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Degree Programs

Aerospace Engineering

**M.Aero.E.—Coursework Only and Design Project**
The M.Aero.E. program emphasizes applications of fluid mechanics, dynamical systems and controls, and continuum and solid mechanics in aerospace engineering. Please refer to Aerospace Engineering and Mechanics (AEM) in the course section of this catalog for courses pertaining to this program.

**Degree Requirements**
The program must include at least 12 credits at the 5xxx or 8xxx level. In addition to the minimum credit requirement, the student must demonstrate understanding of the rudiments of aerodynamics and airplane mechanics, either from previous study or from additional coursework in the graduate program.

**Language Requirements**—None.
**Final Exam**—The final exam is oral.

**M.S.Aero.E.—Plan A and Plan B**
The M.S.Aero.E. program in aerospace engineering emphasizes coursework in engineering sciences that are basic to this field: fluid mechanics, dynamical systems and controls, and continuum and solid mechanics.

Please refer to Aerospace Engineering and Mechanics (AEM) in the course section of this catalog for courses pertaining to this program.

**Degree Requirements**
The program must include at least 42 credits of approved courses and four semesters of colloquium attendance. The program must include at least four courses in aerospace engineering at the 8xxx level and can contain no more than two courses at the 4xxx level. The first year of the Ph.D. program is similar to the master’s program and most Ph.D. students receive the master’s degree. By the end of the first year, the student has chosen an adviser. The second year is devoted to more advanced courses and beginning research. Subsequent years include some coursework with increased focus on research. The time required to complete a research project varies, but most students finish the Ph.D. within five years after their bachelor’s degree.

**Language Requirements**—None.
**Minor Requirements for Students Majoring in Other Fields**—At least 12 credits in aerospace engineering are required, including at least one sequence of two courses at the 8xxx level.

**Agricultural and Applied Economics**

**M.S.—Plan A and Plan B**
The M.S. program degree in agricultural and applied economics prepares students for employment opportunities in the public and private sector and for further graduate study. This flexible program includes core coursework in economic theory and quantitative methods. It offers opportunities for specialized coursework in consumption and marketing economics; development, trade, and policy; natural resource and environmental economics; production and managerial economics; and regional economics.

Please refer to Applied Economics (ApEc) in the course section of this catalog for courses pertaining to this program.

**Degree Requirements**
M.S. students are required to complete graduate-level courses in microeconomic theory, macroeconomic theory, and econometrics or statistics, or to have completed equivalent courses prior to entry into the program. Students are also required to participate in a 1 credit M.S. seminar. Both Plan A and Plan B require at least 30 credits, of which at least 14 must be in the major field and at least 6 must be in a related field or minor. The major field must include a minimum of 7 credits in applied economics (excluding thesis and special topics, independent study, and the M.S. seminar.). Plan A requires 10 thesis credits. Plan B requires a 4- to 6-credit project. A minimum GPA of 3.00 in program courses is required for graduation.

**Language Requirements**—None.
**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—M.S. students must complete at least 9 credits in applied economics at the 5xxx or 8xxx level. Courses for the minor are approved by the director of graduate studies in the Department of Applied Economics. All courses in the minor must be taken A-F and completed with a GPA of 3.00 or better.

**Ph.D.**
The Ph.D. degree program in agricultural and applied economics prepares students for research, teaching, and extension positions and for research and administrative posts in public and private sector organizations. The program includes core coursework in economic theory and quantitative methods and in two fields of specialization selected from the following: consumption and marketing economics; development, trade, and policy; natural resource and environmental economics; and production and managerial economics.

Please refer to Applied Economics (ApEc) in the course section of this catalog for courses pertaining to this program.

**Degree Requirements**
The only specific credit or course requirements for the Ph.D. in agricultural and applied economics are a 1 credit seminar and the Graduate School requirement of a supporting field or minor of 12 to 18 credits and registration for 24 doctoral thesis credits. Ph.D. students follow a study program that includes coursework in microeconomic...
Degree Programs

American Studies

American studies is an interdepartmental program with a graduate faculty drawn from a wide number of departments. Students create a field of concentration and also pursue broad training in analyzing the development of cultural and historical processes that shaped the nation and its diverse cultures, as well as analyzing contemporary practices.

M.A.—Plan A and Plan B

The master’s degree is not designed as a terminal degree, and students are not admitted to it. A Ph.D. student may elect to pursue the M.A. All coursework is applicable to the Ph.D.

Degree Requirements

The master’s degree offered under Plan A (31 credits) is distributed as follows: American studies core seminars—AmSt 8201, 8202 (6 credits); a two-semester research course in American studies or in another department with approval of the director of graduate studies (6 credits); a comparative cultural course covering international or non-U.S. subjects (3 credits); two adviser-approved courses in the field of concentration, including one focused on cultural pluralism within the U.S. experience (6 credits); and 10 thesis credits. The Plan B master’s requires 30 credits distributed as follows: American studies core seminars—AmSt 8201, 8202 (6 credits); a two-semester research course in American studies or in another department with approval of the director of graduate studies (6 credits); a comparative cultural course covering international or non-U.S. subjects (3 credits); five adviser-approved courses in the field of concentration, including one focused on cultural pluralism within the U.S. experience (15 credits). The student is required to write three Plan B papers, each approved by a member of the graduate faculty. The papers are usually expanded seminar papers.

Language Requirements—Reading knowledge of one foreign language is required.

Minor Requirements for Students

Majoring in Other Fields—For a minor or supporting field, students are expected to choose courses consistent with or complementary to their major. Students should complete either AmSt 8201 or 8202 and two more courses in American studies or in an ethnic studies program.

Ph.D.

Degree Requirements

A minimum of 45 credits (15 courses) is required, distributed as follows: introductory seminars AmSt 8201 and 8202 (6 credits); practicum in American studies 8401; dissertation seminar 8801; three one-semester courses from the American studies special seminars or from other units approved by the director of graduate studies (9 credits); one comparative culture course (3 credits); and 7 adviser-approved field of concentration courses, including 6 credits of cultural pluralism courses; 24 thesis credits are also required.

Language Requirements—Reading knowledge of one foreign language is required.

Minor Requirements for Students

Majoring in Other Fields—Minor or supporting field requirements: students must complete at least 12 credits of courses consistent with or complementary to their major, including four courses in American studies, one of which must be AmSt 8201 or 8202.

Anatomy

Freestanding Minor

Note: This semester-based program is under review and has not yet been approved. Although approval is expected in 1999, please note that approved program information may differ from that which appears here. Contact the program director of graduate studies for information on the status of the semester-based program.

This freestanding minor, which is available for M.S. programs only, involves courses in several aspects of morphological studies, including gross anatomy, histology, neuroanatomy, developmental neurobiology, and cell biology. Please refer to Cell Biology and Neuroanatomy (CBN) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The minor requires 12 credits, including two of the four introductory courses in anatomy (CBN 6105—Human Gross Anatomy and Embryology, CBN 6103—Human Histology, CBN 6111/NSc 5111—Human Neuroscience, and CBN 6104—Biochemistry, Molecular and Cellular Biology) and at least 4 credits of advanced courses.

Ancient and Medieval Art and Archaeology

M.A.—Plan A and Plan B

The art and archaeology degree includes a variety of programs ranging broadly over ancient and medieval periods. While these programs concentrate on both art historical and archaeological approaches, they have flexible emphases in languages and textual studies. Students take a common core of courses. Please refer to Akkadian (Akka), Ancient Near Eastern (ANE), Aramaic (Arm), Classics (Clas), Greek (Grk), Hebrew (Hebr), Latin (Lat), and Sumerian (Sum) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

This program includes not only core courses and seminars in the Department of Classical and Near Eastern Studies, but also work in related fields in this and other departments. It is offered in cooperation with the Department of Art History, Interdisciplinary Archaeological Studies, and the Center for Medieval Studies. The total minimum credit requirement for Plan A is 38 credits (including 10 thesis credits), and for Plan B, 32 credits (including directed study registrations for the Plan B papers).

Language Requirements—For the M.A. degree, reading knowledge of one modern foreign language appropriate to the student’s program is required (normally German or French).

Final Exam—The final exams are written and oral.

Minor Requirements for Students

Majoring in Other Fields—Students must complete Class 5794, as well as 9 credits in graduate art/archaeology courses with a Class designator.

Ph.D.

The art and archaeology degree includes a variety of programs ranging broadly over ancient and medieval periods, with flexible emphases in languages and textual studies. Students take a common core of courses. At the Ph.D. level, the four foci are art and archaeology, an ancient textual component, a complementary area (e.g., history, geology, anthropology), and a special (elective) topic.
Degree Programs

Please refer to Akkadian (Akka), Ancient Near Eastern (ANE), Aramaic (Arm), Classics (Clas), Greek (Grk), Hebrew (Hebr), Latin (Lat), and Sumerian (Sum) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
This program includes not only core courses and seminars in the Department of Classical and Near Eastern Studies, but also work in related fields in this or other departments. It is offered in cooperation with the Department of Art History, Interdisciplinary Archaeological Studies, and the Center for Medieval Studies. An extensive supporting program in either art history or classical studies is required. Students who continue from the M.A. program may apply those credits toward the degree, and students entering with an M.A. can usually receive credit for some earlier coursework, subject to director of graduate studies approval and graduate school requirements. A typical Ph.D. program is 71 credits, including at least 21 credits in the major, 12 in the supporting program, and 24 thesis credits.

Language Requirements—The language requirement includes reading proficiency in German and in a second modern research language as appropriate (usually French), and research knowledge of an ancient language as demonstrated by satisfactory performance in a graduate-level reading course.

Minor Requirements for Students Majoring in Other Fields—Students must complete Clas 5794, as well as 12 credits in graduate art/archaeology courses with a Clas designator.

Animal Sciences
Students emphasize one of the animal sciences subdisciplines, such as genetics, growth biology, nutrition, physiology, or production systems. Students have the option of taking a management component in conjunction with the subdiscipline. Technical training involves both animals and laboratory experience.

M.S.—Plan A and Plan B
Degree Requirements
The M.S., which is offered under Plan A and Plan B, requires 30 credits, including 14 course credits in the major and 6 credits in one or more related fields outside the major. Plan A also requires 10 thesis credits, and Plan B requires 10 additional course credits selected by the adviser and student.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—Requirements are designed to fit the student’s needs. A master’s minor requires 8 credits in areas not closely related to the major; no more than 2 of these credits may be in research or special problems.

Ph.D.
Degree Requirements
Even though no minimum number of credits for the major is specified, students must complete basic courses in the selected subdiscipline, 12 credits in a minor or supporting program, and 24 thesis credits.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—Requirements are designed to fit the student’s needs. A doctoral minor requires 12 credits in areas not closely related to the major; no more than 3 of these credits may be in research or special problems.

Anthropology
The Department of Anthropology offers graduate education in sociocultural anthropology and anthropological archaeology. Major areas of faculty research and graduate student training in sociocultural anthropology include the politics and poetics of "tradition" and memory; gender and feminist anthropology; language and rhetorical practices; the cultural construction of economy; the politics of anthropological knowledge; colonialism and nationalism; transglobal processes; culture and consumption; and psychological anthropology. Regional specialization includes Melanesia, India, Europe, Latin America, and North America.

The program in anthropological archaeology offers perspectives on the nature of archaeological knowledge, paleoecology and evolutionary theory, and the use of sociocultural theories and interpretive strategies in the reconstruction of historic and prehistoric pasts. Regional specialization includes Africa, Europe, the Near East, and North America.

M.A.—Plan A and Plan B
Degree Requirements
Graduate students pursuing the M.A. degree must take a sequence of three seminars (3 credits each) during their first year in residence: during fall and spring semesters, all students take the seminars Anth 8001 and Anth 8002; during spring semester, students also take a specialized seminar—Anth 8004 for archaeology students or Anth 8003 for sociocultural anthropology students. Ph.D. students must also take Anth 8217. Ph.D. students must take a minimum of 18 course credits in anthropology (including the 12 for the courses listed above) and 12 credits in a minor or supporting program. The distribution of these courses is determined with the adviser and the director of graduate studies. All graduate students are also required to demonstrate proficiency in statistics.

Language Requirements—Ph.D. students must demonstrate a basic reading knowledge of one language other than English for which there is an anthropological literature or a long-standing literate tradition (e.g., Chinese, Hindi). The adviser and other members of a student’s advisory committee can require additional language training when circumstances warrant.

Minor Requirements for Students Majoring in Other Fields—The minor program in anthropology is individually designed by the student and the director of graduate studies. A minimum of 12 credits in anthropology (5xxx or 8xxx courses) must be completed for the minor.

Applied Plant Sciences
Applied plant sciences is an interdisciplinary program for educating students to become professional scientists well grounded in the applied disciplines of agronomy/agroecology, horticulture, and plant breeding. Graduates of the program are able to provide innovative leadership and contribute to problem solving in their discipline in the public or private sector and within society at large. The program develops the quantitative and qualitative research skills necessary to conduct high quality research and scholarship. Students gain a broad familiarity with all the disciplines within the program and gain in-depth knowledge within their area of expertise. The program’s graduate
Arabic

M.A.—Plan B

Note: No new students are currently being accepted to this program. Contact the Graduate School for information on the status of the semester-based program.

The program focuses on the Arabic language and the literature and culture of the Arabic-speaking world.

Degree Requirements

The M.A. is offered under Plan B only. The minimum requirement is 33 credits, including 27 course credits and 6 credits for the Plan B research paper. The coursework must include 15 credits in Arabic literature or culture, including Afro 5001 (3 credits) and one 8xxx seminar (3 credits). Students also take 6 credits (2 courses) in related fields outside Arabic, depending on the student’s academic goals and subject to the approval of the director of graduate studies.

Language Requirements—Students must complete Afro 5102 (Advanced Arabic) or its equivalent, and must demonstrate reading knowledge of a classical or modern language appropriate to the field.

Final Exam—The final exam is oral.

Minor Requirements for Students

Majoring in Other Fields—A minimum of 12 semester credits for a master’s minor is required. Students must possess an acceptable knowledge of Arabic, but may not apply language-specific courses toward the minor. A program of study must be arranged with the director of graduate studies of Arabic. No written exam is required for the minor.

Architecture

M.Arch.—Plan B

Architecture encompasses the making and study of the buildings and environment that we inhabit. The concerns of architecture involve a wide variety of areas of study, including the art of representing built projects through drawings and computer graphics; the technology of building structure, building materials, and natural and mechanical systems; the history, theory, and art of making, using, and understanding buildings as cultural artifacts for human use; and the practice of architecture in the context of urban form and business economics.

The M.Arch. program introduces students to the practice and discipline of architecture as a speculative, analytic, and investigative endeavor. It prepares students to enter architecture as both a profession and a field of knowledge. The program is organized around the design studio, incorporating coursework in the diverse areas of architectural knowledge: representation, technology, history, theory, urban design, and architectural practice.

The professional M.Arch. degree (M.Arch.) is for those who have an undergraduate degree and seek to become licensed architects. A second, postprofessional M.Arch. degree (M.Arch.II) is also offered. It is for students with a professional degree such as the bachelor of architecture (B.Arch.) or a professional master of architecture. This program allows students to plan a curriculum, with faculty consultation, around their special interests.

Degree Requirements

The professional M.Arch.I curriculum accredited by the National Architectural Accreditation Board (NAAB) consists of a minimum of 93 credits, including the thesis. The first-year integrated curriculum is followed by two years of less structured coursework culminating in the thesis.

Students are required to take intermediate and advanced courses in computer methods in architecture.

Because admitted students will have a broad educational background and have completed fundamental courses, the program focuses on professional and disciplinary coursework, including required and elective lecture, seminar, and design studio courses.

Postprofessional M.Arch.II students take a minimum of 30 credits in an individually developed program, requiring a minimum of 3 semesters.

Language Requirements—None.

Final Exam—Oral and visual presentation of the thesis is required.

Art

M.F.A.

The master of fine arts program places major emphasis on creative visual work of high quality. It promotes not only the conceptual and technical education of the professional artist in the context of the studio environment, encouraging critical inquiry, excellence, an understanding of the history of art, but also an experimental approach toward each media. The following areas of concentration are available: ceramics, drawing and painting, electronic art, photography, printmaking, and sculpture. The M.F.A. is considered the terminal degree in the field of fine arts and is typically the degree required to teach at the college or university level.

Degree Requirements

The M.F.A. degree program in art requires 60 credits total. As such, it is typically a three-year program, and studio space is provided for a maximum of three years for the pursuit of appropriate visual research. The program requires that 42 credits of coursework be completed prior to the final year of thesis registration for 18 credits. Candidates must plan programs with their advisers to include two semesters of the graduate seminar ArtS 8400 (once in each of the first two years of
the program) and 27 credits of visual art coursework. The related field requirement of 9 credits includes three courses in the history of art (or two courses in the history of art and one related academic course). Candidates must be reviewed annually prior to the thesis registration and must pass a written and oral exam in order to continue in the thesis year. At the end of the thesis year, candidates demonstrate their visual research accomplishments through a solo thesis exhibition on campus, a supporting paper, and a final oral exam.

Language Requirements—None.

Final Exam—A thesis exhibition of visual work, written supporting paper, and final oral exam are required.

Minor Requirements for Students
Majoring in Other Fields—A minor in art may be obtained by candidates in a master’s program by completing 9 credits of graduate-level coursework chosen in consultation with the director of graduate studies in art. Candidates in a Ph.D. program must complete 12 credits. The minor must include ArtS 8400—Theoretical Constructions in Contemporary Art.

Art Education

M.A.—Plan B
By focusing on the curricular and instructional processes central to all educational endeavors, graduate programs within the Department of Curriculum and Instruction prepare students for professional roles in pre-K–12 education, in postsecondary and research settings, and in educational service agencies.

The M.A. (Plan B only) in art education focuses on the application of research to practice in art education. Professionals in K-12 art education and other art-related fields, work with advisers to construct a program of studies directed toward a specific professional research interest. Elective coursework can focus on studio arts, art history, and aesthetics, as well as on issues related to curriculum and instruction.

Please refer to Curriculum and Instruction (CI) and Education (Edu) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
The M.A. program requires a minimum of 30 credits: 14 credits in the major, 6 credits from a related field chosen with the consent of the adviser, and 10 elective credits. A Plan B course project is also required.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students
Majoring in Other Fields—Students choosing a minor in art education elect courses appropriate to their research interest in consultation with program faculty. The minor requires a minimum of 6 credits. Coursework is determined on the basis of prior experiences, research competencies, interests, and the professional focus of each student.

Art History
The program in art history offers an emphasis in the history and theory of artistic and cultural developments throughout much of the world.

M.A.—Plan B
Areas of specialization for the M.A. include the following (all areas with an asterisk also pertain to the Ph.D.): *American art, architecture, and popular culture; Baroque art; *East Asian art and Bronze Age archaeology; *Greek and Roman art and archaeology; *Islamic art and architecture; Late Gothic and northern Renaissance art; *modern art, which includes film and photographic studies and nineteenth- and twentieth-century art; *South Asian art and architecture.

Degree Requirements
A minimum of 36 course credits (about twelve courses) is required, including at least two 8xxx seminars in art history. A minimum of 21 course credits must be art historical in content and drawn from courses in at least three of the following areas: American, ancient, medieval, Baroque, modern, East Asian, South Asian, Islamic. Of these, four courses must be in an area of primary concentration, two courses in an area of secondary concentration, and one course in a third area. Students focusing on western art must take at least one course in Asian-Islamic art, while students focusing on Asian-Islamic art must take at least one course in western art. In addition, students must take 6 credits in courses that are not art historical in content. The remaining 9 credits may be either in art history or outside the discipline; this is decided in consultation with the adviser and the director of graduate studies. Two Plan B papers are required, the first of which should be completed by the end of the first year of full-time study.

Language Requirements—For the M.A. degree, students must attain reading proficiency in at least two foreign languages. Students should contact the director of graduate studies for details.

Minor Requirements for Students
Majoring in Other Fields—A doctoral minor requires a minimum of 12 credits in art history.

Astrophysics
Astrophysics is the study of the universe and its constituent parts. The program offers emphases in observational, theoretical, and computational astrophysics and in instrument development. The main research areas include properties and dynamics of normal and active galaxies, quasars, stellar evolution, interaction of stars with their environments, the interstellar medium, astrophysical magnetohydrodynamics, and galactic and cosmological structure.

Observational research includes X-ray, ultraviolet, optical, infrared, and radio astronomy. Extensive research programs in space physics and the elementary particle-cosmology interface are also carried out in interdisciplinary connections with the graduate program in physics. Please refer to Astronomy (Ast) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B
Degree Requirements
The master’s degree requires a minimum of 30 credits, including one semester of classical physics (Phys 5011) and one year of the two-year-long sequences in introductory
astrophysics (Ast 4011-4021 or Ast 5012-5022). Additional requirements depend on whether the student chooses the thesis (Plan A) or non-thesis (Plan B) option. Plan A emphasizes preparation of a thesis and Plan B emphasizes coursework. Plan A requires 20 semester credits of coursework and 10 thesis credits. Plan B requires 30 semester credits of coursework. Completion of the degree normally takes two years.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—For the master’s minor, 8 credits in astrophysics are required, either the Ast 4011-4021 or Ast 5012-5022 sequence.

Ph.D.

Degree Requirements
The Ph.D. degree requires a minimum of 40 course credits, including a year of classical physics (Phys 5011-5012), the two year-long sequences in introductory astrophysics (Ast 4011-4021 and Ast 5012-5022), and 12 credits in a minor or supporting program; 24 thesis credits are also required. The graduate written exam, offered during the spring, must be passed on the second “real” attempt (first-year students are given a free trial). A second-year project must be defended by the end of the fall of the third year. The preliminary oral exam must be passed by the end of the third year.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—For the Ph.D. minor, 12 credits in astrophysics are required, including either the Ast 4011-4021 or the Ast 5012-5022 sequence.

Biochemistry, Molecular Biology and Biophysics

The biochemistry, molecular biology and biophysics program focuses on an explanation at the molecular level of the structures and processes that occur in living organisms. In the broadest sense, the program encompasses the chemistry, physics, and biology of living systems. Included is the study of the structure and function of biomolecules (proteins, nucleic acids, lipids, and carbohydrates), enzyme catalysis, metabolic pathways, bioenergetics, and the biochemical nature of genetic information storage and transmission, as well as the control, regulation, and integration of these processes. The program has three areas of emphasis: enzymology and regulatory biochemistry, molecular biology, and molecular biophysics. All students are expected to demonstrate a minimum level of competence in all three areas but emphasize that area most related to their thesis project. The program involves faculty from the Department of Biochemistry in the College of Biological Sciences and the Department of Biochemistry in the Medical School, as well as many faculty from several other departments in the College of Biological Sciences, Medical School, Institute of Technology, and College of Veterinary Medicine.

Please refer to Biochemistry (BioC) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A

Degree Requirements
Requirements for the M.S. degree include core coursework and laboratory experiences taken by all students, followed by one or more courses in one of the areas of specialization. In addition all students are expected to participate in the seminar involving student reports on current literature and research. A thesis based on original laboratory research is required.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—Students electing an M.S. minor in biochemistry, molecular biology and biophysics are required to complete 6 credits of general graduate-level coursework which may be selected (with approval by the director of graduate studies) from the 5xxx and 8xxx courses offered by the program. BioC 4331 and BioC 4332 may also be considered if approved by the directors of graduate studies of both the major and minor programs.

Ph.D.

Degree Requirements
Requirements for the doctoral degree include core coursework and laboratory experiences taken by all students, followed by one or more courses in one of the areas of specialization. In addition all students are expected to participate in two continuing series of seminars; one involving student reports on current literature and research and the other involving prominent national and international scientists.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—Students electing a minor in biochemistry, molecular biology and biophysics are required to complete BioC 8001 (5 credits), 8002 (5 credits), plus an additional course(s) (2-4 credits) to meet the minimum requirement of 12 total credits. In extenuating cases, students may petition the director of graduate studies for substitution of one or both of the required courses.

Bioethics

Freestanding Minor
The Center for Bioethics, in close cooperation with the Department of Philosophy, offers a minor in bioethics for master’s (M.A. and M.S.) and doctoral students with approval of the director of graduate studies in bioethics. The minor provides a structured program of study as well as formal recognition for academic accomplishments in the field.

While recognizing that philosophy is the focal discipline for the study of bioethics, the minor offers numerous opportunities for multidisciplinary study, including in history and philosophy of medicine, health law and public policy, health-care economics, professional ethics, clinical ethics, medical humanities, and moral development.

Please contact the minor program office for information on relevant coursework.

Degree Requirements
Requirements for Students Majoring in Philosophy—Doctoral students must complete a minimum of 14 graduate credits in bioethics: 8 credits of required courses and 6 credits of electives outside the Department of Philosophy.

Master’s students (M.A. and M.S.) must complete a minimum of 8 graduate credits in bioethics: 6 credits of required courses and 2 credits of electives outside the Department of Philosophy.

Requirements for Students Majoring in a Field Other Than Philosophy—Doctoral students must complete a minimum of 14 graduate credits in bioethics outside the student’s major: 8 credits of required courses and 6 credits of electives.

Master’s students (M.A. and M.S.) must complete a minimum of 8 graduate credits in bioethics outside the student’s major. Master’s students are not required to take electives in bioethics and cognate areas, but are encouraged to do so.

Biological Science

M.B.S.—Coursework Only
A professional master of biological science (M.B.S.) degree is offered with concentrations in areas such as biochemistry, basic biology (animal, plant, cell, applied, and general), biotechnology, physics, ecology, environment, evolution, food science and nutrition, genetics, microbiology, molecular biology, and neuroscience. It is a multicollege, cooperative degree program among the Colleges of Biological Sciences, Veterinary Medicine, and Agricultural, Food, and Environmental Sciences. The program is administered by the College of Biological Sciences and the M.B.S. degree is conferred by the Graduate School.
Biomedical Engineering

Biomedical engineering is the application of engineering methods to problems in biology and medicine. The discipline includes the study of fundamental processes in biology, the study of the diagnosis and treatment of disease and injury in medicine, and the design and development of medical devices and techniques. The program grants M.S. and Ph.D. degrees. Students take courses in mathematics, biology, biomedical engineering, and engineering emphasis areas.

The engineering emphasis areas include biomaterials, musculoskeletal biomechanics, cell/matrix science and tissue engineering, microdevices and instruments, biomedical instrumentation, medical information systems, medical devices, and biomedical heat and mass transfer.

M.S.—Plan A and Plan B

Degree Requirements
The M.S. is offered under two plans: Plan A (with a thesis) and Plan B (with a project). Each program requires courses in mathematics, biology, biomedical engineering, an engineering emphasis area and a minor or related field.

Language Requirements—None.
Final Exam—The final exam is oral.
Minor Requirements for Students Majoring in Other Fields—A minor for students majoring in other fields consists of 6-8 course credits for the M.S. Two courses must be BMEn core courses, with the remainder from an emphasis area.

Ph.D.

Degree Requirements
The Ph.D. program requires coursework, a written preliminary exam, an oral preliminary exam, a dissertation, and a final oral exam. A supporting program or minor field is also required.

Language Requirements—None.
Minor Requirements for Students Majoring in Other Fields—A minor for students majoring in other fields consists of 12 course credits for the Ph.D. Two courses must be BMEn core courses, with the remainder from an emphasis area.

Biomedical Science

Ph.D.

The interdisciplinary biomedical science graduate program enables M.D./Ph.D. students to custom design their Ph.D. program. The goal is to train scientists who will be at the interface of research in several disciplines and to provide an alternative when a traditional graduate program will not satisfy the student’s needs or intentions. Despite the interdisciplinary quality of biomedical science, each student’s program will contain a coherent and cohesive core of individualized course material.

