade, a 2.25 minimum grade average in all courses in the social science major, and a 2.25 minimum grade average in journalism courses. In addition, all journalism students are subject to the following grade requirements:

- The journalism grade point average shall reflect the grades of all required journalism courses attempted (including F's) and of any journalism elective courses applied toward the degree.
- All Y and X grades, unless made up satisfactorily by the end of the subsequent quarter, shall be counted as F's.
- A grade of F and/or N earned twice in the same required course shall be grounds for mandatory transfer out of Medill.
- Students must earn a C or better in Newswriting and Editing I and have a minimum 2.25 journalism grade point average (in Basic Writing, Newswriting, and Editing I) to be eligible for the Teaching Newspaper, Teaching Magazine, or Teaching Television program. Any student earning a C− or below in Newswriting or Editing I must repeat the course to qualify for TN, TM, or TTV. In addition, TM students must receive a C or better and have a minimum 2.25 grade point average in Magazine Article Writing and Magazine Editing. TTV students must receive a C or better and have a minimum 2.25 grade point average in Broadcast Writing and TV News Editing I.
- A maximum of two units of D or below in required journalism courses or three units of D or below overall will be permitted. Exceeding these limits shall be grounds for mandatory transfer out of Medill.
- When journalism courses are repeated, both the previous grade and the subsequent grade are computed in the journalism grade point average. One course does not substitute for the other.
- Students who do not meet the minimum grade point requirements are placed on academic probation. Continued poor performance will result in a mandatory transfer to another school within Northwestern University or dismissal from the University.

2. Medill undergraduates are required to take these courses for letter grades (A, A−, B+, B, B−, C+, C, C−, D, F):

- All journalism courses (except those offered by the faculty under the P/N option).
- All courses in a student's social science major.
- All basic requirements in economics, history, literature, science/math, and American government (political science).

3. Other courses may be taken on the pass/no credit (P/N) option, if that option is available. A total of no more than 6 units of credit shall be taken P/N and counted toward the 45 units required for graduation. (P/N grades from Teaching Newspaper, Teaching Magazine, or Teaching Television are included in these 6.) Only one course per quarter may be taken P/N.

Leaves of Absence

Because students often can gain some advantages by taking a leave of absence from their studies, the school generally will approve requests for a leave of absence for a year or less. Leaves of more than a year will be granted only in special circumstances.

Because a leave of absence interrupts the usual academic program, students may require more than four years to complete their degree. Before taking a leave of absence, students should consult with their adviser and

with the Medill Office of Student Records. The school cannot guarantee that the student will be able to resume studies precisely at the point at which they were interrupted. The sequence in which various courses are offered may be changed during the student's absence, and it is the student's responsibility to adjust to the new course structure on returning to school.

Once a student is accepted by Northwestern University and enrolled in the Medill School of Journalism, all decisions on leaves of absence and readmission to the School of Journalism are made not by the University but by the School of Journalism. Therefore, all correspondence about requests for leaves of absence or extension of existing leaves should be directed to Medill's director of undergraduate studies.

Students who interrupt a degree program by not registering or by withdrawing for one calendar year must apply to the director of undergraduate studies for readmission. There is no fee for this application. Before readmission, the student's record, in every case, is thoroughly reexamined. When a student has been inactive in a program for longer than a calendar year, readmission will be granted only when persuasive evidence of that student's preparation and ability to complete a degree program has been supplied.

Requests for a leave of absence must be received by the Medill School of Journalism at least one month before the leave would begin.

Faculty Advisers

When students enter Medill, they are assigned to a faculty adviser who is available to help each student develop an individual academic program. Medill staff and students also help advise students in such areas as degree requirements, career paths, noncredit internships (especially during the summers), and work on campus media.

Academic Options

Internships

Internship employment by newspapers, magazines, radio and television stations, and advertising agencies may be available to Medill juniors, seniors, and graduate students, particularly during the summer. Many employers look to Medill for talented young people who can be introduced to their organizations through internships. The school encourages these opportunities as a means of enriching the student's education but gives academic credit only for the Teaching Newspaper, Teaching Magazine, and Teaching Television internships.

International Studies Program

Medill undergraduates may enroll in international studies, an undergraduate interschool adjunct major that is taken in conjunction with a traditional major. (See International Studies Program in the Other Undergraduate Programs section of this catalog.)

Undergraduate Leadership Program

The Undergraduate Leadership Program, an interschool certificate program open to all undergraduates, helps students understand the nature of leadership and prepares them to become leaders. (See Undergraduate Leadership Program in the Other Undergraduate Programs section of this catalog.)

Activities

Medill students, through student publications, professional organizations, and convocations, have many journalistically related opportunities outside of the classroom.

Students write and edit the independent student newspaper, the *Daily Northwestern,* published during the academic year, and the *Summer Northwestern,* a weekly newspaper published during the Summer Session. Also published on campus are the *Syllabus,* the student yearbook; *Byline,* a journalism magazine; and a variety of other publications. The University gives no academic credit for work on student-run publications. The *Daily Northwestern, Summer Northwestern,* and *Syllabus* are published by the Students Publishing Company and have no formal connection with the School of Journalism.

Radio station WNUR-FM provides another outlet for student newswriters, sportswriters, editors, and commentators. "Evanston Stories" is a student-produced news program aired on a local cable television channel.

Writing skills help the student in other extracurricular activities such as campus politics, the Waa-Mu show, student-planned colloquia, and various literary publications.

The Society of Professional Journalists and the National Association of Black Journalists—professional organizations that promote high standards among journalists—have chapters on campus. Other organizations for students interested in journalism include Blackboard and the Communications Residential College. Top scholars in the senior and graduate classes are initiated into Kappa Tau Alpha, a national journalism honorary society.

The Medill Student Advisory Council helps make student views known to the administration.

ROTC Course Credits

ROTC course credits may be used as a portion of the 45 units required for graduation. These units may be considered as elective units or in some cases may be used to fulfill an elective minor requirement.

Accelerated Master's Program

Through the Accelerated Master's Program, the Medill School of Journalism allows a few students each year to earn both the bachelor's and master's degrees in editorial journalism in less than five years. Students apply to this program in their junior year; those accepted into the highly selective program must show academic excellence and the promise of success in journalism.

Early Graduation

Students who plan to graduate early must notify the school in writing at least three quarters before the expected date of graduation. These students also should check with the Office of the Registrar to make sure they have fulfilled the University Enrollment Requirement.

Courses

Required Courses

325-B01-0 Basic Writing
Concise, clear, written communication; narrative, descriptive, and expository skills; introduction to basic journalistic disciplines, such as writing to assignment, length, and deadline.

325-C02-0 History of Mass Communications
Study of the rise of journalistic institutions in the United States. Prerequisite: sophomore standing.

325-C20-1,2 Newswriting and Reporting
Thorough groundwork in news gathering and writing.
1. Newswriting. Prerequisites: B01 and sophomore standing.
2. Reporting (2 units). May be replaced by C60-2. Prerequisites: C20-1 and junior standing; take concurrently with C21-2 as part of the Teaching Newspaper or Teaching Magazine program.

325-C21-1,2 Editing I and II
1. Basics of copy handling, including editing for grammar, style, content, tightness; compilation of stories from several sources, editing to space specifications; headline writing.
2. Working with "live" copy under deadline pressure; relationship between newspaper personality and its design. Study of various headline styles and practice in writing them. May be replaced by C62-2. Take concurrently with C20-2 as part of the Teaching Newspaper or Teaching Magazine program.

325-C26-0 Law and Ethics of Journalism
Rights and restrictions of the news media; libel, privacy, journalistic privilege, constitutional guarantees, broadcast law. Prerequisite: senior standing.

Elective Courses

Three courses are required from this list; one must be C25, C60, C80, or C81. Students may take both B03 and B04 only if one of these courses is taken as a 12th journalism unit. Of the 11 journalism units required for the BSJ degree, 10 must be in editorial courses.

310-B03-0 Advertising
Orientation to advertising in our economy and society. Introduction to theory and practice of marketing, research, copywriting, media planning, direct marketing; how advertising works; advertising agencies and other organizations; role of advertising in our society and economy; legal aspects.

316-B04-0 Direct Marketing
Fundamental principles of direct marketing, including marketing, promotion, and business considerations; survey of database, media, and creative techniques used by traditional and nontraditional marketers.

325-B10-0 Communication and American Democracy
Integrated overview of journalism, communication studies, and American democratic theory. Role of the press in a democracy. Political campaign news and advertising. First Amendment as a framework for ethical and policy analyses of media practices. Open to freshmen only.

325-C24-0 News Media and Social Reform
The news media in their adversarial role in public affairs reporting, including investigative and interpretative reporting and advocacy journalism; experimental research on the impact of the news media on public opinion and policy making. Prerequisite: senior standing.

325-C25-0 Newspaper Reporting and Writing
Continued emphasis on sound writing techniques; use of basic documents for investigatory purposes. Prerequisites: C20-2 and senior standing.

325-C60-1,2 Broadcast Writing and Broadcast News
Introduction to broadcast journalism. **1.** Writing. Focus on writing techniques for broadcast and story production. Prerequisite: C20-1. **2.** News (2 units). Orientation to most aspects of television newsroom operation. Emphasis on writing and news gathering. Prerequisites: C60-1 and junior standing; take concurrently with C62-2 as part of the Teaching Television Program.

325-C61-0 Broadcast Reporting
Basics of reporting for broadcast and preparation of broadcast stories. Emphasis on interviewing, packaging a story, and analyzing techniques. Prerequisites: C60-1 and senior standing.

325-C62-1,2 TV News Editing I and II
1. Basics of production for television news. Working behind the scenes in constructing a news broadcast, selecting stories, and using graphics. Prerequisites: C60-1 and senior standing. **2.** Practice in producing news programs and videotape editing. Take concurrently with C60-2 as part of the Teaching Television Program.

325-C80-0 Magazine Article Writing
Basics of writing for consumer and business magazines; differences between magazine and newspaper writing; how to report, organize, and write magazine articles, from department pieces to full-length stories. Prerequisites: C20-2 and senior standing.

325-C81-0 Magazine Editing
The techniques of editing a business or consumer magazine; copy flow and processing; fact-checking; story editing and planning; fundamentals of design. Prerequisites: C20-2 and senior standing.

325-C99-0 Independent Study
Academic work sponsored and supervised by a faculty member.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

School of Music

The Northwestern University School of Music has ranked among the most prestigious music schools in the nation since its establishment in 1895, providing an environment in which young musicians can dedicate themselves to their art. The school educates its students to become highly proficient in performance and to acquire the broad cultural knowledge that will make them total musicians. The Northwestern University School of Music is a professional school within the University—students accepted into the school are also accepted into the University and consequently have the advantage of academic study in a variety of courses with distinguished faculty. As part of a private institution, the School of Music has developed distinctive programs to meet the artistic and professional needs of its students, preparing them for careers as instrumentalists, singers, teachers, composers, conductors, theorists, historians, critics, managers, and others needing a specialized knowledge of music. These programs are responsive to new directions, recognizing that a great institution of musical learning preserves the riches of past practices while it encourages its students to explore the practices that will produce the music of the future.

The faculty believe that each undergraduate should be given a comprehensive musical background, that the education should be centered on performance founded on scholarly studies in music theory and history, and that all musical training should be accompanied by a broad cultural background in the humanities. In addition to providing instruction in voice and all principal instruments, composition, and music technology, the school supports orchestras, bands, choral ensembles, opera, and a wide variety of small ensembles that give students experience in all avenues of musical expression.

The graduate division of the School of Music is open to students who are deemed capable of advanced study. Graduate courses emphasize scholarly performance and include concentrated work and research in students' major fields of interest. The ultimate aim is to develop informed musicians, independent scholars, and inspired teachers.

Although the excellence of any school depends mainly upon the quality of its faculty and students and the soundness of its curriculum, distinguished personages in the field of music are brought to the campus from time to time to enrich the regular programs and to give a special impetus to study. In past years, guests have included Dmitri Shostakovich, Witold Lutoslowsky, John Cage, Sherrill Milnes, James Galway, Pierre Boulez, Erich Leinsdorf, and Sir Georg Solti, among others. A performing arts series annually presents concert artists in performance and master classes for students.

In addition to outstanding instruction and significant platform experience at the University, the school offers excellent opportunities for professional associations in the Chicago metropolitan area. Students can gain valuable experience in performance while studying toward a degree, and the richness of Chicago's musical life can enhance their education as developing musicians.

Mission Statement

We affirm that music is a universally treasured art and an essential component of culture.

The mission of the School of Music is to provide the highest order of education in all major aspects of music. We endeavor also to expand the musical experiences and understandings of students throughout the University and to enhance the quality of our community's musical life. While continuing to animate the vital traditions of music's past, we encourage creative and dynamic visions of its future.

The School of Music pursues this mission through professional undergraduate and graduate programs for a selective student body of highly qualified musicians

who also meet competitive academic standards. We attempt to integrate the artistic and intellectual aspects of our students' education and to provide a depth and breadth of musical study that equips them with a continuing capacity to grow in their musicianship and to adapt to changing professional demands. Our faculty members strive to be inspiring teachers as well as musical and intellectual leaders. They are actively engaged in expanding knowledge about music through their research and scholarship; in preparing students to be performers, composers, teachers, scholars, and informed audiences; and in enriching their community's culture through their own artistry.

Academic Policies

Programs of Study

The School of Music offers programs leading to the professional degrees of bachelor of music, master of music, graduate certificate in music, and doctor of music. While these programs are designed to prepare the individual for a professional life in music, the setting of the school within a university of Northwestern's quality provides special benefits to students for broadening their education in related disciplines. The school also offers a nonprofessional degree, the bachelor of arts in music.

Undergraduates in these programs enter the School of Music as music majors and follow the core program of studies outlined on the following pages. Students may select a specialization that begins in the freshman year or pursue the completion of the core program before choosing a specialization. The core program provides basic experiences, the acquisition of minimum competencies, and the opportunity to reflect on a choice of specialization, together with liberal arts study from a breadth of disciplines. The curriculum provides flexibility for students while providing an education basic to all musicians.

The School of Music is a member of the National Association of Schools of Music, which signifies accreditation of its degree programs.

Bachelor of Music

Courses of study leading to the bachelor of music degree include church music, theory, composition, music history, music education, and performance in organ, piano, guitar, harp, strings, winds, percussion, and voice. Through the use of electives, it is possible in the final two years of study leading to the bachelor's degree, with the adviser's help and the faculty's approval, to design a program that cuts across specializations to meet a particular student's needs and career ambitions. Students interested in a specially designed and approved program that most fits their interests and abilities may petition for such a program. The program is designed in consultation with faculty and area professionals with expertise in the particular area of interest. Ad hoc specializations have included arts administration, music criticism, jazz studies, conducting, ethnomusicology, music theater production, and music industry.

Graduates of the bachelor of music with specialization in the music education program meet all requirements for teacher certification in the state of Illinois (and most other states). In addition to the core program common to all School of Music students, music education majors take a structured sequence of courses in general education, a basic set of courses in music education, and special courses in the chosen music education specialization.

Bachelor of Arts in Music

In addition to the professional curricula just described, the School of Music offers a nonprofessional degree program leading to the bachelor of arts in music. Featuring an opportunity for substantially wider explorations in the liberal arts and fewer music requirements, the bachelor of arts in music is intended for students who have strong ability in music but are not necessarily interested in a musical vocation. Students who are interested in this program may petition for it at any time after they have been admitted to the School of Music.

Degree Requirements

A candidate for the degree of bachelor of music in performance, composition, theory, or history or for the bachelor of arts in music must complete 48 course units. A bachelor of music with specialization in music education may require as many as 52 units but also can be completed within four years. For course requirements, see the Degree Requirements chart. For the last 24 units, students must be registered at Northwestern;

for the last 12 units, students must be registered in the School of Music. Credit toward graduation generally is not granted for summer work taken during the last 24 units in other colleges or universities.

The work offered to meet the requirements for a degree may not average lower than C. Not more than one-fifth of this work may be of grade D. A maximum of six quarter-courses in nonmusic subjects taken under the P/N grade option may be counted toward the degree. Music students may *not* take music courses under the P/N grade option, except for those courses graded solely with P/N grades.

If students interrupt their program of study for an extended period of time and degree requirements are changed during this period, they will normally be held to the new requirements.

Every candidate for a degree must file an application for the degree a year in advance of the date of graduation.

Students coming to Northwestern University for a second undergraduate degree must transfer at least 9 units of credit in music, audition for admission at the C level, complete the general education distribution requirement with transfer credit, and comply with the 24-unit residency requirement.

In addition to and independent of the requirements set by the School of Music, all students must satisfy the University Enrollment Requirement (see Financial Regulations).

Faculty Advisers

Each student is assigned to an adviser who approves the student's program each quarter. Each student has a conference with the adviser during each quarter. Students may not make a change of registration without their adviser's approval.

Music Performance Study

The School of Music offers instruction in organ, piano, guitar, harp, strings, winds, percussion, and voice. Students should consult their adviser or program coordinator for the assignment of instructor. Consent of the instructor and department chair as well as concurrent registration in ensemble are required.

Elective performance study assignments are made by the appropriate department chair as space is available.

Music Performance Instruction for Nonmajors

Students registered in other schools of the University are encouraged to continue their development as instrumentalists or vocalists. This may be done through ensemble participation, class instruction, or private study. Ensembles and music performance instruction require an audition. Information about auditions is available in the *Class Schedule* and in the office of undergraduate music studies.

- Class instruction in voice is offered for credit to students other than music majors in 570-A02 Beginning Voice.
- Class instruction in beginning piano is offered without credit for a limited number of nonmusic majors.
- Private instruction in music performance is a .5 unit registration in P01-0 in the appropriate performance program; each student has a half-hour weekly lesson.

For information about instruction, inquire in person at the School of Music undergraduate music studies office.

Attendance Policy

Students are expected to attend all sessions of courses and ensembles for which they are registered. It is the responsibility of students enrolled in the School of Music to acquaint themselves and comply with the attendance policy of their departments, class instructors, and ensemble conductors.

In addition, students who are absent from classes for three or more consecutive days because of illness are required to notify the Office of the Associate Dean. Students who know they will be absent from classes or performing organizations for three or more consecutive days for such professional or personal commitments as auditions or off-campus performances or for any other nonemergency reasons are required to prepare a petition requesting permission to be absent from their academic and performance responsibilities in the School of Music. This petition must be submitted to the Office of the Associate Dean for approval.

Failure to comply with these regulations can be cause for failure in the courses or ensembles for which a student is registered during that quarter.

Degree Requirements

Bachelor of Arts in Music (48 course units)

Music	*Nonmusic*
Basic Studies Musicianship (6 units) Large ensembles (1 unit) Aural skills (1 unit) Keyboard skills (1 unit—optional) Performance study (3–6 units): includes private instruction and related course work on principal instrument or voice. A second year of instruction may be taken. **Electives** C-level theory (3 units) C-level history (3 units)	**General Education Distribution** (14 units) Includes one English composition course, one freshman seminar or general education elective, and two courses from each of the six CAS distribution areas: natural sciences, formal studies, social and behavioral sciences, historical studies, values, literature and fine arts. **Foreign Language** (6 units) May be satisfied by completing the third quarter of an intermediate (second-year college) course in a classical or modern language or by passing an examination to demonstrate equivalent proficiency. **Electives** (10 units) A maximum of three elective units may be taken as additional courses in music.

Bachelor of Music (48 units)

Music	*Nonmusic*
Basic Studies Musicianship (6 units) Large ensembles (2 units) Aural skills (2 units) Keyboard skills (2 units) Performance (6 units): includes private instruction and related course work on principal instrument, voice, or composition. **Specialization** (12 units) Professional Studies Requirement: see specific department. Specialization in the following areas: principal instrument, voice, music history, music theory, composition, academic studies, and composition or an ad hoc major.	**General Education Distribution** (9 units) Includes one basic or intermediate English composition course; three general education electives, to be used for one year of the same language or to be distributed into two areas; and one course from each of the following CAS distribution areas: natural sciences or formal studies, social and behavioral sciences, historical studies, values, literature and fine arts. (For an alternative course selection, consult your adviser.) **Electives** C-level music electives (3 units) Free electives (6 units)

Bachelor of Music with Specialization in Music Education (up to 52 units)

Music	*Nonmusic*
Basic Studies Musicianship (6 units) Large ensembles (2 units) Aural skills (2 units) Keyboard skills (2 units) Performance (6 units): includes private instruction and related course work on principal instrument or voice. **Specialization** (18.83–19.93 units) Professional Studies Requirement: see specific program and emphasis. **Electives** (1–2 units)	**General Education Distribution** (10 units) Includes one basic or intermediate English composition course; two natural science courses from astronomy, biological sciences, chemistry, geography, geological sciences, or physics; one course each in U.S. history, American government and politics, psychology, aesthetic education, English or comparative literary studies, physics of sound, and general education.

Five-Year Bachelor of Arts and Bachelor of Music (60 course units)

Music	*Nonmusic*
Basic Studies Musicianship (6 units) Large ensembles (2 units) Aural skills (2 units) Keyboard skills (2 units) Performance study (6 units) **Specialization** (12 units) Professional Studies Requirement: see specific department.	**General Education Distribution** (27 units) CAS distribution requirements CAS departmental major **Foreign Language** (3 units) Foreign language A02-1,2,3

Five-Year Bachelor of Science and Bachelor of Music or Bachelor of Arts in Music (69 course units)

Music	*Nonmusic*
BMus: Basic Studies Musicianship (6 units) Large ensembles (2 units) Aural skills (2 units) Keyboard skills (2 units) Performance study (6 units) **BMus: Specialization** (12 units) Professional Studies Requirement: see specific department. **BAMus:** See Music requirements under Bachelor of Arts in Music above.	**Engineering and Applied Science** General education (BMus: 5 units; BAMus: 17 units) Mathematics (6 units) Basic sciences (5 units) Basic engineering (6 units) Computer programming (1 unit) Department program (16 units)

Academic Options

Double Major

Students may earn a double major in four years with proper academic planning and by fulfilling the requirements of both majors.

Bachelor of music candidates may double major only within the School of Music. In certain cases the curriculum may require enrolling in more than four courses per quarter. Typically, the double major combines a specialization in a performance area with one in the academic area or composition, although double majors within the academic area are possible also. A double major in two performance areas is generally not permitted.

Bachelor of arts in music candidates may double major with any major offered in the College of Arts and Sciences.