Degree Requirements
Please read the general information section of this catalog for Graduate School requirements that apply to all major fields.

Language Requirements—None.

Biophysical Sciences and Medical Physics

The graduate program in biophysical sciences and medical physics is interdisciplinary, with faculty members having primary appointments in fields such as radiobiology, physics, engineering, computer science, physiology, dentistry, genetics, and biochemistry. Students

Degree Programs

The M.B.S. is a highly flexible graduate-level practitioner-based program offered to meet the needs of a substantial portion of the working community who wish to increase their knowledge in areas related to modern biology. The program provides educational opportunities beyond those that aim at maintaining and improving productivity within the professions. It fills a gap in the present educational system for those who have neither the time nor the flexibility to earn a graduate degree through more traditional channels. It also provides this population with the most current information and advanced skills in their areas of professional interest, and gives them acknowledgment for their achievement. The degree enables recipients to learn new job skills, change professional emphasis, or provide added value to their present job. Please contact the program office for information on relevant coursework.

Degree Requirements
The program includes coursework, seminars, independent study, workshops, and a capstone project. With guidance from faculty advisers, students complete 30 semester credits. M.B.S. candidates may transfer up to 8 semester credits into the program. Core credits may be waived or substituted if the student can show proficiency in the subject area, pending advisory committee approval. If a core credit is waived, the credits must still be earned in an elective course. Coursework will be taken from the regular curriculum in the participating colleges, as well as from other approved credit-bearing courses (e.g., intensive short courses and Internet courses). The overall GPA of a candidate must be a minimum of 3.00 for the degree to be awarded. A student with 8 or more credits of incomplete (I) will not be allowed to register for additional courses until the I’s are completed.

Language Requirements—None.
Final Exam—A capstone project is required.

Biophysical Sciences

Language Requirements—None.
Minor Requirements for Students Majoring in Other Fields—Programs are arranged on an individual basis and must consist of courses that represent a subfield of the discipline, e.g., radiobiology or medical physics. At least 6 credits of BPhy courses are required.

Ph.D.

Degree Requirements
Ph.D. students take preliminary written exams at the end of the first year of study or as soon as possible after completing the core course sequence in topics in physics for medicine and biology. An oral preliminary exam focuses on the plan for thesis research and the student’s grasp of related information and is taken by the fall of the third year of full-time registration or its equivalent. At least 12 credits are required in a minor or supporting program. Additionally, 24 thesis credits are required.

Language Requirements—None.
Minor Requirements for Students Majoring in Other Fields—Programs are arranged on an individual basis and must consist of courses that represent a subfield of the discipline, e.g., radiobiology or medical physics.
Biostatistics

Biostatistics combines statistics, computing, and biomedical science to further human health research. Biostatisticians design, direct, and analyze clinical trials; plan and carry out health surveys; develop new statistical methods; and analyze data from observational studies, laboratory experiments, follow-up studies, and surveys. The biostatistics program educates practitioners and biostatistical scientists in the application of statistical methods to public health and biomedical science.

Students take courses in biostatistics, biostatistical inference, theory of statistics, clinical trials, statistical computing, analysis of categorical data, survival analysis, and health sciences.

Please refer to Public Health (PubH), particularly numbers 54xx and 84xx, in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B

Degree Requirements

The M.S. degree requires a minimum of 32 credits and a special Plan B project. Credits are distributed as follows: 18 credits of biostatistics, 8 credits of statistics (for the supporting program), and 6 credits in elective health sciences courses.

Although virtually all students complete the M.S. Plan B, an M.S. Plan A option is available. The Plan A program is research oriented and is selected only by students with unusually strong backgrounds. Student select at least 20 credits, with at least 14 in biostatistics courses and 6 in a minor area or coordinated/related field; 10 thesis credits are also required.

Language Requirements—None.

Final Exam—The final exams are written and oral.

Minor Requirements for Students Majoring in Other Fields—The minor program for M.S. students majoring in statistics consists of at least 6 credits selected from the following: PubH 5421—Statistical Computing II (2 cr), PubH 5462—Clinical Trials (3 cr), PubH 5466—Biostatistical Inference II (4 cr), PubH 8420—Survival Analysis (3 cr), PubH 8421—Analysis of Categorical Data (2 cr), PubH 8422—Modern Non-Parametrics (2 cr).

The master’s minor program for nonstatistics majors consists of PubH 5450—Biostatistics I (3 cr), PubH 5452—Biostatistics II (4 cr), and PubH 5421—Statistical Computing II (2 cr) or PubH 5462—Clinical Trials (3 cr).

Minor for Ph.D. students in programs other than statistics consists of PubH 5450—Biostatistics I (3 cr) and PubH 5452—Biostatistics II (4 cr), plus 6 credits selected from the following: PubH 5421—Statistical Computing II (2 cr), PubH 5462—Clinical Trials (3 cr), PubH 8420—Survival Analysis (3 cr), PubH 8421—Analysis of Categorical Data (2 cr), PubH 8422—Modern Non-Parametrics (2 cr).

Biosystems and Agricultural Engineering

M.B.A.E.—Design Project

The master of biosystems and agricultural engineering (M.B.A.E.) degree is for students with a bachelor’s degree in a related engineering field who wish to concentrate on 1) design of efficient, economical processes to improve the quality and safety of food products for consumers; 2) protection and enhancement of the environment through design of sustainable practices to maintain and improve soil, water, and air quality; 3) design of efficient, profitable food production systems that protect the environment, humans, plants, and animals; or 4) design of safe, efficient machines and processes for biological systems.

The M.B.A.E. degree follows the design project track and is considered a terminal degree.

Please refer to Biosystems and Agricultural Engineering (BAE) and Agricultural Engineering Technology (AgET) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

For the M.B.A.E. degree, students are required to complete a minimum of 14 course credits in the major field, 6 course credits in a related field or a minor, and a design project of a minimum of 10 credits. The coursework program must be approved by the biosystems and agricultural engineering graduate program committee. The design project is expected to be of professional caliber.

Language Requirements—None.

Final Exam—Students must present a seminar and pass a final oral exam focused on their design project. Students must also meet all Graduate School requirements regarding the final exam.

Minor Requirements for Students Majoring in Other Fields—A minor consists of at least 6 credits of BAE courses at the 4xxx level or higher.

M.S.B.A.E.—Plan A and Plan B

Graduate education in biosystems and agricultural engineering develops a strong foundation in engineering principles which are applied to important problems involving biological and agricultural systems. The master of science in biosystems and agricultural engineering (M.S.B.A.E.) degree is for students with a bachelor’s degree in a biological, biosystems, agricultural, or related engineering field. Emphases include bioprocessing, food engineering, water quality, surface and subsurface flow, contaminant transport, animal environment and air quality, waste and manure management, resource utilization, terramechanics, safety, and grain quality. Programs usually include study in at least one other engineering discipline as well as study or research in a biological or agricultural discipline.

Please refer to Biosystems and Agricultural Engineering (BAE) and Agricultural Engineering Technology (AgET) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The M.S.B.A.E. may be completed as either a Plan A (thesis) or Plan B (project). Plan A students must complete a minimum of 14 course credits in the major field, 6 course credits in a related field or a minor, and 10 thesis credits. Plan B students must complete a minimum of 14 course credits in the major field, 6 course credits in a related field or a minor, 10 other credits, and at least one Plan B project. All coursework programs must be
Degree Programs

approved by the biosystems and agricultural engineering graduate program committee.

Language Requirements—None.

Final Exam—Students must present a seminar and pass a final oral exam. Students must also meet all Graduate School requirements regarding the final exam.

Minor Requirements for Students Majoring in Other Fields—A minor consists of at least 6 credits of BAE courses at the 4xxx level or higher.

Business Administration

Ph.D.
The Ph.D. program in business administration offers full-time advanced graduate education for students seeking academic placement at leading universities or research-oriented positions in business or government. The program is for individuals who have the intellectual capacity for advanced study, enjoy independent research and analytical thinking, and who wish to master a discipline within business administration.

Students choose to concentrate in one of six areas of specialization: accounting; finance; information and decision sciences (including the management information systems and decision science subfields); marketing and logistics management; operations and management science; and strategic management and organization (covering the subfields of strategy, organization behavior, and business-government-society, which includes an international business focus).

Applicants must have completed an undergraduate degree, in any field, and have successfully completed college courses in microeconomics and finite mathematics or calculus. Scores from the GMAT or GRE test taken no more than five years prior to admission must be submitted.

Please refer to Accounting (Acct); Business Administration (BA); Business, Government, and Society (BGS); Business Law (BLaw); Finance (Fina); Information and Decision Sciences (IDSc); Insurance (Ins); Logistics Management (LM); Management (Mgmt); Marketing (Mktg); and Operations and Management Science (OMS) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

For the Ph.D. degree students are required to complete a minimum of 12 credits in a supporting program or minor and 24 thesis credits. The program also requires a minimum of 10 credits in mathematics, statistics, or numerical analysis, including at least one course in mathematics, and 2 credits of enrichment. The coursework program must be approved by the biosystems and agricultural engineering graduate program committee.

Language Requirements—In lieu of a language requirement for the Ph.D., the program requires completion of a 2-credit enrichment program.

Minor Requirements for Students Majoring in Other Fields—A minor consists of at least 12 credits of BAE courses at the 4xxx level or higher.

Finance: Students must take all three finance classes (Fina 8801, 8811, 8821), for 12 credits, plus the microeconomics sequence (Econ 8101, 8102, 8103, 8104) for 8 credits. The 8-credit macroeconomics and applied econometrics sequences and also highly recommended. Students should take a minimum of 8 additional elective credits in economics, statistics, accounting, etc.

Information and Decision Sciences: This department requires students to take 12 courses over a two-year period (approximately 40 credits total). These must include IDSc 8511 and 8521, and two experimental design and regression analysis courses (OMS 8651 and 8652 recommended). An additional eight courses can be taken as electives and supporting program courses, with at least two of these being methodology courses.

Marketing and Logistics Management: The department requires students to take its five seminars (total 20 credits) plus a minimum of 12 credits of research methodology courses outside the department. Minor or supporting program coursework is determined by the student and adviser, but must total at least 16 credits.

Operations and Management Science: This department requires its students to take a minimum of ten courses (approximately 40 credits), including eight OMS Ph.D. courses, Mgmt 8101, and one graduate-level course in linear programming (either OMS 8661 or Math 5711). Students should supplement this with at least 16 credits from outside the department for a minor or supporting program.

Strategic Management and Organization: This department requires students to take at least five of its seven core Ph.D. courses (20 credits), which must include one course from each of its three areas (strategy, organization behavior, business-government-society), plus two in the student’s area of specialization. The student should take at least five additional classes outside the department (approximately 20 credits).

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—For a Ph.D. minor in business administration, students must complete a cohesive program of at least 16 credits (at least 4 courses) of graduate work in one of the six areas of concentration. This program of study is developed in consultation with an adviser who is a full member of the graduate faculty in business administration.
Business Taxation

M.B.T.—Plan B
This program helps students acquire a conceptual understanding of taxation and develop technical competence in the practical application of the rules of taxation in business and personal decision making. Offered only in the evenings, the program accommodates both part-time and full-time students. Historically, more than 80 percent of students are employed in the business community and take courses on a part-time basis. Graduates of the program possess a common body of knowledge in traditional business areas such as accounting, finance, and marketing. In addition, courses in business, government, and economic tax policy provide breadth to complement the technical tax courses which make up the majority of credits.

Please refer to Accounting (Acct); Business, Government, and Society (BGS); Business Law (BLaw); Finance (Fina); Information and Decision Sciences (IDSc); Insurance (Ins); Logistics Management (LM); Management (Mgmt); Marketing (Mkrg); Master of Business Taxation (MBT); and Operations and Management Science (OMS) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
The M.B.T. requires 30 credits, including 6 credits in specified courses dealing with business and economic tax policy, 10 credits in specified tax courses, 14 credits of elective tax courses. All students must complete coursework in finance, marketing, accounting, economics, statistics, management, business law, operations management, information and decision sciences, and strategic management. It is expected that students with business degrees will have few, if any, deficiencies in these areas. Students with deficiencies must make them up before being awarded the degree and will have few, if any, deficiencies in these areas. Students with deficiencies must make them up before being awarded the degree and defend a thesis. Under special circumstances an M.S. degree (Plan A or Plan B) can be pursued on the Twin Cities campus. A prelim exam is oral. A preliminary oral exam is given that consists of courses from two or more disciplines relevant to the student’s doctoral research. A written exam in physiology and neuroscience is taken before the preliminary oral exam. A preliminary oral exam is given to test the student’s ability to apply principles of both physiology and the minor or supporting program to specific research questions. The final oral exam consists of defense of the candidate’s thesis.

Cellular and Integrative Physiology

M.S.—Plan A and Plan B
A master’s degree in cellular and integrative physiology is offered through the Department of Medical and Molecular Physiology at the University of Minnesota, Duluth School of Medicine. The M.S. can also be pursued in cooperation with the Department of Physiology (Medical School) on the Twin Cities campus.

On the Duluth campus, students can enroll in coursework and participate in research in several basic areas. Students may pursue studies in muscle, cardiovascular, respiratory, and endocrine physiology, as well as in membrane transport, temperature regulation, and several areas of neuroscience. Please refer to Physiology (Phsl) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
All course requirements for the M.S. degree can be completed on the Duluth campus. Students are expected to fulfill all degree requirements over a period of two calendar years. On the Duluth campus, students must complete at least 36 course credits in physiology and 9 course credits in a minor or related field. Students must also present and defend a thesis. Under special circumstances an M.S. degree (Plan A or Plan B) can be pursued on the Twin Cities campus. Students generally are not admitted into this option unless they can demonstrate unusual need (required for career advancement, geographically restricted to the Twin Cities, etc.). The Plan B master’s is primarily for Ph.D. students who, after about two years in the Ph.D. program, cannot or do not wish to complete the Ph.D. program.

Language Requirements—None.
Final Exam—For Plan A, the final exams are written and oral. For Plan B, the final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A minimum of 6 credits in cellular and integrative physiology is required.

Ph.D.
Physiology may be defined as the application of mathematics, physics, and chemistry to the study of structure and function in living systems. As such, physiology is a “hybrid” field in which expertise from many other disciplines is ordinarily required and combined. Typical degree objectives therefore include a rather wide diversity of knowledge. Entering students generally bring strength and enthusiasm from one or more of the hard sciences listed above.

The program emphasizes a quantitative approach to understanding the functions of cells, organs, and systems in living animals. Ph.D. students take a core concentration that provides a broad background in the physiology of membranes, cells, transport, and organ systems. Two core courses are taken with the first-year medical students. Beyond the core courses, individualized programs are structured to build on the student’s strengths and to fill in gaps that would otherwise be an impediment to specific problem solving. Supporting work is usually done in areas such as molecular biology, mathematics, computer science, chemistry, biochemistry, physics, and anatomy. The program also emphasizes ways of thinking that will foster a career-long devotion to individualized learning, in part through literature seminars, journal clubs, and a seminar program focusing on library and laboratory skills. Teaching experience is also available to all students.

Areas of specialization include the neurosciences, membrane and transport processes, cell physiology, and cardiovascular, respiratory, and to a limited extent, exercise and gastrointestinal physiology, and endocrinology. Entering students are expected to take a series of laboratory rotations to familiarize themselves with areas of research active within the degree program. The program offers faculty and corresponding research laboratories from the entire Department of Physiology and from other departments (or divisions), including medicine, psychology, surgery, neurosurgery, veterinary biology, neurology, anesthesia, kinesiology, and animal science. Students enter the Ph.D. program only from the Twin Cities campus, while they enter the master’s program only from the Duluth campus, although a master’s degree is possible from the Twin Cities campus under special circumstances.

Please refer to Physiology (Phsl) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
The Ph.D. program requires courses in medical physiology and human neuroscience. During the first year, students rotate through three laboratories, pick an adviser, and begin a research project. No other courses are required, although graduate-level courses in cellular and molecular biology are strongly encouraged. Students may select a minor in a related field such as biochemistry, neuroscience, pharmacology, or psychology, or a supporting program in lieu of a minor that consists of courses from two or more disciplines relevant to the student’s doctoral research. A written exam in physiology and neuroscience is taken before the preliminary oral exam. A preliminary oral exam is given to test the student’s ability to apply principles of both physiology and the minor or supporting program to specific research questions. The final oral exam consists of defense of the candidate’s thesis.

Language Requirements—None.
Minor Requirements for Students Majoring in Other Fields—Ph.D. students minoring in cellular and integrative physiology are expected to take Phsl 6101.
**Chemical Engineering**

Emphases are available in colloids, interfaces, microelectronic materials, ceramics, polymers, molecular materials, nanostructures and nanocomposites, organic solid-state chemistry, catalysis, surface chemistry and physics, chemical kinetics, molecular theory of rate processes, thermodynamics, chemical reactor analysis, control optimization, fluid and interfacial mechanics, crystal growth, bioengineering, molecular interfaces, interface chemistry and physics, physical and chemical metallurgy, metal physics, electronic properties of materials, electronic structure theory, superconductivity, electrochemistry, corrosion, rheology, structure-property relationships, electron microscopy, scanning tunneling microscopy, and atomic force microscopy.

Please refer to Chemical Engineering (ChEn) and Materials Science (MatS) in the course section of this catalog for courses pertaining to this program.

**M.Ch.E.—Design Project**

This degree is for employees of local industries who wish to pursue their studies part-time. It is intended to provide a fifth year of professional work and is offered under the design project track. While much of the coursework may be in common for the various chemical engineering graduate degrees, the intent of the M.Ch.E. program is to provide more experience and training in engineering than in engineering science or science. No financial support is available from the program.

The M.Ch.E. is a terminal degree. Only under exceptional circumstances is a student allowed to transfer to an M.S. program.

**Degree Requirements**

The M.Ch.E. requires a minimum of 14 course credits in the major field and a minimum of 6 credits in the minor or related fields, plus 10 project credits. The work-related design project consists of an in-depth study of an engineering design. It need not represent a publishable research project. While the amount of work should be the same as for an M.S. thesis, the project can contain elements that the thesis would not, such as economic considerations, design consultation, and social relevance.

**Language Requirements**—None.

**Final Exam**—A final oral exam focused on the design project is required.

**Minor Requirements for Students Majoring in Other Fields**—Approval of the chemical engineering director of graduate studies is required for a master’s minor.

**M.S.Ch.E.—Plan A**

Many entering M.S.Ch.E. students change to the Ph.D. program before or after completing the M.S.Ch.E. degree. Application for a change of status is done in consultation with the adviser and the director of graduate studies.

**Degree Requirements**

The M.S.Ch.E. is offered only under Plan A (with thesis). It requires a minimum of 30 credits, including a minimum of 14 course credits in the major, a minimum of 6 credits in a minor or in one or more related fields, and 10 thesis credits. The program normally is completed in about one calendar year. Students interested in a degree without a thesis should consider the professional master’s in chemical engineering (M.Ch.E.) degree.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—Approval of the chemical engineering director of graduate studies is required for a master’s minor.

**Ph.D.**

The Ph.D. is primarily a research degree, and performance that leads to a research thesis is emphasized. Supporting coursework is planned in consultation with the adviser.

**Degree Requirements**

The Ph.D. requires at least seven courses (21 credits) within the major, at least 12 course credits in a minor or supporting program, and 24 thesis credits.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—Approval of the chemical engineering director of graduate studies is required for a doctoral minor.

**Chemical Physics**

Chemical physics focuses on areas where the techniques of chemistry and physics are brought together for the study of atoms and molecules; their interactions in gases, liquids, and solids; and the detailed structure and dynamics of material changes. Areas of research and specialization include spectroscopy, optical properties, laser applications, molecular collisions, chemical dynamics, quantum mechanics, computational chemistry, statistical mechanics, thermodynamics, low-temperature behavior, polymers and macromolecules, surface science, biochemistry, and biochemical and heterogeneous catalysis.

**M.S.—Plan A**

**Degree Requirements**

The M.S. degree is offered Plan A (with thesis) and requires at least 21 course credits and 10 or more thesis credits. The course credits must include at least 6 credits each in chemistry, physics, and quantum mechanics, and at least 3 credits in thermodynamics, statistical mechanics, or statistical physics. There is no minor or related field requirement.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Ph.D.**

**Degree Requirements**

A proficiency exam in physical chemistry is required. The Ph.D. program ordinarily consists of at least 24 course credits that include coursework in chemistry and/or physics with options for coursework in quantum mechanics, thermodynamics, statistical physics, and chemical dynamics. There is no minor or supporting program requirement. Students must also complete 24 thesis credits.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—Ph.D. minor requirements are determined by the director of graduate studies, the student, and the adviser.

**Chemistry**

Graduate work in chemistry is organized into six specialty areas: analytical, biological, inorganic, materials, organic, and physical chemistry.

**M.S.—Plan A and Plan B**

**Degree Requirements**

Four proficiency exams are required, each in analytical, inorganic, organic, and physical chemistry. Taken on entrance, the results of these exams are used for guidance. M.S. students are expected to pass the proficiency exam in their specialty area in their first academic year in residence. Plan A requires 20 course credits and 10 thesis credits; Plan B requires 30 course credits (and one or two Plan B papers).

One of the following courses may be allowed: Chem 4150 or Chem 4701.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—Six course credits from graduate-level chemistry courses are required for a master’s minor.
Ph.D.

Degree Requirements
The Ph.D. program requires 24 course credits and 24 thesis credits. Students are also required to take four proficiency exams, one each in analytical, inorganic, organic, and physical chemistry and are expected to satisfy the proficiency requirements for all four fields by the end of their first academic year in residence.

Language Requirements—None.

Minor Requirements for Students
Majoring in Other Fields—Ph.D. minor requirements are determined by the director of graduate studies, the student, and the adviser. Chem 4701 may be used.

Child Psychology

M.A.—Plan A and Plan B
The Institute of Child Development does not offer admission for a terminal master’s degree. On occasion, an M.A. degree (Plan A or B) is granted to students who are unable to complete the Ph.D. degree. Also, students who are in either the joint developmental psychopathology and clinical science training program or the joint developmental/school psychology training program may be granted a master’s degree (typically Plan B) during their progression toward the Ph.D.

Degree Requirements
M.A. requirements are met through either Plan A or Plan B. Both require a full academic year of coursework.
Plan A requires 14 course credits in child psychology and 6 credits in another department (traditional minor) or in one or more related fields. The thesis requirement may be satisfied through a first-year project, CPsy 8777 (10 credits).
Plan B requires 30 course credits, of which 14 credits must be in child psychology and 6 credits in one or more related fields.

Language Requirements—None.

Final Exam—The final exam for Plan A is oral; the final exam for Plan B is written. Plan B requires a project equivalent to 120 hours of work (may be satisfied by completing a first-year project).

Ph.D.

The Ph.D. in child psychology focuses primarily on training for research in normal human development, and most students take positions in academic or research settings; a cognate focus is developmental psychology. The goal of the program is to train all students for careers in research and college teaching in child psychology, and to prepare students in the joint program options for careers in applied areas of child psychology. General program students may choose to specialize in an area such as cognitive neuroscience, language, memory, perception, psychobiology, or social development.

Students interested in applied areas may specialize in developmental psychopathology and clinical science or school psychology. The developmental psychopathology and clinical science program is a cooperative effort between the Institute of Child Development and the Department of Psychology to train leaders in research and teaching. Training draws on the unique strengths of each program. Students are admitted to the Ph.D. program in child psychology through the Institute of Child Development, and to this joint training program by the agreement of program faculty in both departments.

The APA-approved school psychology program is a cooperative program of the Institute of Child Development, the Department of Psychology, and the Department of Educational Psychology. Students are admitted jointly to one of the cooperating departments and to the school psychology program. Students must meet the standards and requirements of both the admitting department and the school psychology program.

Degree Requirements
The Ph.D. degree usually requires four years of graduate work. Major program components include coursework, research activities, and teaching experience.
Coursework requirements are specialization specific, but all students are required to take 44 course credits in the major, 14 credits in a supporting program, and 24 thesis credits. Each student specializes in an area such as social and personality development, learning, cognitive development, language development, or perceptual development. Required courses include CPsy 8301, 8302, 8304, 8311, 8321, 8360, 8888, 8980, 8994, and statistics through EPsy 8261 or equivalent.

Language Requirements—None.

Minor Requirements for Students
Majoring in Other Fields—A Ph.D. minor requires 12 credits in child psychology, to include CPsy 8301 (4 credits), CPsy 8302 (4 credits), and CPsy 8996 (1-6 credits). Remaining credits can be taken at the 5xxx level or in CPsy 8360 seminars.

Chinese

The Chinese program provides a structured environment for students to become competent in Chinese, thus enabling them to enter the worlds of the Chinese, both modern and ancient. Students acquire the necessary scholarly tools, in linguistics or in literary studies, to enable them to pursue independent research in areas of interest within Chinese language and literature.

The M.A. degree provides knowledge of the major concerns and achievements in the scholarship of the field. Of special importance is a thorough mastery of the theoretical and methodological foundations of the discipline. At the conclusion of M.A. studies, students should be able to do independent research in an area within the field.

Degree Requirements
Two plans (Plan A and Plan B) are available for M.A. students. A total of 38 credits is required for the degree, whether completed under Plan A or Plan B.
Plan A requires 16 credits (four courses) in Chinese at Chn 5xxx or above and 12 credits in related fields as approved by the student’s adviser. A thesis is also required, for which students register for 10 thesis credits. The topic and scope of the thesis must be approved by the adviser.
Plan B requires 24 credits (six courses) in Chinese at Chn 5xxx or above and 12 credits in related fields as approved by the student’s adviser, and two Plan B papers as approved by the adviser.

Language Requirements—Three years of modern Chinese and one year of classical Chinese are required.

Final Exam—The final exam is oral.

Minor Requirements for Students
Majoring in Other Fields—The M.A. minor in Chinese requires 8 credits (2 courses) in Chinese at Chn 5xxx or above in either Chinese linguistics or Chinese literature.

Ph.D.

The Ph.D. program offers opportunities for advanced study in Chinese linguistics and literature and for independent research in areas related to the specializations of the program faculty. A program of study is designed in consultation with the faculty adviser, subject to the approval of the director of graduate studies and the Graduate School.

Degree Requirements
The Ph.D. program requires 32 credits (eight courses) in Chinese at the 5xxx level or above, which may include courses taken before entering the Ph.D. program, but must include at least three Chn 8xxx courses. Also required are 12 credits in a supporting program or minor field as approved by the student’s adviser. Upon being admitted to Ph.D. candidacy, students must register for 24 thesis credits and write a doctoral thesis.

Language Requirements—Four years of modern Chinese, two years of classical Chinese or its equivalent, and two years of Japanese or French or German are required.

Minor Requirements for Students
Majoring in Other Fields—The minor in Chinese at the Ph.D. level requires 12 credits (three courses) in Chinese at the 5xxx level.
Degree Programs

or above; at least one of these courses must be at the 8xxx level, and the 5xxx courses must be other than those already taken at the M.A. level. All 12 credits must be in either Chinese linguistics or Chinese literature.

Civil Engineering

M.C.E.—Coursework Only and Design Project

The master of civil engineering (M.C.E.) degree is for those who wish to learn about applications of fundamentals in civil engineering design beyond the B.S. degree. Students are expected to follow a coherent program of coursework in one of the following subareas of civil engineering: structural, geotechnical, water resources, environmental, or transportation engineering. The program is selected with the help of a faculty adviser and approved by the director of graduate studies. In addition to completing graduate-level courses, students must demonstrate professional competence either by carrying out and defending a design project or by taking a coursework-related final oral exam (without a project). The degree typically takes one to two years to complete.