Five-Year BA/BMus

Northwestern offers qualified students the opportunity to earn in five years both a bachelor of arts degree from the College of Arts and Sciences and a bachelor of music degree from the School of Music. For course requirements, see the Degree Requirements chart.

All participants in this BA/BMus program must meet the admissions standards of both the College of Arts and Sciences and the School of Music. Students admitted to the program will be expected to have a high school background in a foreign language at least equivalent to a first-year college-level course. Although curricular programs are developed after students arrive on campus, they may apply to the program directly from high school or during their freshman or sophomore year. Students who earn both degrees must complete all course requirements for both the BA and the BMus. Participants in the program may, at some time during their study at Northwestern, choose to complete only one of the two degrees within the conventional four years of undergraduate study. By the time of graduation, however, they must have completed all degree requirements in the school from which they seek a degree. Fulfillment of both sets of requirements will require five years (15 quarters) of full-time study.

Five-Year BS/BMus or BS/BAMus

Northwestern offers unusually capable students the opportunity to earn in five years both a bachelor of music or bachelor of arts in music degree from the School of Music and a bachelor of science degree from the McCormick School of Engineering and Applied Science.

Students in this program must complete all course requirements for a degree in the McCormick School as well as all requirements for the bachelor of music or bachelor of arts in music degree in the School of Music. Fulfillment of both sets of requirements will normally require five years of full-time study.

All participants in this combined program must be accepted by both the School of Music and the McCormick School. Students may apply to the program directly from high school or at any time before the beginning of the sophomore year.

Interdisciplinary Certificates

School of Music students may elect to complete one of the interdisciplinary certificates developed by the School of Music faculty and representing disciplines often used in the music profession. These certificates cross the normally established disciplines to enable students to combine the study of music with another area in an interdisciplinary fashion. Each includes a minimum of six and a maximum of nine courses. Students applying for School of Music interdisciplinary certificates must present records showing a minimum of five courses not double-counted in their specializations.

Students who complete all required courses will receive a notation on their Northwestern transcripts. Applications to receive the certificate are available from the Office of Undergraduate Studies and should be completed along with the Application for a Bachelor's Degree.

Commercial Music

The Certificate in Commercial Music requires nine courses:

- Conducting C26 Conducting and Score Reading
- Conducting C30 Writing for Jazz Ensembles
- Music C35 Selected Topics: Entrepreneurship for the Performing Artist
- Music C98 Internship
- Radio/TV/Film C83 Radio/Audio Production
- Two courses chosen from
  Conducting C20 Band Arranging
  Conducting C21 Writing for Choral Ensembles
  Conducting C31 Advanced Jazz Writing
  Theory and Composition B14 Orchestration
  Theory and Composition C14 Advanced Orchestration
- Two courses chosen from music technology

Jazz Studies

The Certificate in Jazz Studies requires six courses:

- One improvisation course chosen from
  Conducting C36 Jazz Improvisation
  Conducting C37 Advanced Jazz Improvisation
  Music History and Literature C37 Improvisation and World Musicianship
- One jazz writing course chosen from
  Conducting C30 Writing for Jazz Ensembles
  Conducting C31 Advanced Jazz Writing
- One jazz history, theory, or literature course chosen from
  African-American Studies B40-3 Survey of African-American Music (spring quarter)
  Music History C34 Jazz: Its Roots and Elements
- Three electives chosen from improvisation; jazz writing; jazz history, theory, or literature; or jazz piano for the nonkeyboard player courses
- Jazz performance (no credit)
  Large ensemble (University Jazz Ensemble, University Jazz Lab Band, Vocal Jazz Ensemble) and chamber ensemble (Chamber Jazz Ensemble) for six quarters.

Music Business

The Certificate in Music Business requires eight courses:

- Advertising B03 Basic Advertising (University College)
- Economics B60 Accounting and Business Finance (prerequisites: Economics B01, B02)
- Marketing B01 Marketing I: Principles of Marketing (University College)
- Music C35 Selected Topics: Entrepreneurship for the Performing Artist
- Organization Behavior C09 Human Resource Management (University College)
- Organization Behavior C67 Strategic Planning and Management (University College)

- Business-related elective
- Music C98 Internship

Music Criticism

The Certificate in Music Criticism requires nine courses:

- Music History and Literature C24 History and Practice of Criticism
- Music C99 Independent Study (with Professor Willis)
- Three music history and literature electives
- Journalism B01 Basic Writing
- Journalism C20-1 Newswriting
- Journalism C21-1 Editing I
  or C26 Law and Ethics of Journalism
- Journalism C25 Newspaper Reporting and Writing
  or C80 Magazine Article Writing

Interschool Certificates and Adjunct Major

For information about the interschool programs listed below, see the Other Undergraduate Programs section of this catalog.

Integrated Arts Program

The interschool Integrated Arts Program offers courses, leading to a certificate, that explore the creative process from the perspective of the artist in the disciplines of theater, visual arts, music, dance, and media arts.

International Studies Program

International studies, an undergraduate interschool adjunct major that is taken in conjunction with a traditional major, is open to students in the School of Music.

Music Theatre Program

The Certificate in Music Theatre provides the opportunity for School of Music students majoring in voice and School of Speech students majoring in theatre to create a second area of specialization.

Undergraduate Leadership Program

The Undergraduate Leadership Program, an interschool certificate program open to all undergraduates, helps students understand the nature of leadership and prepares them to become leaders.

Graduate Studies

The Graduate Division of the School of Music offers programs of studies leading to the master of music degree, the graduate certificate in performance, and the doctor of music degree. Information concerning these programs is available from the Office of the Associate Dean for Academic Affairs, School of Music. For information about the requirements for the degree of doctor of philosophy, write to the Graduate School.

Resources

Musical Organizations

Music majors are required to participate in those musical organizations for which they are qualified as a part of their program of study. Students from all other schools of the University are encouraged to participate in any organizations for which they qualify.

Symphony Orchestra

This large ensemble provides experience in the concert presentation of representative symphonic repertoire as well as operas and concertos.

Chamber Orchestra

The Chamber Orchestra performs works of all periods. Repertoire is limited to the music of chamber and small symphony orchestras.

Philharmonia

This orchestra is open to interested and qualified students from any school in the University and performs a large range of repertoire.

Symphonic Wind Ensemble

Flexibility and thorough musicianship mark the programs of the Symphonic Wind Ensemble. This is the smallest and most select of the University wind ensembles. Its objectives are to perform literature of the highest aesthetic value with emphasis on major original works for band and to attain perfection in balanced performance through rigid requirements for individual musicianship and advanced playing technique.

Symphonic Band
Made up of 85 outstanding wind and percussion performers, the Symphonic Band seeks to perform the finest works available for large band or wind orchestra at the highest possible level.

Concert Band
The 90-member Concert Band provides an excellent performing experience for interested and qualified students from any school in the University. The Concert Band performs fine literature, including both original and transcribed works.

Wildcat Marching Band
The Wildcat Marching Band is a 150-piece all-University organization that combines marching precision and exceptional playing ability in a finely polished and spirited unit. The band performs for all football games at home and one or more out-of-town games each season.

University Brass Ensemble
The University Brass Ensemble provides performance challenges and learning opportunities for serious brass players interested in literature for ensembles of various sizes and compositional styles.

Jazz Groups
The Jazz Ensemble, Jazz Band, Jazz Lab, and a variety of small combo groups enable students to gain experience in the jazz idiom and to improve improvisation skills. They also offer student composers and arrangers the chance to write for various jazz instrumental combinations.

Percussion and Mallet Ensembles
The Percussion and Mallet Ensembles offer students an opportunity to perform percussion chamber works representative of diverse musical styles from Renaissance transcriptions through avant-garde theater pieces. The ensembles maintain active performance schedules both on and off campus and are open to all percussion students.

Contemporary Music Ensemble
The Contemporary Music Ensemble provides experience for student performers and composers in the performance of contemporary unpublished works. The ensemble annually presents a concert featuring a complete program of student compositions.

University Chorale
The University Chorale is a 40-voice ensemble that is the most select of the University choruses. Its personnel are chosen on the basis of their musicianship and their interest in the performance of both a cappella and accompanied literature.

University Singers
The University Singers is a larger choral ensemble of 60 to 80 singers with high performance standards. This ensemble frequently combines with other choral organizations in the performance of important choral-orchestral works.

University Chorus
The University Chorus is made up of singers from the School of Music, other qualified students, University faculty and staff, and interested residents of the community. It is organized for the purpose of performing large-scale choral works.

Vocal Jazz Ensemble
The Vocal Jazz Ensemble is a select 12- to 16-voice ensemble that provides an excellent opportunity for singers to perform jazz and commercial music. Special emphasis is placed on sound-reinforcement techniques, scat singing, improvisation, and the creation of new works.

Chapel Choir
School of Music students participate in the Chapel Choir at the weekly worship services held in the Alice Millar Chapel. This choir also presents at least three evening concerts during the year.

Early Music Ensemble
The Early Music Ensemble provides study and performance of music written before 1800. Workshops are conducted in early instruments, including recorders, crumhorns, sackbuts, viols, and continuo, and in vocal genres. Any student may request an interview/audition for this ensemble. At least one performance is given each quarter.

Chamber Music Ensembles

Chamber ensembles include piano trio; string trio, quartet, quintet, sextet, and octet; harp ensemble; brass quintet, choir, and band; woodwind quintet; trombone quartet and ensemble; and tuba, saxophone, mixed winds, trumpet, horn, and flute ensembles.

Facilities

The School of Music occupies six buildings. The Music Administration Building houses administrative offices, classrooms, studios, and practice rooms. The faculty of the Department of Academic Studies and Composition as well as the faculty of the Voice and Opera Program and the Piano Program have offices in this building. Regenstein Hall houses rehearsal facilities, practice rooms, a 200-seat lecture/recital room, and the library and offices for the University bands. The Department of Music Performance Studies office and studios for faculty of the Conducting and Ensembles, String Instruments, and Wind and Percussion Instruments programs also are located in Regenstein Hall. Practice Hall contains 35 practice rooms. Lutkin Hall, seating 400, is used for student and faculty recitals and lecture classes. The Music Library is in the Deering Library, part of the University Library. Pick-Staiger Concert Hall provides a 1,000-seat concert hall, rehearsal facilities, and offices and library for the University Symphony Orchestra. The School of Music maintains two computer labs and an electronic music studio.

Music Library

The Music Library, internationally recognized for its collection of contemporary music, is one of the country's finest academic music libraries. It has spacious, aesthetically pleasing facilities, including a multidimensional listening center. Holdings include 127,050 books, music, journals, and microforms, and the Recorded Sound Collection, consisting of 49,510 discs and tapes. The library's special collections include a manuscript collection documenting contemporary notation compiled by John Cage for use in his book, *Notations;* additional holograph scores, sketches, and letters of musicians; the Fritz Reiner Library; rare printed resources; and a portion of the Moldenhauer Archive. The Music Library is also a leader in library automation.

Eckstein Bequest

The School of Music is the beneficiary of an endowment from the estate of Mrs. Louis Eckstein, the Chicago arts patron whose husband founded the Ravinia Music Festival. The Eckstein bequest is used to support all facets of the School of Music, particularly its financial aid and scholarship programs. The Eckstein Endowment has provided the financial resources to support the school's pursuit of excellence.

In recognition of the Eckstein bequest, the school has established the Eckstein Scholars Program for outstanding entering freshmen.

Collection of Artist Instruments

The Northwestern University special collection of string instruments provides an exposure to a concept of sound available only through instruments with special resources of beauty and sonority. It has been formed over a period of years through the generosity of many friends. These instruments are made available to seniors and graduate students for appearance as recitalists or soloists with the University Symphony or the Classic Ensemble.

Pi Kappa Lambda

Pi Kappa Lambda, national music honor society, was founded at Northwestern University in 1918 for the recognition and encouragement of the highest level of musical achievement and academic scholarship among music majors not eligible for Phi Beta Kappa. Alpha chapter elected as its first member Peter Christian Lutkin, the first dean of the School of Music, and his initials in their Greek equivalents were adopted for the name of the society. The national office has been housed in the Northwestern University School of Music since 1984. Two deans and one faculty member from Northwestern have served as national president, and the society has grown to 176 chapters in colleges, conservatories, and university schools of music.

General Music Studies for Nonmajors

The following courses were designed to meet the needs of nonmajors interested in studying music. Students with a good music foundation are encouraged to register for Harmony, followed by Form and Analysis and/or Composition. The music literature sequence is designed to permit students with no background to start with A70. With the background of these

courses, students may then enroll in certain C-level music history/literature and theory courses when space is available.

Courses Open to Undergraduates

501-A70-0 Introduction to Music
Principles of musical organization through the conceptual understanding of the elements of music. Score study and recognition of what is heard in all music, including classic, jazz, rock, and popular. (VI. Literature and fine arts)

501-A75-0 Selected Topics
Topics vary; announced before registration. May be repeated.

482-A90-0 Integrated Arts: Art Process
See Integrated Arts Program in Other Undergraduate Programs. (VI. Literature and fine arts)

501-B52-0 Harmony
Harmonic materials and tonal structures. Analysis of harmonic structures; harmonization of melodies. Musical materials from pieces employing tertian harmonies. Prerequisite: A51, A70, or consent of instructor. (II. Formal studies)

501-B53-0 Form and Analysis
Nature of musical form; typical forms found in musical literature from the Renaissance to the present; analysis of aural examples and musical scores. Prerequisite: B52 or music-reading skills and some understanding of harmony.

501-B70-1 The Western Musical Tradition
Baroque, Classic, and early Romantic periods; major genres and composers from 1600 to 1825. Brief background of 17th-century music by composers such as Monteverdi, Schutz, Lully, and Purcell. Primary emphasis on composers of the generations of Bach and Handel, Haydn and Mozart, Beethoven and Schubert. Prerequisite: A70 or equivalent. (VI. Literature and fine arts)

501-B70-2 The Western Musical Tradition
Romantic and Modern periods; major genres and composers from 1825 to the present. Figures such as Schumann, Chopin, Liszt, Wagner, Brahms, Verdi, Mahler, Bruckner, Strauss, Wolf, Stravinsky, Schoenberg, Berg, Webern, Debussy, Ravel. Prerequisite: A70 or equivalent. (VI. Literature and fine arts)

482-B91-3 Integrated Arts: Modes of Music
See Integrated Arts Program in Other Undergraduate Programs. This course will not satisfy the distribution requirement for music majors. (VI. Literature and fine arts)

482-C90-1 Integrated Arts: Performance Seminar
See Integrated Arts Program in Other Undergraduate Programs. (VI. Literature and fine arts)

482-C90-2 Toward a Theory of the Arts
See Integrated Arts Program in Other Undergraduate Programs. (VI. Literature and fine arts)

Interdepartmental Courses

The musicianship, aural skills, keyboard skills, and ensembles sequences are required for all undergraduates in the School of Music. Ensembles listed in 540 are available by audition to all students in the University.

Courses Open to Undergraduates

510-A15-1,2,3 Musicianship I
Music as sound in time; evolution of music in cultural perspective; historical, literary, structural, stylistic studies; consideration of performance practices. Illustrative experiences in composition and performance. **1.** Non-Western culture as perspective for Western art music. Properties of sound, rhythm, and pitch. **2.** Baroque period and **3.** Classic period: representative genres and styles; critical thought; basic sources for independent research. Analytical studies in the forms, media, textures, and harmonic and melodic materials of the periods. Prerequisite: preceding quarters of A15.

510-A26-1,2,3 Aural Skills I, II, III(.33)
Sight-singing and ear-training; drill in recognition of melodic, rhythmic, and harmonic patterns and aural analysis through listening and dictation. Progresses through six levels of proficiency.

510-A27-0 Keyboard Skills (.33)
Class instruction, in electronic piano classroom; six levels of proficiency. Separate sections for pianists and nonpianists.

510-B15-1,2,3 Musicianship II
Continuation of 510-A15. **1.** Romantic period. **2.** 20th century. **3.** Medieval period and Renaissance. Prerequisite: A15-1,2,3.

510-B26-1,2,3 Aural Skills IV, V, VI(.33)
Continuation of A26.

510-B27-0 Keyboard Skills (.33)
Continuation of A27.

510-B98-0 Student Organized Seminar (0)
Topic not covered in regular course offerings; limited enrollment under sponsorship of one or more faculty.

510-C27-1 Advanced Keyboard Skills VII (.33)
Advanced score-reading. Continues skills development begun in level VI with three- and four-part choral scores. Reading various voice parts in combination and harmonically reducing four-part textures.

510-C27-2 Advanced Keyboard Skills VIII (.33)
Techniques of accompanying by reducing and rewriting accompaniments to make initial performances more effective. Prepared accompaniments, score-reading, and sight-reading materials.

510-C27-3 Advanced Keyboard Skills IX (.33)
Advanced accompanying. Adding accompaniments to a given vocal line. Improvising accompaniments in various styles, including "swing." Transposition of individual lines.

510-C89-0 Convocation (0)
Attendance at the five School of Music convocations held each quarter.

510-C98-0 Internship
Field experience as an intern.

Academic Studies and Composition

This department consists of the Music Composition, Music Education, Music History and Literature, Music Technology, and Music Theory programs.

Bachelor of music specializations are available in music composition, music education, music history, and music theory. These four specializations are described on the following pages. A fifth specialization option, an individualized course of study, requires one course from each of the five programs and seven C-level courses selected from any of the Department of Academic Studies and Composition offerings. Most C-level courses in this department require junior standing.

Music Composition Program

Composition students pursue a course of study that develops analytical and creative skills and enjoy many opportunities to hear their works performed. Students have access to the electronic and computer music studios, which provide the latest technology for experimentation and experience with 20th-century compositional materials. Students intending to major in composition may substitute composition for applied studies during their freshman and sophomore years.

Professional Studies Requirement
For specialization in composition, 12 course units are required:

- Composition and writing skills (6 units)
- Analysis (3 units)
- Departmental core (3 units)
  One C-level course from three different programs outside of composition: music education, music history and literature, music technology, or music theory.

Courses Open to Undergraduates

537-B12-1,2,3 Composition
Class instruction in techniques of original composition. Prerequisite: consent of instructor.

537-B14-0 Orchestration
Instruments of the orchestra; scoring techniques; analysis of instrumental combinations.

537-B78-0 Contemporary Music Ensemble
Performance of contemporary works: avant-garde music, new notation systems, electronic music.

537-C12-0 Composition
Original composition. Prerequisite: B12 or consent of instructor. May be repeated.

537-C14-0 Advanced Orchestration
Stylistic scoring projects and score analysis. Prerequisites: B14 and 540-C26 or equivalent.

537-C22-1,2 Materials of Modern Music
Contemporary musical styles and materials, writing projects, analysis of scores.

537-C99-0 Independent Study

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Music Education Program

Graduates with a major in music education meet all requirements for teacher certification in the state of Illinois as well as most other states. Students take the core program required of all music students, a structured sequence of courses in general education, a basic set of courses in music education, and special courses in the chosen music education specialization. The combination results in a program that prepares professionals with a broad understanding of music and education as well as the skills to be effective music teachers.

Basic Studies Requirement (18 units)

General Education Requirement (10 units)

- Basic Composition (419-A05 or 419-B05)
- Distribution Area I: natural science
  Two units from astronomy, biological sciences, chemistry, geography, geological sciences, or physics
- U.S. history (may not be taken P/N)
- American government and politics (may not be taken P/N)
- 451-A10 Introduction to Psychology
- 205-C03 Aesthetic Education
- Distribution Area VI: English or comparative literary studies only
- General education elective
- Physics of sound lab course

Instrumental Emphasis

Professional Studies Requirement (19.83 units)

- 525-B59 Introduction to Technology for Music Educators
- 525-B60 Music Teacher as Communicator
- 525-B79-1,2,3 Clinical Experience I
- 525-C79-1,2,3 Clinical Experience II
- 540-C26 Conducting and Score Reading
- 225-C01 Human Development: Childhood and Adolescence
- 205-C27 Problems of the Exceptional Child
  or 624-C36 The Field of Special Education
- 525-C63 Teaching High School Nonperformance Courses
- 525-C64 Teaching Instrumental Music I

- 525-C65 Teaching Instrumental Music II
- 525-C68 Teaching Composition in the Schools
- 525-C69 Research and Evaluation in Music Education
- Class instruments (7 classes: brass, clarinet, percussion, strings, trumpet, violin, woodwinds)
- 525-C80-C87 Student Teaching: 3 units and 2 levels
- Physical education (3 quarters, 1 may be NUMB)
- Ensembles (5 quarters; wind and percussion students must take at least 1 NUMB)

Electives

- Free elective (1 unit)

Students are encouraged to take additional music and free electives if their schedule permits.

Choral Emphasis

Professional Studies Requirement (18.83 units)

- 525-B59 Introduction to Technology for Music Educators
- 525-B60 Music Teacher as Communicator
- 525-B79-1,2,3 Clinical Experience I
- 525-C79-1,2,3 Clinical Experience II
- 540-C26 Conducting and Score Reading
- 225-C01 Human Development: Childhood and Adolescence
- 205-C27 Problems of the Exceptional Child or 624-C36 The Field of Special Education
- 525-C63 Teaching High School Nonperformance Courses
- 525-C66 Teaching Choral Music I
- 525-C67 Teaching Choral Music II
- 525-C68 Teaching Composition in the Schools
- 525-C69 Research and Evaluation in Music Education
- 525-C80–C87 Student Teaching: 3 units and 2 levels
- Physical education (3 required, 1 may be NUMB)
- Ensembles (5 quarters)
- Additional skills

  510-C27-1,2,3 Advanced Keyboard Skills

  525-B32 Voice Class

Electives

- Free electives (2 units)

Students are encouraged to take additional music and free electives if their schedule permits.