Degree Requirements

The M.C.E. degree requires 30 credits and is offered under two plans. One requires a minimum of 20 course credits and preparation of a design project (10 credits); the other is a coursework-only degree program and requires 30 course credits. The design project must be carried out by the student in consultation with a faculty adviser.

Language Requirements—None.

Final Exam—A final oral exam is required of all M.C.E. candidates.

Minor Requirements for Students Majoring in Other Fields—For a master’s minor, two or more 5xxx or 8xxx courses from the same subarea of civil engineering are required, for a total of 6 or more credits.

M.S.—Plan A and Plan B

The master of science (M.S.) degree is for those who wish to pursue independent and original studies, and can be earned with emphasis in structural, geotechnical, environmental and water resources, or transportation engineering. Students enter the Ph.D. program normally after completing the M.S. degree. The Ph.D. typically takes four to six years to complete after the B.S. degree.

Degree Requirements

The program leading to the Ph.D. in civil engineering is flexible and developed by the student and his/her adviser. In addition to a flexible number of credits of coursework (usually more than 45) beyond the bachelor’s degree a candidate must register for 24 thesis credits. A supporting program or minor consisting of at least 12 semester credits is to be included in the coursework. Credits earned in an M.S. program may be presented in partial fulfillment of the Ph.D. requirements. The department has not set a rigid requirement on the number of 8xxx courses appropriate for Ph.D. programs. Nonetheless, the Ph.D. represents the highest level of scholarly achievement and coursework should be selected accordingly.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—For a Ph.D. minor, four or more 5xxx to 8xxx courses from one or two subareas of civil engineering are required, for a total of 12 or more credits.

Classics

M.A.—Plan A and Plan B

The classics M.A. program provides students with a broad background in the literature of ancient Greece and Rome in its cultural context. Extensive work in both Greek and Latin is supplemented with courses in history, archaeology, or religion.

Please refer to Akkadian (Akka), Ancient Near Eastern (ANE), Aramaic (Arm), Classics (Clas), Greek (Grk), Hebrew (Hebr), Latin (Lat), and Sumerian (Sum) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

This program requires nearly equal emphasis on courses and seminars in Greek and in Latin, as well as supporting work in related fields. The total minimum credit requirement for Plan A is 47 (including 10 thesis credits), and for Plan B, 41 (including directed study registrations for the Plan B papers).

Language Requirements—The language requirement includes one modern research language as appropriate (normally French or German) and proficiency in reading Greek and Latin as certified by a department exam on previously unseen passages.

Final Exam—The final exams are written and oral.

Minor Requirements for Students Majoring in Other Fields—Students must complete Clas 5794, as well as 6 credits in graduate Latin courses, excluding Lat 8120, and 6 credits in graduate Greek courses, excluding Grk 8120.

Ph.D.

The classics Ph.D. program requires extensive advanced work in both Latin and Greek, together with interdisciplinary studies in fields such as archaeology, history, and religion, to provide a comprehensive understanding of the ancient world.

Please refer to Akkadian (Akka), Ancient Near Eastern (ANE), Aramaic (Arm), Classics (Clas), Greek (Grk), Hebrew (Hebr), Latin (Lat), and Sumerian (Sum) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

This program requires nearly equal emphasis on courses and seminars in Greek and in Latin, as well as supporting work in related fields. Students must take at least three seminars in the major and a two-semester sequence in ancient history, in addition to fulfilling all course requirements specified for the M.A. Students who continue from the M.A. program may apply those credits toward the degree, and students entering with an M.A. can usually receive credit for some earlier coursework, subject to director of graduate studies approval and graduate school requirements. A typical Ph.D.
program is 77 credits, including at least 30
credits in the major, 12 in the supporting
program, and 24 thesis credits.
Language Requirements—The language
requirements includes German, plus another
modern language, preferably French, and
proficiency in reading Greek and Latin as
demonstrated by a department exam on
previously unseen passages.

Minor Requirements for Students
Majoring in Other Fields—Students must
complete Clas 5794, as well as 9 graduate
credits of Greek (excluding Grk 8120) and 9
grade credits of Latin (excluding Lat 8120).

Clinical Laboratory
Science

M.S.—Plan A
The M.S. in clinical laboratory science is a
multidisciplinary program that prepares the
medical technologist or basic science
undergraduate for a career in research,
teaching, or industry within a specialized
area of laboratory medicine. Students pursue
investigative work in one of five specialty
areas: clinical chemistry, genetics/molecular
chemistry, hematology, immunology, or
microbiology. Although each area has a
required courses, flexibility is maintained,
allowing students to choose the remainder of
their coursework to meet individual
requirements and research interests.

Degree Requirements
Credit requirements include at least 17
credits in the specialty area, at least 6 credits
in a minor or in related fields outside the
specialty area, 10 thesis credits, and 2 student
seminar credits.

Language Requirements—None.
Final Exam—The final exam is oral.

Clinical Research

M.S.—Plan A
This interdisciplinary program trains health
professionals to design, implement, and
manage research in clinical populations.
Because clinical research is fast becoming
more complex, sophisticated, and regulated,
there is an emerging recognition of and
demand for formalized training for those who
intend to apply their clinical skills to patient-
based health research. Therefore, of the three
areas within clinical research, this program
focuses primarily on patient-oriented
research (including mechanisms of human
disease, therapeutic interventions, clinical
trials, and development of new techniques).
The program focuses less on epidemiologic
and behavioral studies, and on outcomes
research and health services research,
students interested in these areas might better
be served by seeking a master of public
health (M.P.H.) degree.

Degree Requirements
The M.S., which is offered under Plan A
(with thesis), requires 38 credits, including 2
elective credits and 10 thesis credits.
Coursework in biostatistics, epidemiology,
clinical trials, data collection, grant writing,
and ethics is provided. Elective courses are
chosen in consultation with an adviser. The
thesis may take the form of any approved
clinical research project in which the student
is involved in the design, implementation,
and analysis.

Language Requirements—None.
Final Exam—The final exam is oral.

Minor Requirements for Students
Majoring in Other Fields—Requirements
for a minor are under development. Contact
the director of graduate studies for
information on the status of the minor
program.

Cognitive Science

Freestanding Minor
The minor in cognitive science is available to
master’s (M.A. and M.S.) and doctoral
students. Cognitive science is a field of
inquiry at the interface of cognitive
psychology, computer science, linguistics,
neuroscience, and philosophy. It is concerned
with the acquisition, representation, and use
of knowledge by humans, animals, and
machines. The minor provides students with
a broad theoretical and methodological
overview of the study of cognition.

Degree Requirements
Both a master’s and doctoral minor require
the following core courses outside the
student’s major department: CgSc 8000—
Philosophy of Cognitive Science, CSci
5511—Artificial Intelligence I, and Psy
5015—Cognition, Computation, and Brain.
In addition, CgSc 8001—Proseminar in
Cognitive Science is required for the doctoral
minor. The master’s minor requires a
minimum of 8 graduate credits; the doctoral
minor requires 14 graduate credits.

Additional courses beyond those required
must be taught by faculty in the minor
program or approved in advance by the
cognitive science director of graduate
studies. Courses in the student’s major
department do not count toward the minor.

Degree Requirements
A minimum of 12 course credits in a minor
or supporting program and registration for 24
thesis credits are required. Also required is a
statistics sequence, for which students
typically register during their first two years.
The written and oral preliminary exams are
taken at the end of the second year.

Each student completes a seminar (CDis
8420) and a minimum of 4 credits of
teaching experience that provide an
opportunity for the student to develop and
teach sections of department courses.
Students also complete a seminar (CDis
8410) and a minimum of 4 credits of research
under the direction of one or more faculty
members in the department other than the
adviser.

Language Requirements—None.

Minor Requirements for Students
Majoring in Other Fields—A minimum of
12 credits, approved by the director of
graduate studies, is required for a doctoral
minor.

Communication Disorders

M.A.—Plan A and Plan B
Emphases in the master’s program are
speech-language pathology and audiology,
which are accredited by the American
Speech-Language-Hearing Association’s
Council on Academic Accreditation. Students
who complete the M.A. are eligible for
clinical certification by the Association.

Degree Requirements
Students may select between two M.A.
options. Plan A requires coursework and a
thesis that is experimental in nature. Plan B
requires coursework and one or more written
projects that need not be experimental in
nature but that should reflect rigorous
scholarship.

Language Requirements—None.
Final Exam—The final exam is oral.

Minor Requirements for Students
Majoring in Other Fields—A minimum of
6 credits, approved by the director of
graduate studies, is required for a master’s
minor.

Ph.D.

Emphases in the doctoral program are
speech-language pathology, audiology,
speech science, language science, or hearing
science. The program prepares students for
careers in research and teaching. Most
students entering the program have a
master’s degree in speech-language
pathology, audiology, or a related area. The
Ph.D. degree usually requires three years of
work beyond the master’s degree. In general,
a student’s program is designed by the
student in consultation with the adviser to
satisfy the particular objectives of the
student, but there are also some department
and Graduate School requirements that must
be satisfied. These include coursework,
research activities, teaching experience, and
preliminary and final exams.
Comparative Literature

Comparative literature is the oldest field of literary criticism, dating back to the eighteenth century. Among the wide range of studies currently conducted under the rubric of comparative literature nationwide and internationally, the University focuses on theories of literary criticism and its explanatory bases; indeed the program is seen as one of the principal initiators of such fields of study. This program is likewise engaged in pushing the bounds of critical inquiry in related domains of literary inquiry, directing much of its energies toward women’s writing and emergent literatures, within both First- and Third-World cultures, as well as toward related problems ranging from narrative to postcolonial studies.

M.A.—Plan B
Degree Requirements
The M.A. program requires 30 credits: 8 credits of basic seminar (CLit 8001-8002), 12 credits of CLit courses, 6 course credits in related field(s) outside comparative literature or in a formal minor, and 4 credits either in CLit courses or in the related or minor field. Two Plan B papers are required.

Language Requirements—In addition to English, the following language competencies are required: high competence in one language and reading knowledge of one language. The choice of languages is made with respect to the student’s area of specialization and in consultation with, and with the approval of, the adviser. Final Exam—The final exams are written and oral.

Minor Requirements for Students Majoring in Other Fields—A minimum of 12 credits are required for a master’s minor, which must include CLit 8001 and 8002.

Ph.D.
Degree Requirements
The Ph.D. requires 24 course credits beyond the M.A., including the following: 8 credits of basic seminar (CLit 8001-8002) (if the basic seminar was taken as coursework toward the M.A., these 8 credits must be in other CLit courses) and 12 credits in a minor or a supporting program designed in consultation with the student’s adviser; 24 thesis credits are also required. Overall, the program should include 11 credits at the 8xxx level (exclusive of 8001-8002) and 12 credits in CLit courses (exclusive of 8001-8002). To satisfy these requirements, it may be necessary for the program to exceed 24 course credits.

Language Requirements—In addition to English, the following language competencies are required: high proficiency in one language, proficiency in a second language, and a good reading knowledge of a third language. The choice of languages is made with respect to the student’s area of specialization and in consultation with, and with the approval of, the adviser. For example, a student specializing in theory could have a high proficiency in French and proficiency in German (or vice versa) and reading knowledge of a classical language such as Latin; a student specializing in emergent literatures could have a high proficiency in a language related to the field, and proficiency in French and reading knowledge of German (or vice versa).

Minor Requirements for Students Majoring in Other Fields—A minimum of 16 credits is required for the doctoral minor, which must include CLit 8001 and 8002.

Comparative Studies in Discourse and Society

While most traditional humanistic disciplines tend to focus either on a given mode of discourse, e.g., art history, musicology or a specific cultural context, e.g., American studies, European languages and literatures, this program engages a broader problematic: how discourse and cultural production both shape and are shaped by life in time, space, matter, and society. Drawing on a variety of theoretical positions, the program pays close attention to discourse of various types, e.g., music, film, myth, ritual, architecture, landscape and urban design, painting, sculpture, literature in elite, popular, folk, and mass culture, understanding these as both a site and an instrument of contestation and negotiation among social forces. More generally, the program seeks to reassociate intellectual and cultural history with social and political history, to set discourse of various sorts within a social context, and to consider specific social formations within the ongoing historical process. In all this, the program encourages work that is interdisciplinary (at times, even anti-disciplinary) as well as cross-cultural.

Minor Requirements for Students Majoring in Other Fields—A minimum of 16 credits is required for a master’s minor, which must include CSDS 8001 and 8002.

Ph.D.
Degree Requirements
Ph.D. requirements include the following: For students already holding an M.A. in CSDS—24 course credits beyond the M.A., including 12 credits of CSDS courses and 12 course credits in a minor or a supporting program designed in consultation with the adviser; 24 thesis credits are also required. For students holding an M.A. in a field other than CSDS—32 course credits beyond the M.A., including 8 credits of Basic Seminar (CSDS 8001-8002), 12 credits of other CSDS courses, and 12 credits in a minor or a supporting program designed in consultation with the adviser; 24 thesis credits are also required.

Language Requirements—Reading knowledge of two foreign languages appropriate to the student’s program is required.

Minor Requirements for Students Majoring in Other Fields—A minimum of 16 credits is required for a Ph.D. minor, which must include CSDS 8001 and 8002.

Composition, Literary, and Rhetorical Studies

Freestanding Minor
This minor is available to master’s (M.A. and M.F.A.) and doctoral students. The fields of composition, literary, and rhetorical studies are interdependent, as well as cross-disciplinary. Scholars and practitioners in areas such as English, rhetorical theory, speech-communication, education, linguistics, and cognitive psychology contribute significantly to the production of knowledge in these fields. Each area lends a unique focus to questions about the characteristics of written texts, the comprehension of texts, and the acquisition of writing and reading ability. Those interested in writing, in particular, pay attention to work in literary theory, critical theory, rhetoric, and cultural studies as they try to understand the interactions between and among written texts, literacy, and culture. This interdisciplinary minor brings together faculty from all of these areas. Students who wish to specialize in composition or literacy or rhetorical studies will find a coordinated, articulated program of study.

Please contact the minor program office for information on relevant coursework.
Degree Requirements
Students develop a minor program in consultation with their major adviser and director of graduate studies, and the director of graduate studies for composition, literacy, and rhetorical studies.

A master’s minor (for M.A. or M.F.A.) requires three graduate courses (9 credits), one from each of the following categories: a theoretical topic appropriate to the field, pedagogical theory and practice, and research methods and practices. Students must also fulfill a capstone writing requirement in one of the three classes.

A doctoral minor requires a minimum of four graduate courses (12 credits); a seminar in a theoretical topic appropriate to the field, a seminar or course in pedagogical theory and practice, a seminar or course in research methods and practices, and a capstone writing seminar taken after completion of the other three courses (requires a written proposal approved by the faculty member for admission to the capstone seminar). No more than one of the four courses may be from the student’s home department.

Computer and Information Sciences

Computer science is concerned with the study of the hardware, software (programming), and theoretical aspects of high-speed computing devices and with the application of these devices to a broad spectrum of scientific, technological, and business problems.

The computer and information science degrees are a Ph.D., an M.S. (either Plan A with thesis or Plan B with project), and an M.C.I.S. The M.C.I.S. is a coursework-only degree and is intended to be a terminal degree.

The Department of Computer Science and Engineering also offers a master of science in software engineering (M.S.S.E.) degree. This department and the Department of Electrical and Computer Engineering jointly offer a computer engineering program, and many faculty from the computer science department participate in the scientific computation program.

Please refer to Computer Science (CSci) in the course section of this catalog for courses pertaining to this program.

M.C.I.S.—Coursework Only

Degree Requirements
The M.C.I.S. is a coursework-only degree. It requires 31 credits of graduate work, with the following conditions: 1) at least 18 of the credits must be from CSci classes; 2) students must fulfill a breadth requirement of four courses in four of the five designated areas (computer engineering, artificial intelligence, numerical computing, theory, and systems); 3) at least 6 credits must be from outside the department; 4) at least 6 credits must be at the 8xxx level; and 5) students must take 1 credit of CSci colloquium, which cannot be counted toward any of the other requirements. Students must maintain a GPA above 3.00 after completing 8 credits.

Language Requirements—None.
Final Exam—The final exam is oral.
Minor Requirements for Students Majoring in Other Fields—A minor consists of at least 6 credits in CSci courses at the 4xxx level or higher.

M.S.—Plan A and Plan B

Degree Requirements
The M.S. requires a minimum of 31 credits, with at least 14 of these from CSci courses (at least 6 of which are at the 8xxx level) and 6 from outside the department. There is a breadth requirement of four courses in four of the five areas (systems, computer engineering, artificial intelligence, numerical computing, and theory). For Plan A, at least 10 thesis credits are required; for Plan B, 3 Plan B project credits and 7 additional course credits are required. Students must also take 1 credit of CSci colloquium, which cannot be counted toward the other requirements. Students are expected to maintain a GPA of at least 3.25 for all courses listed on their degree program. Please refer to Computer Science (CSci) in the course section of this catalog for courses pertaining to this program.

Language Requirements—None.
Final Exam—The final exam is oral.
Minor Requirements for Students Majoring in Other Fields—A master’s minor consists of at least 6 credits of CSci courses at the 4xxx level or higher.

Ph.D.

Degree Requirements
The Ph.D. requires at least 43 course credits, of which 13 must be in CSci courses and at least 12 in a minor or supporting program. Additionally, at least 24 thesis credits are required. Students are expected to complete all courses in their degree program with a GPA of at least 3.45.

Language Requirements—None.
Minor Requirements for Students Majoring in Other Fields—At least 12 credits are required for a doctoral minor.

Computer Engineering

Computer engineering is an interdisciplinary graduate program offered jointly by the Department of Electrical and Computer Engineering and the Department of Computer Science and Engineering. Students in this program develop a broad understanding of both hardware and software design issues. The M.S. degree is a traditional research-oriented degree that prepares graduates to work in industry or to continue with their graduate studies in either electrical engineering or computer science. The M.Comp.E. degree is a coursework-only professional engineering degree tailored primarily for working professionals. Students have access to a wide variety of computational and laboratory equipment. Students can focus their studies in several different areas, including computer architecture and system design, compilers, computer-aided design, databases, networks, operating systems, parallel computing, software engineering, and VLSI design and testing.

Please refer to Computer Engineering (CmpE), Computer Science (CSci), and Electrical Engineering (EE) in the course section of this catalog for courses pertaining to this program.

M.Comp.E.—Coursework Only

Degree Requirements
The M.Comp.E. degree requires 30 credits of graduate work distributed as follows: 1) at least 14 credits must be from the approved list of major field courses (of which at least 6 credits must be taken in electrical engineering and at least 6 credits in computer and information sciences); 2) at least 6 of the major field credits must be in 8xxx courses; 3) at least 6 credits must be from a minor or related field; and 4) students take a breadth requirement of three courses in three of the four designated areas (system software, computer architecture and system design; compilers, algorithms, and software engineering). Also, students must maintain a GPA of at least 3.10 to continue with their graduate studies in either electrical engineering or computer science.

The M.Comp.E. degree is a coursework-only professional engineering degree tailored primarily for working professionals. Students have access to a wide variety of computational and laboratory equipment. Students can focus their studies in several different areas, including computer architecture and system design, compilers, computer-aided design, databases, networks, operating systems, parallel computing, software engineering, and VLSI design and testing.

Please refer to Computer Engineering (CmpE), Computer Science (CSci), and Electrical Engineering (EE) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B

Degree Requirements
The M.S. degree requires 30 credits distributed as follows: 1) at least 14 credits must be from the approved list of major field courses (of which at least 6 credits must be taken in electrical engineering and at least 6 credits in computer and information sciences); 2) at least 6 of the major field credits must be in 8xxx courses; 3) at least 6 credits must be from a minor or related field; and 4) students take a breadth requirement of three courses in three of the four designated areas (system software, computer architecture and system design; compilers, algorithms, and software engineering). Also, students must maintain a GPA of at least 3.10 to continue with their graduate studies in either electrical engineering or computer science.

The M.S. degree is a traditional research-oriented degree that prepares graduates to work in industry or to continue with their graduate studies in either electrical engineering or computer science. The M.Comp.E. degree is a coursework-only professional engineering degree tailored primarily for working professionals. Students have access to a wide variety of computational and laboratory equipment. Students can focus their studies in several different areas, including computer architecture and system design, compilers, computer-aided design, databases, networks, operating systems, parallel computing, software engineering, and VLSI design and testing. Please refer to Computer Engineering (CmpE), Computer Science (CSci), and Electrical Engineering (EE) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B

Degree Requirements
The M.S. degree requires 30 credits distributed as follows: 1) at least 14 credits must be from the approved list of major field courses (of which at least 6 credits must be taken in electrical engineering and at least 6 credits in computer and information sciences); 2) at least 6 of the major field credits must be in 8xxx courses; 3) at least 6 credits must be from a minor or related field; and 4) students take a breadth requirement of three courses in three of the four designated areas (system software, computer architecture and system design; compilers, algorithms, and software engineering). Also, students must maintain a GPA of at least 3.10 to continue with their graduate studies in either electrical engineering or computer science.

The M.S. degree is a traditional research-oriented degree that prepares graduates to work in industry or to continue with their graduate studies in either electrical engineering or computer science. The M.Comp.E. degree is a coursework-only professional engineering degree tailored primarily for working professionals. Students have access to a wide variety of computational and laboratory equipment. Students can focus their studies in several different areas, including computer architecture and system design, compilers, computer-aided design, databases, networks, operating systems, parallel computing, software engineering, and VLSI design and testing. Please refer to Computer Engineering (CmpE), Computer Science (CSci), and Electrical Engineering (EE) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B

Degree Requirements
The M.S. degree requires 30 credits distributed as follows: 1) at least 14 credits must be from the approved list of major field courses (of which at least 6 credits must be taken in electrical engineering and at least 6 credits in computer and information sciences); 2) at least 6 of the major field credits must be in 8xxx courses; 3) at least 6 credits must be from a minor or related field; and 4) students take a breadth requirement of three courses in three of the four designated areas (system software, computer architecture and system design; compilers, algorithms, and software engineering). Also, students must maintain a GPA of at least 3.10 to continue with their graduate studies in either electrical engineering or computer science.

The M.S. degree is a traditional research-oriented degree that prepares graduates to work in industry or to continue with their graduate studies in either electrical engineering or computer science. The M.Comp.E. degree is a coursework-only professional engineering degree tailored primarily for working professionals. Students have access to a wide variety of computational and laboratory equipment. Students can focus their studies in several different areas, including computer architecture and system design, compilers, computer-aided design, databases, networks, operating systems, parallel computing, software engineering, and VLSI design and testing. Please refer to Computer Engineering (CmpE), Computer Science (CSci), and Electrical Engineering (EE) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B

Degree Requirements
The M.S. degree requires 30 credits distributed as follows: 1) at least 14 credits must be from the approved list of major field courses (of which at least 6 credits must be taken in electrical engineering and at least 6 credits in computer and information sciences); 2) at least 6 of the major field credits must be in 8xxx courses; 3) at least 6 credits must be from a minor or related field; and 4) students take a breadth requirement of three courses in three of the four designated areas (system software, computer architecture and system design; compilers, algorithms, and software engineering). Also, students must maintain a GPA of at least 3.10 to continue with their graduate studies in either electrical engineering or computer science. The M.Comp.E. degree is a coursework-only professional engineering degree tailored primarily for working professionals. Students have access to a wide variety of computational and laboratory equipment. Students can focus their studies in several different areas, including computer architecture and system design, compilers, computer-aided design, databases, networks, operating systems, parallel computing, software engineering, and VLSI design and testing. Please refer to Computer Engineering (CmpE), Computer Science (CSci), and Electrical Engineering (EE) in the course section of this catalog for courses pertaining to this program.
Degree Programs

Political Science

Students must complete 10 thesis credits and Plan B students must complete 3 credits of a Plan B project. Students take the core courses and are expected to show competency in both the biological and social sciences. With their advisory committee, students develop a program that emphasizes the ecological and social aspects of conservation biology. Dissertation research may require proficiency in supporting areas (e.g., statistics, computing, communications).

Language Requirements—None.
Final Exam—The final exam is oral.

Ph.D.

Degree Requirements
Ph.D. students complete a 46 credits, which include 10 credits for courses required as part of the major, 12 credits for the minor or supporting program, and 24 thesis credits. Students take the core courses and are expected to show competency in both the biological and social sciences. With their advisory committee, students develop a program that emphasizes the ecological and social aspects of conservation biology. Dissertation research may require proficiency in supporting areas (e.g., statistics, computing, communications).

Language Requirements—None.
Minor Requirements for Students Majoring in Other Fields—Requirements for a minor in conservation biology are determined in consultation with the director of graduate studies and the student’s graduate committee.

Control Science and Dynamical Systems

Ph.D.

Student programs must emphasize modeling (mathematical and physical analyses of control or dynamical systems, with some computational or numerical expertise) and two areas selected from the following three: control theory for deterministic processes; stability theory and general analysis of dynamical systems; stochastic processes and information theory. Applicants are strongly encouraged to obtain a faculty adviser before formally applying to the program.

Degree Requirements
Programs are designed by the student and the adviser. Coursework is normally selected from those science, mathematics, engineering, and related fields that are relevant to control science and dynamical systems. Normally students can prepare for the written preliminary exam by completing three 8xxx or suitably advanced courses in three of the four areas of emphasis. In addition, students typically take substantial coursework in advanced mathematics.

Language Requirements—None.

Creative Writing

M.F.A.

The Department of English offers the master of fine arts degree for students committed to pursuing the writing life. This three-year degree provides advanced, graduate-level coursework in writing, language, and literature, as well as study in a related field. The third year of the program focuses on the final development of a book-length manuscript suitable for publication. At the heart of the program are writing workshops in poetry, fiction, and literary nonfiction, and courses in the Reading as Writers and Topics in Advanced Writing series, which enable writers to explore a variety of issues relating to contemporary themes in American and world literature. The program encourages experimentation across genres, fostering the discovery of new and varied forms for a developing voice.

Please refer to English Composition (EngC), English: Creative and Professional Writing (EngW), and English Language and Literature (EngL) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
The M.F.A. requires 47 credits distributed over a three-year period, culminating in a book-length manuscript and a public reading from the work. An M.F.A. essay is also required, generally completed in the spring of the second year.

Required coursework includes EngW 8101 (4 credits); four writing workshops (16 credits total), three of which must be in the student’s genre of choice and include one 8xxx course, and one of which must be outside the student’s primary genre; language and literature courses (12 credits); related field (3 credits); and a creative project, a book-length manuscript suitable for publication (12 credits, 4 of which are for manuscript preparation and 8 for creative project registration).

Language Requirements—None.
Final Exam—The M.F.A. essay is a week-long, take-home exam based on 20 texts designated by program faculty.

Dentistry

M.S.—Plan A and Plan B

The M.S. program in dentistry prepares dentists and dental hygienists with clinical expertise for positions of leadership in education, research, and program administration in the oral health field. The program, which is housed in the School of Dentistry, is taught by a multidisciplinary
Design, Housing, and Apparel

The design, housing, and apparel graduate program focuses on the study of relationships between humans and their designed environments. This focus is based on the assumption that design and analysis of environments contribute to the improvement of the human condition. The program addresses theory, research, and application, using a shared disciplinary base from the social and behavioral sciences. The goal of the program is for students to analyze, evaluate, and integrate theoretical frameworks related to humans and their designed environments.

The M.A., M.S., and Ph.D. programs offer four areas of emphasis: apparel, design communication, housing, and interior design. The M.F.A. program offers an area of emphasis in multimedia. The emphasis in apparel advances both theoretical and practical knowledge of textile and apparel products. Students focus on design, clothing aesthetics, historic costume, museology, sociopsychological, and sociocultural aspects of apparel and textiles, and textile and apparel product analysis. The emphasis in design communication focuses on design theory, design process and methodology, visual communication (design and analysis), and color systems and perception. The housing emphasis advances both theoretical and practical knowledge in the field. Students are prepared to assist people in their shelter-related problems through research. Courses emphasize human needs and behavior, analysis of designed environments and technology, policy and community development, and housing for special populations. The emphasis in interior design includes study of the theory, research, and specialized practice components of design as applied to the interior environment. The emphasis in multimedia provides students with experience in designing for the electronic environment. The program integrates theory with practice in the application of emerging technologies and software to digital design solutions. Students complete a capstone design project involving faculty and community mentors.