General Music Emphasis

Professional Studies Requirement (18.83 units)

- 525-B59 Introduction to Technology for Music Educators
- 525-B60 Music Teacher as Communicator
- 525-B79-1,2,3 Clinical Experience I
- 525-C79-1,2,3 Clinical Experience II
- 540-C26-0 Conducting and Score Reading
- 225-C01-0 Human Development: Childhood and Adolescence
- 205-C27 Problems of the Exceptional Child or 627-C36 The Field of Special Education
- 525-C61-0 Teaching General Music I
- 525-C62-0 Teaching General Music II
- 525-C63-0 Teaching High School Nonperformance Courses
- 525-C68-0 Teaching Composition in the Schools
- 525-C69-0 Research and Evaluation in Music Education
- Class instruments (4 classes: guitar I, guitar II, recorder, voice)
- 525-C80–C87 Student Teaching: 3 units and 2 levels
- Physical education (3 quarters, 1 may be NUMB)
- Ensembles (5 quarters)

Electives

- Free electives (2 units)

Students are encouraged to take additional music and free electives if their schedule permits

Courses Open to Undergraduates

525-B31-1,2 Guitar Class I, II (.33)

525-B32-0 Voice Class (.33)

525-B33-0 Clarinet Class (.33)

525-B34-0 Woodwinds Class (.33)

Performance characteristics and pedagogical strategies most strongly associated with teaching flute, saxophone, oboe, and bassoon to beginning and intermediate instrumentalists. Prerequisite: 525-B33.

525-B35-0 Trumpet Class (.33)

525-B36-0 Brass Class (.33)

Performance characteristics and pedagogical strategies most strongly associated with teaching horn, trombone, euphonium, and tuba to beginning and intermediate instrumentalists. Prerequisite: 525-B35.

525-B37-0 Violin Class (.33)

525-B38-0 Strings Class (.33)

Performance characteristics and pedagogical strategies most strongly associated with teaching viola, cello, and string bass to beginning and intermediate instrumentalists. Prerequisite: 525-B37.

525-B39-0 Percussion Class (.33)

525-B40-0 Recorder Class (.33)

525-B41-0 Guitar Techniques (.33)

525-B59-0 Introduction to Technology for Music Educators

Computers and the music experience. Computer-aided instruction, music printing, MIDI sequencing, software development, and nonmusic topics such as word processing.

525-B60-0 The Music Teacher as Communicator

For all students considering a specialization in music education. Discussion and observation of school music programs and effective presentational skills.

525-B79-1,2,3 Clinical Experience I (.33 each)

Field placement, two hours weekly. Sophomore: fall—elementary; winter—junior high; spring—high school. One-hour seminar meets alternate weeks.

205-C03-0 Problems in the Philosophy of Education: Aesthetic Education
Underlying issues in teaching and learning. Jointly with School of Education and Social Policy. (V. Values)

525-C40-0 Selected Topics in Music Education
Topics vary; announced before registration. May be repeated.

525-C61-0 Teaching General Music I
Curriculum materials and strategies for developing musical growth. Laboratory experiences; developing creativity in the music classroom. Open only to music majors or with consent of instructor.

525-C62-0 Teaching General Music II
Effective teaching of general music classes. Available curriculum materials; innovative approaches.

525-C63-0 Teaching High School Nonperformance Courses
Planning and teaching high school music, arts, humanities courses. Present practices; development of exemplary course plans.

525-C64-0 Teaching Instrumental Music I
Development and application of teaching and administrative principles for school instrumental music programs. Rehearsal dynamics, conducting, rehearsal room management, and pedagogy for secondary school instrumentalists.

526-C65-0 Teaching Instrumental Music II
Application of teaching concepts consistent with aesthetic education to the instrumental music program. Jazz pedagogy and pedagogy for young instrumentalists. Prerequisite: 525-C64.

525-C66-0 Teaching Choral Music I
Development and application of skills, knowledge, and understandings for teaching choral music in elementary and middle school.

525-C67-0 Teaching Choral Music II
Further development of skills, knowledge, and understandings developed in C66. High school choral program, curriculum model, repertoire, sight-reading, rehearsal techniques, programming, administration.

525-C68-0 Teaching Composition in the Schools
Practical and research literature in teaching composition in the schoolroom. Design of curricular materials for teaching sequences dealing with composition. Hardware and software in school settings.

525-C69-0 Research and Evaluation in Music Education
Various procedures and issues associated with excellence in research and evaluation in music teaching. Practical application of research findings to decision making in music teaching and learning.

525-C79-1,2,3 Clinical Experience II (.33 each)
Field placement, two hours weekly. Juniors: fall—student's choice; winter/spring—correlated with methods courses. Seminar meets alternate weeks.

525-C99-0 Independent Study

Student Teaching Courses

Students are assigned to specific classes in cooperating schools under joint university/school supervision.

525-C80-0 Student Teaching in the Elementary School: General Music (1–4 units)

525-C81-0 Student Teaching in the Middle School/ Junior High School: General Music, Choral (1–4 units)

525-C83-0 Student Teaching in the Senior High School: Choral and Nonperformance Courses (1–4 units)

525 C85-0 Student Teaching in the Elementary School: Instrumental (1–4 units)

525-C86-0 Student Teaching in the Middle School/ Junior High School: Instrumental (1–4 units)

525-C87-0 Student Teaching in the Senior High School: Instrumental and Nonperformance Courses (1–4 units)

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Music History and Literature Program

An undergraduate major in music history is available within the bachelor of music degree or as a concentration within the bachelor of arts. The 12 courses required for this specialization are selected from music history, analysis, and the departmental core. As some of the courses are offered on a two-year alternating schedule, certain courses may not be available during a given academic year.

Professional Studies Requirement
For specialization in music history, 12 course units are required:

- Music history (6 units) selected from C30, C50–C55
- Analysis (3 units) selected from C-level courses in analysis
- Departmental core (3 units)
  One C-level course from three different programs outside of music history and literature: music composition, music education, music technology, or music theory.

In addition, two years of German are taken as part of elective and general education distribution credit.

Courses Open to Undergraduates

530-B99-0 Early Music Ensemble
Performance of choral, solo, and instrumental music of the Middle Ages through the early Baroque.

530-C23-0 Proseminar in Ethnomusicology
Ethnomusicology; its history, bibliographical resources, methods, and theories.

530-C24-0 History and Practice of Criticism
Concepts and practice of present-day critical and descriptive writing about music; aesthetics and technique. Open to nonmusic students with consent of instructor.

530-C25-0 Comparative Arts
Background, foreground, and relationship of today's intermedia activity: visual, literary, and musical. Open to nonmusic students with consent of instructor.

530-C26-1,2 Music of the World's Peoples
Music systems in their broad cultural contexts: religious, social, historical, learning processes. **1.** Folk and traditional music of the Western continents: Africa, North and South America, Europe. Emphasis on African music. **2.** Music cultures of the Pacific, the Near East, and Asia. Emphasis on music of India.

530-C30-0 Selected Topics in Music
Topics vary; announced before registration. May be repeated.

530-C34-0 Jazz: Its Roots and Elements
The basic elements of jazz from its roots in African and early African-American music to the present.

530-C35-0 Practicum in Early Music
Application of music historical inquiry to practical performance by editing, playing, and analyzing chamber music selections from repertoire of the 12th through the 19th centuries. Literature varies depending on style period and performance medium. Team-taught by music history and literature, strings, and winds and percussion faculty. Two-quarter sequence required for 1 unit credit.

530-C36-0 Learning and Creativity among Improviser/Composer
Interdisciplinary and cross-cultural perspective of the American jazz community. Analysis of improvisation as a compositional process. Prerequisites: 482-A90 and 482-B91-3 or permission of instructor.

530-C37-0 Improvisation and World Musicianship
Improvisation in music systems such as Western art music, jazz, Indian, and African music; performance workshops in African drumming, Indian solfeggio, and rhythmic mnemonics.

530-C38-0 African Mbira Music
The mbira, one of the most popular and ancient melodic instruments in black Africa. Construction; development of basic playing skills. Prerequisite: consent of instructor.

530-C50-0 History of Music—Middle Ages
Gregorian and Medieval chant, secular monophony, and the development of polyphony from the earliest records through the music of Ockeghem and Busnois.

530-C51-0 History of Music—Renaissance
Middle and late Renaissance and early manifestations of the Baroque, from Josquin through the Gabrielis.

530-C52-0 History of Music—Baroque
The Baroque from Monteverdi through Bach and Handel.

530-C53-0 History of Music—Classic
Classic period from the early Italian symphonists through Beethoven.

530-C54-0 History of Music—Romantic
Romantic period from Schubert through Wolf and other late romantics.

530-C55-0 History of Music—20th Century
The 20th century from its roots in late Romanticism to the present.

530-C99-0 Independent Study

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Music Technology Program

The music technology program offers a unique professional preparation for a career combining creative thinking with technological tools. Students engage in creating and using technology for artistic purposes. They develop skills in applying technology to musical tasks and acquire knowledge of the technical and musical foundations of the field.

Courses Open to Undergraduates

533-C25-0 Introduction to MIDI Music Systems
Theory and practical application of MIDI synthesizer and recording systems. Creative use of MIDI music systems. Prerequisite: consent of instructor.

533-C26-0 Advanced MIDI Systems and Composition I
Theory and practical application of advanced MIDI systems, including various synthesizers/samplers, computers, and MIDI programs. Composition, analysis, and creative use of the equipment. Prerequisite: entry-level course or equivalent experience.

533-C27-0 Advanced MIDI Systems and Composition II
Theory and practical application of MIDI equipment used to control analog and digital devices. Individual composition instruction. Prerequisite: C26.

533-C35-0 Multimedia Software Development
Software design in scripting languages such as HyperCard and other multimedia support systems. Extensive integration of CD-ROM, MIDI, music printing, digitized video and sound. Prerequisite: entry-level courses or equivalent experience.

533-C38-0 Programming I
Programming of musical applications. Syntax of programming language, program development, user interfaces, and music-specific algorithms. May be repeated when programming language changes. Prerequisite: entry-level course or equivalent experience.

533-C39-0 Programming II
Music programming techniques for creating musical applications; music-specific algorithms and programming techniques, music and sound representation. May be repeated when programming language changes. Prerequisite: C38.

533-C40-0 Composing with Computers
Development of techniques for composing with computers through hands-on experience and analysis. New technologies for real-time interactive music and nonreal-time synthesis. Computer music repertoire. Prerequisite: entry-level course or equivalent experience.

533-C41-0 Advanced Computer Composition
Advanced instruction in the use of computers to create musical compositions. Composition projects of several etudes and at least one larger composition. Prerequisite: C38.

533-C42-0 Computer Sound Processing
Techniques of computer sound synthesis: simulation of musical instruments, the voice, room acoustics; digital filtering, effects processing; digital recording, mixing, editing. Prerequisite: entry-level course or equivalent experience.

533-C44-0 Advanced Projects in Music Technology
Individual instruction in projects related to music technology. Prerequisite: consent of instructor.

533-C99-0 Independent Study

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Music Theory Program

Undergraduates majoring in theory receive training in a variety of advanced analytical methods, including rhythmic analysis, tonal and atonal analysis, and Schenkerian analysis. Courses in perception and music technology are encouraged.

Professional Studies Requirement
For specialization in music theory, 12 course units are required:

- Advanced keyboard skills (1 unit)
- Atonal analysis (1 unit)
- Rhythmic analysis (1 unit)
- C16, C17, C53 (3 units)
- Departmental core (3 units)
  One C-level course from three different programs outside of music theory: music composition, music education, music history and literature, or music technology.
- Cognate areas (3 units)

Courses Open to Undergraduates

535-C13-0 Selected Topics in Music Theory
Topics vary; announced before registration. May be repeated.

535-C16-0 Baroque Counterpoint
Baroque dance suite, chorale prelude, invention, fugue, chiefly involving the music of J. S. Bach. Melodic, harmonic, structural characteristics; contrapuntal techniques.

535-C17-0 Renaissance Counterpoint
Contrapuntal textures from two to four voices. Cadence and form, melodic line and motive, rhythm, simple and complex imitation, and treatment of dissonance in the sacred music of Lassus, Josquin, and Palestrina.

535-C21-1,2 Analytical Techniques
Detailed analysis of all parameters of selected musical examples; compositional procedures as a means of developing an intelligent rationale for interpretation. Prerequisite: 510-B15 or consent of instructor.

535-C31-0 Analytical Studies
Extension and refinement of concepts and techniques acquired in 510-A15, B15.

535-C51-0 Music Cognition
Survey of issues and research methods in music cognition. Music listening, memory for music, development of skills.

535-C52-0 Score Analysis Skills
Development of facility for recognizing quickly the character and succession of tonalities in compositions for a variety of media. Exploration of the expressive potentials residing in the conventional tonal system.

535-C53-0 Schenkerian Analysis
Heinrich Schenker's theories of musical structure and analyses of musical works. Techniques of Schenkerian analysis applied to compositions by Bach, Beethoven, Chopin, Mozart, Schubert, and others.

535-C54-0 Music Perception
Literature and methods of research in the perception of musical sound. Fundamentals of acoustics and psychoacoustics, timbre of musical instruments, singing voice, spatial hearing and room acoustics, organization of hearing system, formation of auditory images, musical pitch, consonance and dissonance, scales, tuning.

535-C99-0 Independent Study

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Music Performance Studies

This department consists of the Church Music and Organ, Conducting and Ensembles, Piano, String Instruments, Voice and Opera, and Wind and Percussion Instruments programs.

Church Music and Organ Program

Through a grant from the Carnegie Corporation, the program in church music was established at Northwestern in 1926. The course of study includes all the branches of theoretical and applied music essential to thorough musicianship as well as a comprehensive survey of church music.

Professional Studies Requirement

For specialization in church music and organ, 12 course units are required:

- 520-C63 Organ Performance (6 units)
- C-level music history and/or theory (2 units)
- Counterpoint and conducting (3 units)
- Organ literature (1 unit)

In addition, participation in Chapel Choir is required for six quarters.

Courses Open to Undergraduates

539-A63-0, B63-0, C63-0, D63-0 Organ Performance

555-B30-0 Class Organ
See Piano.

539-C10-0 Keyboard Harmony/Improvisation I, II, III

539-C11-1 Professional Concerns

539-C11-2 Organ Pedagogy
Comparative methods, practice techniques; repertory for various levels

539-C11-3 Repertoire for Children's Choir

539-C12-0 Voice

539-C13-0 Harpsichord

539-C14-0 Piano

539-C15-0 Organ Maintenance

539-C35-0 Selected Topics in Church Music
Topics vary; announced before registration. May be repeated.

539-C39-0 Colloquium
Biweekly colloquium focusing on theological understandings and practical issues in the arts and worship.

539-C71-0 German Organ Literature
The German organ school pre–J. S. Bach to present.

539-C72-0 French Organ Literature
The French organ school from 1600 to present.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Conducting and Ensembles Program

Courses in the Conducting and Ensembles Program are available to all majors. While an ad hoc major in conducting is available to undergraduates, students are urged to consider majoring in conducting at the graduate level. Courses for the ad hoc major are selected in consultation with the department chair.

Courses Open to Undergraduates

540-B64-0 Choral Organizations
University Chorale, University Singers, University Chorus, Vocal Jazz Ensemble, and Women's Chorus. Open to all qualified students.

540-B68-0 Chapel Choir
Open to all qualified students.

540-B74-0 Band Organizations
Marching Band, Concert Band, Symphonic Band, Symphonic Wind Ensemble. Open to all qualified students.

540-B77-0 Jazz Ensembles
Membership by audition in jazz ensembles.

540-B93-0 Orchestral Organizations
Membership by audition in Symphony Orchestra, Chamber Orchestra, or Philharmonia.

540-C20-0 Band Arranging
Transcriptions, arrangements, and composition for concert and symphonic bands. Editing, rescoring, and arranging for performance, at various levels and from both keyboard and instrumental resources.

540-C21-0 Writing for Choral Ensembles
Composing and arranging for choral ensembles; selected choral repertoire; techniques and resources.

540-C23-0 Marching Band Techniques
Writing for marching and pep bands; rehearsing for the marching band.

540-C26-0 Conducting and Score Reading
Team-taught minisubjects in conducting; fundamentals in both instrumental and choral conducting; transpositions, ranges, and podium technique. Extensive laboratory experience with videotaped evaluation.

540-C30-0 Writing for Jazz Ensembles
Composing and arranging for jazz ensemble. Score study and rehearsal techniques with jazz groups and stage bands.

540-C31-0 Advanced Jazz Writing
Continuation of C30. Emphasis on creative scoring, composition, and commercial writing.

540-C35-0 Selected Topics in Conducting
Topics relevant to the professional needs of conducting majors.

540-C36-0 Jazz Improvisation
Basic elements of jazz improvisation, including harmony, modes, and basic progressions.

540-C37-0 Advanced Jazz Improvisation
Continuation of development of jazz improvisation skills. Prerequisite: C36 or consent of instructor.

540-C40-1,2,3 Advanced Conducting
Separate quarters of band, orchestral, and choral conducting that emphasize the techniques of score preparation and analysis, repertoire, and rehearsal methods. Prerequisite: C26 or equivalent. May be repeated.

540-C41-0 Advanced Choral Literature I
A comprehensive knowledge of choral music literature from the Renaissance, Baroque, and Classical periods.

540-C42-0 Advanced Choral Literature II
A comprehensive knowledge of choral music literature from the 19th and 20th centuries.

540-C99-0 Independent Study

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Piano Program

A major in piano performance combines a strong musical basis for a professional career with the broad humanistic interests embodied in a liberal arts education. The course of instruction focuses on the studio and includes private lessons, studio classes, a thorough course in piano repertoire, piano pedagogy, and accompanying classes. Electives are available in chamber music and other areas, allowing students to tailor a program to their individual needs. Frequent performances as a soloist and as an assisting musician develop skills in public presentation. Solo recitals, required in both the junior and senior years, are considered an integral part of the program.

Professional Studies Requirement
For specialization in piano performance, 12 course units are required:

- C13 Piano Repertoire (3 units)
- C15 Piano Pedagogy (3 units)
- C61 Piano Performance (6 units)

In addition, enrollment in 510-C89 Convocation is required for four quarters.

Students enrolled in a five-year double-degree program may substitute three C-level music history and/or theory electives for the pedagogy requirement.

Courses Open to Undergraduates

555-A61-0, B61-0, C61-0 Piano Performance

555-B30-0 Class Organ (0)
Primarily for sophomore pianists.

555-C13-1,2,3 Piano Repertoire
Analytical and historical study of piano solo and concerto repertoire from early keyboard literature to the present.

555-C15-1,2,3 Piano Pedagogy
Lecture/demonstration/laboratory course in piano teaching at all levels. Principles and techniques of group and individual instruction; survey of teaching materials. Seniors and graduate students.

555-C28-0 Accompanying/Recital Preparation (.5)
Piano students work with a singer and instrumentalist in the preparation and performance of mainstream recital repertoire.

555-C91-0 Chamber Music (.5)
For juniors and seniors.

555-C92-0 Chamber Music: Trios

555-C99-0 Independent Study

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

String Instruments Program

Majors in string instruments prepare for professional performance and teaching as well as for advanced study. The curriculum is built around individual performance study and ensemble participation, including chamber music and orchestra, with orchestral studies and string pedagogy available to qualified juniors and seniors. A junior recital and a senior recital are required. Students in this program may major in violin, viola, cello, string bass, harp, or classical guitar.

Professional Studies Requirement
For specialization in string performance, 12 course units are required:

Violin, viola, cello, string bass performance

- C-level string performance (6 units)
- Six quarters of large ensembles (3 units)
- 560-C19-1,2,3 Orchestral Studies (1.5 units)
- Pedagogy (1.5 units)

In addition, enrollment in 510-C89 Convocation is required for four quarters.

Harp Performance

- C-level harp performance (6 units)
- Six quarters of large ensembles (3 units)
- 560-C18-1,2,3 Harp Pedagogy (1.5 units)
- 560 C19-1,2,3 Orchestral Studies

In addition, enrollment in 510-C89 Convocation is required for four quarters.

Guitar Performance

- C-level guitar performance (6 units)
- Six quarters of 560-C74 Guitar Ensemble (3 units)
- 560-C75-1,2,3 Lute and Guitar Literature (1.5 units)
- 560-C76-1,2,3 Guitar Pedagogy (1.5 units)

In addition, enrollment in 510-C89 Convocation is required for four quarters.

Courses Open to Undergraduates

560-A41-0, B41-0, C41-0 Violin Performance

560-A42-0, B42-0, C42-0 Viola Performance

560-A43-0, B43-0, C43-0 Cello Performance

560-A44-0, B44-0, C44-0 String Bass Performance

560-A51-0, B51-0, C51-0 Harp Performance

560-A71-0, B71-0, C71-0 Classical Guitar Performance

560-B91-0 Chamber Music
Performance of string quartet literature with the addition of some piano and string works. For freshmen and sophomores.

560-C14-0 Pedagogy and Orchestral Studies
Concurrent registration in C15, C16, C17, or C18 and C19-1, 2, or 3. May be repeated for credit.

560-C15-0 String Pedagogy
Guests and master classes related to playing and teaching.

560-C16-0 String Pedagogy
Further studies in teaching/learning concepts.

560-C17-0 Principles of Studio and Master Class Teaching (Violin, Viola, Cello, String Bass, Harp)
Principles of right-arm and left-hand development. Application of principles to repertory (e.g., etudes, scales, concert pieces, sonatas, concertos).

560-C18-1,2,3 Harp Pedagogy
1. Guests and master classes related to playing and teaching.
2. Instrument maintenance and repair clinic with hands-on experience in routine maintenance and common repairs.
3. Pedagogical instruction and demonstration of teaching techniques for all levels and ages.

560-C19-1,2,3 Orchestral Studies (Violin, Viola, Cello, String Bass, Harp)

560-C27-0 Interpretation of Instrumental Chamber Music
Interpretation of instrumental chamber music through performance practice analysis and coaching of selected chamber works, emphasizing string performance but including winds and keyboards as well. May be repeated for credit.

560-C48-0 Recital Preparation
Instrumentalists work in ongoing partnership with a pianist. Frequent coaching in class preparing for performances. Auditors (noncredit) admitted.

560-C72-0 Guitar Literature and Ensemble
Concurrent registration in C74 and C75-1,2,3 required for three consecutive quarters. Alternates yearly with C73.

560-C73-0 Guitar Pedagogy and Ensemble
Concurrent registration in C74 and C76-1,2,3 required for three consecutive quarters. Alternates yearly with C72.

560-C74-0 Guitar Ensemble
Performance of the chamber literature for guitar: guitar duos, trios, and quartets; flute and guitar; voice and guitar; chamber works with strings; etc.

560-C75-1,2,3 Lute and Guitar Literature
Analytical and historical survey of the literature for plucked instruments from the 16th through the 20th centuries. The study of tablatures, instrument construction and tuning, performance practice, and style.