M.A.—Plan A and Plan B

Degree Requirements

M.A. requirements for the program’s five competency areas include 1) 3 credits in courses that focus on theory building and the theoretical and philosophical bases of inquiry in the discipline; 2) 3 credits in courses on qualitative and quantitative methods of research and evaluation; 3) 8 credits for Plan A students, and 18 credits for Plan B students, in the area of emphasis; 4) 10 thesis credits for Plan A students; and 5) 6 credits in a related field.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students

Majoring in Other Fields—For a master’s minor, a minimum of 9 credits in design, housing, and apparel is required, including DHA 8101. Courses are selected in consultation with the director of graduate studies.

M.F.A.

Degree Requirements

M.F.A. requirements for the program’s five competency areas include 1) 6 credits in courses that focus on theory building and the theoretical and philosophical bases of inquiry in the discipline; 2) 6 credits in evaluation and analysis, including DHA 5388—Design Planning and Analysis and a 3-credit course in graduate-level statistics; 3) 28 credits in the area of emphasis; 4) 12 credits of M.F.A. creative thesis; and 5) 8 credits in a related field.

Language Requirements—None.

Final Exam—The final exam is oral.

M.S.—Plan A and Plan B

Degree Requirements

M.S. requirements for the program’s five competency areas include 1) 3 credits in courses that focus on theory building and the theoretical and philosophical bases of inquiry in the discipline; 2) 3 credits in courses on qualitative and quantitative methods of research and evaluation; 3) 8 credits for Plan A students, and 18 credits for Plan B students, in the area of emphasis; 4) 10 thesis credits for Plan A students; and 5) 6 credits in a related field.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students

Majoring in Other Fields—For a master’s minor, a minimum of 9 credits in design, housing, and apparel is required, including DHA 8101. Courses are selected in consultation with the director of graduate studies.

Ph.D.

Degree Requirements

Ph.D. requirements for the program’s five competency areas include 1) 6 credits in courses that focus on theory building and the theoretical and philosophical bases of inquiry in the discipline; 2) 9 credits in courses on qualitative and quantitative methods of research and evaluation; 3) 12 credits in the area of emphasis; 4) 24 thesis credits; and 5) 12 credits in a supporting program.

Language Requirements—None.

Minor Requirements for Students

Majoring in Other Fields—For a doctoral minor, a minimum of 12 credits in design, housing, and apparel is required, including DHA 8101—Philosophical Foundations of Design, Housing, and Apparel. Courses are selected in consultation with the director of graduate studies.
Degree Programs

Development Studies and Social Change

(continued)

East Asian Studies

M.A.—Plan A and Plan B

The program offers an entry point for interdisciplinary study of East Asia, particularly China and Japan. It serves both as a stepping stone to advanced academic work and as a terminal degree for those with non-academic career goals related to East Asia. Please refer to East Asian Studies (EAS) and Area Studies (Area) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The program uses an interdisciplinary approach that emphasizes the humanities and social sciences and requires proficiency in a foreign language, a theoretical framework, broad knowledge of the area in question, and a concise understanding of a topical theme to be developed in the Plan A thesis or Plan B papers.

Plan A requires 31 credits: a minimum of 21 course credits (7 courses), including 15 credits (5 courses) in the major and 6 credits (2 courses) in one or more fields outside the major, and 10 thesis credits. Coursework must include the 3-credit introductory scope and methods course (Area 8061) and three proseminars/seminars.

Plan B requires 30 course credits, in order to provide a broader knowledge of the chosen field and allied subjects. It requires at least 15 credits (5 courses) in the major field and 12 credits (4 courses) in one or more related fields outside of the major, which must include three proseminars/seminars. Students must also take the 3-credit introductory scope and methods course (Area 8061). Three Plan B papers must be written, at least one of them outside of the major.

Language Requirements—The language requirement may be fulfilled by successful completion of either three years (six semesters) of a Chinese or Japanese language sequence, or at least four semesters of Chinese or Japanese language study and an approved study abroad experience in East Asia. For a Korean focus, it is possible to have a comparable level of Korean language in lieu of the Chinese or Japanese requirement. (Note: Proficiency exams and evaluations are provided by relevant language departments.)

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A master’s minor requires two years of language study or equivalent proficiency, plus at least three courses (minimum of 9 credits) in the field that include at least two semesters of seminars/proseminars.

Ecology

Ecology is the inquiry into the biology of organisms and their environments: how organisms interact in social groups, populations, and communities and how those interactions have influenced their distribution and evolution in space and time. The program provides broad training in the general areas of ecology, evolution, and animal behavior, and more specialized courses and research in behavior, evolution, population genetics, population ecology, community ecology, ecosystem ecology, limnology, and paleoecology. Opportunities are offered for field research in various parts of the world as well as in local ecosystems. Seminars and tutorials are an important part of student programs.

The program’s graduate faculty are drawn from the Bell Museum of Natural History and the Departments of Ecology, Evolution, and Behavior; Civil Engineering; Entomology; Forest Resources; Geology and Geophysics; Soil, Water, and Climate; Plant Biology; and Plant Pathology. Please refer to Ecology, Evolution, and Behavior (EEB) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B

Degree Requirements

The M.S. is offered under both Plan A (with thesis) and Plan B (without thesis). Both plans require a minimum of 14 course credits in the major and a minimum of 6 course credits in one or more related fields outside the major; Plan A also requires 10 thesis credits, and Plan B requires 10 additional course credits and one to three research papers, which may be written in conjunction with graduate courses. Significant field experience and competence in statistics, to include hypothesis testing, regression, and correlation, are required. Each degree program is planned by the student and an advisory committee of three faculty members to meet the student’s interests and needs.

Language Requirements—None.

Minor Requirements

Minor Requirements for Students Majoring in Other Fields—A minimum of 7 credits of EEB courses at the 4xxx, 5xxx, and 8xxx levels is required for a master’s minor in ecology.

Ph.D.

Degree Requirements

Ph.D. students are expected to acquire knowledge of ecology, evolution, and behavior through courses, seminars, and directed study. A minimum of 3 course credits and 24 thesis credits are required in the major, and at least 12 course credits are required for either a minor in another field or a supporting program from several relevant fields. Significant field experience, proficiency in using computers in research, and competence in statistics, including experimental design, are required. Degree programs are planned by the student and an advisory committee of three to five faculty members.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—A minimum of 12 credits of EEB courses at the 4xxx, 5xxx, and 8xxx levels is required for a doctoral minor in ecology.

Economics

The economics graduate program offers degree work in both theoretical and applied fields of economics: in economic theory, econometrics, economic growth and development, financial economics, game theory, industrial organization, international economics, labor economics, mathematical economics, monetary economics, and public economics. Students are admitted only for the Ph.D.; the M.A. is an optional part of the Ph.D. program.

M.A.—Plan A and Plan B

Degree Requirements

The M.A. is offered under Plan A (with thesis) or Plan B (without thesis). Coursework for the M.A. is drawn from the Ph.D. program and must include at least 10 credits of economic theory drawn from the first-year Ph.D. sequences in theory (for majors) or microeconomic analysis (for minors) and macroeconomics, plus at least 3 credits in quantitative economics or
econometrics. Beyond these restrictions the general Graduate Student requirements govern. For the Plan B degree, a Ph.D. student will have completed requirements for the M.A. when the written preliminary exams have been completed. Two Plan B projects consisting of research papers or literature reviews are required; the Ph.D. written preliminary exams required in two fields outside of economic theory (“field exams”) may be used to satisfy either or both of the Plan B projects. Because the standards used to judge whether a preliminary exam has satisfied the requirement for the M.A. are less rigorous than those for the Ph.D., students may qualify for the M.A. Plan B without having satisfied all requirements for the Ph.D. written preliminary exams.

Language Requirements—None.

Final Exam—The final exam is oral for Plan A, written for Plan B.

Minor Requirements for Students Majoring in Other Fields—A master’s minor in economics consists of 6 credits in 4xxx, 5xxx, or 8xxx economics courses, all taken A-F and completed with grades of B or better (one course at the 8xxx level may carry a grade of C). The 6 credits include Econ 5151 and Econ 5152 or more advanced courses in economic theory.

The economic theory requirement may be waived if, in the judgment of the director of graduate studies, the student’s previous work in economics has included courses equivalent to Econ 5151 and 5152, though the requirement to complete 6 credits would still stand.

Ph.D.

Emphasis in all aspects of the program is on careful development of the theoretical basis for the work, whether the work is theoretical or applied and whether the relevant theory is drawn from economics, econometrics, mathematics, statistics, or other related disciplines.

Degree Requirements

Before undertaking research for a doctoral thesis, the student must pass written preliminary exams in micro- and macroeconomic theory, plus in two of the fields listed under the program description above. The program does not specify a minimum number of courses for the major; rather, the courses taken to help prepare for the preliminary exams constitute the major program. In addition, the student must complete 12 credits outside the major for a supporting program, which may include economics courses not included in the major. As part of or in addition to the major and supporting program, the student must demonstrate competence in econometrics or quantitative methods in economics, frequently by completing a one-year course in applied econometrics; the program’s recruitment brochure and graduate student handbook contain details.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—Requirements for a doctoral minor include five or more from among the following courses: Econ 8001-2-3-4 or 8101-2-3-4, and 8105-6-7-8; plus completion of at least two 8xxx courses in economics other than those listed above. All courses must be taken A-F, with no grade lower than C and no more than two course grades of C.

In addition, students must pass the microeconomics preliminary exam for minors or majors, and either the macroeconomics preliminary exam for minors or majors, or a preliminary exam for majors in one of the fields listed under the program description above.

Education—Curriculum and Instruction

By focusing on the curricular and instructional processes central to all educational endeavors, graduate programs within the Department of Curriculum and Instruction prepare students for professional roles in pre-K-12 education, in postsecondary and research settings, and in educational service agencies.

M.A.—Plan B

The M.A. (Plan B only) in education with an emphasis in curriculum and instruction includes concentrations in curriculum studies, education, elementary education, English education, instructional systems, reading education, science education, second languages and cultures education, and social studies education.

Please refer to Curriculum and Instruction (CI) and Education (Educ) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

A total of 76 credits is required for the Ph.D. program in education (curriculum and instruction). Requirements include three core courses (9 credits) and at least 15 other credits in an area of concentration. Students must also complete 9 credits in research methodology; 6 credits from social, historical, philosophical, and psychological foundations; 12 credits in a minor or supporting program; and 24 thesis credits. Specific courses and additional work are planned with the adviser.

Language Requirements—Students in the second languages and cultures concentration must give evidence of advanced proficiency in the second language of choice.

Minor Requirements for Students Majoring in Other Fields—A minimum of 12 credits is required for a minor in education (curriculum and instruction). A demonstrated understanding of foundational knowledge related to curriculum and instruction is required.

Education—Recreation, Park, and Leisure Studies

Ph.D.

Ph.D. students in education with an emphasis in recreation, park, and leisure studies (RPLS) pursue an individualized program specializing in leisure services management, outdoor education/recreation, sport management, or therapeutic recreation.
Please refer to Recreation, Park, and Leisure Studies (Rec) and Education (Educ) in the course section of this catalog for courses pertaining to this program.

**Degree Requirements**

The Ph.D. requires at least 86 credits, including 12 credits in an RPLS common core, 21 credits in an RPLS specialization, 17 credits in research development, 12 credits in a supporting program or minor, and 24 thesis credits (Educ 8888). A minimum GPA of 3.00 is required to maintain good standing and to graduate.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—A doctoral minor in education emphasis: recreation, park, and leisure studies requires at least 12 credits of graduate-level courses in RPLS, including Rec 5101 (3 cr) and Rec 8980 (2 cr).

**Education—Work, Community, and Family Education**

The program offers specializations in adult education, agricultural education and extension, business and industry education, family education, human resource development, and comprehensive work, community, and family education. Students combine study and related experiences to develop, apply, analyze, synthesize, and evaluate knowledge of the purposes, practices, issues, and problems of work, community, and family education; social, economic, historical, political, cultural, educational, technological, and psychological contexts within which work, community, and family education exist; and types of research that contribute to or apply that knowledge to the specialization.

See also Work, Community, and Family Education for information about the Ed.D. degree.

Please refer to Adult Education (AdEd), Agricultural Education and Extension (AgEE), Business and Industry Education (BIE), Education (Educ), Family Education (FE), Human Resource Development (HRD), and Work, Community, and Family Education (WCME) in the course section of this catalog for courses pertaining to this program.

**M.A.—Plan A and Plan B**

**Degree Requirements**

The M.A. is offered under Plan A and Plan B. Students in either plan complete a minimum of 30 credits at or above the 5xxx level, including a minimum of 14 credits in the major and 6 credits in the related field. Plan A students also take 10 thesis credits; Plan B students complete a 3- to 6-credit project or paper, with remaining credits taken in either the major or related field.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—The master’s minor requires a minimum of 6 credits in one of the specializations, approved by the director of graduate studies.

**Ph.D.**

**Degree Requirements**

The Ph.D. requires 60 course credits and 24 thesis credits. Course credits include a minimum of 16 credits in general aspects, a minimum of 16 credits in research, and a minimum of 16 credits in the specialization. Course credits must also include 12 elective credits and 12 credits from outside the department, which may overlap with those in general aspects, research, and the specialization.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—The doctoral minor requires a minimum of 12 credits in one of the specializations, approved by the director of graduate studies.

**Educational Administration**

**Certificate of Specialist**

*Note:* For information, contact the program director of graduate studies.

**Educational Policy and Administration**

The Department of Educational Policy and Administration is committed to the study of education policy and to the preparation of leaders who can act effectively and ethically within the structures, processes, and cultural contexts of organized education. The department prepares administrators, scholars, and analysts for leadership roles in education through four complementary but distinct program emphases: educational administration, evaluation studies, higher education, and comparative and international development education. Three Graduate School degrees are offered through the department: M.A., Ed.D., and Ph.D.

Academic work in educational policy and administration is discipline-based and carefully designed, yet flexible in the options for degrees and specializations. The programs incorporate relevant knowledge from the behavioral and social sciences and the humanities, with primary reliance on sociology, management science, political science, public affairs, economics, philosophy, history, and anthropology. While these disciplines undergird graduate studies in the department, each program draws upon them in unique ways.

**M.A.—Plan B**

**Degree Requirements**

The M.A. is available with emphasis in educational administration, evaluation studies, higher education, or comparative and international development education. All M.A. programs include 12 or more credits in program core courses, 6 or more credits in a related field, 6 or more credits in methodology courses, and 2-4 credits for the Plan B paper. A Plan B research paper and final oral exam are also required. Within the general framework for M.A. requirements in educational policy and administration, the M.A. degree program is developed by the student and his or her adviser, subject to approval by the department’s director of graduate studies and the Graduate School.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Ph.D.**

**Degree Requirements**

The Ph.D. is available with emphasis in educational administration, evaluation studies, higher education, or comparative and international development education. All Ph.D. programs include 10 credits in department core courses, 12 or more credits in program core courses, 6 or more credits in other program courses, 12 or more credits in methodology courses, 12 or more credits in a supporting program or minor, and 24 thesis credits. Preliminary written and oral exams are required, and students must complete a dissertation. Within the general framework for Ph.D. requirements in educational policy and administration, the Ph.D. degree program is developed by the student and his or her adviser, subject to approval by the department’s director of graduate studies and the Graduate School.

**Language Requirements**—None.

**Ed.D.**

The doctor of education (Ed.D.) is a professionally oriented degree program for those who will provide leadership in educational institutions. The program emphasizes breadth of preparation in educational policy and administration and in related fields such as curriculum and instruction, educational psychology, work/ community/family education, and the historical, social, and philosophical foundations of education. Through courses, seminars, workshops, and independent study, students learn to apply the products of disciplined inquiry to educational policy issues and practical situations in educational environments.
Degree Requirements
The Ed.D. is offered in two areas in educational policy and administration: educational administration and the leadership academy (postsecondary education). The Ed.D. degree is offered only in the context of cohort programs of 20-30 students each. The following framework applies to all Ed.D. cohort programs in the Department of Educational Policy and Administration. Within this framework, specific course requirements are developed for each program emphasis and cohort.

Department Core (6 cr): EdPA 5001—Formal Organizations in Education, and EdPA 8002—Critical Issues in Contemporary Education
Program Core (18 cr), including philosophical and social foundations, leadership (includes management and planning), policy (strategic, legal, fiscal, legislative), and programs and practices (serving special needs, collaborative services)
Methodology (at least 9 cr), including research design, program evaluation, and statistical methods
Supporting Courses in EdPA and College of Education and Human Development (18 cr)
Supporting Courses outside College of Education and Human Development (3 cr)
EdD Project (24 thesis cr)
Preliminary written and oral exams are required, and students must complete a professional field project that contributes to the improvement of educational policy or practice.

Language Requirements—None.
Final Exam—The final exam is oral.

Educational Psychology—Counseling/Personnel
The counseling and student personnel psychology (CSPP) program subscribes to the scientist/practitioner model, which assumes that scholarly inquiry and counseling practice are interdependent and complementary. The program prepares counseling psychologists who will use their professional training to apply psychological and educational knowledge. Students become skilled clinicians and critical producers and users of qualitative and quantitative research.

Certificate of Specialist
Degree Requirements
Students must complete at least 60 credits, including 11 credits in EPsy core courses (statistics, measurement, learning, social psychology, and personality), 26 credits in counseling theory and practice, and at least 10 additional credits within educational psychology.

Language Requirements—None.
Final Exam—The final exam is oral.

M.A.—Plan A and Plan B
Degree Requirements
Students must complete at least 43 credits, including 11 credits in EPsy core courses (statistics, measurement, learning, social psychology, and personality), 26 credits in counseling theory and practice, and 6 credits in a related field or minor. Plan A students must also take 10 thesis credits.

Language Requirements—None.
Final Exam—The final exam is written; students must also submit a portfolio.

Minor Requirements for Students Majoring in Other Fields—A master’s minor requires at least 6 credits of graduate-level EPsy courses.

Ph.D.
Degree Requirements
Students must complete 26 credits in EPsy core courses (statistics, measurement, learning, social psychology, personality, foundations, and research methods); 51 credits in counseling theory and practice, practica, and internships; 12 credits in a supporting program or minor; and 24 thesis credits.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—A doctoral minor requires at least 14 credits of graduate-level EPsy courses: 8 credits in psychological foundations and 6 credits in applied areas, of which at least 8 credits must be 8xxx level; the minor is not covered in the preliminary exams.

Educational Psychology—Psychological Foundations
Graduate study in psychological foundations of education prepares students for research and teaching positions in colleges and universities, schools, private industry, human service organizations, health science units, government agencies, and other research and development centers. Graduates of the program are typically employed as professors, researchers, directors of testing, instructional designers, evaluation specialists, planning officers, statisticians, and computer programmers. Students may specialize in the methodological or psychological foundations of education.

The program offers M.A. and Ph.D. degrees with emphases in statistics, social psychology, research methods, personality, measurement, learning and cognition, human relations, computer applications, educational technology, and evaluation. Students typically choose one of these areas in addition to achieving broad competence in all aspects of the curriculum.

M.A.—Plan A and Plan B
Degree Requirements
Students must complete at least 30 credits, including 11 credits in EPsy core courses (statistics, measurement, learning, social psychology, and personality) and 6 credits in a related field or minor. Plan A students must also take 10 thesis credits.

Language Requirements—None.
Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A master’s minor requires at least 6 credits of graduate-level EPsy courses.

Ph.D.
Degree Requirements
Students must complete 26 credits in EPsy core courses (statistics, measurement, learning, social psychology, personality, foundations, and research methods), 12 credits of EPsy electives, 12 credits in a supporting program or minor, and 24 thesis credits.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—A doctoral minor requires at least 14 credits of graduate-level courses in EPsy: 8 credits in psychological foundations and 6 in applied areas, of which at least 8 credits must be 8xxx level; the minor is not covered in the preliminary exams.

Educational Psychology—School Psychology
School psychology is an interdepartmental program involving the Departments of Educational Psychology and Psychology and the Institute of Child Development. It is fully accredited by the American Psychological Association, the Minnesota Board of Teaching, and the National Association of School Psychologists. Through coursework and practica/internships, students develop competencies in assessment, consultation, intervention and program development, research, and evaluation. Graduates are employed as psychologists in local schools, university clinics and hospitals, and community mental health centers, and as trainers/researchers in universities. Since 1988, training has focused on the delivery of
psychological services in schools and school communities to promote children’s and adolescents’ academic, social, and behavioral success.

The program integrates didactic and experiential components of training and applied research. Students develop specific competencies through a broad range of applied experiences, including field placements, practical assignments, and a full-year internship.

Certificate of Specialist

The specialist program, which is for students who want to become practitioners, meets the Minnesota certification requirements for school psychologists.

Degree Requirements

Students must complete at least 60 credits, including 11 credits in EPsy core courses (statistics, measurement, learning, social psychology, and personality) and 21 credits in school psychology theory and practice and child development, followed by a year-long internship designed to first meet requirements for the M.A. degree in educational psychology, then the specialist certificate in school psychological services and certification under Minnesota state regulations.

Language Requirements—None.

Final Exam—The final exam is a written, special field exam.

M.A.—Plan A and Plan B

Degree Requirements

The M.A. is offered under Plan A (thesis) and Plan B (paper) and requires at least 30 credits: 11 credits in EPsy core courses (statistics, measurement, learning, social psychology, and personality) and 6 credits in a related field or minor. Plan A students must also take 10 thesis credits; Plan B students take 2 research credits (EPsy 8900).

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A master’s minor requires at least 6 credits of graduate-level EPsy courses.

Ph.D.

The Ph.D. program educates future school-based researchers, with emphases in family/school partnerships, outcome assessment, school dropouts, and school outcomes and interventions for children/adolescents at risk.

Degree Requirements

Students must complete 26 credits in EPsy core courses (statistics, measurement, learning, social psychology, personality, foundations, and research methods). In consultation with their advisers, students develop a curriculum and select courses and practica placements that are appropriate to their interests, prior experience, and career directions.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—A doctoral minor requires at least 14 credits of graduate-level EPsy courses: 8 credits in psychological foundations and 6 credits in applied areas, of which at least 8 credits must be 8xxx level; the minor is not covered in the preliminary exams.

Educational Psychology—Special Education

M.A., Ph.D., and certificate of specialist degrees are offered in special education in the following specializations: deaf/hard-of-hearing, social/emotional disabilities, early childhood special education, learning disabilities, mild/moderate disabilities, severe/profound disabilities, physical/health disabilities, and blind/visual disabilities. Early involvement in research projects and the development of original research programs in such areas as instructional strategies, social and cognitive development, behavioral and psychological management, child development, and technology are encouraged. Special projects and training programs supplement academic studies. The program focuses on the attainment of core competencies and related skills, since special education professionals share many common concerns and goals. A complementary emphasis is placed on problems unique or extremely influential in the field, including social and cultural perceptions about disabilities, and federal, state, and local legislation regarding prevention and the care, treatment, education, training, and support of persons with disabilities.

Certificate of Specialist

Degree Requirements

Students must complete 26 credits in EPsy core courses (statistics, measurement, learning, social psychology, personality, foundations, and research methods) and 6 credits in special education foundations. The remaining coursework usually focuses on two or more special education areas, determined in consultation with the adviser.

Language Requirements—None.

Final Exam—The final exam is oral.

M.A.—Plan A and Plan B

Students may emphasize consulting, administration, college teaching, or research in one or more of the specializations.

Degree Requirements

Students must complete at least 30 credits, including 11 credits in EPsy core courses (statistics, measurement, learning, social psychology, personality, and research methods), 6 credits in special education foundations, and 6 credits in a related field or minor. Plan A students must take 10 thesis credits.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A master’s minor requires at least 6 credits of graduate-level EPsy courses.

Ph.D.

The Ph.D. trains graduates to address problems related to the full development of individuals with disabilities and their families. Intensive course-related learning and guided experiences prepare students to assume professional leadership. Further competencies may be achieved in four areas of emphasis: research, professional, educational, and clinical practice/community service.

Degree Requirements

Students must complete 26 credits in EPsy core courses (statistics, measurement, learning, social psychology, personality, foundations, and research methods), 12 credits in special education (EPsy 8701 and 8702 and 6 additional credits, of which at least 2 must be from EPsy 86xx or 87xx offerings), 12 credits in a supporting program or minor, and 24 thesis credits.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—A doctoral minor requires at least 14 credits of graduate-level EPsy courses: 8 credits in psychological foundations and 6 in applied areas, of which at least 8 credits must be 8xxx level; the minor is not covered in the preliminary exams.
Electrical Engineering

The Department of Electrical and Computer Engineering offers diverse educational programs that encompass nearly all aspects of modern electrical and computer engineering, ranging from the very theoretical system and information theory to highly experimental work in novel device research and microelectronics. Emphases in the major are solid state and physical electronics, surface physics, thin films, sputtering, noise and fluctuation phenomena, quantum electronics, plasma physics, automation, power systems theory, wave propagation, communication systems and theory, optics, lasers, fiber optics, magnetism, semiconductor properties and devices, VLSI and WSI engineering in theory and practice, network theory, signal and image processing, and computer and systems engineering. Interdisciplinary work is also available in bioelectrical sciences, control sciences, computer sciences, solar energy, applications of systems theory to urban transportation and economic planning, and biological modeling.

M.E.E.—Coursework Only and Design Project

Degree Requirements
The M.E.E. degree is offered under both the design project and coursework-only tracks. Both options require 30 credits, including 1) at least 14 credits from electrical engineering courses numbered 5xxx and higher and 2) at least 6 credits from courses numbered 4xxx and higher in a minor or related field (which normally are from departments within the Institute of Technology or the statistics department, and never include electrical engineering courses). Colloquium and seminar credits cannot be used in any M.E.E. program. A design project program should include 10 credits for the design project, which do not count toward meeting the major coursework credit requirement.

Language Requirements—None.

Final Exam—A final oral exam is required for the design project track; no final exam is required for the coursework-only track.

Minor Requirements for Students

Majoring in Other Fields—Credits for the master’s minor must be from classroom and laboratory courses graded A-F. In particular, colloquia, seminar, and special investigations credits do not count toward meeting the minor requirements.

M.S.E.E.—Plan A and Plan B

Degree Requirements
Every M.S.E.E. degree program must include 30 credits, including 1) at least 14 credits from electrical engineering courses at the 5xxx level or higher (no 4xxx electrical engineering courses can be used on the program) and 2) at least 6 credits from courses outside electrical engineering at the 4xxx level or higher (normally from departments in the Institute of Technology or statistics; these credits cannot come from colloquia or seminar registrations). A Plan A program (with thesis) cannot include more than 2 credits from projects, seminars, special investigations, or directed studies; in a Plan B program (without thesis) the limit is 3 credits. A Plan A program should include 10 thesis credits. Part-time students must choose Plan B; full-time students may choose either Plan A or Plan B.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students

Majoring in Other Fields—The 6 credits for the master’s minor must be from classroom and laboratory courses graded A-F. In particular, colloquia, seminar, and special investigations credits do not count toward meeting the minor requirements.

Ph.D.

Degree Requirements
The Ph.D. requires at least 40 course credits, including 1) at least 6 credits in 7xxx courses, 2) at least 14 credits in electrical engineering courses, and 3) at least 12 credits in the supporting program or minor, which cannot include electrical engineering courses. In addition, 24 thesis credits are required. The program may contain up to 2 credits from seminars or special investigations registrations and up to 8 credits of M.S. thesis registration, none of which can be used to meet the requirements under 1), 2), or 3) above. No credits can be included from colloquia or M.S. Plan B projects. At least 14 credits must be coursework taken at the University of Minnesota. The degree program form should be submitted no later than the end of the second year of the Ph.D. program. Each Ph.D. student must complete the department’s program in oral paper presentation before the thesis proposal will be approved.

Language Requirements—None.

Minor Requirements for Students

Majoring in Other Fields—The 12 credits for the Ph.D. minor must be from classroom and laboratory courses graded A-F. In particular, colloquia, seminar, and special investigations credits do not count toward meeting the minor requirements.

Elementary Education

M.A.—Plan B

By focusing on the curricular and instructional processes central to all educational endeavors, graduate programs within the Department of Curriculum and Instruction prepare students for professional roles in pre-K-12 education, in postsecondary and research settings, and in educational service agencies.

The M.A. in elementary education typically concentrates on one or two curriculum areas and includes foundational coursework in the area(s) of concentration, together with courses offering research review and preparation. Please refer to Curriculum and Instruction (CI) and Education (Educ) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
The program requires 30 credits, which includes a minimum of 14 credits in CI courses focusing on elementary education (e.g., Teaching Reading in the Elementary School, Teaching Science and Health in the Elementary School), with 3-6 credits applied to the Plan B paper. A balanced program of coursework is selected in curriculum and instructional research related to each student’s area of concentration.

Language Requirements—None.

Final Exam—The final exam is oral.

English

Over the past 20 years, the field of English studies has dramatically changed from a discipline concerned with studying the literary works produced by English speakers in Britain and the United States to encompass writings in English from around the globe. The concerns of literary scholars have broadened to include not only textual analyses but also cultural, social, political, and economic contexts. The field of literature itself now includes not only the traditional genres of poetry, prose (fiction and belles-lettres), and drama, but also extra-literary discourses: folklore, popular culture, film, television, legal documents, conduct books, and manifestoes. English as a field has moved to embrace its natural borders with cultural studies, feminist studies, and area studies. The department has been in the forefront of interdisciplinary projects, thanks to the efforts of a faculty committed to research in American studies, medieval studies, feminist studies, film studies, and cultural studies. At the same time, the department maintains the core concerns of the discipline—the traditional study of the literatures and languages in English—as well as develops writers for the present and future through the master of fine arts in creative writing degree (see creative writing for program information). The department is engaged in two simultaneous projects: to preserve the core curriculum and to reimagine its future shape.

The Department of English offers two master’s degrees, the master of arts in English language and literature and the master of fine arts in creative writing. The M.A. offers extensive training in the areas of literary history, literary theory and interpretation, language, linguistics, rhetoric, and composition. Students in the M.A. can
Degree Programs

develop specific concentrations through consultation with the director of graduate studies. The M.A. is a terminal degree and is not normally a route to the Ph.D.

Please refer to English Composition (EngC), English: Creative and Professional Writing (EngW), and English Language and Literature (EngL) in the course section of this catalog for courses pertaining to this program.

M.A.—Plan B

Degree Requirements
The minimum requirement for the M.A. is 30 credits. Coursework must include at least 24 credits in English and 6 credits in related fields outside of English or in a minor field. All M.A. students must complete the two-semester introductory sequence EngL 5001-5002 on methods and theory of literary study; at least 12 credits in English at the 5xxx course level and 4 credits in English at the 8xxx seminar level; and three Plan B papers, one of which will constitute a capstone project supervised by two faculty members chosen by the student.

Language Requirements—For the M.A., a reading knowledge of one classical or modern language, approved by the director of graduate studies, is required.

Final Exam—None.

Minor Requirements for Students

Majoring in Other Fields—A minimum of 16 undergraduate semester credits in English literature is a prerequisite for undertaking a minor in English. For a master’s minor, 8 course credits are required.

Ph.D.

Degree Requirements
A minimum of 66 credits, including 24 thesis credits, is required. Course requirements for the Ph.D. program are broadly defined, allowing students to shape a personal program of study. The following courses are required: EngL 5001 and 5002, preferably during the first year of doctoral study (6 credits); four English courses distributed among broad areas (minimum of 12 credits); four additional English courses in a focused area of emphasis (minimum of 12 credits); 12 credits in a supporting program. At least four of the above courses, in addition to the introductory sequence, must be taken at the 5xxx level, and at least three of the above courses must be taken at the 8xxx seminar level. Students are encouraged to enroll in additional courses as appropriate.

Language Requirements—For the Ph.D., a reading knowledge of two languages, classical or modern, approved by the director of graduate studies, is required. Students specializing in medieval or early modern literature and culture are advised to include Latin for one of their languages.

Minor Requirements for Students

Majoring in Other Fields—A minimum of 16 semester credits in English literature is a prerequisite for the minor. The minor consists of 12 credits in English. Course selection is determined in consultation with the director of graduate studies.

English as a Second Language

M.A.—Plan A and Plan B

The program in English as a second language (ESL) offers a course of study leading to the master of arts (M.A.). Degree holders are qualified to teach ESL to adults at the college or university level. The program emphasizes research in language analysis, language acquisition, teaching methodology, materials development, and intercultural communication. Students are expected to do independent and creative work in one or two of these areas with the aim of developing a more complete understanding of the issues facing professionals in the field of ESL today.

Please refer to Teaching English as a Second Language (TESL) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
The M.A. program in ESL normally takes at least two years to complete. The Plan A option requires a thesis demonstrating original work in areas related to the field, familiarity with research methodology, and knowledge of the effective presentation of investigative study results. The Plan B option requires two qualifying papers, usually consisting of course papers which have been rewritten under the supervision of a faculty member. The same standards of excellence are applied to both Plan A and Plan B options.

Plan A and Plan B students must complete 24 credits in required coursework and 6 credits of elective coursework in related fields. Plan A students must complete an additional 10 thesis credits for a total of 40 credits and Plan B students must complete an additional 3 credits in elective coursework for a total of 33 credits. Elective and related field courses must be chosen with the help of an adviser to ensure the relevance of courses to students’ goals.

Language Requirements—Proficiency, demonstrated by exam or coursework, in one language not native to the student is required upon completion of the program.

Final Exam—The final exam is oral.

Minor Requirements for Students

Majoring in Other Fields—For a minor in ESL, students must take TESL 5721, TESL 5401, and TESL 5402, for a total of 11 credits.

Entomology

Entomology centers on the study of insects and includes specializations in ecology, behavior, molecular genetics, microbiology, neurobiology, physiology, population dynamics, systematics, and taxonomy. Specialized or applied areas include apiculture, biological control, cell culture, insect conservation, insect-vector relations, integrated pest management, and modeling. Research programs are active in aquatic systems, crop and animal agriculture, human health, and the natural and urban environments.

M.S.—Plan A and Plan B

Degree Requirements
Requirements for the M.S. include a minimum of 20 course credits for Plan A plus 10 thesis credits, and 30 course credits for Plan B. Students take a core curriculum of fundamental entomology courses and 2 credits of graduate seminar. Additional requirements are flexible and are determined in consultation with the adviser and other members of the student’s advisory committee. Plan A is recommended for students contemplating a career in entomological research. Written and oral preliminary exams, in addition to the final oral exam, are required for all entomology graduate degrees.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students

Majoring in Other Fields—A master’s minor requires 6 credits in 4xxx, 5xxx, or 8xxx entomology courses.

Ph.D.

Degree Requirements
Ph.D. requirements include a core curriculum of fundamental entomology courses and 2 credits of graduate seminar. Additional requirements are flexible and are determined in consultation with the adviser and other members of the student’s advisory committee.

Language Requirements—None.

Minor Requirements for Students

Majoring in Other Fields—The doctoral minor requires 12 credits in 4xxx, 5xxx, or 8xxx entomology courses, including Ent 5021.
Environmental Health

Environmental health is concerned with the interface between people and their environments: work, home, and the outdoors. Understanding how exposures to external hazards create a toxic dose, how that dose may elicit biological responses, and how those responses may progress to disease or injury are the areas uniquely addressed by environmental health professionals. This division offers academic programs at the master’s and doctoral levels, conducts research in diverse areas of occupational and environmental health, and undertakes continuing education and outreach efforts. The academic programs prepare students to be leaders and practitioners in environmental and occupational health in industry, academia, agencies delivering preventive health services and health care, consulting groups, and government and public sector agencies. The division’s training and research programs emphasize the importance and applications of basic scientific knowledge to current societal problems and concerns. Applicants must indicate an interest in one of the following specialties within this major: industrial hygiene, environmental chemistry, environmental and occupational epidemiology, environmental toxicology, environmental health policy, occupational health nursing, and environmental microbiology.

Please refer to Public Health (PubH), particularly numbers 51xx-52xx and 81xx-82xx, in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B

The M.S. program prepares students for specialized careers in environmental and occupational health. M.S. students receive a solid technical background in their disciplines and by graduation are proficient in applied or basic research.

Degree Requirements

The minimum credits required for graduation is dependent upon the specialty area chosen, most of which require a two-year program. M.S. students have the option of completing a Plan A with a thesis or a Plan B project.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—Students completing a minor in environmental health must complete 7 credits in environmental health, including PubH 5105—Environmental and Occupational Health Policy (3 cr), PubH 5104—Toxicology and Epidemiologic Methods for Evaluation of Environmental Health Hazards (2 cr), and PubH 5103—Exposure to Environmental Hazards (2 cr).

Ph.D.

Degree Requirements

The Ph.D. focuses on research, supplemented with advanced coursework and developed under the guidance of a faculty adviser and a Ph.D. committee. Students are required to register for 24 thesis credits. Students usually require a minimum of two to three years beyond the master’s degree to complete the doctorate.

Language Requirements—For the doctoral degree, reading ability in a foreign language or additional coursework is required at the discretion of the adviser.

Minor Requirements for Students Majoring in Other Fields—Students are required to take a minimum of 12 credits in environmental health, including PubH 5105 Environmental and Occupational Health Policy (3 cr), PubH 5104 Toxicology and Epidemiologic Methods for Evaluation of Environmental Health Hazards (2 cr), and PubH 5103 Exposure to Environmental Hazards (2 cr).

Epidemiology

Epidemiology is the science that anchors public health. It is concerned with the occurrence, patterns, and prevention and control of disease in human populations. It observes, quantifies, and develops theories about the characteristics, causes, and prevention of occurrences affecting population health. Epidemiologic methods are applied to identify and understand causes and effects of public health problems and are also applied in the planning and evaluation of public health interventions to reduce population diseases or to evaluate outcomes of health services delivery. Epidemiologic investigations range from the specific (e.g., finding the cause of outbreaks of infectious disease, disease caused by acute exposures, or the genetic basis of population disease patterns) to the general (e.g., determining causes of worldwide patterns of diseases). At the University, epidemiology also includes the study of prevention programs and policies from a behavioral and social science base.

Please refer to Public Health (PubH), particularly numbers 53xx and 83xx, in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B

M.S. students gain the knowledge and skills needed either for a professional position in epidemiology or to proceed to a doctoral program in epidemiology or a related field.

Degree Requirements

The M.S. program offers a 30-credit curriculum for students who have completed an M.D., D.D.S., D.V.M., or Ph.D. in a related field, and a 45-credit curriculum for students with other backgrounds. Students complete a two-course sequence in epidemiology; a two-course sequence in biostatistics; public health core courses in management and environmental health; courses in statistical computing, data collection, behavioral science, and the epidemiology of cardiovascular disease, cancer, or infectious diseases; elective courses; and a master’s project presentation seminar. The 45-credit program also requires one course in human physiology and one in the pathobiology of human disease. Students in both programs also complete a master’s project and an internship.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—The master’s minor requires 7 credits.

Ph.D.

The Ph.D. program is for students interested in research and teaching careers. Students select one of two field concentrations: the social and behavioral or the biologic aspects of disease etiology and prevention, with particular emphasis on cardiovascular disease; cancer; alcohol, tobacco, and other substance abuse; and infectious diseases. Both concentrations use an empirical perspective and emphasize study design, measurement, analysis, and interpretation.

Degree Requirements

The Ph.D. program includes a core curriculum of 63-69 credits. In addition to the preliminary exam and dissertation requirements, students must prepare a manuscript for publication as senior author. Coursework includes 16 credits in epidemiology and biostatistics core courses; 6 credits in advanced courses (advanced epidemiologic theory, teaching practicum, writing research grants, seminar on epidemiologic issues); 4-6 credits in Ph.D.-specific electives; 24 thesis credits; 6-8 credits (three courses) of epidemiologic-related interventions/methods taken from a menu of courses (e.g., Cancer Epidemiology, Public Health Policy as a Prevention Strategy, Smoking Intervention); and 7-9 credits in advanced biologically or behaviorally related courses.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—The minor in epidemiology is under revision. Contact the director of graduate studies in epidemiology for current information.
Experimental Surgery

M.S.Exp.Surg.—Plan A

The general surgery program trains medical doctors for the practice of surgery and for academic positions. See the Medical School Catalog for professional degree requirements; see below for academic degree requirements. Trainees spend two to three years in laboratory research, either in a basic science or in surgery, after which they begin their senior residency and chief residency training. The Medical School’s laboratory departments offer many graduate courses closely related to surgery (see the graduate programs in anatomy; biochemistry, molecular biology and biophysics; cellular and integrative physiology; microbiology, immunology, and molecular pathobiology; and pharmacology). These fields also offer opportunities for research work. The Department of Surgery offers supervised work in its experimental research laboratories, as well as in its hospital and outpatient departments, in the areas of surgical diagnosis and operative surgery and in some surgical specialties (such as colon and rectal surgery, transplantation, thoracic and cardiovascular surgery, and pediatric surgery). The experimental surgery program provides an opportunity to gain practical research experience.

Please refer to Surgery (Surg) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The M.S. Exp.Surg. is offered under Plan A only. A minimum of 32 course credits (26 in the major and 6 in the minor or related fields) plus 10 thesis credits are required for a total of 42 credits.

Language Requirements—None.

Final Exam—The final exam is oral.

Family Practice and Community Health

M.S.—Plan B

The M.S. program emphasizes acquisition of academic and investigative, rather than clinical, skills in the discipline of family medicine. The program aims to produce physician scholars who will devote their careers to teaching, research, and academic administration as well as clinical practice, and who will enlarge the knowledge base of the discipline. The program is distinct from the residency training program in family practice and community health and from the department’s fellowship programs. Applicants to the M.S. program must already hold an M.D. or D.O. degree.

Degree Requirements

The M.S. is offered under Plan B only. At least 30 credits are required, of which a minimum of 14 credits must be from the major field. Nonclinical courses must make up at least 50 percent of the credits in the major; if the total number of credits in the major is 20 or fewer, a minimum of 11 credits must be in nonclinical courses. For the minor, at least 6 credits are required. Courses may be taken from more than one department if they are relevant to the major and form a coherent sequence related to the minor. All courses included in the minor must be nonclinical, and must be taken A-F. In lieu of a minor, students may take a minimum 6 credits in related nonclinical fields outside the major.

Language Requirements—None.

Final Exam—The final exam is oral.

Family Social Science

Family social science is a multidisciplinary department offering an integrated program of study that uses the knowledge and methods of social science to examine family systems and their interactions with various environments. The mission of family social science is the enhancement of family functioning in diverse family settings through the generation and application of knowledge about families in a changing world. Students acquire a broad knowledge of family social science, engage in independent research related to families, and specialize in areas of application to human problems. The program assists students in integrating family theory, research, and practice; producing family research; and demonstrating competencies in two or more human problem areas of family social science.

M.A.—Plan A and Plan B

Degree Requirements

The M.A. program is offered under Plan A and Plan B. Plan A requires a minimum of 30 credits, including at least 20 course credits, of which 6 credits are outside the department in a related field, and 10 thesis credits. The Plan A master’s is for students who intend to pursue a Ph.D. degree.

Plan B requires a minimum of 30 credits, including at least 26 course credits, of which 6 credits are outside the department in a related field, and at least 4 credits for a Plan B project.

Language Requirements—None.

Final Exam—The final exam is oral.

Feminist Studies

M.A.—Plan B

The M.A. is available only to students admitted to the Ph.D. program who wish to secure this credential for ABD employment purposes or because they need to exit the program. It is similar to the Ph.D., but with fewer credits and no dissertation.

Please refer to Women’s Studies (WoSt) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The M.A. requires 6 credits of Feminist Theory and Methods (WoSt 8108-8109), 3 credits of History of Western Feminism (WoSt 5101), 6 course credits satisfying the history and diversity requirement, 6 elective credits in advanced women’s studies, and 9 credits in a related field or in a declared minor. In addition, three Plan B papers and a final oral exam are required (which are effectively identical to the Ph.D. preliminary written and oral exams.)

Language Requirements—None.

Final Exam—The final exam is oral.
Minor Requirements for Students

Majoring in Other Fields—A master’s minor requires WoSt 8108 and 8109 and two graduate-level electives approved by the director of graduate studies for feminist studies.

Ph.D.

The Ph.D. program is an interdisciplinary, multicultural, and international study of women and gender in which students develop competence in interdisciplinary and disciplinary feminist theories, research methods, and educational methods. The program pays theoretical and practical attention to all aspects of women’s diversity, nationally and globally. Students select a disciplinary focus from among the concentrations of feminist theory, literary studies, historical studies, and social sciences and public policy. The program anticipates adding a fifth concentration in gender and international development. Students may, with the advice and consent of the director of graduate studies, design their own area of concentration.

Please refer to Women’s Studies (WoSt) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The courses required for the Ph.D. fall into roughly two categories: interdisciplinary courses satisfying core requirements and courses constituting or enhancing a concentration. Students take 18 credits in required courses, including two electives from a list of courses that satisfy the core requirement in the history of feminism and cultural diversity. The remainder of coursework is coordinated into one of the four areas of concentration and includes 12 credits in the area of concentration, 6 credits in research methods, and 12 credits in the minor field or supporting program (related to the area of concentration). Students are also expected to register for up to 4 credits of WoSt 8996 Colloquium; to participate in a weekly or biweekly series of faculty, student, and guest lecturer presentations; and register for 24 thesis credits.

Because some courses may fall into more than one category, e.g., courses in the concentration may also satisfy core course requirements, students are permitted to double count up to 6 credits in the major program. The minimum requirement of 42 course credits is therefore less than simple addition would suggest.

Language Requirements—None.

Minor Requirements for Students

Majoring in Other Fields—To complete a Ph.D. minor, students must successfully complete WoSt 8108 and 8109 and three graduate-level electives (9 credits) drawn from a list of eligible courses determined by the director of graduate studies for feminist studies.

Fisheries

The fisheries program combines basic biology and ecology with other academic areas and with applied problem solving in natural resource management and conservation. The main areas of specialization are fish ecology, fish behavior, fish physiology, fisheries ecology and management, population genetics and conservation, population modeling and management, stream ecology, exotic/introduced species management and control, and aquaculture.

Please refer to Fisheries and Wildlife (FW) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B

Degree Requirements

Both Plan A (with thesis) and Plan B (without thesis) programs are offered. Plan A and Plan B require a minimum of 14 course credits in the major and 6 course credits in a minor or related field; Plan A also requires 10 thesis credits, and Plan B requires 10 additional course credits. The Plan A thesis should be in an area of specialization. Coursework requirements are flexible, but typically include courses in fisheries, limnology or aquatic biology, statistics and biometrics, computer science, and related subjects. Programs may include a traditional minor or coursework in a related field. An oral preliminary exam is required.

Language Requirements—None.

Final Exam—the final exam is oral.

Minor Requirements for Students

Majoring in Other Fields—A master’s minor requires 6 credits of courses approved by the director of graduate studies.

Ph.D.

Degree Requirements

The doctoral program includes a major research effort in the areas of emphasis, resulting in a written dissertation. It also includes advanced coursework in fisheries, limnology or aquatic ecology, and related subjects.

Language Requirements—None.

Minor Requirements for Students

Majoring in Other Fields—A doctoral minor requires 12 credits of courses approved by the director of graduate studies.

Food Science

Food science applies scientific principles to the manufacture, distribution, marketing, and consumer aspects of food. Food scientists apply the basic principles and techniques of many disciplines, including chemistry, physics, microbiology, and nutrition, to food processing and preservation, new product development, and food marketing. Food scientists are concerned with the theoretical and practical aspects of the food chain, from the production of raw materials to the use of food products by consumers.

Please refer to Food Science and Nutrition (FScN) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B

Degree Requirements

The M.S. offers both Plan A (with thesis) and Plan B (without thesis) options. All students must complete the 8-credit core course requirement (FScN 8311-8318) and the general seminar (FScN 8310). An additional 6 credits must be taken in a minor or related field. Plan A requires additional approved food science courses to meet the minimum 14-credit requirement for the major, plus 10 thesis credits. Plan B requires an additional 10 credits of approved food science courses and must write a Plan B paper. The minor may be chosen from fields such as biochemistry, chemistry, chemical engineering, microbiology, nutrition, and statistics.

M.S. students may exceed the 40 percent limit on transfer of University College credits customarily permitted in the Graduate School. Students wishing to do so must consult the director of graduate studies.

Language Requirements—None.

Minor Requirements for Students

Majoring in Other Fields—For a master’s minor, two of the following courses must be taken: FScN 4111, 4121, or 4331, which will total 7 or 8 credits. The minor must be approved by the food science director of graduate studies.

Ph.D.

Degree Requirements

All Ph.D. students must complete the 8-credit core course requirement (FScN 8311-8318) plus the general seminar (FScN 8310). (If FScN 8311-8318 were taken for completion of the M.S. at the University of Minnesota, they do not need to be repeated.) Additional courses in the major are determined by the student and the adviser with the approval of the graduate studies committee. Students must also take 12 credits in a minor or additional supporting program with the approval of the graduate studies committee (if a student has completed an M.S. at the University of Minnesota, the total additional credits in the supporting field or minor is 6 credits). Students must also register for 24 thesis credits.

Language Requirements—None.

Minor Requirements for Students

Majoring in Other Fields—For a Ph.D. minor, students must take FScN 4111, 4121, 4331, and other courses, for a total of 12 credits. The minor must be approved by the food science director of graduate studies.
**Forestry**

Forestry students normally emphasize one of the following subfields: the chemistry of lignocellulosic materials; paper and fiber products recycling; deterioration of wood; wood mechanics; structural design with wood; wood moisture interaction and drying; processing and performance of wood composites; economics of manufacturing systems; technology and processing of solid wood products; design and production of housing components; energy-efficient building construction; ecology and silviculture; ecophysiology; economics in forest and related natural resource management; genetics and tree improvement; geographic information systems; hydrology and water quality; watershed management; survey, measurement, and modeling; policy and administration; tree physiology and tissue culture; recreation land management; remote sensing; and urban forestry.

Please refer to Forestry (Fors), Forest Resources (FR), Natural Resources and Environmental Studies (NRES), and Wood and Paper Science (WPS) in the course section of this catalog for courses pertaining to this program.

**M.F.**

**Degree Requirements**

The M.F. requires 30 course credits; no thesis or Plan B paper is required. Students are required to complete basic science and introductory forestry courses if not included in their undergraduate program.

**Language Requirements—**

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—Students who wish to minor in forestry should contact the director of graduate studies. The selection of courses is influenced by the student’s background and educational objective. Minor field competence is evaluated in the oral exam.

**M.S.—Plan A and Plan B**

**Degree Requirements**

The M.S. is offered under Plan A (with thesis) and Plan B (without thesis). The minimum number of course credits for Plan A is 20 credits and for Plan B is 30 credits; Plan A students also register for 10 thesis credits. Plan A students usually design a program to support their specific thesis project. Plan B students design a program, in consultation with faculty members, that develops competence in one or more subfields. Students are required to present a seminar on the thesis, Plan B project, or a topic selected in consultation with the graduate adviser. Specific requirements vary by subfield; prospective students should contact the director of graduate studies or a prospective faculty adviser for specific information.

**Language Requirements—**

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—Students who wish to minor in forestry should contact the director of graduate studies. The selection of courses is influenced by the student’s background and educational objective. Minor field competence is evaluated in the oral exam.

**Ph.D.**

**Degree Requirements**

The doctoral program is designed to ensure that students gain the necessary competence in their subfield for independent research. Programs normally vary from 30 to 60 credits, not including 24 thesis credits. Course selection and thesis proposals are developed by each student in consultation with the faculty adviser for review and approval by the forestry graduate study committee.

**Language Requirements—**

Minor Requirements for Students Majoring in Other Fields—Students who wish to minor in forestry should contact the director of graduate studies. The selection of courses is influenced by the student’s background and educational objective. Minor field competence is evaluated in the oral exam.

**French**

The program covers all areas of French literature and culture from the Middle Ages to the present. Traditional areas of study and scholarship are influenced by the faculty’s interests, expertise, and research in areas that have shaped—and continue to shape—the discipline of French studies. The program has particular strengths in literary and cultural studies, critical theory, feminist studies, medieval studies, and francophone studies. In their teaching and research, the faculty considers literature critically and interdisciplinarily, engaging it in its intersections with other discourses and symbolic systems, such as history, philosophy, music, the visual arts, psychoanalysis, political and legal theory, and performance.

Please refer to French (Fren) and French and Italian (FrIt) in the course section of this catalog for courses pertaining to this program.

**M.A.—Plan A and Plan B**

**Degree Requirements**

Students may pursue Plan A (with thesis) or Plan B (without thesis). Plan A requires a minimum of 34 credits, Plan B a minimum of 33 credits. Both plans require at least 18 credits in the major, and 6 credits in related fields or, in the case of a minor, the number of credits required by the minor program (usually 6 credits). Plan A also requires 10 thesis credits.

**Language Requirements—**

Minor Requirements for Students Majoring in Other Fields—A master’s minor requires 9 credits.

**Ph.D.**

**Degree Requirements**

The Ph.D. requires 57 course credits and 24 thesis credits. Coursework involves a minimum of 45 credits in the major field and a minimum of 12 credits (usually four courses) outside the major in related fields or, in the case of a minor, the number of credits required by the major program (usually 12 credits).

**Language Requirements—**

Minor Requirements for Students Majoring in Other Fields—A Ph.D. minor requires 12 credits.

**Geographic Information Science**

**M.G.I.S.—Plan B**

The master of geographic information science (M.G.I.S.), offered by the Department of Geography, provides graduate-level work in the theory, applications, and technology of geographic information science (GIS). The degree is for students who 1) are currently working in GIS or a related area, such a surveying or planning, and wish to obtain advanced education to further their careers, 2) have a bachelor’s degree and wish to change careers but have no formal work experience/education in GIS, or 3) have recently obtained a B.A./B.S. in GIS and wish to pursue an advanced degree in GIS. The program 1) provides a comprehensive GIS degree that balances work in the theoretical/conceptual aspects of GIS (core classes), the technical side of the discipline (software/hardware), and the potential applications of GIS (applied project); 2) offers coursework at a time convenient for employed students (at night, early morning, or late afternoon); and 3) emphasizes the societal impacts of such technologies throughout the curriculum.
Degree Requirements
The degree is offered Plan B (nonthesis) and requires 35 credits, with 20 credits in core technology classes (only 6 credits may count from the technology course category), 9 credits of electives, and 6 credits of applied project, normally completed through enrollment in the Directed Research course. A minimum of 6 credits must be taken outside the geography department, but may include those taken in the core GIS classes (e.g., forest resources).

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A master’s minor is developed in consultation with an appropriate faculty adviser. Consult the M.G.I.S. director of graduate studies about selecting an adviser. The minimum requirement is 9 credits (3 courses).