560-C76-1,2,3 Guitar Pedagogy
Principles of individual and group study. Survey of development of right- and left-hand technique from 16th-century lute and vihuela tutors through modern classical guitar methods. Interaction between musical texture and technical innovations; influence of fingering on stylistic inflection and ornamentation.

560-C92-0 Advanced Chamber Music
Continuation of B91. For juniors and seniors.

560-C99-0 Independent Study

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Voice and Opera Program

Students majoring in voice take a concentrated program of courses designed to prepare them for professional performance. In addition to individual instruction, students take courses in music history, vocal science, conducting, opera workshop, repertory, and foreign language. A senior recital is required, and students are urged to take advantage of the numerous other performance opportunities offered by the school.

Opera at Northwestern is supported by a generous endowment in memory of Edith Mason Ragland, famous American operatic soprano. The Edith Mason and William E. Ragland Opera Workshop presents scene recitals and full-scale productions.

Professional Studies Requirement
For specialization in voice performance, 12 course units are required:

- C10 Voice Performance (6 units)
- C-level music history (3 units)
- 540-C26 or C40 Choral Conducting (1 unit)
- 570-C23 Study of the Vocal Mechanism (1 unit)
- 570-C51 Opera Workshop (1 unit)

Three quarters of vocal solo class are required of all voice majors during professional studies, for a total of nine quarters over the four years. Transfer students are required to attend vocal solo class each quarter until they graduate or until they fulfill the requirement of nine quarters.

Three quarters of a major choral ensemble as well as three additional quarters of a major choral ensemble or opera workshop are required.

Majors are advised to take one year of French, German, or Italian as part of their general education requirement.

Courses Open to Undergraduates

570-A02-0 Beginning Voice
Class instruction for nonmusic majors. Basic music skills required. Consult self-evaluation questionnaire in Undergraduate Music Office before registration.

570-A10-0, B10-0, C10-0 Voice Performance

570-A11-1,2,3 Phonetics and Diction
Required of freshman and transfer students who plan to major in voice. Three quarters: Italian, German, French.

570-B02-0 Voice Performance: Musical Theatre
Private instruction for theatre majors seeking a Certificate in Music Theatre. Prerequisite: admission to Program in Music Theatre and completion of 570-A02 or equivalent.

570-C23-0 Study of the Vocal Mechanism
Lectures, readings, discussions, and demonstrations of basic vocal physiology, common vocal problems, and use of exercises and songs for vocal improvement. One quarter course for junior or senior voice students. Other students, with consent of the instructor.

570-C48-0 Recital Preparation
Singers work in ongoing partnership with a pianist. Frequent coaching in class preparing for performances.

570-C51-0 Introduction to Opera Workshop
Basic acting skills for the singer and survey of dramatic styles.

570-C52-0 Opera Scene Recital (0–1 unit)
Operatic scenes and ensembles culminating in a scene recital. Prerequisite: C51 or equivalent.

570-C91-0 Advanced Chamber Music
For juniors and seniors.

570-C99-0 Independent Study

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Wind and Percussion Instruments Program

Designed to prepare students for professional performance and teaching as well as for advanced study, the major in wind and percussion instruments offers a concentrated curriculum emphasizing performance studies, frequent master classes, required participation in large and small ensembles, and a required senior recital. Students anticipating graduate study in winds or percussion performance are advised to elect additional courses in C-level theory and history.

Professional Studies Requirement
For specialization in winds and percussion performance, 12 course units are required:

- C-level winds and percussion performance (6 units)
- Six quarters of large ensembles (3 units)
- Six quarters of small ensembles (3 units)

In addition, enrollment in 510-C89 Convocation is required for four quarters.

Courses Open to Undergraduates

565-A11-0, B11-0, C11-0 Flute Performance

565-A12-0, B12-0, C12-0 Oboe Performance

565-A13-0, B13-0, C13-0 Clarinet Performance

565-A14-0, B14-0, C14-0 Saxophone Performance

565-A15-0, B15-0, C15-0 Bassoon Performance

565-A21-0, B21-0, C21-0 Trumpet Performance

565-A22-0, B22-0, C22-0 French Horn Performance

565-A23-0, B23-0, C23-0 Euphonium Performance

565-A24-0, B24-0, C24-0 Trombone Performance

565-A25-0, B25-0, C25-0 Tuba Performance

565-A31-0, B31-0, C31-0 Percussion Performance

565-B91-0 Chamber Music
Percussion and mallet ensembles, brass ensembles, woodwind quintets, saxophone quartets, and clarinet quartets. For freshmen and sophomores.

565-C35-0 Selected Topics in Winds and Percussion
Topics vary; announced before registration. May be repeated.

565-C36-0 Woodwind Orchestral Repertoire
Wind section performance practices and performance techniques in the standard orchestra literature.

565-C38-0 Brass Orchestral Repertoire
Study of brass section performance practice and performance techniques in the 19th and 20th century orchestral repertoire. Limited to junior, senior, and graduate students. May be repeated once.

565-C39-0 Performance Practices and Criticism
Performance and criticism of woodwind, brass, and percussion repertoire in a master class setting. Team-taught.

565-C42-0 Brass Instrument Repertoire
Brass literature and performance practices; solos, pedagogical materials, and chamber music for various levels of performance.

565-C47-0 Percussion Pedagogy and Performance
Methods, materials, and writings related to percussion playing and teaching. Prerequisite: C-level standing in percussion performance or consent of instructor.

565-C48-0 Recital Preparation
Instrumentalists work in ongoing partnership with a pianist. Frequent coaching in class preparing for performances. Auditors (noncredit) admitted.

565-C51-0 Alexander Techniques

565-C52-0 Preparing for an Audition

565-C53-0 Introduction to the Harp

565-C54-0 Woodwind Instrument Repair

565-C55-0 Free-lance Musician

565-C56-0 Making Musicianship Audible

565-C57-0 Reedmaking for Single Reed Instruments

565-C59-0 Brass Teaching Techniques

565-C61-0 Jazz Piano for the Nonkeyboard Player
Jazz voicing, harmonization, analysis, and technique through keyboard instruction. Prerequisite: basic keyboard proficiency, jazz performance and harmonic background.

565-C91-0 Advanced Chamber Music
Continuation of B91. For juniors and seniors.

565-C99-0 Independent Study

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

School of Speech

Speech is the primary mode of communication, the principal means by which people exchange ideas and feelings. It is a means of inquiry and reporting. It is a means of persuasion. And it is a means of appreciation, inspiration, and entertainment. Students of speech study the nature of such communication and the conditions, circumstances, and properties affecting it. They may concentrate on speech as a scientific phenomenon, as a fine art, or as a rhetorical art.

Speech is conversation, discussion, debate, and public address. It is the performance of prose, poetry, and dramatic literature. It is theatre—acting, directing, and exploring the many facets of the physical theatre and dramatic production. It is radio, television, and film—the media of mass communication. It is the study of language and the analysis and improvement of speech and hearing disabilities. And it is the preparation of teachers, directors, clinicians, and other professionals in these fields. It is study and research in all these areas.

Founded by Robert Cumnock in 1878, the School of Speech is now the third largest of Northwestern's six undergraduate divisions. It annually enrolls more than 1,000 undergraduate majors and 300 graduate students.

Originally, the curriculum and its related activities were concerned with public speaking and interpretative reading as performing arts. As the field and the school grew, the faculty added instruction in theatre, speech pathology, audiology, radio, television, film, and other specialties in oral communication. The five departments of instruction indicate the scope of the modern curriculum: Performance Studies; Communication Studies; Radio/Television/Film; Communication Sciences and Disorders; and Theatre. In addition to the specialized program presented by each department, the five departments of the School of Speech combine to offer the undergraduate degree program in Interdepartmental Studies. All departments offer graduate courses. The School of Speech sponsors four of Northwestern's eight National High School Institute divisions: debate, Lincoln-Douglas debate, radio/television/film, and theatre arts.

This wide range of educational activities is currently housed not only in the school's original building, Annie May Swift Hall, but also in Harris Hall; two former residences on Chicago Avenue; the Communication Sciences and Disorders complex, which includes the Frances Searle Building and the medical and dental clinical facilities in Chicago; the Theatre and Interpretation Center; and John J. Louis Hall, a state-of-the-art studio production facility.

Academic Policies

Requirements for the Degree of Bachelor of Science in Speech

The School of Speech grants the degree of bachelor of science in speech upon (1) the satisfactory completion of 45 quarter-courses; (2) the fulfillment of the distribution requirement of the student's major department; and (3) the completion of an approved program of study in speech and related fields suited to the student's special interests and needs. If students interrupt the program of study for an extended period of time and degree requirements are changed during this period, they are normally held to the new requirements.

In addition to and independent of the requirements set by the School of Speech, students must satisfy the University Enrollment Requirement (see Financial Regulations).

General Requirements

Of the required 45 courses, the last 23 courses must be taken while the student is enrolled as an undergraduate in Northwestern University, and the student must be

enrolled in the School of Speech for the last three quarters preceding the granting of the degree. Credit for summer work taken at other colleges or universities as part of the last 23 courses requires approval by petition.

Thirty-five of the required 45 units must be completed with grades of A, B, or C. A minimum of 18 courses must be taken outside the School of Speech. No more than 18 of the 45 courses offered for the degree may be taken in the major department.

A transfer student will be required to complete at least 11 courses in the School of Speech at Northwestern. A speech placement interview is required at the time of first registration for all transfer students.

Distribution Requirements

All major programs in speech require 18 courses outside the major department in the following areas:

- Science, mathematics, and technology
- Individual and social behavior
- Humanities and fine arts

Students should consult the department concerned for the range of disciplines within each category and the number of courses required.

Major Programs in Speech and Related Requirements

All students in the School of Speech must meet the requirements of one of the following major programs: interdepartmental studies, performance studies, communication studies, radio/television/film, communication sciences and disorders, or theatre. Basic speech courses are required in all programs, and provisions are made for study in other divisions of the University to complement the major program.

Teaching Certification

The Department of Communication Sciences and Disorders offers a program leading to public school certification. Undergraduates in other departments of the School of Speech who wish certification should contact the Office of Student Affairs at the School of Education and Social Policy during their freshman year and work closely with an adviser in the Secondary Teaching Program. Further details about teaching certification options are available from the appropriate department.

Faculty Advisers

Each new student is assigned a faculty adviser in the chosen major field within speech. This adviser is available for consultation, especially for the purpose of planning for the next registration. Freshmen have a separate advising period before the fall registration. Ultimate responsibility for meeting degree requirements rests with the student.

Academic Options

Interdepartmental Studies

This program provides an interdisciplinary opportunity within speech for students whose special interests are not satisfied by one of the established programs. Majors in interdepartmental studies may seek a general education with exposure to a broad range of disciplines or a professional preparation from two closely related areas of speech.

Requirements for a Major in Interdepartmental Studies

- A minimum of three courses distributed among at least three departments and selected from the following: 601-A01, A02, A03, A08; 630-A40.
- A minimum of three courses at the B level distributed among at least three departments.
- An additional 10 courses in speech distributed among at least two departments, including at least eight courses at the C or D level. It is the student's responsibility to take all courses prerequisite for C- and D-level courses. Eligible students are urged to elect C99 during their senior year; this independent study should be arranged to correlate two of the speech areas the student has studied.
- Six courses at the B level or above outside speech, including at least three C-level courses. If they apply, courses taken to meet the distribution requirement may be used to satisfy this requirement.
- Major programs for undergraduate work must be approved by the associate dean for undergraduate affairs.

Interschool Certificates and Adjunct Major

For information about the interschool programs listed below, see the Other Undergraduate Programs section of this catalog.

Integrated Arts Program
The interschool Integrated Arts Program offers courses, leading to a certificate, that explore the creative process from the perspective of the artist in the disciplines of theater, visual arts, music, dance, and media arts.

International Studies Program
International studies, an undergraduate interschool adjunct major that is taken in conjunction with a traditional major, is open to School of Speech students.

Music Theatre Program
The Certificate in Music Theatre provides the opportunity for School of Music students majoring in voice and School of Speech students majoring in theatre to create a second area of specialization.

Undergraduate Leadership Program
The Undergraduate Leadership Program, an interschool certificate program open to all undergraduates, helps students understand the nature of leadership and prepares them to become leaders.

Graduate Study

The School of Speech has been a national center for graduate study and research in the field of speech for many years. Programs for the master of arts, master of fine arts, and doctor of philosophy degrees with majors in speech are administered by the Graduate School of Northwestern University. All candidates for these degrees must satisfy the Graduate School requirements. The school itself offers a master of science in communication.

The School of Speech offers departmental and thesis sequences leading to the master's degree as well as a program leading to the degree of master of science in communication. Requirements for the departmental and thesis master's degrees, the master of fine arts, and the doctor of philosophy degrees in any division of the School of Speech are described in the Graduate School catalog. Requirements for the master of science in communication degree are available from the School of Speech.

All departments of the School of Speech participate in graduate studies and research. Graduate programs may be relatively specialized in the offerings of one department or arranged to represent the offerings of two or more departments.

Introductory and Related Courses

601-A01-0 Interpersonal Communication
Laboratory experience in human interaction. Analysis of communication within the group.

601-A02-0 Public Speaking
Theory, composition, delivery, and criticism of public speeches.

601-A03-0 Analysis and Performance of Literature
Critical reading, written analysis, and performance of literary texts; general introduction to performance studies. Individual conferences.

601-A04-0 Argumentation and Debate
Theories of argumentation and debate, with many opportunities for practice. Recommended for students planning to participate in intercollegiate debate or to develop debate skills.

601-A05-0 Improving Voice and Articulation
Correction of deficiencies in voice or articulation, analysis of speech problems, intensive directed exercises based on an understanding of the speaking mechanism and of elementary phonetics. Prerequisite: consent of instructor or recommendation of adviser.

601-A08-0 Processes and Pathologies of Human Communication
Human communication and its disorders. Listening, speaking, reading, and writing. Introduction to clinical approaches. Clinical observation required.

601-A10-0 Voice for Performance
Intensive individual development and use of voice for performance.

601-A20-0 Communication and American Democracy
Issues in journalism, rhetoric, and interpersonal and mass communication relevant to American democracy. Role of the press in a democratic society; objectivity and processes of news gathering; rhetoric and effects of political campaign news, debates, advertising; First Amendment; ethical implications of news gathering.

601-B04-0 Paradigms and Strategies of Leadership
Theoretical models of leadership. Group vision, change, and decision making. Weekly student-led small groups discuss case studies. Meetings videotaped, followed by feedback sessions.

635-B11-0 Children's Literature
Exploration and evaluation of children's literature: picture books, folklore, poetry, modern fantasy, realism. Interpreting literature to children through a variety of media.

635-C77-1,2 The Teaching of Speech
1. Development of personal teaching philosophy and behaviors compatible with that philosophy. Modern instructional strategies and resources; applications to the teaching of speech. Speech-communication curricular content. Lecture, observations, microteaching. **2.** Continuation of C77-1. More content for speech courses. Organization, administration, and coaching of extracurricular speech events; executing individually designed project in a high school. Individualized field work.

Communication Sciences and Disorders

The Department of Communication Sciences and Disorders is the locus at Northwestern of basic science and research in human communication and its disorders. It offers clinical training programs in audiology and hearing sciences, learning disabilities, and speech and language pathology. Undergraduate, graduate, and postdoctoral curricula emphasize the study of normal human communication, thereby providing a foundation for the study of disorders of hearing, speech, and language. Classroom, clinical, and research facilities of the department are located in the Frances Searle Building on the Evanston campus, with the opportunity to do further clinical work at the Medical School on the Chicago campus.

Programs of Study for Departmental Majors

The undergraduate program in communication sciences is designed to provide a thorough background of information about human communication and its disorders. Basic science principles that underlie all human communication are emphasized. Students also are introduced to clinical issues that pertain to disorders of communication.

Undergraduate majors in communication sciences and disorders may choose among four areas of concentration: human communication sciences, audiology and hearing sciences, learning disabilities, and speech and language pathology. Many courses in the department are taken as electives by students from many departments and schools of the University. Undergraduates may select their area of concentration any time after entering the department. However, they are encouraged to make this decision by the spring quarter of their sophomore year and are required to decide no later than the beginning of their junior year. (Students may always petition to change the area of concentration.) An honors program is also available for students who have maintained an outstanding undergraduate record through the junior year.

Upperclass students in the department may register for units of independent study, in which they work closely with a faculty member on a topic of mutual interest. Students interested in independent study should select courses that may lead to more advanced library or laboratory research. Seniors with a satisfactory academic record also may apply to the department's honors program. Upon successful completion of an honors project, they will graduate with honors in communication sciences and disorders.

Human Communication Sciences

This area of concentration is particularly well suited to students who plan to attend graduate or professional school in fields such as medicine, dentistry, psychology, biomedical engineering, or neuroscience. It also provides excellent preparation for students who plan to pursue graduate study in audiology and hearing sciences, learning disabilities, or speech and language pathology to conduct research in these areas or to engage in professional practice. In addition to taking a number of basic science courses in the Communication Sciences and Disorders Department, students in this program take a minimum of 12 science, mathematics, engineering, and/or psychology courses outside the department.

Students admitted to the seven-year Honors Program in Medical Education with an emphasis in human communication sciences meet the C- and D-level course requirements of the department (see following description). However, because they spend only three years on the Evanston campus, they take fewer A- and B-level courses in the department and the School of Speech than some four-year undergraduates.

Audiology and Hearing Sciences

This area of concentration encompasses the study of hearing, hearing disorders, and the treatment of hearing disorders. Undergraduate course work in this program provides the scientific undergirding necessary for clinical practice and/or auditory research. Emphasis is on basic communication science, including study of the anatomical, physiological, and physical bases of hearing. Information on normal communication processes is presented. An introduction to audiologic assessment and aural rehabilitation is provided, with the opportunity for supervised clinical experience for advanced undergraduate students.

The master's degree program in audiology and hearing sciences is a professional program designed to prepare students for the clinical practice of audiology. Students interested in careers in auditory research may emphasize the development of research skills in the master's program to prepare for continued study at the doctoral level.

Students completing master's study in audiology and hearing sciences may qualify for clinical certification by the American Speech-Language Association (ASHA), Illinois state licensure in audiology, and registration with the Illinois Department of Public Health in the area of hearing aid dispensing. Audiology professionals may be employed in hospitals, community and university clinics, industry, schools, rehabilitation centers, and research laboratories. Advanced professionals may be self-employed in private practice.

Learning Disabilities

Undergraduate concentration in learning disabilities involves a preprofessional course of study that provides academic preparation for graduate study leading to the MA and PhD degrees. The field is concerned with learning processes and their dysfunctions, including disorders of perception, memory, language, and conceptualization. Theoretical, scientific, clinical, and educational aspects are stressed, but students may concentrate on one phase of study, such as differential diagnosis or research, or may plan an interdisciplinary program by combining learning disabilities with such ancillary fields as speech and language pathology, audiology, psychology, education, neurology, or biomedical engineering.

Learning disabilities specialists may work in public or private schools, universities, hospitals, or community clinical facilities. The MA program enables graduates to qualify for certification to teach children with learning disabilities.

Speech and Language Pathology

The undergraduate emphasis in speech and language pathology combines academic instruction with laboratory activities and supervised clinical experiences to give students a background for graduate study in the field. The first two years of the undergraduate curriculum emphasize language development and the psychological, linguistic, neurological, acoustical, anatomical, and physiological bases of normal auditory and oral language behavior. As knowledge of normal speech, language, learning, and hearing processes increases, students are introduced to the communicative disorders that result from the disruption of these processes.

Advanced undergraduate courses are concerned with the nature, recognition, and management of common communicative disorders, such as problems of speech sound production, language development, fluency, and voice. This program also offers courses of study leading to the MA and PhD degrees as well as postdoctoral study in speech and language pathology. Graduate courses are concerned with the neurophysiologic and structural disorders affecting communication and with a more detailed study of disorders of language, fluency, articulation, and voice. Students study the theory, evaluation, and management of aphasia, cerebral palsy, cleft palate, laryngeal pathologies including laryngectomy, and other complex disorders.

Students completing graduate programs of study in speech and language pathology may qualify for teaching certification by the Illinois State Board of Education, Illinois state licensure, and certification by the American Speech-Language-Hearing Association (ASHA). Professional speech and language pathologists work in schools, child development programs, specialized educational settings, universities, hospital clinics, rehabilitation centers, and private practice.

Requirements for a Major in Communication Sciences and Disorders

- Introductory courses: 601-A08 or 620-A01 and at least 2 of the following: 601-A01, A02, A03
- B-level courses: B01, B02, B03, B04
- C- and D-level courses in communicative disorders: 9 courses (excluding practicum courses), including at least one in audiology and hearing sciences, learning disabilities, and speech and language pathology
- Electives: 14 courses, at least 8 of which must be outside the department

  Students who eventually plan to work on the elementary or secondary level are advised to include courses in education and other areas that apply toward the requirements for a teaching certificate in their special field.
- Courses taken in the department: 22 are the maximum number that can be counted toward the BS degree
- Writing proficiency requirement: all students must meet the writing proficiency requirement as described under Academic Policies in the CAS section of this catalog
- Residence requirement: enrollment in the department for the last five quarters preceding the granting of the degree

Basic Science

Courses Primarily for Undergraduates

620-A01-0 Seminar in Communication Sciences and Disorders
Major topics of research interest in communicative disorders. Principles of research in communicative disorders.

601-A05-0 Improving Voice and Articulation
See Introductory and Related Courses.

601-A08-0 Processes and Pathologies of Human Communication
See Introductory and Related Courses.

620-B01-0 Phonetics
Training in transcription of English speech sounds. Introduction to distinctive feature analysis, phonological rules, prosodic features, dynamics of articulation, American dialectal variants.

620-B02-0 Biological Foundations of Human Communication
Human anatomy, physiology, and neurology in relation to communicative behavior. Sensory, perceptual, cognitive, and motor processes. Prerequisite: A08 or consent of instructor.

620-B03-0 Acoustics of Speech
Nature of sound, acoustics, and acoustic composition of speech. Contributions of acoustical research to the theory of speech production and perception.

620-B04-0 Quantitative Methods in Communicative Disorders
Principles of measurement applied to speech, hearing, language, and learning. Introduction to statistical inference. Reliability, validity, and applicability of these measures.

620-B05-0 Introduction to the Study of Learning and Learning Problems in Children
Application of three theories—stimulus-response, cognitive development, and psychoanalytic—to learning and learning problems in classrooms. Field placement in a classroom; supervised observations of a child with learning problems and a normal achieving classmate.