Geography
Geography is broadly concerned with the study of human-environment relations and their visual representation. It emphasizes the significance of place, location, and scale in understanding the complexity of biophysical phenomena, patterns and processes of natural resource use, human settlements, economic development, political organization, and cultural and social landscapes. The program emphasizes research and teaching in the following areas: urban systems, environmental systems, regional geography and international development, geography of population and health, geographic information systems and cartography, and the history and philosophy of geography. It is a highly individualized program with a limited number of requirements. Students work with their advisers to design individual programs suited to their educational and professional goals.

M.A.—Plan A and Plan B
Degree Requirements
The M.A. is offered under Plan A (with thesis) and Plan B (without thesis). Plan A requires a minimum of 21 course credits (plus 10 thesis credits); Plan B, a minimum of 31 course credits. All students must take a minimum of two prosemnars and one research seminar in geography and two courses outside geography. The M.A. program is usually completed within 2 years.

Language Requirements—M.A. students are expected to acquire competency in the foreign language/research methodology necessary for their graduate research. This requirement is set by the advising committee, which is also responsible for certifying that the requirement has been met before the final exam.

Final Exam—The final exam is oral.

Degree Requirements for Students Majoring in Other Fields—A master’s minor must be developed in consultation with an appropriate faculty adviser. Consult the director of graduate studies about selecting an adviser. The minimum requirement is 6 credits (two courses).

Ph.D.
Degree Requirements
Each Ph.D. student is required to take a minimum of two prosemnars and two research seminars in geography, as well as as four courses outside geography (at least one at the 8xxx level). Students are also required to take 24 thesis credits and a minimum of three elective courses. Course credits from the M.A. program may be transferred to the Ph.D. program. Further details on degree requirements may be found in the department publication The Graduate Program in Geography at the University of Minnesota.

Language Requirements—Ph.D. students are expected to acquire competency in the foreign language/research methodology necessary for their graduate research. This requirement is set by the advising committee, which is also responsible for certifying that the requirement has been met before the final exam.

Minor Requirements for Students Majoring in Other Fields—A doctoral minor program must be developed in consultation with an appropriate faculty adviser. Consult the director of graduate studies about selecting an adviser. The minimum requirement is 9 credits (three courses).

Geological Engineering
The geological engineering program focuses on research and study in rock, soil, and groundwater mechanics. Study and research emphasize fundamental aspects of geomechanics and its applications. Research in geomechanics focuses on the use and development of continuum and discrete theories such as elasticity, plasticity, fracture mechanics, and poroelasticity for solving engineering problems dealing with rocks, soils, and bulk solids. Numerical methods are being developed for obtaining solutions, and modern experimental methods and novel apparatus are being applied and invented for gathering physical evidence. Examples of applications are processes of comminution, flow of granular materials, hydraulic fracturing, and static and dynamic joint and fault deformations.

M.Geo.E.—Design Project
The master of geological engineering (M.Geo.E.) degree is for those who wish to learn about applications of fundamentals in geological engineering beyond the B.S. degree. Students are expected to follow a coherent program of coursework selected with the help of a faculty adviser and approved by the director of graduate studies. Students also must demonstrate professional competence by carrying out and defending a design project. An M.Geo.E. degree typically takes one to two years to complete.

Degree Requirements
The M.Geo.E. requires 30 credits of graduate work: 20 course credits (6 from outside the department) and 10 credits toward a design project carried out in consultation with a faculty adviser. Students must maintain a GPA above 3.00.

Language Requirements—None.

Final Exam—A final oral exam is required of all M.Geo.E. students.

Minor Requirements for Students Majoring in Other Fields—For a master’s minor, two or more 5xxx to 8xxx courses from the same area of geological engineering are required, for a total of 6 or more credits.

M.S.—Plan A and Plan B
The master of science (M.S.) degree is for those who wish to learn about fundamentals and applications in geological engineering beyond the B.S. degree. Students are expected to follow a coherent program of coursework and research selected with the help of a faculty adviser and approved by the director of graduate studies. The M.S. typically takes one to two years to complete.

Degree Requirements
The M.S. requires 30 credits and is offered under two plans. Plan A emphasizes preparation of a thesis and Plan B emphasizes coursework. The thesis must be written on a research project carried out in consultation with a faculty adviser and should result in a scientific or technical contribution to the field. Under Plan B the student must demonstrate the ability to work independently and present results of such work effectively by completing one to three Plan B papers as determined by the faculty adviser. A wide variety of studies have been submitted as Plan B papers, including computer programs, annotated bibliographies, field investigations, and the analysis/design of special engineering problems. Plan A requires 20 course credits and 10 thesis credits. Plan B requires 30 course credits. At least 6 credits of coursework must be from outside the department. Students must maintain a GPA above 3.00.

Language Requirements—None.

Final Exam—The final exam is oral.
Degree Programs

Minor Requirements for Students Majoring in Other Fields—For a master’s minor, two or more 5xxx to 8xxx courses from geological engineering are required, for a total of 6 or more credits.

Ph.D.
The Ph.D. demands the ability and desire to pursue independent and original studies, and students enter the program normally after completing an M.S. degree. The Ph.D. typically takes four to six years to complete after the B.S. degree.

Degree Requirements
The Ph.D. program is flexible and is developed with the adviser. A typical program consists of 43 or more course credits beyond the bachelor’s degree plus 24 thesis credits. A supporting program or minor consisting of at least 12 credits is included in the coursework. Credits earned in an M.S. program may be presented in partial fulfillment of Ph.D. requirements. Although the department has no set requirement on the number of 8xxx courses, the Ph.D. represents the highest level of scholarly achievement, and coursework should be selected accordingly.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—For a Ph.D. minor, four or more 5xxx to 8xxx courses are required, for a total of 12 or more credits.

Geology
The geology major includes the areas of Quaternary studies, structural geology, stratigraphy, mineralogy, economic geology, experimental and theoretical petrology, isotopic and aqueous geochemistry, experimental geochemistry, geomorphology, glaciology, groundwater geology, limnology, and sedimentology. Students may accommodate other areas of interest, such as earth resources, engineering geology, environmental geology, materials science, soil science, and paleoecology by choosing a minor or supporting field from outside the department.

Please refer to Geology and Geophysics (Geo) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B and Coursework Only with Emphasis in Hydrogeology and Environmental Geoscience

Degree Requirements
The M.S. is offered Plan A (with thesis), Plan B (with project), and coursework only. Plan A requires a minimum of 14 course credits in the major, 6 course credits in the related field, and 10 thesis credits. Plan B requires a minimum of 30 course credits, including 22 credits in the major (6 of which are in independent study leading to a Plan B project) and 8 credits in the related field. The coursework-only option requires a minimum of 30 course credits, including 20 credits in the major and 10 credits in the related field or a minor. Typically no more than 30 percent of the total course credits is taken at the 4xxx level. Courses in the minor and related field are normally taken from outside the department, although they may be taken from within in special cases.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—The master’s minor is established on an individual basis with approval by the graduate studies committee. Typically no more than 50 percent of the total course credits are taken at the 4xxx level.

Ph.D.

Degree Requirements
The Ph.D. requires a minimum of 37 course credits in the major, 12 course credits in a supporting program, and 24 thesis credits. Typically, no more than 30 percent of the total course credits are taken at the 4xxx level. Courses in the minor and support program are normally taken from outside the department, although they may be taken from within in special cases.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—The Ph.D. minor is established on an individual basis with approval by the graduate studies committee. Typically, no more than 50 percent of the total course credits are taken at the 4xxx level.

Geophysics
The geophysics major includes the areas of applied and theoretical geophysics, paleomagnetism and rock magnetism, and mineral and rock physics. Students may accommodate other areas of interest such as earth resources, engineering geology, environmental geology, materials science, soil science, and paleoecology by choosing a minor or supporting field from outside the department.

Please refer to Geology and Geophysics (Geo) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B

Degree Requirements
The M.S. is offered Plan A (with thesis), Plan B (with project), and coursework only. Plan A requires a minimum of 14 course credits in the major, 6 course credits in the related field, and 10 thesis credits. Plan B requires a minimum of 30 course credits, including 22 credits in the major (6 of which are in independent study leading to a Plan B project) and 8 credits in the related field. Typically no more than 30 percent of the total course credits is taken at the 4xxx level. Courses in the minor and related field are normally taken from outside the department, although they may be taken from within in special cases.

Language Requirements—None.

Final Exam—Plan A and Plan B students must pass a final oral exam.

Minor Requirements for Students Majoring in Other Fields—The master’s minor is established on an individual basis with approval by the graduate studies committee. Typically no more than 50 percent of the total course credits are taken at the 4xxx level.

Ph.D.

Degree Requirements
The Ph.D. requires a minimum of 37 course credits in the major, 12 course credits in a supporting program, and 24 thesis credits. Typically, no more than 30 percent of the total course credits are taken at the 4xxx level. Courses in the minor and support program are normally taken from outside the department, although they may be taken from within in special cases.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—The Ph.D. minor is established on an individual basis with approval by the graduate studies committee. Typically, no more than 50 percent of the total course credits are taken at the 4xxx level.

German

M.A.—Plan B
The M.A. offers students the opportunity to do advanced work in German studies and prepares them with the adequate theoretical and practical tools to enter a Ph.D. program in the field.

Please refer to German (Ger); German, Scandinavian, and Dutch (GSD); and Dutch (Dutch) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
The M.A. requires 35 credits, including a course in contemporary literary and cultural theory (CLit 8001), an introductory course in German studies, four courses in different periods of German literature, a philology course, a pedagogy course, an elective in German literature/culture, and two courses outside the German program.

Language Requirements—No languages other than German are required, although students who intend to continue in the Ph.D. program are encouraged to acquire a reading proficiency in one other foreign language during their M.A. program.
Final Exam—The M.A. requires an oral exam based on coursework in both the major and minor fields.

Minor Requirements for Students
Majoring in Other Fields—A master’s minor requires three courses in German (all electives).

Ph.D.
The Ph.D. offers students the opportunity to do advanced work in German studies and prepares them with the adequate theoretical and practical tools to serve as researchers, scholars, and teachers in the field.

Please refer to German (Ger); German, Scandinavian, and Dutch (GSD); and Dutch (Ditch) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
The Ph.D. requires 33 course credits, including a semester course in Germanic philology, six courses in German literature/culture, a pedagogy course, the dissertation seminar, and three courses outside the German program; 24 thesis credits are also required.

Language Requirements—The program requires reading competence in two languages or a high degree of proficiency in one language other than German.

Minor Requirements for Students
Majoring in Other Fields—A doctoral minor requires four courses in German literature/culture (all electives).

Germanic Philology
Germanic philology is a cover term for the study of several related languages (English, German, Dutch, the Scandinavian group, and Latin) and the literature written in them. Its focus is historical; when it studies modern languages, modern folklore, etc., it views them as the product of age-long development. Unlike individual philologies (the history of English, the history of German, and others), Germanic philology treats the whole field of inquiry; studies language, literature, and folklore in their interrelations; and examines the Germanic group from within (ties between separate languages) and from without (Germanic and the rest of Indo-European).

Graduate faculty come from the Departments of German, Scandinavian, and Dutch; English; and Classical and Near Eastern Studies; and the Institute of Linguistics and Asian and Slavic Languages and Literatures; most are members of the Center for Medieval Studies with which the program is closely tied. Graduates of the program are not only specialists in Germanic linguistics and literature, but also medievalists with a broad interest in classical antiquity, history, archeology, art history, and every aspect of medieval life and culture.

M.A.—Plan A and Plan B

Degree Requirements
The M.A. is offered under both Plan A and Plan B (Plan B is recommended). Plan A requires at least 21 course credits, plus 10 thesis credits. Plan B requires at least 30 course credits, including a minimum of 18 credits (six courses) in Germanic philology; an additional 6 credits (two courses) in a related field, which may or may not constitute a minor (a minor is optional since the philology courses are interdisciplinary); and an additional 6 credits (two courses). Plan B requires three papers in Germanic philology in courses approved by the director of graduate studies. Students are encouraged to min or in medieval studies. Students are expected to complete their course requirements in four semesters and to take their M.A. exam at the end of the second year (fourth semester).

Language Requirements—Students must select one medieval Germanic language as their major language and acquire a working knowledge of one other medieval Germanic language.

Final Exam—The final exams are written and oral.

Minor Requirements for Students
Majoring in Other Fields—All students must consult the Germanic philology director of graduate studies to be assigned an adviser. An M.A. minor requires a minimum of 6 credits (two courses).

Ph.D.

Degree Requirements
The Ph.D. requires at least 48 credits (16 courses), including 18-24 credits (six to eight courses) from the M.A. and 12 credits (four courses) in a minor field or supporting program. Students must also register for 24 thesis credits.

Two tracks are offered: language track and literature track. Students in both tracks take courses in language skills and language history, theory and methods, and medieval literature.

Language Requirements—A Ph.D. candidate must demonstrate a reading knowledge in English, German, Latin, and two additional languages in consultation with the adviser.

Minor Requirements for Students
Majoring in Other Fields—All students planning to minor in Germanic philology must consult the Germanic philology director of graduate studies to be assigned an adviser. The Ph.D. minor requires a minimum of four courses.

Gerontology

Freestanding Minor
The minor, which is available to master’s (M.A. and M.S.) and doctoral students, provides a multidisciplinary foundation in gerontology and a concentration in one of four tracks: clinical care; social and behavioral sciences; policy, administration, and ethics; and arts and humanities. Students who have minored in gerontology have majored in many departments, including but not limited to, curriculum and instruction (adult education); communication disorders; dentistry; design, housing, and apparel; family practice and community health; family social science; journalism and mass communication; kinesiology; nursing; psychology; social work; and sociology.

Degree Requirements
The master’s and doctoral minors are developed in consultation with the director of graduate studies for gerontology. Courses are taken from the designated course list. The master’s minor requires a minimum of 6 graduate credits, including Multidisciplinary Perspectives on Aging (3 credits; this course is offered under several designators and numbers, including Gero 5105). It is recommended that the remaining 3 credits be taken in one of the four tracks.

The doctoral minor requires a minimum of 12 graduate credits, including Nura 8320 Multidisciplinary Seminar on Social Perspectives of Aging (3 credits). The remaining credits must be taken in one of the four tracks, 6 credits of which must be selected from designated fundamental courses.

Greek

M.A.—Plan A and Plan B

The Greek M.A. is a flexible program which permits a minor or related fields program in another disciplinary area such as archaeology, linguistics, modern Greek studies, myth and folklore, philosophy, and religious studies.

Please refer to Akkadian (Akka), Ancient Near Eastern (ANE), Aramaic (Arm), Classics (Clas), Coptic (Copt), Greek (Gkr), Hebrew (Hebr), Latin (Lat), and Sumerian (Sum) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
A core of advanced work in Greek is supplemented by a supporting program in another field. The total minimum credit requirement for Plan A is 47 (including 10 thesis credits), and for Plan B, 41 (including directed study registration for Plan B papers).

Language Requirements—One modern research language as appropriate, preferably French or German, is required.
Degree Programs

Final Exam—The final exams are written (Greek reading proficiency) and oral (general).

Minor Requirements for Students

Majoring in Other Fields—Students must complete Clas 5794, as well as 9 graduate credits of Greek (excluding Grk 8120).

Ph.D.
The Greek Ph.D. is a flexible program which requires a minor/supporting program in another disciplinary area such as archaeology, linguistics, modern Greek studies, myth and folklore, philosophy, or religion.

Please refer to Akkadian (Akka), Ancient Near Eastern (ANE), Aramaic (Arama), Classics (Clas), Coptic (Copt), Greek (Grk), Hebrew (Hebr), Latin (Lat), and Sumerian (Sum) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

Extensive advanced coursework in Greek is combined with a rigorous supporting program in another field. Students must take at least three seminars in the major and a two-semester sequence of ancient history, in addition to completing all M.A. course requirements. Students who continue from the M.A. program may apply those credits toward the degree, and students entering with an M.A. can usually receive credit for some earlier coursework, subject to director of graduate studies approval and graduate school requirements. A typical Ph.D. program is 77 credits, including at least 15 credits in Greek, 15 credits in the supporting program, 12 credits in related fields, and 24 thesis credits.

Language Requirements—The language requirements include German and a second modern language, preferably French, and reading proficiency in ancient Greek as demonstrated by a department exam on previously unseen passages.

Minor Requirements for Students

Majoring in Other Fields—Students must complete Clas 5794, as well as 15 graduate credits in Greek (excluding Grk 8120).

Health Informatics

M.S.—Plan A and Plan B

The M.S. offers instruction in health services computing, clinical decision making, health systems analysis, simulation, and consulting. Training is provided for health professionals in information management and for information technologists obtaining a master’s degree to emphasize health applications.

Degree Requirements

The research-oriented Plan A master’s degree is available to advanced applicants, such as those with a doctoral degree in a health sciences discipline. It requires 33 course credits and 10 thesis credits. The Plan B option requires 39-41 course credits, including 6-7 credits from a technical area and 6-7 credits from the health sciences. Both plans require seven core courses, a sequence in statistics or biostatistics, and registration in the health informatics Seminar (HInf 5436) for the first year and for a minimum of two semesters after that (1 credit each semester). For most students, the program takes two academic years and one summer.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students

Majoring in Other Fields—Approval of the director of graduate studies is required.

Ph.D.
The program in health informatics trains students in the application of computer and information sciences to the quantitative aspects and decision needs of the health and life sciences. Health informatics encompasses not only mathematics, statistics, and computing, but also other engineering, management, and information sciences applied to problems arising in biology, medicine, and the delivery of health care. In addition to basic biostatistical and computing techniques, it is necessary that students be familiar with methodologies such as mathematical modeling, systems analysis, image and signal processing, management information systems, and decision sciences. Possible areas of emphasis include health information systems, biomathematical modeling, evaluation of health programs, system development, clinical decision studies, and health computer sciences.

Degree Requirements

The Ph.D. program is for those who wish to obtain advanced training and to conduct research. Students are expected to complete the same requirements as those for the Plan B master’s program (a survey of health informatics, biostatistics, selected health science areas and advanced training in selected informatics areas), as well as advanced coursework in health informatics and an area of concentration complementary to health informatics. The work is completed with an original research project reported in the doctoral dissertation. Student are expected to earn a minimum of 43 credits in their major field, 12 credits in a minor field or supporting program, and 24 thesis credits, for a minimum total of 79 credits.

Language Requirements—None.

Minor Requirements for Students

Majoring in Other Fields—Approval of the director of graduate studies is required.

Health Services Research, Policy and Administration

M.S.—Plan A and Plan B

Health services research focuses on the organization and delivery of cost-effective health services. It deals with policy issues related to costs, access, and quality of health services and equitable distribution of health resources. The program prepares health services researchers and health policy analysts to carry out sophisticated empirical studies, formulate policy options, work effectively in the political arena to shape and implement policies, and evaluate policies once implemented. The M.S. can serve as a terminal degree or as a first step toward the Ph.D.

Please refer to Public Health (PubH), particularly numbers 58xx and 88xx, in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The M.S. is offered under Plan A, for students with a professional degree in medicine, dentistry, nursing, or pharmacy, and Plan B, for students with a nonhealth professional background. Plan A requires a thesis (publishable research paper); Plan B requires an internship and a research proposal. Both programs are full-time and require two years of coursework.

Plan A requires 27 course credits, 9 credits in a minor, and 10 thesis credits; Plan B requires 38 course credits and 9 credits in a minor.

Language Requirements—None.

Final Exam—For Plan A, the final exam is oral. For Plan B, a critique of the research proposal is required.

Ph.D.

Health services research is an ideal field for those interested in affecting public policy related to health-care systems. Students come from a variety of educational backgrounds, including economics, political science, sociology, and public affairs. Strong quantitative skills are essential. The program is primarily for students interested in academic careers or senior research positions in government or the private sector. The core curriculum is a multidisciplinary exam of the social, political, and economic forces that affect the organization, financing, and delivery of health-care services. The emphasis is on theory, modeling, and quantitative methods. Students continue with required courses in either the policy or management concentration. Coursework is supported by the student’s ongoing involvement with faculty on research projects and is linked to the health-care field through these projects. In addition, the program provides further interchange with faculty...
Degree Programs

Hispanic and Luso-Brazilian Literatures and Linguistics

Ph.D.
The goal of the department is to provide an intellectual locus for all traditions and modes of inquiry related to Hispanic and Luso-Brazilian literatures, cultures, and linguistics. The department offers three M.A. programs: Luso-Brazilian literature; Hispanic literature; and a Ph.D. in Hispanic and Luso-Brazilian literatures and linguistics.

The department is organized so as to minimize the potentially fragmenting force of language difference, regional sentiment, and divergent specificity of intellectual tradition, while recognizing that these factors correspond to present and historical conditions. The department requires an integration of these cultural and language areas into each degree program. Students study the main problems, issues, topics, and approaches that constitute their various fields and also develop the skills, theories, and methodologies necessary to research, analyze, organize, reproduce, and communicate this material. In particular, Ph.D. students are expected to make scholarly contributions based on a thorough understanding of the history of the field of specialization and of the approaches used to study it. Because the department believes that language and literary texts cannot be studied in a historical vacuum, students learn the fundamental trends of the history and thought related to various cultural and language areas. In this respect, the department encourages and promotes a diversity of philosophies, approaches, and methods.

The Ph.D. offers four areas of emphasis: Latin American literature, Spanish American literature, Luso-Brazilian literatures, and Hispanic linguistics.

Minor Requirements for Students

Majoring in Other Fields—The minor is developed uniquely for each student with the advice and counsel of the director of graduate studies. The proposed minor is then reviewed and approved by the full faculty.

Hispanic Literature

M.A.—Plan A and Plan B
See Hispanic and Luso-Brazilian Literatures and Linguistics for program description.
Please refer to Portuguese (Port), Spanish (Span), and Spanish-Portuguese (SpPt) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The M.A. is offered under both Plan A and Plan B. Plan A requires a minimum of 31 credits, including 15 credits in the major field taken from among designated core courses at the 5xxx level, 6 credits outside the program, and 10 thesis credits. Plan B requires a minimum of 33 course credits and two Plan B papers. Most students pursue the Plan B option.

Language Requirements—For the M.A., students must have a reading knowledge of English and at least one foreign language in addition to Spanish and Portuguese.

Final Exam—The final exams are written and oral.

Minor Requirements for Students

Majoring in Other Fields—A master’s minor requires a minimum of 6 credits.

History

History examines the human experience from its origins till the present day. Areas of concentration include Medieval, Early Modern, and Modern Europe; Africa; Asia; England; Ancient; Early Modern World; Latin America; and the United States.

M.A.—Plan A and Plan B

Degree Requirements

The M.A. is offered under Plan A and Plan B. Both plans require six history courses (one of which is 8015) and two courses in other departments (6 credits minimum). Plan A also requires 10 thesis credits, for a total of 31 credits minimum, and Plan B requires an additional two courses in history or another department, for a total of 30 credits minimum.

Language Requirements—A reading knowledge of one foreign language is required before admission to the master’s exam.

Final Exam—The final exam is oral.

Minor Requirements for Students

Majoring in Other Fields—A master’s minor is offered for Plan A students only. A minimum of two related courses in history (at least 6 credits) are required.
Ph.D.

Degree Requirements

The Ph.D. requires 36 credits in 12 history courses (Hist 8015, nine courses in the major, and two courses in an outside subarea) plus 12 credits in four supporting program courses; 24 thesis credits are also required.

Language Requirements—A reading knowledge of two foreign languages is required before admission to the preliminary exam. Some areas of concentration may require additional foreign languages. In some cases, competence in quantitative methods may replace one of the foreign languages.

Minor Requirements for Students Majoring in Other Fields—For the doctoral minor, at least four history courses, including a proseminar or seminar, are required, along with a written and oral exam.

History of Medicine and Biological Sciences

The history of medicine and biological sciences studies the development of medical and biological knowledge through anatomical dissection, biological experiments, and the systematic observation of the effects of disease in patients. It deals with the influence of disease on human populations, with the effects of the historically recent control of epidemic diseases, and thus, with medicine, biology, and public health as factors in the history of civilization.

Please refer to History of Medicine (HMed) in the course section of this catalog for courses pertaining to this program.

M.A.—Plan A

Degree Requirements

The M.A. is offered under Plan A only. The M.A. requires at least 12 course credits in the major, 6 credits in a history minor, 2 elective credits, and 10 thesis credits. The program is normally completed in two to three semesters of full-time study or its part-time equivalent.

Language Requirements—M.A. students must demonstrate competence in one foreign language, preferably French or German.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A master’s minor requires 12 credits in the history of medicine and biological sciences.

Ph.D.

Degree Requirements

The Ph.D. requires approximately 24 course credits, including survey courses in the history of medicine and biological sciences and in the history of science and technology. Students choose other courses in consultation with the director of graduate studies. Students are required to take their minor or supporting program in history, unless they already possess extensive training in history. Students must also complete 24 thesis credits.

Language Requirements—Ph.D. students must demonstrate competence in two foreign languages, preferably French and German, and pass an exam in one language before the end of their first academic year and in the second language before the end of their second academic year. Students interested in a historical period before 1800 are required to demonstrate competence in Latin as a third required foreign language.

Minor Requirements for Students Majoring in Other Fields—A Ph.D. minor requires a minimum of 12 credits in the history of medicine and biological sciences.

History of Science and Technology

The program offers opportunities for advanced research and study in three general areas: history of the physical sciences, history of the biological sciences, and history of technology. Students focus on the following approaches: conceptual development of the disciplinary fields; social, economic, and cultural contexts; the interaction among science, technology, and society; or a combination of these. The faculty’s interests span the period from the Scientific Revolution of the sixteenth and seventeenth centuries through twentieth-century developments.

M.A.—Plan A and Plan B

Degree Requirements

The M.A. is offered under Plan A and Plan B. Plan A requires a minimum of 20 course credits and 10 thesis credits; Plan B requires a minimum of 30 course credits. M.A. students must choose two of the general areas (history of the physical sciences, biological sciences, or technology). Six courses (18 credits) must be taken in these two areas, with at least two courses (6 credits) in any one area. Two courses (6 credits) must cover the pre-1800 period and two courses (6 credits) the post-1800 period. Courses used to satisfy the area requirements can also be used to satisfy these period requirements. Because of this possible overlap, these course credits may not add up to 18 credits. In addition, each student must take the historiography course (HSci 8111) and two courses (6 credits) in a minor or related field. Under the Plan A option, students must also take 10 thesis credits. All of the courses selected for the requirements must be passed with a grade of B or better. HSci 4xxx courses may be included as appropriate for the area and period requirements.

Language Requirements—M.A. students must demonstrate reading proficiency in one foreign language, normally French or German.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—The master’s minor requires 6 credits and is structured for the student’s interests.

Ph.D.

Degree Requirements

The Ph.D. is for those planning professional careers that require a high degree of scholarly competence, including teaching and research. Students must choose two of the general areas (history of the physical sciences, the biological sciences, or technology) in preparation for preliminary written and oral exams. Six courses (18 credits) must be taken in these two areas, with at least two courses (6 credits) in any one area. Two courses (6 credits) must cover the pre-1800 period and two courses (6 credits) the post-1800 period. Courses used to satisfy the area requirements can also be used to satisfy these period requirements. In addition, each student must take the historiography course (HSci 8111) and a minor or supporting program consisting of four courses (12 credits). Students must also take 24 thesis credits. All of the courses selected for the requirements must be passed with a grade of B or better.

Language Requirements—Before taking the preliminary exams, students must demonstrate reading proficiency in two foreign languages, normally French and German.

Minor Requirements for Students Majoring in Other Fields—The doctoral minor requires 12 credits and is structured for the student’s interests.

Hospital Pharmacy

M.S.

Note: A proposal to merge this program with social and administrative pharmacy is under administrative review and has not yet been finally approved. Approval of the merged program is expected in 1999. Contact the program director of graduate studies for information on the status of the semester-based program.
Human Factors/Ergonomics

Freestanding Minor
Human factors/ergonomics (HF/E) is an interdisciplinary area of study focusing on how human performance and behavior are influenced by design factors in the performance environment. HF/E has its roots in psychology, engineering, physiology, kinesiology, cognitive science, computer science, software engineering, and operations research. The minor, which is available to master’s (M.A. and M.S.) and doctoral students, provides integrated coursework that emphasizes conceptual, empirical, and practical aspects of HF/E. The minor’s primary goals are to complement graduate training in traditional disciplines as a foundation for diverse career opportunities in the field and to promote interaction among graduate students and faculty involved in HF/E.

Coursework addresses the question of how and why variability in human performance—with quality, productivity, efficiency, safety, and health implications—is influenced by interaction with designs of systems and system components, such as machines and tools, computers and software, complex technological systems, jobs and working conditions, organizations, and sociotechnical institutions.

Please refer to Human Factors (HumF) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
A master’s minor requires 10 graduate credits, including 7-8 credits of core courses and 2-3 credits of electives. A doctoral minor requires 16 graduate credits, including the three core courses (7-8 credits) and 8-9 credits of electives. The core courses consist of HumF 5001 Foundations of Human Factors/Ergonomics (3 credits), HumF 8001 Topics in Human Factors/Ergonomics (2-3 credits), HumF 8002 Proseminar in Human Factors/Ergonomics (1 credit each for two semesters).

Human Resources and Industrial Relations

M.A.—Plan A and Plan B
Human resources and industrial relations studies the employment relationship. Courses are offered in the following subfields: staffing, training, and development; organization behavior and theory; compensation and benefits; labor market analysis; and labor relations and collective bargaining. Research methods and quantitative analysis of employment problems and issues are also included. Specialization in one or more of the subfields is possible through electives.

Degree Requirements
The M.A. is offered under Plan A (thesis) and Plan B (project) in day and evening programs.

Plan A requires a minimum of 40 course credits and 10 thesis credits. Major coursework includes 8011 and 8012; three courses from among 8031, 8041, 8051, 8061, and 8071; and 12-16 additional HRIR credits. Also required are 6-10 credits in an approved field or fields of study related to industrial relations.

Plan B requires a minimum of 50 credits and a Plan B project. Major coursework includes 8011, 8012, 8031, 8041, 8051, 8061, and 8071 and 16 credits of HRIR electives. A minimum of 8 credits must be earned in related fields.

Commonly selected related fields include business administration, economics, human resource development, psychology, public affairs, sociology, and research methods.

Language Requirements—None.

Final Exam—The final exam is oral.

Ph.D.
Human resources and industrial relations studies the employment relationship. The Ph.D. program prepares students for academic careers in research universities that have degree programs emphasizing employment issues and problems. Students concentrate in two of the following five subfields: staffing, training, and development; organizational behavior and theory; compensation and benefits; labor market analysis; and labor relations and collective bargaining.

Degree Requirements
Degree requirements are determined in consultation with the student’s adviser and the director of graduate studies. In addition to 24 thesis credits, all students must complete 18 credits of research methods; at least 6 credits of human resources and industrial relations seminars in each of their two subfields; at least 3 credits in each of the other three subfields; 9 additional major credits; and at least 12 credits in a minor or supporting program in one or more of the following behavioral sciences: anthropology, business administration, economics, history, political science, psychology, and sociology. Research methods courses taken outside the program may be applied toward the minor or supporting program requirement. Students must pass preliminary exams in each of their subfields and research methods.

Language Requirements—None.

Industrial Engineering

Industrial engineering offers coursework and research in industrial engineering, operations research, and human factors. Special emphasis is on methodologies for design, planning, and management of manufacturing systems. Additional emphases are in logistics, transportation, computer-aided design and manufacturing, health systems, and management of technology.

Please refer to Industrial Engineering (IE) and Mechanical Engineering (ME) in the course section of this catalog for courses pertaining to this program.

M.S.I.E.—Plan A and Plan B
Degree Requirements
The M.S.I.E. requires a minimum of 30 credits, including a minimum of 14 course credits in the major to include at least 1 credit of graduate seminar and 6 course credits in a minor or related field; Plan B requires 10 thesis credits. Plan B, one to three Plan B papers are required (the number in part depending on their length), determined in consultation with the adviser. The papers may derive from courses in the major or may address topics chosen by a graduate faculty member and the student. No courses at the 4xxx level or below may be applied toward the degree.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students
Majoring in Other Fields—A minimum of 12 credits in industrial engineering is required for a master’s minor.

Ph.D.
Degree Requirements
The Ph.D. requires a minimum of 44 course credits, including a minimum of 12 course credits in a minor field or supporting program and a minimum of 2 credits of graduate seminar; 24 thesis credits are also required. No courses at the 4xxx level or below may be applied toward the degree.

Language Requirements—None.

Minor Requirements for Students
Majoring in Other Fields—A minimum of 12 credits in industrial engineering is required for a doctoral minor.
Degree Programs

Interdisciplinary Archaeological Studies

The program offers opportunities to create individualized degree programs in which a focus in archaeology is integrated with aspects of one or more other fields. In consultation with their co-advisers, students design a program suited to their individual interests and needs. Only faculty expertise and interest limit the potential combination of archaeology with other fields. Work toward the master’s degree can be pursued on the Twin Cities campus or Duluth campus or both. All programs of study are subject to review by the program steering committee.

M.A. and M.S.—Plan A and Plan B

Degree Requirements

The M.A. and M.S. are offered under two plans: Plan A, which includes a thesis, and Plan B, which substitutes additional coursework and a special project for the thesis. Students interested in research and in pursuing the Ph.D. program generally adopt the Plan A option, while those interested in a broad foundation in interdisciplinary archaeology adopt the Plan B option.

Coursework for both plans must include two core seminars (InAr 8004, InAr 8100) and a minimum of 30 credits. For Plan A, the distribution of credits is 6 credits in core seminars, 10 thesis credits, and 14 additional course credits determined by the students and their co-advisers. For Plan B, the distribution of credits is 6 credits in core seminars and 24 additional course credits determined by the students and their co-advisers. Plan B projects usually consist of two papers, but are not restricted to this format. Plan A students must take a minimum of 10 credits, and Plan B students a minimum of 17 credits, in the liberal arts.

Language Requirements—All students are expected to acquire competence in the research tools necessary for their graduate and future professional work. Often these are foreign languages and/or quantitative or experimental skills. The student’s advising committee sets the language and/or technical requirement.

Final Exam—The final exam is oral.

Ph.D.

Degree Requirements

Except for a 3-credit interdisciplinary topics seminar (InAr 8100), the Ph.D. does not specify a minimum number of course credits for the degree. Rather, students take courses both within and outside the major that prepare them for the preliminary exams. These courses are determined by the students and their co-advisers. Students may be required to take the introductory archaeology method and theory seminar (InAr 8004) if they have not taken an equivalent course at the master’s level. The program also requires 24 thesis credits. No minor field or supporting program is required because of the interdisciplinary nature of the program.

Language Requirements—All students are expected to acquire competence in the research tools necessary for their graduate and future professional work. Often these are foreign languages and/or quantitative or experimental skills. The student’s advising committee sets the language and/or technical requirement.

International Education

Freestanding Minor

The interdisciplinary minor in international education is for students enrolled in any M.A. or doctoral program who wish to enter careers in research, consulting, administration, and teaching in an international context. The minor offers a coordinated set of courses from the Departments of Curriculum and Instruction, Educational Policy and Administration, Educational Psychology, and Work, Community, and Family Education; the School of Kinesiology and Leisure Studies; and the Institute of Child Development.

Please contact the minor program office for information on relevant coursework.

Degree Requirements

A minimum of 9 graduate credits is required at the master’s level, 12 at the doctoral level. Each program is developed in consultation with the student’s adviser, major director of graduate studies, and the director of graduate studies for international education.

Requirements may include critical issues in international education; foundations of international education (EdPA 5103, 5124; one for M.A., both for doctoral minor); research (EdPA 5121; for doctoral students only); and area-specific coursework (one course minimum for M.A. and doctoral minors: AgEE 5351, CI 5747, EdHD 5001, EdPA 5032, 5101, 5121, 5132, EPsy 5101, 5112, 5113, 5401, 5432, 5461, 8403, HRD 5408, 5496, 5821, Kin 5371, 8607, WCFE 8142). While not all courses have specific international content, they all produce competencies and skills essential to people intending to work in an international context.

Interpersonal Relationships Research

Freestanding Minor

The minor in interpersonal relationships research provides doctoral students with a broad theoretical and methodological foundation for research on behavioral interaction patterns between two persons and the impact of these interactions. A recently recognized and rapidly advancing interdisciplinary field of scientific inquiry, interpersonal relationships research has its roots in psychology, sociology, family studies, communication, and nursing. The program brings together faculty and students from eight University departments and schools.

Degree Requirements

The doctoral minor requires a minimum of 14 graduate credits, including three required core courses and additional elective courses selected from an approved list. The required courses are IRel 8001 (taken for 2 credits), IRel 8021 (2 credits), and Psy 5204 (3 credits).

Italian

M.A.—Plan A and Plan B

The M.A. program adopts a strong interdisciplinary approach to the study of the literatures and cultures of Italy. Students are encouraged to explore the modes of expression and production defining the cultural identities of Italy and to be critically aware of the power of disciplinary and national boundaries in defining cultural differences. The program has special strengths in Dante and Early Modern studies, and in the Romantic and Modern periods.

Please refer to Italian (Ital) and French and Italian (FrIt) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The M.A. is offered under Plan A (with thesis) or Plan B (with paper). Plan A requires a minimum of 22 course credits and 10 thesis credits. Plan B requires a minimum of 30 course credits.

Language Requirements—By the time of their final exam, students must demonstrate proficiency in one ancient or modern language besides Italian and English; French, Spanish, or Latin is recommended.

Final Exam—The final exams are written and oral.

Minor Requirements for Students

Majoring in Other Fields—A master’s minor requires a minimum of 6 credits.
Japanese

Two areas of concentration are available within the Japanese graduate programs: literature and linguistics. Programs may include courses from both of these areas, but must minimally fulfill the core requirements for one of them, as determined in consultation with the student’s adviser. Areas of subspecialty in the literature concentration include literature of the classical, modern, or contemporary periods; modern drama; and modern literary theory and criticism. Areas of subspecialty in the linguistics concentration include Japanese phonology, syntax, semantics, pragmatics, discourse/conversation analysis, and the history of Japanese.

M.A.—Plan A and Plan B

Degree Requirements
The M.A. offers Plan A and Plan B. The requirements for Plan A include 16 credits (four courses) in Japanese literature and/or Japanese linguistics, 8 credits (two to three courses) in supporting field(s), and 10 credits for writing a thesis. The requirements for Plan B include 20 credits (five courses) in Japanese literature and/or Japanese linguistics, 14 credits (four to five courses) in supporting field(s), and three Plan B papers, which may be revised and expanded course papers.

Language Requirements—The ability to work with Japanese-language materials is required.

Final Exam—The final exam is oral.

Minor Requirements for Students

Majoring in Other Fields—A declared minor at the M.A. level in Japanese literature or linguistics requires a minimum of two courses (8 credits), to be chosen in consultation with a member of the Japanese faculty.

Ph.D.

Degree Requirements
The requirements for the Ph.D. degree include 20 credits (five courses) in Japanese literature and/or Japanese linguistics, 16 credits (four to six courses) in supporting field(s), and 24 credits for writing a thesis. Many students come to the Ph.D. program with an M.A. from this or from another program; requirements for a Ph.D. are in addition to requirements for an M.A.

Language Requirements—Students must demonstrate the ability to do research in Japanese and also must complete, or demonstrate by exam an ability equivalent to, two years of Chinese language study. Students must also demonstrate a reading knowledge of French, German, or Russian (which may be fulfilled by passing the Graduation Reading Proficiency Test offered by the relevant language program at the University). Certification of competence in all required languages must be obtained prior to taking preliminary exams.

Minor Requirements for Students

Majoring in Other Fields—A declared minor in Japanese literature or linguistics at the Ph.D. level requires four courses (16 credits), which should be chosen in consultation with a member of the Japanese faculty.

Kinesiology

M.A.—Plan A and Plan B

Kinesiology M.A. students specialize in adapted physical education, biomechanics, exercise physiology, human factors/ergonomics, international/comparative sport, motor development, motor learning/control, sport psychology, or sport sociology.

Degree Requirements
The M.A. is offered under Plan A and Plan B. Plan A requires 30 credits, including at least 14 credits in kinesiology, 6 credits in a minor or related field, and 10 thesis credits (Kin 8777). Plan B also requires 30 credits, including at least 14 credits in kinesiology, 6 credits in a minor or related field, 4 credits of a research project (Kin 8995), and 6 additional credits in any of these areas. For both the Plan A and Plan B, students must take Kin 5981 (3 credits), Kin 8980 (1 credit), and in the related field or minor, EPsy 5261 (3 credits) or 8261 (3 credits). A 3.00 minimum GPA is required to maintain good standing and to graduate.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students

Majoring in Other Fields—A master’s minor requires at least 6 credits of graduate-level kinesiology courses.

Ph.D.

Kinesiology Ph.D. students pursue an individualized program specializing in adapted physical education, biomechanics, exercise physiology, human factors/ergonomics, international/comparative sport, motor development, motor learning/control, sport psychology, or sport sociology.

Degree Requirements
The Ph.D. requires a minimum of 48 course credits and 24 thesis credits, for a total of 72 credits. Course credits include 24 credits in kinesiology, 9 credits in statistical methods, 12 credits in a supporting program or minor (statistical methods courses may be included), and an additional 3 credits in any of these areas. A minimum GPA of 3.00 is required to maintain good standing and to graduate.

Language Requirements—None.

Minor Requirements for Students

Majoring in Other Fields—A doctoral minor requires at least 12 credits of graduate-level kinesiology courses, including Kin 5171 (3 credits) and Kin 8995 (1 credit).

Landscape Architecture

Landscape architecture is the design, planning, and management of the landscape to create environments that embody ecological function and realize human aspirations for community, health and safety, and beauty. Landscape architects are concerned with a wide range of projects, including large-scale regional landscape planning; design of exterior environments for working, living, and recreation; commercial, institutional, and industrial development; transportation systems; and multiple-use areas. Professional services include studies of land-use allocation and management; detail grading; construction drawings; and planting plans. Landscape architects often interact with other professionals such as architects, planners, engineers, geographers, physical scientists, biologists and ecologists, and social scientists in developing projects.

The Department of Landscape Architecture offers the professional master of landscape architecture (M.L.A.), required to become a registered landscape architect, and the master of science (M.S.), a research-oriented degree allowing a specialized focus within landscape architecture.

The cornerstone of the programs is the execution of landscape design informed by an ecological understanding of natural and cultural systems. National leadership in research, active testing of design ideas locally and nationally, and the integration of these experiences into the classroom give the department a powerful springboard for fostering innovation in design. Collaborative opportunities within the University offer a further means of realizing the potentials of landscape architecture as well as a means of asserting the necessity for ecological responsibility in design and planning.

M.L.A.—Plan B, Coursework Only

The M.L.A. program, which is accredited by the national Landscape Architecture Accreditation Board (LAAB), is for students who wish to become registered landscape architects. Areas of coursework within the program include design, technology and ecology, graphic and written communication, landscape history, and research methods. Students are encouraged to select from among graduate seminars to develop a special focus or particular point of view.
Degree Programs

Degree Requirements
To meet the LAAB standards, 92 graduate credits are required for students without previous design experience. Because coursework is organized in a sequential framework of nine design studios, commitment to the program for three successive years is important.

Students who hold an accredited professional bachelor’s degree in landscape architecture may complete the M.L.A. with 30 credits, including 12 credits of landscape architecture studio courses, 3 credits of landscape architecture research issues and methods, 1 credit of project programming, and 14 elective credits (6 credits of which must be outside the department). The final studio course is the capstone project, which is presented and defended at the final exam. Up to 9 credits earned as part of the M.L.A. may be applied to the M.S.

Language Requirements—None.

Final Exam—Students present and defend their capstone project.

M.S.—Plan A
The M.S. is for students with a clear focus in research related to landscape architecture. M.S. students build specialized expertise related to the practice of landscape architecture as they learn how to conduct research. Students specialize within areas of faculty expertise, which may include art and landscape architecture, landscape ecology, landscape architectural history and theory, park and recreation design, rural and suburban landscape planning, and transportation. Prospective students may request a summary of current faculty research for a description of potential specializations.

Degree Requirements
The M.S. requires 30 credits, including a minimum of 6 credits within landscape architecture and 8 credits from other programs that are counted as major credits (as determined by the adviser), 10 thesis credits, and a minimum of 6 credits in an area of focus outside of landscape architecture.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students

Majoring in Other Fields—Minor requirements are determined in consultation with the director of graduate studies.

Latin

M.A.—Plan A and Plan B
The Latin M.A. is a flexible program that permits a minor or related fields program in other disciplinary areas such as archaeology, linguistics, medieval studies, myth and folklore, oral performance, and religious studies.

Please refer to Akkadian (Akka), Ancient Near Eastern (ANE), Aramaic (Arm), Classics (Clas), Greek (Grk), Hebrew (Hebr), Latin (Lat), and Sumerian (Sum) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
A core of advanced work in Latin is supplemented by a supporting program in another field. The total minimum credit requirement for Plan A is 47 (including 10 thesis credits), and for Plan B, 41 (including directed study registration for Plan B papers).

Language Requirements—The language requirements include one modern research language as appropriate, preferably German or French, and reading proficiency in Latin as demonstrated by a department exam on previously unseen passages.

Final Exam—The final exams are written (language) and oral (general).

Minor Requirements for Students

Majoring in Other Fields—Students must complete Clas 5794, as well as 9 graduate credits of Latin (excluding Lat 8120).

Ph.D.
The Latin Ph.D. is a flexible program which combines extensive advanced work in Latin with a supporting program or minor in another discipline such as archaeology, linguistics, medieval studies, oral performance, or religious studies.

Please refer to Akkadian (Akka), Ancient Near Eastern (ANE), Aramaic (Arm), Classics (Clas), Greek (Grk), Hebrew (Hebr), Latin (Lat), and Sumerian (Sum) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
A series of advanced courses in Latin are combined with a rigorous supporting program in another field. Students must take at least three seminars in the major and a two-semester sequence in ancient history, in addition to completing all M.A. course requirements. Students who continue from the M.A. program may apply those credits towards the degree, and students entering with an M.A. can usually receive credit for some earlier coursework, subject to director of graduate studies approval and Graduate School requirements. A typical Ph.D. program is 77 credits, including at least 15 credits in Latin, 15 credits in the supporting program, 12 credits in related fields, and 24 thesis credits.

Language Requirements—Language requirements include German and a second modern research language, preferably French, and reading proficiency in Latin as demonstrated by a department exam on previously unseen passages.

Minor Requirements for Students

Majoring in Other Fields—Students must complete Clas 5794 and 15 graduate credits of Latin (excluding Lat 8120).

Law

Freestanding Minor
A law minor is available to both master’s (M.A. and M.S.) and doctoral students and is individually tailored to their academic interests.

Please contact the minor program office for information on relevant coursework.

Degree Requirements
A master’s minor requires a minimum of 6 graduate credits; a doctoral minor requires a minimum of 12 graduate credits.

Liberal Studies

MLS—Plan B
The graduate major in liberal studies offers an interdisciplinary curriculum that includes an introductory course, a choice of liberal studies seminars, a choice of electives from disciplines throughout the Graduate School, and a final project course. Although courses for the M.L.S. are scheduled mainly late afternoons and evenings, most graduate-level courses offered during the day are also open to M.L.S. students.

Degree Requirements
The M.L.S. is a specific variation of the master’s Plan B option. The program requires at least 30 credits. The required 2-credit Introduction to Interdisciplinary Inquiry begins the program, and the required 4-credit Final Project ends the program. Students must also take at least 9 credits of liberal studies seminars. The remaining 15 credits are composed of electives from disciplines throughout the Graduate School or Directed Study, Directed Research, or additional liberal studies seminars. Careful selection of courses, with the help of the student’s graduate faculty adviser, is crucial to insuring a coherently interdisciplinary program of study.

Language Requirements—None.

Final Exam—The final project must be prepared as part of LS 8001 and must be signed off by at least two faculty members.

Linguistics

Linguistics is the scientific study of human language. Investigation in phonology, syntax, and semantics/pragmatics seeks to determine general principles governing the structure of human language and the parameters which determine degree and manner of variation across languages. These core areas of language structure constitute the foundation for other subfields of linguistics, including psycholinguistics, sociolinguistics, historical linguistics, and computational linguistics.
Majoring in Other Fields

Minor Requirements for Students

The requirements for the M.A. degree (both Plan A and Plan B) include eight required courses in the major: six courses covering core areas of language structure (phonetics, phonology, syntax, semantics/pragmatics), one course in field methods, and one research paper course. The total number of credits, assuming no prior coursework in linguistics, is 32 (including the required 6 credits in related fields). Students who have already taken required courses or their equivalents as undergraduates (or as graduates in another program), can substitute electives in the major or in related fields, in accordance with minimum M.A. requirements set by the Graduate School. In addition to course requirements, Plan A requires a thesis and Plan B requires a Plan B paper.

Language Requirements—The M.A. program requires knowledge of one language not native to the student. Mechanisms for demonstrating knowledge are described in the program’s Graduate Student Handbook.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—Courses required for a master’s minor in linguistics are Ling 5001—Introduction to Linguistics (4 credits); Ling 5201—Introduction to Syntax (3 credits); and Ling 5301—Introduction to Phonetics (4 credits). Students who have had these courses or their equivalents as undergraduates can substitute other linguistics courses. The M.A. minor requires a minimum of 9 credits.

Ph.D.

The Ph.D. program focuses on language structure (phonology, syntax, semantics/pragmatics), language acquisition (first and second), and language/discourse processing (cognitive processes that underlie language use). The program especially emphasizes research which integrates core areas of theoretical linguistics with language acquisition or processing.

Degree Requirements

For the Ph.D., no minimum number of credits is required besides the 12 credits in related fields and 24 thesis credits. However, all Ph.D. students are expected to complete M.A. course requirements (15-26 credits in the major, depending on amount of prior coursework in linguistics), a second-semester course in field methods (4 credits), and an individualized plan of study (including at least three 8xxx courses) to be determined in consultation with the student’s committee. Upon completion of required coursework, Ph.D. students must pass a preliminary written exam in phonology, syntax, and their primary and secondary areas of concentration. Papers judged to be of near publishable quality by the student’s committee can be substituted for exam questions in any of these areas. The preliminary oral exam is a defense of a research paper-length dissertation prospectus, which introduces and motivates the student’s dissertation topic and provides a detailed plan for completion of the dissertation.

Language Requirements—The Ph.D. degree requires knowledge of two languages not native to the student. Mechanisms for demonstrating such knowledge are described in the program’s Graduate Student Handbook.

Minor Requirements for Students Majoring in Other Fields—The minimum number of credits required for the doctoral minor is 15 (five courses). Students who have had no prior coursework in linguistics must take six courses approved by the director of graduate studies, including the three courses required for the M.A. minor: Ling 5001—Introduction to Linguistics; Ling 5301—Introduction to Phonetics, and Ling 5201—Introduction to Syntax. Students who have taken Introduction to Linguistics or its equivalent as undergraduates do not have to substitute another course. Students who have had Phonetics can substitute a 3-credit linguistics course.

Luso-Brazilian Literature

M.A.—Plan A and Plan B

The goal of the department is to provide an intellectual locus for all traditions and modes of inquiry related to Hispanic and Luso-Brazilian literatures, cultures, and linguistics. The department offers three M.A. programs: in Hispanic literature, Luso-Brazilian literature, and Hispanic linguistics, and a Ph.D. in Hispanic and Luso-Brazilian literatures and linguistics.

The department is organized so as to minimize the potentially fragmenting force of language difference, regional sentiment, and divergent specificity of intellectual tradition, while recognizing that these factors correspond to present and historical conditions. The department requires an integration of these cultural and language areas into each degree program. Students study the main problems, issues, topics, and polemics that constitute their various fields and also develop the skills, theories, and methodologies necessary to research, analyze, organize, reproduce, and communicate this material. Because the department believes that language and literary texts cannot be studied in a historical vacuum, students learn the fundamental trends of the history and thought related to various cultural and language areas. In this respect, the department encourages and promotes a diversity of philosophies, approaches, and methods.

Please refer to Portuguese (Port), Spanish (Span), and Spanish-Portuguese (SpPt) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The M.A. is offered under both Plan A and Plan B. Plan A requires a minimum of 31 credits, including 15 credits in the major field taken from among designated core courses at the 5xxx level, 6 credits outside the program, and 10 thesis credits. Plan B requires a minimum of 33 course credits and two Plan B papers. Most students pursue the Plan B option.

Language Requirements—For the M.A., students must have a reading knowledge of English and at least one foreign language in addition to Spanish and Portuguese.

Final Exam—The final exams are written and oral.

Minor Requirements for Students Majoring in Other Fields—The master’s minor requires a minimum of 6 credits.

Management of Technology

M.S.MOT.—Plan B

The master of science in the management of technology (M.S.MOT.) program is administered by the Institute of Technology’s Center for the Development of Technological Leadership in partnership with the Carlson School of Management. The two-year, executive-format program integrates the fields of technology and management, providing working engineers and scientists with the management knowledge and skills needed to assume a technical leadership role within their organizations. It is a practitioner-oriented program and focuses on management in technology-based environments, in both traditional and emerging industries. The curriculum includes technical and advanced management courses, such as manufacturing, pivotal technologies, technology forecasting, project management, quality engineering, management of innovation, and strategic management of technology. The core management curriculum includes areas such as finance, marketing, accounting, strategic planning and decision making, and conflict management. Students enter the program in the fall and advance as a cohort, taking a prescribed sequence of courses together. Case studies, class discussions, and study-group interaction stimulate the learning process. Students also participate in several off-campus residencies, including one in the Asia-Pacific region; complete individual and team projects; and develop final projects as part of a capstone course. Most students receive corporate financial support.
Degree Programs

Materials Science and Engineering

Emphases are available in colloids, interfaces, microelectronic materials — ceramics, polymers, molecular materials, nanostructures and nanocomposites, organic solid state chemistry, catalysis, surface chemistry and physics, chemical kinetics, molecular theory of rate processes, thermodynamics, chemical reactor analysis, control optimization, fluid and interfacial mechanics, crystal growth, bioengineering, molecular interfaces, interface chemistry and physics, physical and chemical metallurgy, metal physics, electronic properties of materials, electronic structure theory, superconductivity, electrochemistry, corrosion, rheology, structure-property relationships, electron microscopy, scanning tunneling microscopy, and atomic force microscopy.

Please refer to Materials Science (MatS) and Chemical Engineering (ChEn) in the course section of this catalog for courses pertaining to this program.

M.Mat.S.E.—Design Project

This degree is for employees of local industries who wish to pursue their studies part-time. It is intended to provide a fifth year of professional work and is offered under the design project track. While much of the coursework may be in common for the various chemical engineering graduate degrees, the intent of the M.Mat.S.E. program is to provide more experience and training in engineering than in engineering science or science. No financial support is available from the program.

The M.Mat.S.E. is a terminal degree. Only under exceptional circumstances is a student allowed to transfer to an M.S. program.

Degree Requirements

The M.Mat.S.E. requires a minimum of 14 course credits in the major and a minimum of 6 credits in a minor or related fields. The work-related design project consists of an in-depth study of an engineering design. It need not represent a publishable research project. While the amount of work should be the same as for an M.S. thesis, the project can contain elements that the thesis would not, such as economic considerations, design consultation, and social relevance.