620-C01-0 Anatomy and Physiology of the Vocal Mechanism
Lectures, readings, discussions, demonstrations, and laboratory dissections presenting the structure and function of the neuromuscular system involved in breathing, phonation, and articulation. Prerequisites: junior standing or above; B02.

620-C02-0 Anatomy and Physiology of the Hearing Mechanism
Gross and fine structure, development, and function of the peripheral and central auditory system. Prerequisites: junior standing or above; B02 and B03; or consent of instructor.

620-C03-0 Brain and Cognition
Brain anatomy and physiology, neuropsychological techniques, sensory physiology, and neural development. The brain's role in language, attention, learning and memory, thinking, intelligence, and reading.

620-C04-0 Introduction to Research Methods
Introduction to research design and data analysis in communication sciences and disorders; statistical inference.

620-C05-1 Electronic Laboratory Instrumentation
Basic analog and digital electronic theory for the use, modification, and design of behavioral laboratory equipment. Applications in speech and hearing.

620-C05-2 Computer Laboratory Instrumentation
Computer use in the laboratory for equipment control and data acquisition. Real-time programming and networking between computers and laboratory equipment. Prerequisites: C05-1 and proficiency in any computer language.

620-C06-0 Introduction to Psychoacoustics
Introduction to principles underlying perception of pitch, loudness, auditory space, speech; psychophysical procedures for studying psychoacoustics.

620-C09-0 Culture, Language, and Learning
Language and culture; transmission of culture through language; effects of cultural variety on perception, cognition, and learning; implications of cultural and linguistic diversity in communicative disorders.

620-C10-0 Developmental Auditory Perception
Empirical data and theories about developmental changes in auditory perception. Infancy to old age; emphasis on childhood years.

620-C11-0 Principles of Electronics and Acoustics
Parallel development of concepts in electronics and acoustics that are useful for advanced laboratory research in communicative disorders and related fields.

620-C12-0 Applied Research Methods in Human Communication Science
Survey, experimental, and clinical-case-review methods pertinent to hearing, speech, language, and learning; discussion of research strategies. Laboratory.

620-C20-0 Physiologic Instrumentation
Fundamentals of physiological measurement and analysis. Use of physiological instrumentation for the transduction and measurement of speech articulator movement. Design of experiments and interpretation of data. Prerequisite: C01.

620-C50-0 Cognitive Development in Atypical Learners
Introduction to theories of cognitive development; implications for the study of atypical learners; review of research on the impact of perceptual and language impairments on cognitive growth. Laboratory, with cognitive assessment procedures.

620-C99-0 Independent Study
Prerequisite: permission by petition.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Audiology and Hearing Sciences

Courses for Undergraduates and Graduates

621-C18-0 Introduction to Audiology
Introduction to the measurement of hearing in humans. Basic anatomy of the ear, measurement of hearing, potential disorders of hearing.

621-C19-0 Pediatric Audiology
Etiological factors, assessment, and implications of hearing impairment, selection of hearing aids, remedial programs, counseling of parents. Emphasis on hard-of-hearing infants and children. Prerequisites: C23 or consent of instructor.

621-C20-0 Pathologies of the Auditory System
Physiologic abnormalities of the auditory system that result in hearing impairments. Prerequisite: C02, C23, or equivalent.

621-C21-0 Evaluation and Use of Amplification Systems
Electroacoustic characteristics of the hearing aid, clinical selection of wearable amplification and group auditory training systems, and patient management. Lecture/laboratory. Prerequisite: C23 or consent of instructor.

621-C23-0 Measurement of Hearing
Basic audiometric and immittance techniques; interpretation of test results. Introduction to amplification systems. Lectures/laboratories. Prerequisite: junior standing or above.

621-C24-0 Differential Evaluation of the Auditory System
Audiometric techniques used in differential evaluation of cochlear, retrocochlear, and functional hearing loss. Calibration techniques. Prerequisite: C23 or equivalent.

621-C25-0 Electrophysiologic Techniques: Evoked Potentials
Electrophysiologic evaluation of auditory, visual, and somatosensory systems, emphasizing electric response measures. Theoretical and practical considerations in clinical application; interpretation of test results. Prerequisite: C24 or equivalent.

621-C26-0 Electrophysiologic Techniques: Electronystagmography and Case Studies
Electrophysiological evaluation of the auditory system; consideration in the measurement of caloric nystagmus. Integration of electrophysiologic test findings with audiometric and immittance test results in clinical case studies of auditory and vestibular disorders. Prerequisite: C25 or consent of instructor.

621-C66-0 Introduction to Aural Rehabilitation
Principles and strategies in hearing loss management in children and adults. Information about speech reading and auditory training. Prerequisite: C23 or equivalent.

621-C67-0 Advanced Aural Rehabilitation
Current research and theory in aural rehabilitation.

621-C68-0 Theory and Practice in Rehabilitation of Hearing-Impaired Children and Adults
Theories of methods of designing and implementing individual and group rehabilitation programs for hearing-impaired. Lectures, discussions, demonstrations relating to clinical practice. Prerequisites: C66 and consent of instructor.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Learning Disabilities

Courses Primarily for Undergraduates

623-C73-0 Introduction to Learning Disabilities
Psychological, neurological, and linguistic theories of language and learning as related to learning disabilities. Prerequisite: junior standing or above.

623-C75-0 Diagnostic Procedures for Exceptional Children
Principles and procedures for differential diagnosis. Characteristics of children with major handicapping conditions.

623-C76-0 Remedial Education for Children with Learning Disabilities
Remedial programs for children with learning disabilities. Teaching techniques for aphasia, dyslexia, and related disorders. Educational planning and placement. Prerequisite: junior standing or above or consent of instructor.

623-C77-0 Learning Disabilities in Early Childhood
Theoretical issues, assessment, and educational principles for young children with learning disabilities. Problems of language, cognition, and preacademic learning. Instruction and home management.

623-C78-1,2 Supervised Teaching in Learning Disabilities
1. Supervised teaching of children with psychoneurological learning disabilities. Observation and participation in classes of normal children as well as those with learning disabilities. **2.** Continuation of C78-1. Prerequisites: C75, C76, D78, D89.

623-C79-1,2 Supervised Teaching in Learning Disabilities
1. Required continuation of C78. **2.** Continuation of C79-1. Prerequisites: C75, C76, D78, D89.

623-C80-0 Introduction to Clinical Procedures in Learning Disabilities
Practicum experience in clinical settings. Learning processes and application of instructional approaches. Field studies, reading, and weekly seminars. Prerequisites: C75, C76.

623-C81-0 Social Development in Normal and Learning-Disabled Children
Current theories of and empirical research on social-emotional development from infancy through adolescence; identification and treatment of social deficits in learning-disabled children. Prerequisite: C73, C76, or consent of instructor.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Speech and Language Pathology

Courses Primarily for Undergraduates

624-C31-0 Speech Sound Learning and the Modification of Articulation
Development of speech production and speech sound perception skills in children. Factors affecting phonological development and auditory-motor learning. Assessment and modification of atypical articulatory patterns. Prerequisite: B01 or equivalent.

624-C32-0 Fluency, Disfluency, and Stuttering
Normal development of fluency and factors that may disrupt it. Introduction to the problem of stuttering; its nature, etiologies, development, and treatment. Prerequisite: B01 or consent of instructor.

624-C33-0 Vocal Physiology and Pathology
Normal and abnormal adaptations of respiration, phonation, and resonance to production of voice in speech. Techniques, materials, and instrumentation for voice diagnostics and therapy applicable to children and adults. Prerequisites: B02, C01.

624-C34-0 Delivery Systems in Speech and Language Pathology
Organization, administration, and implementation of speech-language pathology services in public, private, and special schools; clinics, rehabilitation agencies, hospitals; private practice.

624-C35-0 Diagnostic Procedures in Speech and Language Pathology
Clinical examination of persons with oral language problems; evaluation of sensory and motor processes of speech; assessment of speech and language maturity levels. Prerequisites: senior standing or above; C31 and C37; or consent of instructor.

624-C36-0 The Field of Special Education
Organization of special education programs; criteria for selection and educational management of pupils in special programs. Prerequisite: junior standing or above or consent of instructor.

624-C37-0 Language Development and Usage
Language learning and its relation to other aspects of child development. Patterns of normal language development as a guide for evaluation and treatment of developmental language disorders. Prerequisite: junior standing or above or consent of instructor.

624-C38-0 Introduction to Clinical Procedures in Speech and Language Pathology
Beginning practicum experience in a clinical setting. Emphasis on planning and executing a remedial program for individuals with problems of speech sound production and language usage. Prerequisite: consent of instructor.

624-C40-1,2 School Practicum in Speech and Language Pathology
1. Application of academic background to clinical teaching in the schools. Organizing, executing, evaluating a speech and language pathology program. For each course unit, 50 clock hours of supervised teaching. 2. Continuation of C40-1. Prerequisites: C31, C32, C34, C37, and consent of instructor.

624-C41-1,2 School Practicum in Speech and Language Pathology
1. Advanced supervised clinical teaching in speech and language pathology in a specialized school setting. For each unit of enrollment, 50 clock hours of supervised teaching. 2. Continuation of C41-1. Prerequisites: C40-1,2.

624-C69-0 Special Topics in Speech and Language Pathology
Summer only.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Communication Studies

The Department of Communication Studies provides a program that combines a liberal education with an in-depth understanding of human communication processes. Students who major in the department are men and women with broad interests in the humanities and social sciences and with a special concern for the ways in which people influence and relate to one another. The department offers courses in rhetoric (the art of public communication), interpersonal and group communication, and mass communication.

Majors in communication studies devote approximately one-third of their undergraduate program to study within the department and two-thirds to work in the College of Arts and Sciences and other divisions of the University. The course work both in and out of the department has a liberal arts orientation; the major is not designed as a performance, skills, or professional training program. It is, of course, hoped that students may become more sensitive or skillful communicators as a result of study in the department, but this will come primarily because they are themselves able to apply new insights to their own behavior.

In addition to a regular program, the department offers several academic options, including independent and field studies and a combined four-year bachelor's and master's degree program for exceptionally qualified undergraduates. The department has an honors program for outstanding seniors who wish to engage in original scholarly research with a member of the faculty. An active program of intercollegiate debate is maintained. The Communication Research Center of the School of Speech provides a base for students interested in experimental studies.

Students majoring in the program enter a variety of careers in which understanding of human communication is a key element. Many have gone into law, management, advertising, public relations, personnel training, or the clergy. Some majors work in community organizations or in international affairs. Of course, majors may also do graduate work in communication studies or in closely related disciplines, such as psychology, sociology, history, and political science.

Requirements for a Major in Communication Studies

- At least two of the following: 601-A01, A02, A03, A04.

- An additional 12 courses in speech, at least 9 of which must be in the department. At least 5 courses within the department must be at the C level. Not more than one unit of C93 Field Study and not more than two units of C99 Independent Study may be applied toward the total of 12 courses in speech.
- A field of concentration in an area other than speech (normally one of the disciplines of the College of Arts and Sciences), consisting of at least 6 courses with half or more of this study at the C or D level. Courses taken to satisfy the distribution requirement may be applied to the field of concentration if they fall within the discipline in which the student chooses to concentrate.
- Electives in speech and other areas.

Four-Year BSSp/MA

The department offers a four-year BSSp/MA program for outstanding undergraduate majors. Interested students should apply to the department by the end of their sophomore year; departmental approval is required before application to the Graduate School, which should be made during the junior year. By the end of the junior year, students should have completed all requirements for the undergraduate major, the field of concentration, and the distribution requirements, with a total of at least 38 units of credit. During the fourth year, students enroll in nine graduate-level courses to complete work on the master's degree and three undergraduate electives to complete work on the bachelor's degree.

Courses Primarily for Freshmen and Sophomores

601-A01-0 Interpersonal Communication
See Introductory and Related Courses.

601-A02-0 Public Speaking
See Introductory and Related Courses.

601-A04-0 Argumentation and Debate
See Introductory and Related Courses.

610-B01-0 Research Methods in Communication Studies
Logic and underlying assumptions of behavioral research; reliability and validity of measurement; experimental design; sampling, statistical, and computing techniques. Survey research with emphasis on sampling and statistical analyses, field studies, content analysis, and other techniques used in communication research.

610-B05-0 Theories of Persuasion
Principal variables and theories explaining the response of individuals and groups to persuasive communication.

610-B10-1,2 Landmarks in Rhetorical Theory
Origins and development of rhetorical theory. **1.** Contributions of the Sophists, Plato, Aristotle, and Cicero. **2.** Developments in rhetorical theory, late Roman period through the 19th century. Prerequisite: B10-1.

610-B14-0 Legal Argumentation
Argumentation practices in the legal forum; the history and problems of legal reasoning. Principles of advocacy in moot court; forensic controversy settings.

610-B15-0 Principles of Rhetorical Criticism
Theories and methods of the rhetorical criticism of discourse.

605-B16-0 Performance and Culture
See Performance Studies.

610-B20-0 Theories of Argumentation
Argumentation as a type of discourse, a philosophical method, and an instrument of critical decision making.

610-B21-0 Speech Writing
Theory and practice in the principles of composition and in the preparation and delivery of manuscript speeches.

610-B25-0 Forms of Public Address
Selected genres of public address: the eulogy, the censure, the inaugural, the apology, and the dedication.

610-B35-0 Philosophy of Language and Communication
Relationship between language and human communication behavior; how language structures individual world views; the process of meaning formation; therapeutic communication; the experience of creativity.

610-B40-0 Theories of Interpersonal Communication
Theories and research dealing with communication in relatively unstructured situations.

610-B50-0 Small Group Processes
Theories and research relating to communication in small groups; applications.

610-B60-0 Theories of Organizational Communication
Theories and research dealing with communication in formal organizations and institutions.

610-B70-0 Theories of Mass Communication
Major theoretical perspectives on the mass media, the audience, and their relationship; mass media effects on political, developmental, and interpersonal processes.

610-B75-0 The Rhetoric of Contemporary Culture
Impact of contemporary public and mass communication strategies upon audiences.

610-B90-0 Forensics
Independent research and analysis in conjunction with participation in intercollegiate forensics. Credit may not be earned for B90 more than once.

Courses Primarily for Juniors, Seniors, and Graduates

610-C10-0 Greek Rhetorical Theory
Survey of the history of Greek rhetoric from its origins in the fifth century BC through the Byzantine period. The main concentration is the classical period, with special attention to Gorgias, Protagoras, Isocrates, Plato, and Aristotle.

605-C11-0 Performance in Everyday Life
See Performance Studies.

610-C11-0 Latin Rhetorical Theory
Survey of the history of Latin rhetoric from Cicero through Francis Bacon. Cicero's rhetorical works serve as the foundation, but attention is paid also to Quintilian and Augustine.

610-C12-0 Modern Rhetorical Theory
Survey of the history and fate of late-Enlightenment rhetorical theory: ranging from the works of Campbell and Whately to 20th-century rhetoricians, such as Richards, Weaver, and Burke, and the rebirth of rhetorical studies.

610-C15-0 Rhetoric of Social Movements
Rhetorical theory of movements; analysis of the rhetoric of selected social movements. Prerequisite: B15.

605-C16-0 Folklore and Oral Traditions
See Performance Studies.

610-C20-0 Philosophical Argumentation
Problems, issues, and methods of inquiry within contemporary philosophical analysis. Recurrent philosophical disputes and modes of resolving controversy. Prerequisite: B20.

610-C21-0 Public Argumentation
Alternative political philosophies as groundings of public argument; issues of foreign and domestic policy as representative of recurring forms of argument. Prerequisite: B20.

610-C25-1,2,3 Rhetorical History of the United States
Communication phenomena of rhetorical significance as products of cultural change and as influences in major intellectual and social movements. **1.** Colonial period to the outbreak of the Civil War. **2.** Civil War to the coming of the New Deal. **3.** New Deal to the present.

610-C27-0 Contemporary Rhetorical Practice
Contemporary history from a rhetorical perspective; analysis of public communications and rhetorical study of nonoratorical events. Social movements and political controversy in America since 1960.

610-C28-0 The Rhetoric of War
The genre of war rhetoric; American experience in the 20th century. Speeches, diaries, newspaper reports, government documents, films, and poetry.

610-C29-0 Communication and the Phenomenon of Technology
Philosophical study of how intensification of technology in the 20th century has affected the structure and dynamics of human communication.

610-C30-1,2 Contemporary Problems in Freedom of Speech
Legal restrictions on freedom of expression in the United States; surrounding controversies. **1.** Principles and court decisions governing conflicts between freedom of expression and national security, public order, morality, privacy, fairness, and access to mass media. **2.** In-depth analysis of issues introduced in C30-1. Prerequisite: C30-1.

610-C40-0 Communication and Socialization
Communication processes involved in the socialization of children. Communication with major socializing agencies. Prerequisites: B01 and either B40 or B70.

610-C41-0 Communication and Aging
Relationship between adult developmental processes and changes in communication behavior. Prerequisites: B01 and B40.

610-C43-0 Social Cognition and Communication
Relationship between social cognition and communication behavior. Impact of attribution and schemata on interpersonal, public, and media effects. Prerequisites: B01 and B40.

610-C44-0 Interpersonal Conflict
Conflict behavior within interpersonal relationships, especially friendships and families. Causes of conflict and methods of conflict resolution. Prerequisites: B01, B05, and B40.

610-C45-0 Theories of Nonverbal Communication
Contributions of various disciplines to the development of theories of nonverbal communication systems. Prerequisites: B01 and B40.

610-C60-0 Current Perspectives in Organizational Communication Research
Micro- and macro-level theories of communication behavior in organizational settings. Prerequisites: B01 and B60.

610-C61-0 Intergroup Communication and Urban Change
The small group as an agent of social change in urban society; internal and external communication in such change. Prerequisites: any two of B40, B50, B60, and B70.

610-C62-0 Professional-Client Communication
Communication between professionals and clients in medicine, law, education, psychotherapy, and social services. Alternatives to the professional-client model of problem solving. Prerequisites: B01 and either B40 or B60.

610-C63-0 Bargaining and Negotiation
Communication in bargaining and negotiation within organizational settings. Cognitive and motivational theories; bargaining and negotiation strategies. Prerequisites: B01, B05, and B60.

610-C70-0 Current Perspectives in Mass Communication Research
Theories currently being used to investigate mass communication, including uses and gratifications theory, the knowledge-gap hypothesis, and parasocial interaction. Prerequisites: B01 and B70.

610-C71-0 Public Opinion
Nature of public opinion; history of techniques for expressing and assessing public opinion. Theories about the relationships among media, public opinion, and policy. Prerequisites: B01 and B70.

610-C72-0 Mass Communication and Campaign Strategies
Planning, implementing, and evaluating mass media campaigns by applying mass communication theories. Prerequisites: B05 and B70.

610-C75-0 Rhetoric and the Arts
Impact of art forms such as theatre, music, dance, film, and television on the public. Critiquing of guest artists by students. Prerequisite: B75.

610-C76-0 The Rhetoric of Popular Criticism
Rhetorical strategies used by popular critics in public communication. Prerequisites: B15 and B75.

610-C77-0 The Rhetoric of Cultural Genres
Impact of specific cultural forms on audiences. Topics vary. Samples: film, comedy, popular music, news, docudrama, the novel. Prerequisites: B15 and B75.

610-C78-0 Rhetoric and Aesthetic Theory
Interpretation and critique of the impact of major movements in aesthetic theory on theory and practice of rhetorical communication. Prerequisite: B10-1, B15, or an equivalent course in interpretation or criticism.

610-C80-0 Political Communication
Nature and functions of communication within established political institutions; decision-making strategies, deliberative discourses, and electoral campaigns; field study of advocates and interest groups. Prerequisite: B05, B10-1, or B70.

610-C81-0 Classroom Communication Behavior
Classroom as a communication system; verbal and nonverbal patterns of interaction. Systematic analysis of teacher-student behavior according to interpersonal and group processes. Lecture, laboratory.

610-C82-0 Family Communication Behavior
Family as a communication system; application of communication perspective to family interaction. Family interaction research and methods of improving family communication. Lecture, laboratory.

610-C85-0 Mass Media Economics
"Information revolution" in terms of technologies, industries, and social and cultural issues faced by information-dependent societies. Opportunities for and challenges to equitable participation in public affairs; productive and meaningful employment in the workplace; access to diverse sources of news and entertainment in the home. Prerequisite: B70.

610-C86-0 Legal and Political Dimensions of Telecommunication
Legal and regulatory processes affecting mass media and common carrier (voice and data transmission) communication industries. Specific laws and regulations and the policy-making process.

610-C89-0 Practicum in Mass Communication Research
Research design, conduct, and analysis of data gathered in mass communication contexts. Research on public opinion and mass communication processes. Prerequisites: B01 and B70.

610-C91-0 Ethical Issues in Communication
Ethical problems in public, group, and interpersonal communication; criteria for their resolution.

610-C93-0 Field Study in Communication
Enrollment only by petition in advance. Arrangements for winter quarter must be made by November 1 and for spring quarter by February 1.

610-C95-0 Topics in Communication Studies
Reading, research, and discussion in areas of significance. Topics vary.

610-C98-0 Undergraduate Seminar
Student- or faculty-initiated seminars to consider special topics. Credit for C98 may be earned more than once. No more than two units of such credit may be applied toward fulfillment of the major requirements.

610-C99-0 Independent Study
Prerequisite: permission by petition.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Performance Studies

The Department of Performance Studies is committed to the interdisciplinary study of the processes and forms of performance, with emphasis on performative expression. The courses explore a broad range of literary, sociocultural, and personal texts in performance. Students can study the adaptation and presentational staging of texts, particularly narrative works; performance art; performance theory and criticism; cultural studies and ethnography; intercultural performance; the practice of everyday life; and visual and electronic media-based practices of performance. Extracurricular work provides students with a wide variety of opportunities to perform, further encouraging them to explore the unity of language and body in the experience of texts.

Graduates of the department go on to varied professional work. Many teach literature, theatre, and performance studies; some pursue careers in professional theatre. Interest is growing in such fields as performance art and cultural and ethnographic studies of performance. Performance studies is

a useful related area for students in anthropology, radio/television/film, English, theatre, creative dramatics, dance, and communication studies.

The department presents performance hours and major productions in all genres of literature and in all performance modes and occasionally arranges lectures, readings by authors, and other special events.

Requirements for a Major in Performance Studies

- Introductory courses: one quarter of either 601-A01 or A02; 601-A03.
- B-level courses: a minimum of three courses in speech, including at least two quarters of B-level courses in the department.
- Production courses in theatre: two units selected from 630-A40-1,2,3; 630-B40-1,2,3; 630-B41-1,2,3; or one unit selected from preceding courses and one registration for 630-A19.
- An additional ten courses in speech, including at least six courses at the C level or above in the department. It is desirable that courses be distributed among the various forms and media (drama, prose fiction, poetry, nonfiction, presentational aesthetics, and performance art) and that they include courses in aesthetic and cultural performance.
- Six courses at the B level or above outside speech, including at least three C-level courses in literature, two of them in periods before 1900. Courses in literature are offered in English, classics, French and Italian, German language and literature, Slavic languages and literatures, Hispanic studies, African-American studies, and comparative literary studies. If they apply, courses taken to meet the distribution requirement may be used to satisfy this requirement.
- Electives in speech and other areas.

Courses Primarily for Freshmen and Sophomores

601-A03-0 Analysis and Performance of Literature
See Introductory and Related Courses.

605-B10-1 Performance of Poetry
Introduction to the analysis and performance of poetry. Prerequisite: A03 or equivalent.

605-B10-2 Performance of Narrative Fiction
Introduction to the study of narrative performance. Prerequisite: A03 or equivalent.

605-B10-3 Performance of Drama
Introduction to the analysis and performance of dramatic literature. Prerequisite: A03 or equivalent.

605-B16-0 Performance and Culture
Performative bases of culture; social structures, beliefs, values, and tensions in expressive forms; how cultural performances sustain or subvert human societies. Premodern cultures and primordial figures and forms of performance.

605-B24-0 Adapting Narrative for Group Performance
Introduction to theories and methods of adapting narrative for the stage, with special emphasis on the chamber theatre text and its relationship to film, drama, and other performance modes. Prerequisite: A03 or equivalent.

Courses Primarily for Juniors, Seniors, and Graduates

Unless otherwise indicated, one B-level course in the department is a prerequisite.

605-C07-1,2 Studies in Gender and Performance
Exploration of recent research on the social and political background of gender, particularly women's access to performative expressions. **1.** Women in the interstices of culture: evidence of women's performance traditions in paratheatrical cultural practices. **2.** Feminist theories of performance: feminist critiques of performance and production in the contemporary context. Theatre C07 is the third course in this series.

605-C08-0 Performing Modern and Contemporary Poetry
Use of performance in the analysis and criticism of modern and contemporary poetry.

605-C09-1,2,3 Performance of Black Literature
Exploration and performance of contemporary literature by black writers in three major genres. **1.** Drama. **2.** Novel. **3.** Poetry.

605-C11-0 Performance in Everyday Life
Conceptual view of human beings as actors. Dramatism and the perspective of life as theatre.

605-C15-0 Nonfiction Studies
Exploration of the dramatic impulse in nonfiction texts. Emphasis on autobiographical and intercultural works.

605-C16-0 Folklore and Oral Traditions
Genres of oral literature and an introduction to the methods and aims of folklore research. Two themes in modern folkloristics: the nature of verbal art as performance and the importance of cultural context.

605-C18-0 Shakespeare: Performance and Criticism
Use of performance in the analysis and criticism of selected plays by Shakespeare. Emphasis on presentational performance modes.

605-C20-0 Languages of the Body
Exploration of nonverbal body movement and gestural vocabularies in theatre, dance, and performance art, with reference to TV/film and productions of the body in visual and commercial media and popular-cultural styles.

605-C21-0 Performing the American 50s
Use of performance in the analysis and criticism of selected postwar American literature. Emphasis on the relationship of literature, film, and American popular culture.

605-C22-0 Performing the Psychological Novel
Use of performance in the analysis and criticism of selected 19th- and 20th-century novels. Emphasis on the representation of character psychology in novelistic discourse.

605-C24-1,2 Presentational Aesthetics
1. Theatrical convention, presentational mode, and conscious artifice in the performance of dramatic literature, poetry, and nonfiction. **2.** Theory and practice of chamber theatre, its conventions and presentational modes; adaptation, staging, and performance of prose fiction. Choice of performer's or director's perspective. Prerequisite: B24-0.

605-C26-1,2 Performance Art
1. History, development, and theories of performance art as a live-art genre from the modernist avant-garde to contemporary cross-cultural forms. Media in all forms, with emphasis on performance process and audience relationship. **2.** Further theoretical and laboratory exploration of compositional processes and political strategies of performance, media, and event/audience contexts.

605-C27-0 Field Methods in Performance Studies
Theory and practice of fieldwork on performance, from the collection of data to the write-up and presentation of material; practical fieldwork experience; critiques of current performance ethnographies.

605-C28-0 Studies in James Joyce
Primary emphasis on extensive critical study and performance of Joyce's *Ulysses,* resulting in either a lecture-performance, a recital, or a research paper.

605-C29-0 Performing Individual Poetic Styles
Content varies. Major poems of a significant writer or writers, permitting in-depth encounter with the writer, cultural context, and performance-related issues.

605-C99-0 Independent Study
Prerequisite: permission by petition.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Radio/Television/Film

In its undergraduate and graduate programs, the Department of Radio/Television/Film approaches the modern media of communication and art through their history, criticism of them, and practical experience in the making of audio, video, and film works. Theory and practice are linked: all students take courses in media study and media production.

Scholarly and critical education investigates the technologies and techniques, economic and legal aspects, social and aesthetic functions of the media. Production training includes audio recording, filmmaking, studio and location video, and computer graphics.

Television and radio facilities and activities include a color television studio, portable video cameras for field production, postproduction editing suites, sound recording studios, and the student-operated 7200-watt FM radio station WNUR, which serves the Chicago area. Studio 22, an extracurricular student organization, sponsors hour-long video productions; the Niteskool Project and Northwestern Student Television are student groups engaged in film, audio, video, and television production. In addition to on-campus production experience, internships at television and radio stations and film studios are available to selected juniors and seniors. Professional media makers are part-time instructors and guest lecturers.

Requirements for a Major in Radio/Television/Film

- Introductory courses: A12; a minimum of three courses at the A or B level in speech outside the department.
- B-level courses: B0l; B20; two from B80, B81, B82, B93.
- An additional eight courses in speech at the C and D levels, including at least six courses in the department at the C and D levels. Not more than one unit of C49 Internship in Radio/Television/Film and C99 Independent Study may be applied toward the six courses required in the department. The remaining internship and C99 units count as elective credits.
- Six courses at the B level or above outside speech, including at least three courses at the C level or above. Courses taken to meet the distribution requirement may be used to fulfill this requirement.
- Language requirement: proficiency in a modern foreign language equal to four quarters of college study. Proficiency may be established by placement exam or by completion of the fourth quarter.
- Electives in speech and other areas.

Courses Primarily for Freshmen and Sophomores

615-A12-0 Creative Processes in Sight and Sound
Introduction to media production and aesthetics, examining concepts of media literacy through the analysis and production of images.

615-B01-0 Mass Media and Society
Major historical, cultural, economic developments; influences on radio, television, film. Prerequisite for all C-level courses in the department.

615-B02-0 Introduction to Popular Culture: The Mass Media
Cultural meanings of narrative and commercial forms in radio, television, and film. Historical and contemporary theories of popular culture.

615-B15-0 Media Literacy
Production/criticism for nonmajors. Grammar of still and moving images: photography, television, film, radio, computer graphics.

615-B20-0 Introduction to Film History and Criticism
Film as art, entertainment, and industry; focus on the narrative fiction film but also attention to documentary and experimental traditions. Film criticism, authorship, genre, film theory. Prerequisite to all C-level film courses in the department.

615-B80-0 Introduction to Radio
United States radio market and station practices. Programming trends at radio stations. Prerequisite: A12.

615-B81-0 Introduction to Television
Principles, tools, and craft of studio television production; special problems in live television directing. Prerequisite: A12.

615-B82-0 Production Aesthetics
Issues related to film/video production aesthetics addressed within the context of extensive small-format video production. Emphasis on the actual production of work, development of technical skills, and critique of work in class. Weekly demonstrations of different aesthetic issues supplement class exercises. Prerequisite: A12.

615-B93-0 Introduction to Computer Graphics
Introduction to the process of creating images with computers, including scanning photos and flat art and creating 2-D computer animation using prepared software.

615-B98-0 Studies in Media Topics
Theoretical or practical or both; emphasis on evolving trends.

Courses Primarily for Juniors, Seniors, and Graduates

615-C01-0 Broadcast News
Survey of existing research and critical analysis of the process, content, impact, and utilization of broadcast news.

615-C10-1,2 History of Broadcasting
Evolution of U.S. radio and television; development of the industry and important programs; evolution of programming and audiences; survey of literature and research; trends, cultural influences, issues.

615-C12-1,2 History of Film
International survey of motion pictures as a distinctive medium of expression from its prehistory to the present.

615-C13-1 Documentary Film: History and Criticism
Survey of the schools, styles, and purposes of documentary film as a unique form of artistic expression and sociopolitical persuasion.

615-C13-2 Documentary Film and Video
Contemporary work and issues in documentary film and video.

615-C20-0 Modes of Film and Television Communication
Concepts of documentary, experimental, and narrative fiction forms of film expression and related aesthetic considerations.

615-C21-0 Radio/Television/Film Authorship
Idea of authorship in the media and an examination of different uses of author theory related to the work of particular artists.

615-C22-0 Radio/Television/Film Genre
Concept of genre in the media, with reference to popular American forms.

615-C23-1 Experimental Film: History and Criticism
Films and theories of experimentalists since the 1920s; contemporary underground movement.

615-C23-2 Experimental Film and Video
Contemporary work in experimental film and video.

615-C26-0 Mass Media Criticism
Contemporary critical methods applied to mass communication media. Critical literature supplemented by written analyses of selected films, television programs, and other appropriate material.

615-C30-0 Electronic Media Management
Organization and management of the television station and other electronic media organizations and facilities; functions and interrelationships of various departments.

615-C31-0 Regulation of Broadcasting
Government regulation and industry self-regulation; historical perspective and examination of current issues.

615-C33-0 Cable Communications
Legal, technical, and programming aspects of cable and satellite communications. Services offered by existing system and the complexities of developing systems.

615-C34-0 Television in Education
Uses, potentialities, current developments in educational media, including noncommercial educational media stations and media in the schools.

615-C41-0 Technological Innovations
How technology develops and is assimilated into mass media.

615-C42-0 Program Planning and Programming
Programming the broadcast station in relation to audiences, markets, coverage, station policies, facilities.

615-C43-0 Political Economy of Mass Media
Issues related to media industries, market structure and power, ownership and control, global dimensions and public policy.

615-C44-0 Program Distribution and Promotion
Analysis of network program distribution, syndication, cable distribution, and how series are promoted; how a station programmer makes decisions.

615-C45-0 Film As Business
American film industry's structure, policies, and relations with foreign governments and other segments of the entertainment business, including financing, distribution, and exhibition.

615-C49-1,2 Internship in Radio/Television/Film
Selected students work 40 hours each week in production departments of television stations and film studios. Guided research and reading.

615-C50-0 Telecommunications Policy
The nature of telecommunications technology; its development in a historical, political, economic, and cultural context; and its relation to contemporary problems in media.

615-C51-0 National Cinema
Historical aspects of cinema in a culture outside the United States or a social/cultural/intellectual movement within the general evolution of cinema.

615-C53-0 National Mass Media
The problem of creating a distinct national cultural identity through mass media; specific nations as case studies.

615-C55-0 Audience Analysis
Methods used to analyze electronic media audiences, with emphasis on quantitative research techniques.

615-C60-0 Radio/Television/Film Dramatic Writing I
Introduction to forms, techniques, and types of dramatic screenplay and television writing. Lecture/workshop.

615-C61-0 Radio/Television/Film Dramatic Writing II
Workshop in dramatic writing for the media, culminating in completion of full-length script. Prerequisite: C60.

615-C79-0 Topics in Film/Video/Audio Production
In-depth study and practice of one area of film, video, or television. May be taken more than once for credit, depending on changes in topic. Prerequisites: C80 and C81.

615-C80-0 Film Production
Techniques and technologies of 16mm filmmaking from initial conception to completed motion picture. Lecture/laboratory.

615-C81-0 Video Production
Techniques and technologies of ¾-inch video; single-camera shooting and multisource electronic editing. Lecture/laboratory.

615-C83-0 Radio/Audio Production
Production of complex radio programs. Lecture/laboratory.

615-C85-0 Integrated Media Arts
Introduction to theory and practice of media using microcomputers. For nonmajors; an elective in the Integrated Arts Program.

615-C90-0 Dramatic Directing
Introduction to film and video single camera directing techniques. Emphasis on the technical aspects of directing. Prerequisites: C80 and C81.

615-C91-0 Television Studio Directing
Directing, crewing, and technical skills for multiple camera live-on-tape television production in narrative and nonnarrative genres; preproduction, directorial communication, blocking, pacing, visualization. Prerequisite: C80 or C81.

615-C92-0 Documentary Production
Techniques for film and video, emphasizing preproduction planning, cinematography, sound recording, and editing. Prerequisites: C13-1 and C80 or C81.

615-C93-0 Computer Animation
Study and practice of creating 3-D computer graphics and animation, including the creation of still and sequenced images, modeling, and the creation of 3-D objects and scenes for video. Prerequisite: B93 or consent of instructor.

615-C94-0 Experimental Film and Video Production
Production experience in the making of art film or video; tapes, films, or installations that work outside established genres. Prerequisites: C23-2 and C80 or C81.

615-C98-0 Symposium: Issues in Radio/Television/Film
Special issues and topics in the analysis of radio, television, film, and popular culture.

615-C99-0 Independent Study
Prerequisite: permission by petition.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Theatre

Students who major in theatre at Northwestern combine a liberal arts education with intensive training in the theories and arts of the theatre. At the heart of the theatre program lies the idea that the best theatre artist is the one who combines a broad knowledge of the literature and theory of the field with highly developed skills in its practice. With the aid of an adviser, theatre majors select courses from three general areas of theatrical training: acting/directing/dance, design/technical, and history/literature/criticism. On completion of the introductory courses, students proceed to more intensive and more highly specialized courses, continually supplementing scholarly training with the discipline and challenge of performance.

The principal laboratories for student work are the Theatre Center Series during the academic year and the Drama Festival in the summer. Both offer subscription seasons to a large and demanding audience. The Theatre Center mounts a series of plays, usually three each quarter, during the regular term. Children's Theatre productions are offered also during the academic year and in the summer. Many plays, including studio theatre productions, are produced each quarter—directed, designed, and performed by students.

A major in dance is also available within the Department of Theatre. The dance major prepares students for further advanced academic work or apprentice-level positions in professional dance. The major's comprehensive curriculum emphasizes the study of dance as well as the act of dancing. Students are prepared for lifetime involvement in dance and how to continue to develop intellectually, artistically, and professionally within the dance world. The program provides students with opportunities to write about, research, and analyze the field and to study choreography and technique. The major presents a well-integrated view of dance while also providing sound technical training. The students are exposed to a variety of forms, with modern dance and jazz as the foundation techniques. The department supports the Dance Ensemble and Danceworks as well as self-produced dance concerts.

Requirements for a Major in Theatre

- Introductory courses: A40-1,2,3 Theatre in Context; A19 Production Laboratory (3 quarters, no credit); and two from the following: 601-A01 Interpersonal Communication, 601-A02 Public Speaking, 601-A03 Analysis and Performance of Literature, 601-A10 Voice for Performance
- Noncredit dance or physical education courses: 3 quarters from a selected list
- B- and C-level courses: a minimum of 5 courses at the B level and 5 courses at the C level or above in theatre, with at least 3 courses from each of the following groups:

Performance
B10 Training the Actor's Voice
B43-1,2,3 Acting I
C39 Advanced Acting (see Summer Session catalog)
C40-1,2 Stage Directing
C41-1,2,3 Acting II
C59 Directing for the Open Stage (see Summer Session catalog)

History/Literature
B44-1,2 The Development of Contemporary Theatre
C45-1,2,3 History of Western Theatrical Practice
416-C62-1,2,3 Modern Drama
D44 Dramatic Criticism

Design
B40-1,2,3 Stagecraft
B41-1,2,3 Design Process
C42-1,2,3 Stage Lighting II
C43-1,2,3 Scene Design II
C44-1,2,3 Costume Design II
C54-1,2,3 History of Costume and Decor (1 unit only)

- Courses outside speech: 6 courses at the B level or above, including at least 3 courses at the C level or above (courses taken to meet the distribution requirement may be used)
- Electives: note the School of Speech 18-unit requirement (see General Requirements)

Requirements for a Major in Dance

- Introductory courses: A30-1,2,3 Introduction to the Dance Experience; A19 Production Laboratory (2 quarters, no credit); one from the following: 601-A01, A02, A03, A10
- B- or C-level Speech courses: 3 courses
- Noncredit technique course: at least 1 course/quarter
- At least 9 courses chosen from the following categories, with a minimum of 3 courses from each category:

Performance
A33 Movement for the Stage
B32 Dance Composition
B33 Choreography for the Musical Stage
C32 Improvisation for Dance, Music, and Theatre
C33 Dance and Music: Studies in Collaboration
C34 Advanced Choreographic Study

History /Theory/Criticism
B30 History of the Dance
B31 Period Dance and Historical Movement Styles
C30 Dance Criticism
C35 Special Topics in Dance Research (methods or history topics)
CAS dance history/theory courses

Professional Studies
C31 Summer Dance Institute
C35 Special Topics in Dance Research (dance science/medicine, design for dance)
C36 Labanotation
C37 Dance and Expressive Arts Therapies
C75 Dance in Education
Crew: 3 units following A19

Courses Primarily for Freshmen and Sophomores

630-A19-0 Production Laboratory
Registration for students fulfilling production requirements.

630-A30-1,2,3 Introduction to the Dance Experience
Technique, improvisation, lecture, and discussion on dance history and cultural studies. **1.** What is dance. **2.** World history of dance up to the 20th century. **3.** World history of dance in the 20th century. Prerequisite: consent of instructor.

630-A33-0 Movement for the Stage
Movement/body awareness. Improvisational techniques using time, space, weight, and effort as the performer's instrument of expression.

630-A40-1,2,3 Theatre in Context
The concept of total theatre history and literature, voice and performance, and production activities. Two lectures a week plus intensive discussion, laboratory, and small-group production experiences. **1.** Tragedy. **2.** Comedy. **3.** Tragicomedy and modern forms.

630-A43-0 Acting: Basic Techniques
For nonmajors. Sensory and spatial awareness, concentration, relaxation, basic stage action. Prerequisite: consent of instructor.

630-B10-0 Training the Actor's Voice
Three actions—structural, tonal, and consonant. Individual practice sessions. Script analysis and discovery of subtext through use of actions. Prerequisite: A40-1,2,3 or equivalent.

630-B30-0 History of the Dance
Movement concepts in the major developmental periods of Western ballet and modern dance.

630-B31-0 Period Dance and Historical Movement Styles
Body carriage, use of gesture, and dance of the preclassic period. Practical and theoretical understanding of movement styles of the Middle Ages and Renaissance and Baroque periods.

630-B32-0 Dance Composition
The choreographic process; contributions of various artists. Fundamental choreographic elements: time, space, shape, form, dynamics, and design.

630-B33-0 Choreography for the Musical Stage
Setting movement/dance for vocalists and actors. Teaching choreography to nondancers and working with large numbers (chorus) on stage.

630-B40-1,2,3 Stagecraft
Craft and technology used in mounting a theatrical production. Participation in department productions. **1.** Lighting: mechanics, physics, and practices of the stage lighting technician. **2.** Scenery: construction, rigging, and handling. **3.** Costumes: sewing techniques, fitting, tools, and fabrics. Prerequisite: sophomore standing or consent of instructor.

630-B41-1,2,3 Design Process
Responsibilities of the theatrical designer, from initial reading of the script to production realization. Participation in department productions. **1.** Scene design I. **2.** Costume design I. **3.** Lighting design I. Prerequisite: sophomore standing or consent of instructor.

630-B42-0 Stage Makeup
Theory and practice of stage makeup. Lecture, laboratory. Prerequisite: consent of instructor.

630-B43-1,2,3 Acting I: Principles of Characterization
1. Basic concepts. **2.** Characterization in scene study. **3.** Ensemble and advanced scene study. Prerequisites: A40-1,2,3 or equivalent; consent of instructor.

630-B44-1,2 The Development of Contemporary Theatre
Critical study of major dramatists, theories, and production styles. **1.** 1870 to 1920. **2.** 1920 to present.

630-B49-0 Production Coordination
Organization and coordination of the theatrical production; role of the stage manager.

630-B53-0 Mime
Art of mime; theory and practice. Physical and mental conditioning of the performer, progressing to intensive work in performance concepts. Summer only.

Courses Primarily for Juniors, Seniors, and Graduates

Unless otherwise noted, these courses are open only to students who have completed the departmental B-level requirements or their equivalents.

630-C07-0 Studies in Gender and Performance
Exploration of recent research on the social and political background of gender, particularly women's access to performative expressions. Historical aesthetics: changing debates on women's participation in the public theatre and the significance of the body in performance. Performance Studies C07-1,2 are the first two courses in this series.

630-C10-0 Advanced Voice/Styles
Advanced vocal techniques of the stage actor; dramatic language analysis; scanning and speaking Shakespearean verse. Prerequisites: A10 or equivalent; consent of instructor.

630-C11-0 Dialects for the Stage
Dialects most frequently used by the American stage actor; systematic approach to dialect acquisition. Prerequisites: A10 or equivalent; consent of instructor.

630-C30-0 Dance Criticism
Critical and theoretical thought of writers on Western theatrical dance.

630-C32-0 Improvisation for Dance, Music, and Theatre
Improvisation as a source for performance and composition. Interrelationships of the performing arts. For musicians and actors to expand their knowledge of the vocabulary of dance and for dancers to investigate the musical and theatrical dimensions of their art. Prerequisite: consent of instructor.

630-C33-0 Dance and Music: Studies in Collaboration
Music and dance collaborations from historical and theoretical perspectives. Seminar, practicum.

630-C34-0 Advanced Choreographic Study
Lecture-laboratory investigation of advanced choreographic concepts; abstraction, style, use of music, group work, humor in dance. Prerequisite: B32 or consent of instructor.

630-C35-0 Special Topics in Dance Research
Research methodologies, dance scholarship, criticism, historical reconstruction. Critical issues and contemporary problems. Content varies. Prerequisite: consent of instructor.

630-C36-0 Labanotation, Elementary Level
Scientific system of notating movement; observation, analysis, accurate recording.

630-C37-0 Dance and Expressive Arts Therapies
Dance and the creative arts therapies in the treatment of the disabled, handicapped, and emotionally ill. Symbolic meaning,

group dynamics, and the language of movement as it relates to personality, body image, and expression. Prerequisite: consent of instructor.

630-C40-1,2 Stage Directing
1. Staging fundamentals: blocking, movement, business, tempo, script selection and analysis, casting, and rehearsal planning. **2.** Special problems: exposition, suspense, surprise, marking of climaxes, and the creation of mood. Prerequisite: consent of instructor.

630-C41-1,2,3 Acting II: Analysis and Performance
Theory, principles, and techniques of interpretation of drama from the point of view of the actor. **1.** Greek drama. **2.** Elizabethan drama. **3.** Contemporary drama. Prerequisite: consent of instructor.

630-C42-1,2,3 Stage Lighting II
1. Lighting methodologies and elements of lighting design, composition, and orchestration. Electrical practice and instrumentation. **2.** Design problems and their graphic notation. Light plots, hookups, and cueing. **3.** Advanced problems in lighting design and execution of nontraditional forms. Control and color. Participation in departmental productions. Prerequisite: B40-1, B41-3, or consent of instructor.

630-C43-1,2,3 Scene Design II
1. Design concept and traditional modes of presentation; linear composition, light and shade, rendering.
2. Composition; elements of design and historical source material. **3.** Mechanics; spatial design and contemporary materials. Participation in departmental productions.

630-C44-1,2,3 Costume Design II
1. Design elements and principles; color, form, line, and fabric. **2.** Personal technique and theatrical style.
3. Developing large projects and sustaining a style. Participation in departmental productions. Prerequisites: B40-3 and B41-2.

630-C45-1,2,3 History of Western Theatrical Practice
History and theory of theatre and drama. **1.** Theatre and culture in the classical period. **2.** Theatre and culture in the Middle Ages and Renaissance. **3.** Cultural crosscurrents from the Restoration.

630-C46-1,2 Playwriting
Fundamental techniques of playwriting. **1.** Beginning projects. **2.** Advanced projects. C46-1 prerequisite for C46-2. Prerequisite: consent of instructor.

630-C47-0 Children's Theatre
Selection, direction, and production of plays for children.

630-C48-1,2 Creative Drama
Principles and practices of improvised drama as a teaching method and a means of learning for the elementary school child. **1.** Basic theory through reading, discussion, film, observation, and team teaching project. **2.** Comparison of philosophies and practices of creative drama teachers in England and United States. Culminates in teaching project. C48-1 prerequisite to C48-2. Prerequisite: consent of instructor.

630-C49-1,2,3 Acting III: Problems in Style
Advanced problems in acting theories and styles. **1.** Methods of comic technique. **2.** Contemporary drama. **3.** Special projects in scene study. Prerequisite: consent of instructor.

630-C50-1,2,3 Problems in Advanced Technical Planning
Planning, organization, and materials in mounting productions based on contemporary theatrical practice. **1.** Engineering drawing techniques; skill development for technicians and designers. **2.** Coordination of personnel and material in production. **3.** Materials, methods, and equipment employed in contemporary scenic construction. Participation in departmental productions. Prerequisite: junior standing or consent of instructor.

630-C51-0 The Staging of Contemporary Drama
Production problems peculiar to directing of plays for contemporary theatre. Prerequisite: C40 or equivalent.

630-C52-1,2 Music Theatre Techniques
Various performance styles of musical theatre. **1.** Early works from the turn of the century through the classical musicals of Rodgers and Hammerstein. **2.** Integrated musicals through the development of concept and rock musicals. Prerequisites: junior standing; B43-1,2,3.

630-C54-1,2,3 History of Costume and Decor
History of costume, accessory, architecture, furniture, and ornamentation. **1.** Ancient times to Renaissance. **2.** Renaissance to 19th century. **3.** 19th century. Participation in departmental productions. Prerequisite: junior standing or consent of instructor.

630-C55-0 Scene Painting
Advanced scenic artists' techniques and procedures. Color use for the stage. Follow approaches established by professional scenic artists. Lab fee; supply own brushes. Prerequisite: consent of instructor.

630-C56-1,2,3 Graphic Arts for the Stage Designer
Projects in the use of calligraphy, color, and styles for the theatre artist. **1.** Drawing and painting. **2.** Color, calligraphy, model making; art techniques and practical application of color and material theories. **3.** Scene painting; traditional and contemporary theory. Participation in departmental productions. Prerequisite: junior standing or consent of instructor.

630-C61-0 Makeup, Masks, and Wigs
Design principles and construction methods used in creating visual accessories to costume design. Participation in departmental productions. Prerequisite: B41-2 or equivalent.

630-C63-0 Theatre Sound
Planning and execution of sound for the theatrical production; design of the actor's acoustical environment. Prerequisite: junior standing or consent of instructor.

630-C64-0 Period Pattern Drafting and Draping
Techniques of flat pattern drafting and advanced construction required for creating historical garment patterns for the stage. Participation in departmental productions. Prerequisite: junior standing or consent of instructor.

630-C65-0 American Theatre and Drama
Major movements and significant dramatists in the history, form, and practice of the American theatre.

630-C66-0 Studies in Individual Dramatic Styles
Intensive reading and discussion of selected works of major dramatists; the work's unique character, imparted by the dramatist's personal style. Prerequisites: two units of either B44 or C45.

630-C67-0 History of the Lyric Theatre
Three-part course, covering the major movements in the histories of dance, opera, and musical comedy. Examination of artists and their works.

630-C75-0 Dance in Education
Organizing and teaching dance for children and adolescents. Creative play, movement exploration, acquisition of basic motor skills. Lecture, laboratory, field experiences.

630-C76-0 Participation Theatre for Young Audiences
Principles and practices of participation and story theatre, incorporating improvisation into the structure of a scripted play for the child audience. Prerequisite: consent of instructor.

630-C80-0 Internship in Theatre Practice
(3 units for undergraduates; 2 units for graduates) Full-time participation in production and/or management activities in a theatre company. Prerequisite: consent of department.

630-C99-0 Independent Study
Prerequisite: permission by petition.

D-Level Courses

Courses at the D level are primarily for graduate students but may be open to advanced undergraduate students with permission. For descriptions of graduate courses and programs, see the appropriate graduate publication.

Other Undergraduate Programs

Integrated Arts Program

The interschool Integrated Arts Program offers courses that explore the creative process from the perspective of the artist in the disciplines of theater, visual arts, music, dance, and media arts. Students participate in lecture/discussion and studio courses crossing the boundaries of the traditional arts and involving collaboration between different art forms. They work in this program with a faculty of artists and scholars from the College of Arts and Sciences, the School of Music, and the School of Speech.

The curriculum also features courses in different disciplines that take art as their subject, e.g., sociology and the arts, philosophy and the arts, communication studies and the arts. Many courses are team-taught to provide the double perspective of practitioner and scholar. Integrated arts courses examine the creative process in relation to the artist, media, artwork, and audience. The program's goals are to create a climate conducive to the making and understanding of art and to enhance the general liberal arts education of its students.

Students applying for CAS certificates must present records showing a minimum of five courses not double-counted in their majors. Some Integrated Arts Program courses satisfy distribution requirements of the College of Arts and Sciences, the School of Music, and the School of Speech. Additional information about the Integrated Arts Program is available from the office of the Integrated Arts Program, the CAS Office of Studies, and the dean's offices in the Schools of Music and Speech.

Undergraduate Certificate in Integrated Arts

Students who satisfactorily complete seven courses qualify for the certificate in integrated arts. Five of the seven are the program's core courses; two are drawn from a list of electives. Core courses cannot be taken for P/N credit. No background in visual arts, music, theater, or dance is required.

Core courses: A90; two chosen from B91-1, B91-2, B91-3, B91-4; and (to be taken after completing two C-level electives) C90-1 and C90-2.

Elective courses: Art History C95; Art Theory and Practice C72; Communication Studies C78; Comparative Literary Studies C65; English C12, C35; Music History and Literature C36; Performance Studies C26-1,2; Philosophy C80; Radio/Television/Film C85; Sociology C50; Theatre C32, C33. A list of other approved elective courses is available in the program office.

Courses

482-A90-0 Art Process
Team-taught foundational introduction to common concerns in the arts (theater, art, music), using the analytic paradigm of artist/media/artwork/audience to understand the creative process. Lecture/discussion and studio format. Visits to theaters, concerts, and galleries.

482-B91-1 Modes of Theater
Introduces the modes of theater and tools for their analysis through studio exercises and assignments. Performance from dramatic and nondramatic texts. Lecture/studio format. Prerequisite: A90 or permission of instructor.

482-B91-2 Modes of Art
Team-taught. Introduces the elements of visual perception through thematic study of important examples of world art combined with related creative work in varied media. Lecture/studio format. Prerequisite: A90 or permission of instructor.

482-B91-3 Modes of Music
Introduces the basic vocabulary of music so that students can analyze, create, and compose music in significant musical forms. Prerequisite: A90 or permission of instructor.

482-B91-4 Modes of Dance
Team-taught. Introduces dance, the elements of choreography, and dance literacy; develops skills in oral and written communication about dance; and analyzes dance works in their unique contexts. Lecture/discussion and studio format with readings, videos, and films. Prerequisite: A90 or permission of instructor.

482-C90-1 Performance Seminar
Team-taught. Culmination of experiences and study of the previous courses in the Integrated Arts Program. Creates a final ensemble presentation integrating theater, art, and music and examines its design, direction, and production outside conventional institutional boundaries. Prerequisites: two B91 courses and two C-level electives or permission of instructor.

482-C90-2 Toward a Theory of the Arts
Investigates the theoretical implication of the Integrated Arts Program paradigm of artist/media/artwork/audience. Exam-

ines fundamental texts and aesthetic issues; the arts and symbolic structures; and art and audience. Prerequisite: C90-1 or permission of instructor.

International Studies Program

International studies is an undergraduate major with two special features: it is not situated in any one school but is open to students in all schools, and it does not replace any other major but complements it as an adjunct major that may be taken only in conjunction with a departmental major.

Through an integrated combination of area studies, comparative studies, and international relations, the international studies major describes our interconnected world system and addresses such issues as how the contemporary world is politically structured and economically organized; what social problems, policy issues, and ethical choices confront us as individual and collective participants in the world system; and how cultural diversity, conflict, diffusion, and exchange characterize the world system and shape responses to it. In addition to inquiring into larger conceptual issues, students focus on the history, art, literature, music, beliefs, and social systems of one particular geographical/cultural region.

Program of Study

Eleven quarter-courses are required for the major as well as proficiency in a language other than English at a level equivalent to two full years of instruction. Three of the courses are a year-long core sequence; three are core electives; four are regional (area studies) electives; and one is an upper-level seminar or research project.

Core sequence: International Studies B01-1,2,3 Introduction to the World System

Core electives (one from each of the following three groups):

- International politics and economics: Political Science B40, C40, C42, C45, C72; Economics C05, C06, C25
- Approaches to culture: Anthropology B11, B15; Performance Studies B16; Linguistics B09, C10; Religion A10
- Approaches to international ethics and cooperation: International Studies B02

Regional electives: four quarter-courses concerning either one geographical area listed below or a comparative approach to important dimensions of international studies. The four courses are one from each of the thematic groups also listed below; where no course is available for a given combination of area and group, students may, in consultation with a program adviser, substitute a course from another thematic group. Advisers have the lists of appropriate courses.

- Geographical areas: Africa, Asia, Europe, Latin America, Middle East, and a nongeographical comparative area
- Thematic groups: historical studies, literature, the arts, and beliefs and social systems

Upper-level seminar or research project: each year several options are offered through International Studies or other departments. Students may do an independent research project (Intl C99) based on a proposal approved in advance by their international studies adviser.

Advising: each student's major has a different combination of courses. Students design their programs in consultation with faculty advisers.

Courses

495-B01-1,2,3 Introduction to the World System
Three-quarter sequence investigating the origins and nature of contemporary global economic, political, and cultural interdependence. The first two quarters concern the historical evolution of the international system with focus on state formation, the rise of markets, and the creation of the interstate system. The third quarter highlights 20th-century problems. **1.** Origins of the global system. **2.** International system in the 18th and 19th centuries. **3.** International system in the 20th century.

Military Studies Programs

The military studies programs are not departments of any school; they are administered by the Office of the Provost.

Naval Science

The Northwestern University Naval Reserve Officers Training Corps (NROTC) Unit was established in 1926 by Congressional authorization when Northwestern became one of the original six universities to create a Naval Science Department. The professor of naval science (PNS), who chairs Northwestern's Department of Naval Science, and department faculty members are commissioned officers serving on active duty in the United States Navy or Marine Corps. They are selected and nominated by their respective services and screened and approved by the University. The unit is located at 617 Haven Street, Evanston, Illinois 60208-4140, phone 708/491-3324.

Naval ROTC Programs

The Naval Reserve Officers Training Corps offers young men and women the opportunity to obtain leadership and management experience as commissioned officers in the United States Navy (Navy option) or Marine Corps (Marine Corps option) after graduation from Northwestern, through either the Scholarship Program or the nonscholarship College Program.

At Northwestern, NROTC midshipmen lead essentially the same campus life as other students. They make their own arrangements for room and board and participate in campus activities of their choice. There are no prescribed academic majors for NROTC students, although scientific and technical studies are encouraged. NROTC students are required to complete the naval science curriculum, attend a weekly two-hour

laboratory, and participate in four to six weeks of active duty for summer training at sea or ashore. NROTC students are required to abide by the Midshipmen Regulations issued by the unit. Under certain conditions, students may enroll in the NROTC Program at any time from the beginning of their freshman year until the end of their sophomore year.

Courses

In addition to the required courses listed below, participants in the NROTC program must satisfactorily complete a number of other courses prescribed by the Department of the Navy, which are offered by other departments of the University. Current information on those course requirements is available from the NROTC unit.

With the exception of A10, Northwestern credit is granted for the successful completion of naval science courses subject to limitations imposed by the responsible University faculty committee and by the undergraduate schools. For more information on credit availability, consult the dean of each school. Naval science courses are open to non-NROTC students with department approval. Courses with an asterisk (*) are not required for Marine Corps option students.

937-A10-0 Introduction to Naval Organization
Components of the naval organization, its use and function in the Department of the Navy and Armed Forces of the United States.

***937-B10-0 Marine Navigation**
The theory underlying marine navigation. Basic piloting; dead reckoning, terrestrial lines of position, set and drift, extensive chart work; elements of celestial navigation; solution of the navigational triangle; use of the sun, moon, stars, and planets in position finding at sea; actual sextant observations of the sun/moon (weather permitting).

937-B20-0 Naval Ship Systems II (Naval Weapons Systems)
Theory and concepts of naval weapons systems. Ballistics of both powered and free-flight modes in single or multimedia environments; theory of target acquisition, identification and tracking; command and control systems. Development of ability to analyze, synthesize, and critically evaluate representative naval weapons systems.

***937-C31-0 Naval Operations**
Consists of several distinct segments. Students examine or practice rules of the nautical road, use of the maneuvering board, deck seamanship, and basic shiphandling theory.

937-C36-0 Evolution of Warfare (Marine Option Only)
Evolution of warfare from the Alexandrian Period to the present; broad coverage of history of warfare. Actions and decisions of opposing commanders evaluated in terms of classic theoretical principles of war.

***937-C41-0 Naval Leadership and Management**
Final development of students' managerial and professional competencies. Preparation for personal and professional responsibilities in human resources management, personnel management, material management, division discipline, and administrative responsibilities of the junior officer.

937-C45-0 Naval Ship Systems I (Naval Engineering)
Introduction to thermodynamics and basic power cycles used in naval propulsion and nonpropulsion auxiliary systems. Basics of electrical theory and shipboard electrical systems. Elements of ship design to achieve safe operations and ship stability characteristics.

937-C46-0 History of Amphibious Warfare (Marine Option Only)
Evolution of amphibious warfare; development of amphibious concepts and principles. Major amphibious operations from Gallipoli to present.

937-C50-0 Naval Science Laboratory
One two-hour lab weekly, required each quarter for all midshipmen. Emphasizes professional development and skills as well as drill and physical fitness.

Aerospace Studies

Northwestern students may participate in the programs of the Air Force Reserve Officers Training Corps through a cross-enrollment agreement with the Illinois Institute of Technology (IIT). Within the limits of the Northwestern school in which the student is registered, credits earned in aerospace studies courses at IIT may be counted toward the degree requirements at Northwestern. Further information may be obtained from Air Force ROTC Detachment 195, Illinois Institute of Technology, 3201 South Michigan Avenue, Chicago, Illinois 60616, phone 312/567-3525.

Military Science

Northwestern students may participate in the programs of the Army Reserve Officers Training Corps through a cross-enrollment agreement with the University of Illinois at Chicago (UIC). Within the limits of the Northwestern school in which the student is registered, credits earned in military science courses at UIC may be counted toward the degree requirements at Northwestern. Further information may be obtained from the Department of Military Science, University of Illinois at Chicago, Box 4348, Chicago, Illinois 60680, phone 312/996-3451.

Music Theatre Program

The Certificate in Music Theatre provides the opportunity for School of Music students majoring in voice and School of Speech students majoring in theatre to create a second area of specialization that is important to their development as musical theatre artists. For voice majors, the program provides training in acting and other theatre courses. Theatre majors have weekly voice classes and exposure to other music offerings.

The prescribed sequence of courses is only open to students accepted into the program through audition. The auditions are held annually in the spring quarter and are limited to freshman and sophomore theatre and voice majors. Auditioners are required to perform a vocal selection and a monologue and to participate in a dance audition.

Certificate Requirements for Voice Majors

Voice majors must take seven units of credit and four noncredit courses:

- Theatre B43-1,2,3 Acting I: Principles of Characterization (3 units)
- Theatre C52-1,2 Music Theatre Techniques (2 units)
- Theatre C67 History of the Lyric Theatre (1 unit)
- Design or dance elective (1 unit)
- Theatre A19 Production Lab (one quarter, no credit)
- Dance (3 classes, no credit)

Certificate Requirements for Theatre Majors

Theatre majors must take seven units of credit and six noncredit courses:

- Music A02 Beginning Voice (1.5 unit)
- Music A27 Keyboard Skills (1 unit)
- Music B02 Voice Performance: Musical Theatre (1.5 unit)
- Theatre C52-1,2 Music Theatre Techniques (2 units)
- Theatre C67 History of the Lyric Theatre (1 unit)
- Dance (minimum of 6 classes, no credit)

Undergraduate Leadership Program

The Undergraduate Leadership Program is an interschool certificate program open to all Northwestern undergraduates. The program helps students understand the nature of leadership and prepares them to become leaders on campus, in the community, and in their professions. Through course work, small group activities, seminar discussions, lectures, off-campus retreats, and involvement in campus and community organizations, participants learn the theories of leadership, experience the challenge of leading others, and create a sense of community with each other and members of participating organizations.

Certificate Requirements

The program combines theoretical, historical, practical, and experiential knowledge into a two-phase course of study. In the first phase, freshmen and sophomores begin the program by taking two required courses on leadership. After successfully completing both courses, students apply to enter the second phase. The activities in the second phase are primarily extracurricular and include group retreats, seminars, University-wide lectures, and internships.

The Office of the Provost awards a certificate to each student who successfully completes both phases of the Undergraduate Leadership Program, usually by the end of the junior year. Beyond the formal program, certificate holders may draw on their course work and experiences to enrich community life at Northwestern and in the surrounding community, fulfilling the program's goal of engaging constructively in civic and professional leadership activities.

Courses

The following courses are required for the first phase of the Undergraduate Leadership Program. Speech B04 offers conceptual models of leadership and experience in leading group analyses of case studies, which are videotaped and reviewed by group members. History B95 begins with the view that leaders and leadership are uniquely related to their constituency and their historical context. The course illustrates the consequences of the success or failure of leadership.

601-B04-0 Paradigms and Strategies of Leadership
See Introductory and Related Courses in the School of Speech.

427-B95-0 Leaders in History
See History in the College of Arts and Sciences.

Administration and Faculty

University Administration

University Officers

Arnold R. Weber, PhD, LHD, President of the University

David H. Cohen, PhD, Provost

C. William Fischer, MPA, Senior Vice President for Business and Finance

Margaret J. Barr, PhD, Vice President for Student Affairs

William I. Ihlanfeldt, PhD, LLD, Vice President for Institutional Relations

C. William Kern, PhD, Vice President for Research and Graduate Studies

Marilyn McCoy, MPP, Vice President for Administration and Planning

Morteza A. Rahimi, PhD, Vice President for Information Systems and Technology

Ronald D. Vanden Dorpel, AM, Vice President for University Development and Alumni Relations

Michael C. Weston, JD, Vice President and General Counsel

Rebecca R. Dixon, MEd, Associate Provost of University Enrollment

John D. Margolis, PhD, Associate Provost

Roxie R. Smith, PhD, Associate Provost

Jeremy R. Wilson, PhD, Associate Provost

Office of the Vice President for Student Affairs

Margo Brown, MS, Assistant to the Vice President for Student Affairs

Mark R. Gardner, MD, Director, Student Health Service

Bruce T. Kaiser, BS, Director, Norris University Center

Gregg Kindle, MA, Assistant Dean and Director, Undergraduate Residential Life

Victor R. Lindquist, MBA, Associate Dean and Director, Placement Center

G. Garth Miller, BA, Director, Dormitories and Commons Services

Karla Spurlock-Evans, MA, Associate Dean and Director, African-American Student Affairs

Tom Roland, MA, MFA, Director, Special Events

Timothy S. Stevens, MDiv, University Chaplain

William C. Tempelmeyer, MS, Director, University Housing

Office of the Associate Provost of University Enrollment

Alan Wolff, BA, Manager, Information Systems Office

Registrar's Office

Donald G. Gwinn, PhD, University Registrar

Margaret B. Hughes, BA, Associate Registrar

Richard S. Lurie, MA, Assistant Registrar

Financial Aid Office

Carolyn V. Lindley, MA, Director, Financial Aid

Patsy M. Abel, BS, Senior Associate Director

Mary L. Stonis, BA, Associate Director

Mark J. Mitchell, BS, Assistant Director

Charles W. Munro, BA, Assistant Director

Adina Osborn, MS, Assistant Director

Jessica Shisler, BA, Assistant Director

Judy H. Lefferdink, BA, Financial Aid Counselor

Undergraduate Admission Office

Carol A. Lunkenheimer, MA, Director, Undergraduate Admission

F. Sheppard Shanley, MA, Senior Associate Director

Jeanne Lockridge, PhD, Associate Director of Admission and Financial Aid

Carmine Salvucci, BA, Associate Director of Admission and Financial Aid

Jean Egmon, MA, Associate Director of Admission

Allison Gaines, MSJ, Assistant Director

Wayne Gordon, MM, Assistant Director

Worth Gowell, MA, Assistant Director

Katherine Jones, BA, Assistant Director

Shanlee McNally, BA, Assistant Director

Joan Miller, MA, Admission Counselor

University Library

David F. Bishop, MSLS, University Librarian

James S. Aagaard, MS, PhD, Assistant University Librarian for Information Technology

Adele W. Combs, MA, Assistant University Librarian for Public Services

Karen L. Horny, AMLS, Assistant University Librarian for Technical Services

Lance Query, AMLS, PhD, Assistant University Librarian for Planning and Administration

Eugene Wiemers, MLS, PhD, Assistant University Librarian for Collection Management

Undergraduate Schools

Each faculty listing that follows shows the highest academic or professional degree and the institution granting the degree. *University* and *College* are usually omitted; familiar abbreviations and short forms are used when appropriate. Faculty rank within the department is given. The word *also* indicates a joint appointment at the same rank in another department. An asterisk (*) before a name indicates a part-time faculty member.

College of Arts and Sciences

Administration

Lawrence B. Dumas, PhD
Dean of the College of Arts and Sciences and Professor of Biochemistry, Molecular Biology, and Cell Biology

Steven L. Bates, PhD
Associate Dean and Lecturer in English

Michael F. Dacey, PhD
Associate Dean and Professor of Anthropology and Geological Sciences

Christopher C. Herbert, PhD
Associate Dean and Professor of English

Robert C. MacDonald, PhD
Associate Dean and Professor of Biochemistry, Molecular Biology, and Cell Biology and Neurobiology and Physiology

Michael R. Stein, PhD
Associate Dean for Undergraduate Studies and Professor of Mathematics

Marie Thourson Jones, PhD
Assistant Dean and Lecturer in Political Science

Judith N. Levi, PhD
Assistant Dean for Freshmen and Associate Professor of Linguistics

Marvin J. Lofquist, PhD
Assistant Dean and Senior Lecturer in Chemistry

Gerald L. Mead, PhD
Assistant Dean and Associate Professor of French and Italian

Sara L. Schastok, PhD
Assistant Dean and Lecturer in Art History

Richard P. Weimer, MA
Assistant Dean

African-American Studies

Leon Forrest (Chicago)
Professor and Chair; also English

Henry C. Binford (PhD Harvard)
Associate Professor; also History

Phillip J. Bowman (PhD Michigan)
Associate Professor; also Education and Social Policy

Madhu Dubey (PhD Illinois)
Assistant Professor; also English

Olakunle George (PhD Cornell)
Assistant Professor; also English

Aldon D. Morris (PhD SUNY Stony Brook)
Professor; also Sociology, Center for Urban Affairs and Policy Research

Charles M. Payne (PhD Northwestern)
Associate Professor; also Sociology, Center for Urban Affairs and Policy Research

Sandra L. Richards (PhD Stanford)
Associate Professor; also Theatre

Fannie T. Rushing (PhD Chicago)
Lecturer

Diana T. Slaughter-Defoe (PhD Chicago)
Professor; also Education and Social Policy

African and Asian Languages Program

Richard Lepine (PhD Wisconsin)
Lecturer and Acting Director

Muhammad S. Eissa (PhD Al-Azhar)
Senior Lecturer

Edna G. Grad (PhD Texas)
Senior Lecturer

Wen-hsiung Hsu (PhD Chicago)
Senior Lecturer

Shirley Chang Juan (MA Ohio State)
Lecturer

Kiyomi Kagawa (MA Illinois)
Lecturer

Chizu Kanada (MA British Columbia)
Lecturer

Phyllis I. Lyons (PhD Chicago)
Associate Professor

Ken-ichi Miura (MA Wisconsin)
Lecturer

Anthropology

James A. Brown (PhD Chicago)
Professor and Chair

Gillian Bentley (PhD Chicago)
Assistant Professor

Caroline H. Bledsoe (PhD Stanford)
Associate Professor

Michael F. Dacey (PhD Washington)
Professor; also Geological Sciences; Associate Dean, College of Arts and Sciences

Marian Dagosto (PhD CUNY)
Assistant Professor; also Dental School, Medical School

Micaela diLeonardo (PhD Calif Berkeley)
Associate Professor; also Women's Studies, Center for Urban Affairs and Policy Research

Anna Di Rienzo (PhD Rome)
Assistant Professor

Malcolm Dow (PhD Calif Irvine)
Professor; also Sociology

Karen T. Hansen (PhD Washington)
Associate Professor

John C. Hudson (PhD Iowa)
Professor

William Irons (PhD Michigan)
Professor

Robert G. Launay (PhD Cambridge)
Associate Professor

Donald S. Sade (PhD Calif Berkeley)
Professor

Helen B. Schwartzman (PhD Northwestern)
Professor

Brian T. Shea (PhD Duke)
Associate Professor; also Dental School, Medical School

Gil J. Stein (PhD Pennsylvania)
Assistant Professor

Oswald Werner (PhD Indiana)
Professor; also Linguistics, Education and Social Policy

Art History

David T. Van Zanten (PhD Harvard)
Professor and Chair

S. Hollis Clayson (PhD UCLA)
Associate Professor

Whitney Davis (PhD Harvard)
Associate Professor

Sandra Hindman (PhD Cornell)
Professor

Michael Leja (PhD Harvard)
Assistant Professor

David Mickenberg (MA Wisconsin Milwaukee)
Lecturer; Director, Mary and Leigh Block Gallery

Ikem S. Okoye (MSc London)
Instructor

Sara L. Schastok (PhD Michigan)
Lecturer; Assistant Dean, College of Arts and Sciences

Larry Silver (PhD Harvard)
Professor

Otto K. Werckmeister (PhD Berlin)
Mary Jane Crowe Distinguished Professor of Art History

Art Theory and Practice

William Conger (MFA Chicago)
Professor and Chair

Ed Paschke (MFA Art Institute Chicago)
Professor

Lorraine Peltz (MFA Chicago)
Assistant Professor

James R. Valerio (MFA Art Institute Chicago)
Professor

James Yood (MA Chicago)
Lecturer

Biochemistry, Molecular Biology, and Cell Biology

Richard I. Morimoto (PhD Chicago)
Arthur E. Andersen Professor and Chair

Gary W. Ashley (PhD Calif Berkeley)
Assistant Professor; also Chemistry

Raymond L. Costa (PhD Pennsylvania)
Lecturer and Assistant Chair

Lawrence B. Dumas (PhD Wisconsin)
Professor; Dean, College of Arts and Sciences

J. Douglas Engel (PhD Oregon)
Owen L. Coon Professor of Molecular Biology

J. Lawrence Fox (PhD Arizona)
Lecturer (Abbott Laboratories)

Richard F. Gaber (PhD Wisconsin)
Associate Professor

Erwin Goldberg (PhD Iowa)
Professor

Brian M. Hoffman (PhD Caltech)
Professor; also Chemistry

Robert A. Holmgren (PhD Harvard)
Associate Professor; also Biological Sciences, Neurobiology and Physiology

Robert C. King (PhD Yale)
Professor

Robert A. Lamb (PhD Cambridge)
John Evans Professor of Molecular and Cellular Biology; Investigator, Howard Hughes Medical Institute

David M. LeMaster (PhD Yale)
Assistant Professor; also Chemistry

Daniel I. H. Linzer (PhD Princeton)
Associate Professor

James A. Lippincott (PhD Washington U)
Professor

Paul A. Loach (PhD Yale)
Professor; also Chemistry

Robert C. MacDonald (PhD UCLA)
Professor; also Neurobiology and Physiology; Associate Dean, College of Arts and Sciences

Kelly E. Mayo (PhD Washington)
Associate Professor; also Neurobiology and Physiology

Alfonso Mondragón (PhD Cambridge)
Assistant Professor

Francis C. Neuhaus (PhD Duke)
Professor

Scott A. Ness (PhD UCLA)
Assistant Professor

Thomas V. O'Halloran (PhD Columbia)
Associate Professor; also Chemistry

Vikram P. Patel (PhD Clark)
Assistant Professor

Susan K. Pierce (PhD Pennsylvania)
Professor

Marianne Schiffer (PhD Columbia)
Adjunct Professor (Argonne National Laboratory)

Richard B. Silverman (PhD Harvard)
Professor; also Chemistry

Angela U. Wandinger-Ness (PhD UCLA)
Assistant Professor

Neil E. Welker (PhD Case Western Reserve)
Professor; also Biological Sciences

Edwin M. Westbrook (MD, PhD Chicago)
Associate Professor (Argonne National Laboratory)

Jonathan Widom (PhD Stanford)
Associate Professor; also Chemistry

Tai Te Wu (PhD Harvard)
Professor; also Biomedical Engineering, Engineering Sciences and Applied Mathematics

Biological Sciences, Undergraduate Program in

Robert A. Holmgren (PhD Harvard)
Associate Professor and Director; also Biochemistry, Molecular Biology, and Cell Biology, Neurobiology and Physiology

John S. Bjerke (PhD Wisconsin)
Senior Lecturer

Roberta W. Ellington (BA Barat)
Lecturer

Gary J. Galbreath (PhD Chicago)
Senior Lecturer and Associate Director

John C. Mordacq (PhD Northwestern)
Lecturer and Director of Undergraduate Laboratories

Neil E. Welker (PhD Case Western Reserve)
Professor; also Biochemistry, Molecular Biology, and Cell Biology

Chemistry

Duward F. Shriver (PhD Michigan)
Charles E. and Emma H. Morrison Professor of Chemistry and Chair

Gary W. Ashley (PhD Calif Berkeley)
Assistant Professor; also Biochemistry, Molecular Biology, and Cell Biology

Joyce C. Brockwell (PhD Indiana)
Senior Lecturer

Donald E. Ellis (PhD MIT)
Professor; also Physics and Astronomy

Brian M. Hoffman (PhD Caltech)
Professor; also Biochemistry, Molecular Biology, and Cell Biology

Joseph T. Hupp (PhD Michigan State)
Associate Professor

James A. Ibers (PhD Caltech)
Charles E. and Emma H. Morrison Professor of Chemistry

Martin F. Jarrold (PhD Warwick)
Professor

Manfred M. Kappes (PhD MIT)
Adjunct Professor

C. William Kern (PhD Minnesota)
Professor; Vice President for Research and Graduate Studies

Joseph B. Lambert (PhD Caltech)
Clare Hamilton Hall Professor of Chemistry

David M. LeMaster (PhD Yale)
Assistant Professor; also Biochemistry, Molecular Biology, and Cell Biology

Frederick D. Lewis (PhD Rochester)
Professor

Paul A. Loach (PhD Yale)
Professor; also Biochemistry, Molecular Biology, and Cell Biology

Marvin J. Lofquist (PhD Northwestern)
Senior Lecturer; Assistant Dean, College of Arts and Sciences

Robert J. Loyd (MS Oklahoma State)
Lecturer and Manager, Research Instrumentation

Claude A. Lucchesi (PhD Northwestern)
Senior Lecturer and Director, Analytical Services

Tobin J. Marks (PhD, MIT)
Charles E. and Emma H. Morrison Professor of Chemistry; also Materials Science and Engineering

Frank E. McDonald (PhD Stanford)
Assistant Professor

Chad A. Mirkin (PhD Penn State)
Assistant Professor

Frederick J. Northrup (PhD Toronto)
Lecturer

Thomas V. O'Halloran (PhD Columbia)
Associate Professor; also Biochemistry, Molecular Biology, and Cell Biology

Kenneth R. Poeppelmeier (PhD Iowa State)
Dow Chemical Company Research Professor in Chemistry

John A. Pople (PhD Cambridge)
Adjunct Professor

Mark A. Ratner (PhD Northwestern)
Professor

Eric J. Roskamp (PhD Wayne State)
Assistant Professor

Wolfgang M. H. Sachtler (PhD Braunschweig)
Vladimir Ipatieff Research Professor of Organic Chemistry; also Chemical Engineering

George C. Schatz (PhD Caltech)
Professor

Richard B. Silverman (PhD Harvard)
Professor; also Biochemistry, Molecular Biology, and Cell Biology

Kenneth G. Spears (PhD Chicago)
Professor; also Biomedical Engineering

Peter C. Stair (PhD Calif Berkeley)
Professor

Richard P. Van Duyne (PhD North Carolina)
Charles E. and Emma H. Morrison Professor of Chemistry

Thomas R. Weaver (PhD Northwestern)
Senior Lecturer

Daniel P. Weeks (PhD Delaware)
Senior Lecturer and Director of Undergraduate Studies

Eric Weitz (PhD Columbia)
Professor

Jonathan Widom (PhD Stanford)
Associate Professor; also Biochemistry, Molecular Biology, and Cell Biology

Classics

John Wright (PhD Indiana)
John Evans Professor of the Latin Language and Literature and Chair

Reginald Allen (PhD Yale)
Professor; also Philosophy

Daniel H. Garrison (PhD Calif Berkeley)
Associate Professor

Martin Mueller (PhD Indiana)
Professor; also English

James E. Packer (PhD Calif Berkeley)
Professor

Jeanne Ravid (MA Northwestern)
Lecturer

Robert W. Wallace (PhD Harvard)
Associate Professor

Economics

Robert J. Gordon (PhD MIT)
Stanley G. Harris Professor of the Social Sciences and Chair

Marcus Alexis (PhD Minnesota)
Board of Trustees Professor of Economics; also Management and Strategy

Joseph G. Altonji (PhD Princeton)
Professor; also Center for Urban Affairs and Policy Research

Kyle Bagwell (PhD Stanford)
Household International Corporation Research Professor of Economics

Rebecca M. Blank (PhD MIT)
Associate Professor; also Center for Urban Affairs and Policy Research

Ronald R. Braeutigam (PhD Stanford)
Harvey Kapnick Professor of Business Institutions; also Transportation Center

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Professor

Robert M. Coen (PhD Northwestern)
Professor

Ian Domowitz (PhD Calif San Diego)
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Martin Eichenbaum (PhD Minnesota)
Professor

*Robert Eisner (PhD Johns Hopkins)
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Joseph Ferrie (PhD Chicago)
Assistant Professor

Bo Honoré (PhD Chicago)
Associate Professor; also Statistics

Hugo Hopenhayn (PhD Minnesota)
Assistant Professor

Morton I. Kamien (PhD Purdue)
Joseph and Carole Levy Professor of Entrepreneurship; also Managerial Economics and Decision Sciences

Per Krusell (PhD Minnesota)
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Kiminori Matsuyama (PhD Harvard)
Associate Professor

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Professor

Rosa Matzkin (PhD Yale)
Associate Professor

Bruce Meyer (PhD MIT)
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Joel Mokyr (PhD Yale)
Professor; also History

James Montgomery (PhD MIT)
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Ida C. Cook Professor

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Harold L. Stuart Professor of Decision Sciences; also Managerial Economics and Decision Sciences

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Assistant Professor

John C. Panzar (PhD Stanford)
Louis W. Menk Professor; also Transportation Center

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Assistant Professor

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William R. Kenan Jr. Professor of Economics

Stanley Reiter (PhD Chicago)
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Donald G. Saari (PhD Purdue)
Professor; also Mathematics

Mark A. Satterthwaite (PhD Wisconsin)
Earl Dean Howard Professor of Management; also Managerial Economics and Decision Sciences

Ian P. Savage (PhD Leeds)
Senior Lecturer; also Transportation Center

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Adjunct Professor

Alan M. Taylor (PhD Harvard)
Assistant Professor

Christopher Udry (PhD Yale)
Assistant Professor

Mark W. Watson (PhD Calif San Diego)
Professor; also Statistics

Arnold R. Weber (PhD MIT)
Professor; President, Northwestern University

Burton Weisbrod (PhD Northwestern)
John Evans Professor of Economics; Director, Center for Urban Affairs and Policy Research

Asher Wolinsky (PhD Stanford)
Professor

English

Barbara J. Newman (PhD Yale)
Professor and Chair; also Religion

Sharon Achinstein (PhD Princeton)
Assistant Professor

Alfred Appel Jr. (PhD Columbia)
Professor

Steven L. Bates (PhD Princeton)
Lecturer; Associate Dean, College of Arts and Sciences

Paul Breslin (PhD Virginia)
Associate Professor

Albert R. Cirillo (PhD Johns Hopkins)
Associate Professor

Douglas Cole (PhD Princeton)
Professor

Tracy Davis (PhD Warwick)
Assistant Professor; also Theatre

Helen Deutsch (PhD Calif Berkeley)
Assistant Professor

Elizabeth Dipple (PhD Johns Hopkins)
Professor

Madhu Dubey (PhD Illinois)
Assistant Professor; also African-American Studies

Joseph Epstein (BA Chicago)
Lecturer

Lawrence G. Evans (PhD Harvard)
Associate Professor

Leon Forrest (Chicago)
Professor; also African-American Studies

Christine Froula (PhD Chicago)
Herman and Beulah Pearce Miller Research Professor of Literature

Olakunle George (PhD Cornell)
Assistant Professor; also African-American Studies

Reginald Gibbons (PhD Stanford)
Professor; Editor, *TriQuarterly*

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Professor; Associate Dean, College of Arts and Sciences

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Professor

Jules David Law (PhD Johns Hopkins)
Assistant Professor

Joanna Lipking (PhD Columbia)
Lecturer

Lawrence Lipking (PhD Cornell)
Chester D. Tripp Professor of the Humanities

Susan A. Manning (PhD Columbia)
Assistant Professor; also Theatre

John D. Margolis (PhD Princeton)
Professor; Associate Provost

Martin Mueller (PhD Indiana)
Professor; also Classics

Terence Mulcaire (PhD Calif Berkeley)
Assistant Professor

Johnny Payne (PhD Stanford)
Assistant Professor

Catharine Regan (PhD Illinois)
Associate Professor

Mary Beth Rose (PhD Duke)
Adjunct Associate Professor

Carl S. Smith (PhD Yale)
Associate Professor

Julia Stern (PhD Columbia)
Assistant Professor

Wendy Wall (PhD Pennsylvania)
Assistant Professor

Nicola Watson (DPhil Oxford)
Assistant Professor

William B. Worthen (PhD Princeton)
Professor; also Theatre

French and Italian

William D. Paden (PhD Yale)
Professor and Chair

Albert Ascoli (PhD Cornell)
Associate Professor

Marie-Thérèse Cunningham (MA Grenoble III)
Lecturer

Scott Durham (PhD Yale)
Assistant Professor

Charles S. Fineman (MPh Yale)
Lecturer; Humanities Bibliographer, University Library

Bernadette Fort (Doctorat du Troisième Cycle Paris)
Professor

Michal Ginsburg (PhD Yale)
Associate Professor

Anne Landau (PhD Northwestern)
Lecturer

Françoise Lionnet (PhD Michigan)
Assistant Professor

Gerald L. Mead (PhD Yale)
Associate Professor; Assistant Dean, College of Arts and Sciences

Karen E. Pinkus (PhD CUNY)
Assistant Professor

Concettina Pizzuti (PhD Harvard)
Senior Lecturer

Christiane Rey (Licence en Droit, Liège)
Lecturer

Sylvie Romanowski (PhD Yale)
Associate Professor

Tilde A. Sankovitch (PhD Northwestern)
Professor

Janine W. Spencer (PhD Northwestern)
Senior Lecturer

*Todd Straus (PhD Calif Berkeley)
Lecturer

Claude Tournier (PhD Northwestern)
Senior Lecturer

Geological Sciences

Richard G. Gordon (PhD Stanford)
Professor and Chair

Susan M. Agar (PhD Imperial College London)
Assistant Professor

Craig R. Bina (PhD Northwestern)
Assistant Professor

G. Edward Birchfield (PhD Chicago)
Professor

Finley C. Bishop (PhD Chicago)
Associate Professor

Michael F. Dacey (PhD Washington)
Professor; also Anthropology; Associate Dean, College of Arts and Sciences

David Hollander (PhD Swiss Federal Tech)
Assistant Professor

Donna M. Jurdy (PhD Michigan)
Professor

Abraham Lerman (PhD Harvard)
Professor

Emile André Okal (PhD Caltech)
Professor

John W. Rudnicki (PhD Brown)
Professor; also Civil Engineering

Bradley B. Sageman (PhD Colorado)
Assistant Professor

Robert C. Speed (PhD Stanford)
William Deering Professor of Geology

Seth A. Stein (PhD Caltech)
Professor

John V. Walther (PhD Calif Berkeley)
Professor

William R. Walton (PhD Calif San Diego)
Adjunct Professor

Johannes Weertman (ScD Carnegie)
Professor; also Walter P. Murphy Professor of Materials Science and Engineering

German Language and Literature

Volker O. Dürr (PhD Princeton)
Associate Professor and Chair

William Anthony (PhD Johns Hopkins)
Senior Lecturer

Peter D. Fenves (PhD Johns Hopkins)
Associate Professor

Kathy Harms (PhD Northwestern)
Associate Professor

Peter F. Hayes (PhD Yale)
Alfred W. Chase Professor of Business Institutions; also History

Peter Lutz Lehmann (PhD Free University Berlin)
Associate Professor

Franziska B. Lys (PhD Northwestern)
Senior Lecturer

John A. McCumber (PhD Toronto)
Associate Professor; also Philosophy

Helmut Müller-Sievers (PhD Stanford)
Assistant Professor

Ellen Margaret Risholm (PhD Wisconsin)
Lecturer

Rainer Rumold (PhD Stanford)
Associate Professor

Géza von Molnár (PhD Stanford)
Professor

Hispanic Studies

E. Inman Fox (PhD Princeton)
Professor and Chair

Stewart I. M. Adams (PhD St. Andrews)
Lecturer

Lois Baer Barr (PhD Kentucky)
Lecturer

John Dagenais (PhD Illinois)
Associate Professor

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