Language Requirements—None.

Final Exam—A final oral exam focused on the design project is required.

Minor Requirements for Students

Majoring in Other Fields—Approval of the director of graduate studies in materials science and engineering is required for a master’s minor.
M.S.—Plan A and Plan B

The School of Mathematics offers an M.S. with emphases in industrial and applied mathematics, mathematics education, and actuarial science. For more information, see the Graduate Studies in Mathematics brochure.

Degree Requirements

The M.S. is offered under Plan A and Plan B. Plan A requires a minimum of 20 course credits and 10 thesis credits. Plan B allows more breadth; students complete at least 30 course credits, half of which may be in areas outside of mathematics.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—The master’s minor requires a two-semester 8xxx or 4xxx sequence.

Ph.D.

The School of Mathematics offers a general Ph.D. in mathematics and a Ph.D. in mathematics with emphasis in industrial and applied mathematics. Special areas of research include ordinary and partial differential equations; probability; real, complex, harmonic, functional, and numerical analysis; differential and algebraic geometry; topology; number theory, algebra, and group theory; logic; combinatorics; and mathematical physics and industrial mathematics.

Degree Requirements

The Ph.D. preliminary written exam, given twice each year, cover real analysis, complex analysis, algebra, and manifolds and topology. Students must pass the exam by the end of their second year. After passing this exam and completing the coursework, students may take the preliminary oral exam, which they must pass by the end of their fourth year. If a supporting program is chosen, it may consist partly or entirely of mathematics courses. The choice of courses and exams for the emphasis in industrial and applied mathematics is different from those in the general program. In particular, applications are stressed early on. For more information, see the program’s Graduate Studies in Mathematics brochure.

Language Requirements—Two foreign languages are required from among the following: French, German, Russian, and Italian.

Minor Requirements for Students Majoring in Other Fields—Consult the director of graduate studies in mathematics.

Degree Programs

Mechanical Engineering

Mechanical engineering offers coursework and research in bioengineering; biomechanics; combustion; computer-aided design; computer-aided manufacturing; computer graphics; control systems; design; energy conservation; environmental control; environmental engineering; fluid mechanics; heat and mass transfer; history of science and technology; innovative methodologies; integration of structural and environmental systems; lubrication; manufacturing engineering; particle technology; plasma chemistry; plasma heat transfer; power, propulsion, and applied thermodynamics; solar energy; solar processing and thermochemistry; structures; systems dynamics; technology assessment; thermal energy storage; thermal environmental engineering; thermodynamics; transportation; tribology; vibration; and interdisciplinary finite element methodology. Additional instructional and research programs can be formulated. Please refer to Mechanical Engineering (ME) and Industrial Engineering (IE) in the course section of this catalog for courses pertaining to this program.

M.S.M.E.—Plan A and Plan B

Degree Requirements

The M.S.M.E. requires a minimum of 30 credits, including a minimum of 14 course credits in the major (to include at least 1 credit of graduate seminar) and 6 course credits in a minor or related field; Plan A also requires 10 thesis credits. For Plan B, one to three Plan B papers are required (the number in part depending on their length), determined in consultation with the adviser. The papers may derive from courses in the major or may address topics chosen by a graduate faculty member and the student. No courses also are taken in mathematics and educational psychology. A 6-credit Plan B paper is required.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A minimum of 6 credits in mechanical engineering is required for a master’s minor.

Mathematics Education

M.A.—Plan B

By focusing on the curricular and instructional processes central to all educational endeavors, graduate programs within the Department of Curriculum and Instruction prepare students for professional roles in pre-K-12 education, in postsecondary and research settings, and in educational service agencies. The M.A. in mathematics education serves students interested in teaching at the elementary, middle grades, and secondary school levels. Students design their program of study in consultation with their adviser. Please refer to Mathematics Education (MthE) and Education (Educ) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The program requires 30 credits, of which 14 must be earned in the major field. Typically courses also are taken in mathematics and educational psychology. A 6-credit Plan B paper is required.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A minimum of 6 credits in mechanical engineering is required for a master’s minor.
Ph.D.

Degree Requirements
The Ph.D. requires a minimum of 44 course credits, including a minimum of 12 course credits in a minor field or supporting program and a minimum of 2 credits of graduate seminar; 24 thesis credits are also required. No courses at the 4xxx level or below may be applied toward the degree.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—A minimum of 12 credits in mechanical engineering is required for a doctoral minor.

Mechanics

M.S.—Plan A and Plan B
The M.S. program in mechanics emphasizes coursework in fluid mechanics, dynamical systems and controls, and continuum and solid mechanics. Theoretical, analytical, experimental, and computational aspects of these subjects are covered by the courses and research opportunities offered by the department.

Please refer to Aerospace Engineering and Mechanics (AEM) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
The M.S. program in mechanics requires 20 credits that include at least one sequence in mechanics at the 8xxx level and no more than 8 credits at the 4xxx level. The student must also demonstrate a breadth of knowledge in mechanics, either from previous study or from coursework in more than one M.S. subfield of mechanics.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—At least one sequence of two courses in mechanics at the 8xxx level is required.

Ph.D.

The Ph.D. program in mechanics emphasizes coursework and research in the subfields of fluid mechanics, dynamical systems and controls, and continuum and solid mechanics. Theoretical, analytical, experimental, and computational aspects of these subjects are covered by the courses and research opportunities offered by the department. Many courses offered by the department serve both major fields: aerospace engineering and mechanics. The difference between these major fields is most apparent in the thesis topics, which for mechanics concern fundamental aspects of dynamical systems, material properties, and fluid and solid behavior.

Please refer to Aerospace Engineering and Mechanics (AEM) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
The Ph.D. program in mechanics requires about two years of coursework, but the heart of the Ph.D. program is the thesis research. The program must contain a minimum of 42 credits of approved courses and four semesters of colloquium attendance. The program must include at least four courses in mechanics at the 8xxx level and can contain no more than two courses at the 4xxx level. The coursework must include some breadth among the subfields of mechanics. The first year of the Ph.D. program is similar to the master’s program and most Ph.D. students receive the master’s degree. By the end of the first year, the student has chosen an adviser. The second year is devoted to more advanced courses and beginning research. Subsequent years include some coursework with increased focus on research. The time required to complete a research project varies, but most students finish the Ph.D. within five years after their bachelor’s degree.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—At least 12 credits in mechanics is required, including at least one sequence of two courses at the 8xxx level.

Medicinal Chemistry

The program emphasizes the application of chemical principles to research on the action of drugs on biological systems. Areas of research include drug design and synthesis; chemical aspects of drug metabolism; chemical mechanisms of drug toxicity and carcinogenicity; computer-assisted drug design; pharmaceutical cell systems; nuclear magnetic resonance spectroscopic analysis of drug-macromolecule interactions; design of catalytic antibodies; and development of radiopharmaceuticals.

M.S.—Plan A

Degree Requirements
Students must complete a core curriculum of advanced courses in organic chemistry (4 credits) and medicinal chemistry (10 credits), 6 credits in a minor or related field, and 10 thesis credits.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A minimum of 6 credits is required for a master’s minor.

Ph.D.

Degree Requirements
All students must complete a core curriculum of advanced courses in organic chemistry (7 credits), biochemistry (8 credits), and medicinal chemistry (13 credits), and 24 thesis credits. Students must also participate in the department seminar program, successfully complete a cumulative exam requirement, which serves as the preliminary written exam, and prepare and defend an original research proposal, which serves as the preliminary oral exam.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—A minimum of 12 credits is required for the doctoral minor, including an introductory course (MedC 5600), advanced medicinal chemistry courses, and other courses in the medicinal chemistry core curriculum.

Medieval Studies

Freestanding Minor
The medieval studies minor is available to master’s (M.A. and M.F.A.) and doctoral students. The Center for Medieval Studies (CMS) encourages collegial interaction and scholarly collaboration among faculty and students in all areas of medieval studies. CMS seeks to provide an opportunity for scholars of all disciplines and at all levels to focus intensively on historical, literary, anthropological, social, economic, religious, artistic, cultural, and methodological inquiries into the medieval period, which may fall within the chronology of roughly 300 to 1500 A.D. and may include the geographical area of Europe, the Middle East, and Russia. The primary emphasis of the program is on Latin, which is the most common learned and written language of the period, and secondarily on an interdisciplinary approach to medieval culture. The minor involves the Departments of Art History; German; History; Italian; Jewish Studies; Modern and Contemporary Literature; Music; Scandinavian, and Dutch; Spanish and Portuguese; and Classical and Near Eastern Studies, and the program in Germanic philology.

Degree Requirements
The master’s minor requires 6 graduate credits: two courses in medieval studies outside the student’s major department, including a Latin course (Latin 33xx or 34xx taken as 8120 or any Latin course at the 5xxx level or above) and either one MeSt core course (5610 or 8110) or another approved course with medieval or Latin content; if the latter option is chosen, MeSt 8010 (the medieval colloquium course) is also required. The doctoral minor requires 12 graduate credits, comprising courses in medieval studies outside the student’s major department and including an additional Latin
course at the 5xxx level or above. Students from Classical fields using Latin to satisfy requirements in those fields must substitute for the medieval studies Latin requirement an equivalent quantity of a medieval vernacular language.

Microbial Ecology

Freestanding Minor
This minor is available to master’s (M.S.) and doctoral students. Microbial ecology is an interdisciplinary research area concerned with the relationships of microorganisms to their natural environment. The microbial ecology minor offers core coursework in microbiology, microbial physiology, microbial genetics, and theoretical ecology as well as in microbial ecology. Additional courses and opportunities to interact with others interested in microbial ecology are also part of the minor. The microbial ecology/biotechnology seminar series allows students and faculty to interact with microbial ecologists from other universities. The curriculum encourages interdisciplinary interaction, communication, and synthesis. Please contact the minor program office for information on relevant coursework.

Degree Requirements
The master’s minor requires 6 graduate credits, all of which must be outside the student’s major department and must include at least one laboratory course in microbiology (e.g., MicB 4215) and one ecology (EEB) course chosen from the list below; the remaining courses are chosen from the other courses listed below with the guidance and approval of the director of graduate studies in microbial ecology.

The doctoral minor requires 12 graduate credits, 9 credits of which must come from the core courses listed below (contact the director of graduate studies for potential alternatives to these courses). The remaining credits must come from at least two courses chosen from the additional courses listed below, but may not be in the student’s major.

Core Courses: EEB 5053—Ecology Theory and Concepts (4 cr); MicB 4111—Microbial Physiology and Diversity (3 cr); MicB 4121—Microbial Ecology and Applied Microbiology (3 cr); MIMP 8002—Structure, Function, and Genetics of Bacteria and Viruses (4 cr).

Additional Courses: CE 8551—Environmental Microbiology/Lab; CE 8541—Aquatic Chemistry; CE 8542—Chemistry of Organic Pollutants in Environmental Systems; EEB 4601—Limnology; EEB 4609—Ecosystem Ecology; EEB 8620—Advanced Limnology; MicB 4215—Advanced Laboratory: Microbial Physiology and Diversity; PIPA 5202—Biological and Ecology of Fungi; PIPA 8102—Epidemiology and Ecology of Plant Disease; PIPA 8103—Physiological and Molecular Plant-Microbe Interactions; Soil 5515—Soil Genesis and Landscape Relations; Soil 5611—Soil Biology and Fertility.

Microbial Engineering

M.S.—Plan A and Plan B
The M.S. program in microbial engineering is an interdisciplinary program integrating basic microbiology, molecular biology, chemical engineering, and related sciences. Students are trained in the industrial application of microorganisms, cultured cells, and immunologic agents. They learn both modern basic microbiology and biological engineering and can either proceed to a Ph.D. program in a related discipline or work directly with research and development staff in biotechnology industries. The program is coordinated by the Biological Process Technology Institute (BPTI), involving faculty from ten departments and four institutes of the University.

Degree Requirements
The M.S. requires 32 credits (including 10 thesis credits) for Plan A and 32 credits (including 1-3 research credits) for Plan B. The two-year program comprises coursework in a specialized program of microbiology, molecular biology, immunobiology, and chemical engineering. In addition, students present two seminars and teach one laboratory course in advanced microbiology, molecular biology, immunobiology, or chemical engineering. Students may choose supporting coursework (at least 6 credits) from specified fields, including biochemistry, food science, pharmacognosy, genetics, and cell biology and must demonstrate proficiency in computer programming and one computer language. Plan A students carry out a research project resulting in a thesis. Plan B students complete a summer preceptorship (about 2 1/2 months) in a private company research laboratory or at a research institute in the University and prepare a Plan B paper based on the research project. Presentation of the original laboratory research thesis/project to the graduate faculty is required at the end of the second year.

Language Requirements—None.
Final Exam—The final exam is oral.

Ph.D.

Degree Requirements
The Ph.D. requires a minimum of 22 course credits in the major, 12 course credits in a minor or supporting program, and 24 thesis credits.

Beginning study in the fall, students spend their first year on major coursework, identifying an adviser by doing laboratory rotations, selecting a track, and initiating their thesis research project. All students take courses on the structure, function, and metabolism of microorganisms; molecular immunology; and pathobiology, as well as in their chosen track during their first two years.

In addition to coursework and research, students have opportunities to participate in laboratory meetings, journal clubs, and student research seminars, and to assist in laboratory courses. Most students complete the Ph.D. in four to five years.
Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—A doctoral minor requires MIMP 8001 (3 credits), MIMP 8910 (1 credit), and two of the following courses: MIMP 8003 (4 credits), MIMP 8004 (4 credits), or BioC 8001 (5 credits).

Molecular, Cellular, Developmental Biology and Genetics

This program provides scientific training in the basic life sciences, with emphasis on the molecular basis of genetics, development, and cell biology. Areas of specialization are cell biology, developmental biology, genetics, and human genetics. Special institutes in human genetics, plant molecular genetics, and biological process technology provide opportunities for graduate study, as does a specialty in genetic counseling. The program is interdisciplinary and involves faculty from several departments in the College of Biological Sciences, the Medical School, the College of Agricultural, Food, and Environmental Sciences, the School of Dentistry, the College of Veterinary Medicine, and the School of Public Health. Please refer to Molecular, Cellular, Developmental Biology and Genetics (MCDG), Genetics and Cell Biology (GCB), and Cell Biology and Neuroanatomy (CBN) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B

Students are admitted to the M.S. program only under exceptional circumstances (e.g., if they can be in the area for only two years) or if they are accepted into the genetic counseling specialization; in both cases, applicants must also be competitive for admission at the Ph.D. level.

Degree Requirements

The M.S. is offered under Plan A and Plan B. Plan A requires a minimum of 20 course credits and 10 thesis credits; Plan B requires a minimum of 30 course credits and the completion of Plan B papers. Students take a core curriculum, which is multidisciplinary and contributes to both the major and minor or related field requirements. Students may choose a track or specialization within the program. Examples of tracks are cell biology, developmental biology, genetics, or human genetics. The M.S. on average takes two years to complete.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A master’s minor requires 6 credits.

Ph.D.

Degree Requirements

The Ph.D. program is designed by the student and the adviser to meet individual interests and goals. Advanced courses in genetics, molecular biology, cell biology, developmental biology, and biochemistry are required, in addition to special courses, topical seminar courses, laboratory research rotations, thesis research, student research seminars, departmental seminars, and journal clubs.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—A doctoral minor typically includes the genetics core (GCB 8131 and 8121 or 5034), cell biology (GCB 8151 or 5036), and developmental biology (GCB 8161 or 4161), as appropriate to the student’s field of specialization.

Molecular Veterinary Biosciences

The mission of the graduate program in molecular veterinary biosciences is to educate students in basic biological mechanisms associated with or responsible for animal health and disease. This mission makes it unique among other biomedical science graduate programs at the University. Faculty research interests focus on molecular mechanisms of pathogenesis, including areas of immunobiology, microbiology, parasitology, virology, and pathology, and on comparative biomedical sciences, including areas of cellular and molecular biology, biochemistry, genetics, neuroscience, physiology, and pharmacology. The program brings together basic and clinical scientists to provide students with biomedical research training and to apply new knowledge toward the understanding of animal disease, animal populations, comparative aspects of biology and pathology across species, and animal models of human disease. This program thus facilitates the application of basic knowledge toward the improvement of animal health and productivity, disease prevention, and diagnostic techniques.

M.S.—Plan A

Degree Requirements

The M.S. requires a core curriculum of fundamental coursework and laboratory experiences, followed by one or more courses (6 credits) in the area of specialization. Students complete 20 course credits and 10 thesis credits; the thesis is based on original laboratory research.

Language Requirements—None.

Final Exam—The final exam is oral.

Ph.D.

Degree Requirements

The Ph.D. requires a core curriculum of fundamental coursework and laboratory experiences, followed by one or more courses in areas of special interest. Considerable flexibility is available for students to construct a program around their own interests. Students also take 12 credits in a minor or supporting program and 24 thesis credits. All students are expected to participate in two continuing series of seminars: one involving reports on current literature and research and the other involving seminars by prominent national and international scientists.

Language Requirements—None.

Museum Studies

Freestanding Minor

The museum studies minor offers a structured graduate curriculum for master’s (M.A. and M.S.) and doctoral students interested in museums. It provides students from a variety of disciplines with an introduction to the issues involved in museum practices (e.g., educational, curatorial, administrative, and conservation). The curriculum includes seminars, directed readings, and internships.

Degree Requirements

The master’s and doctoral minors require an introductory seminar (MSt 5011; 3 credits) and the museum practices course (MSt 5012; 3 credits). An internship (MSt 5020) is also required, 1 credit for the master’s minor, 6 credits for the doctoral minor.

Music

M.A.—Plan A and Plan B

The master of arts (M.A.) in music offers emphases in musicology and ethnomusicology (Plan A and Plan B), theory (Plan B only), and composition (Plan B only).

Please refer to Music (Mus), Music Applied (MusA), and Music Education (MuEd) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The M.A. in music with emphasis in musicology and ethnomusicology requires 34 credits (24 course credits and 10 thesis credits) for Plan A and 30 course credits for Plan B; the emphasis in composition requires 41 course credits (Plan B only), and the emphasis in music theory requires 30 course credits (Plan B only). The credit totals for all emphases include 6 credits required for courses outside the major field.
Degree Programs

Language Requirements—A reading knowledge of French, German, or Italian is required for all degree emphases.

Final Exam—For the emphasis in musicology and ethnomusicology, the final exams are written and oral. For the emphases in theory and composition, the final exam is oral.

M.M.—Plan B

The master of music (M.M.) degree (Plan B only) offers emphases in piano, harpsichord, organ, voice, violin, viola, cello, double bass, flute, oboe, clarinet, saxophone, bassoon, French horn, trumpet, trombone, euphonium, tuba, percussion, harp, guitar, piano, pedal harp, accompanying and coaching, orchestral conducting, wind ensemble and band conducting, choral conducting, and church music (choral and organ concentrations).

Please refer to Music (Mus), Music Applied (MusA), and Music Education (MuEd) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The M.M. Plan B requires credit distribution among the following for each emphasis: applied music study directly related to the emphasis (literature, pedagogy, performance practice, conducting, secondary instrument, chamber music, etc.), ensemble, and Mus 5xxx or 8xxx musicology/ethnomusicology and theory/composition, with a minimum of one 3-credit course in each area. At least one recital is required.

The minimum credit requirement for each emphasis is as follows: 30 credits are required for piano, instrumental performance, harp, guitar, piano, pedal harp, orchestral conducting, wind ensemble and band conducting, and church music (choral concentration); 32 credits for choral conducting; 33 credits for organ and voice; 40 credits for church music (organ concentration); and 41 credits for accompanying and coaching (two recitals are required).

Language Requirements—None.

Final Exam—A final oral exam is required that covers coursework and the final project and/or recital.

D.M.A.

For the doctor of musical arts (D.M.A.), emphases are offered in piano, organ, accompanying and coaching, voice, violin, viola, cello, clarinet, woodwinds, trumpet, trombone, guitar, and orchestral conducting.

Please refer to Music (Mus), Music Applied (MusA), and Music Education (MuEd) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The D.M.A. requires a minimum of 85 credits: 32 credits of applied study; 12 credits in musicology/ethnomusicology and theory/composition, with at least one 3-credit course in each area; a minimum of 8 credits directly related to the emphasis (literature, pedagogy, performance practice, conducting, secondary instrument, chamber music, etc.); 9 credits in a supporting program outside of music; 20 recital credits for five recitals; and 4 thesis credits for the D.M.A. project document.

Minimum credit requirements for the D.M.A. emphases are as follows: 85 credits for piano, instrumental performance, guitar, and orchestral conducting; 87 credits for organ and woodwinds; 89 credits for voice; and 93 credits for accompanying and coaching.

Language Requirements—The D.M.A. with emphasis in accompanying and coaching requires two languages chosen from French, German, and Italian; the emphasis in orchestral conducting requires either French or Italian.

Ph.D.

For the doctor of philosophy (Ph.D.) in music, emphasis are offered in musicology, ethnomusicology, theory, composition, and music education.

Please refer to Music (Mus), Music Applied (MusA), and Music Education (MuEd) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The doctor of philosophy (Ph.D.) in music, emphasis are as follows: 51 credits for musicology, ethnomusicology, and theory; 62 credits for composition; and 66 credits for music education. Programs are individualized and build on the core of coursework required for the corresponding master’s degrees. Coursework includes 12-18 credits outside the major. In addition, 24 thesis credits are required.

Language Requirements—The language requirement for each emphasis is as follows: Musicology, ethnomusicology, and composition: Two languages chosen from French, German, and Italian (substitution may be made when a different language is needed for the thesis. For composition, one language may also, with approval, be replaced by a collateral field of knowledge or a special research technique).

Theory: German and either French or Italian (substitution may be made when a different language is needed for the thesis; with approval, the second language may also be replaced by a collateral field of knowledge or a special research technique).

Music education: None.

Music Education

M.A.—Plan B

The M.A. in music education offers two emphases: music education and music therapy. The music education emphasis involves planning, teaching, learning, and evaluating processes with musical content applied to formal schooling, kindergarten through college. While knowledge of acculturation phenomena is included, applications generally are directed toward formal educational settings. The music therapy emphasis furthers the preparation of professionals who use music to accomplish therapeutic aims. The two emphases are highly compatible and mutually enhancing.

The M.A. is a research-oriented degree with coursework fairly evenly divided between scholarly skill development, musical knowledge and skills, theoretical music education content, and applications.

Please refer to Music (Mus), Music Applied (MusA), and Music Education (MuEd) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The M.A. requires 30 course credits: 12 credits in music education for the major; 8 credits in music; 5 credits of electives from professional education, music, and music education; and a 5-credit research project (Plan B).

Language Requirements—None.

Final Exam—The final exam is oral.

Neuroscience

Ph.D.

Neuroscience is a relatively new field of inquiry. The objects of this inquiry, the brain and nervous systems, are sufficiently complex and unique among biological systems to require analytical approaches that cross the traditional boundaries of anatomy, behavioral biology, biochemistry, cell biology, genetics, pharmacology, physiology, and psychology. In some instances, neuroscience also encompasses computer science, information processing, engineering, physics, and mathematics.

Degree Requirements

The neuroscience Ph.D. curriculum begins in the summer session with the intensive laboratory course in cellular and molecular neurobiology (NSc 5551), held at the Lake Itasca Biological Station. The core curriculum continues on the Twin Cities campus with NSc 5461, 5481, 5661, 8210 (pending), and CBN 6111, during which students explore research opportunities in the faculty’s laboratories (NSc 8333) and thereby select a thesis adviser. Most students take a course in cell biology (such as Biol 4004) in the first semester. Because thesis research is expected to include statistical analysis of
Degree Programs

data, a course in statistics (such as Stat 5021) is required. Elective courses and at least 12 credits in a minor or supporting program are selected in consultation with the adviser (typical minors include cell biology, physiology, statistics, psychology, and medicine; medicine is primarily for students in the M.D./Ph.D. program). Students with sufficient background and previous course experience may apply for a waiver of specific requirements. Proficiency in at least one computer programming language is highly recommended.

Students are also expected to participate in teaching neuroscience and to attend weekly seminar series, including the survival skills seminars, the jointly sponsored physiology/neuroscience seminars, and evening seminars planned by second-year students. Students are strongly encouraged to attend seminars in other areas and departments that may interest them.

Language Requirements—There is no language requirement, though a reading knowledge of a foreign language relevant to the student’s major field of interest is highly recommended.

Minor Requirements for Students

Majoring in Other Fields—A doctoral minor program is developed in consultation with the director of graduate studies for neuroscience. Students must take NSc 5461, CBN 6111, and elective courses in neuroscience, for a minimum of 12 credits (including core courses).

Nursing

M.S.—Plan A and Plan B

The master’s program prepares students for advanced practice nursing positions that address complex health and illness issues. The program is offered under Plan A and Plan B. Plan A emphasizes research; Plan B prepares students who will integrate research into advanced practice roles or leadership positions.

Coursework is offered in the following areas: adult health nursing; child and family nursing; children with special health-care needs; family nurse practitioner; gerontological clinical nurse specialist; gerontological nurse practitioner; nurse midwifery; nursing administration; nursing education; oncology nursing; pediatric nurse practitioner; public health nursing with emphasis in administration, adolescent health, older adult health, school health, and parent, child, and family health; psychiatric/mental health nursing; and women’s health care nurse practitioner.

Degree Requirements

The M.S. is offered under Plan A (thesis) and Plan B (project).

Plan A requires 30 credits: 14 credits in the major, including Nurs 8170—Research in Nursing (3 credits); 6 credits in a minor or related fields; and 10 theses credits.

Plan B requires 33 credits: 9 credits of disciplinary core courses; 12 credits of advanced nursing core courses, including Nurs 8194—Problems in Nursing (3 credits); 6 credits of specialty core courses; and 6 credits in related fields.

Language Requirements—None.

Final Exam—The final exam is oral.

Ph.D.

The Ph.D. program prepares creative and productive scholars in nursing. Students gain a depth of knowledge and experience in the development and modification of health-related behaviors; human responses to environmental and life process events disruptive to health; the phenomenon of health; and the organization and system of delivery of nursing knowledge and of nursing care.

Degree Requirements

Students plan with their advisers individualized programs of study and independent research, subject to approval by a faculty committee. The Ph.D. requires 12 credits in a minor or supporting field.

Language Requirements—None.

Minor Requirements for Students

Majoring in Other Fields—A doctoral minor requires 12 credits in nursing with at least 8 credits at the 8xxx level.

Nutrition

Nutrition is the study of how nutrients, both essential and non-essential, affect health and all life processes. Consequently, nutrition is an extremely broad field that encompasses physiology, biochemistry, education, public health, and public policy, and the graduate program is interdisciplinary. Advisers and financial support may come from any of the departments or schools in which nutrition graduate faculty reside, including the Department of Food Science and Nutrition (Colleges of Human Ecology and Agricultural, Food, and Environmental Sciences), Division of Epidemiology (School of Public Health), Department of Pediatrics (Medical School), Department of Surgery (Medical School), Department of Animal Science (College of Agricultural, Food, and Environmental Sciences), School of Kinesiology and Leisure Studies (College of Education and Human Development), Hormel Institute (Austin, MN), and Veterans Administration Hospital (Minneapolis, MN). Please refer to Nutrition (Nut) and Food Science and Nutrition (FScN) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B

Degree Requirements

The M.S. is offered under both Plan A (thesis) and Plan B (non-thesis). Plan A requires a minimum of 20 course credits and 10 thesis credits; Plan B requires a minimum of 30 course credits, including a Plan B project. General requirements include the graduate nutrition core series (three courses), an orientation and presentation skills class, courses in biochemistry and statistics, and presentation of the thesis or project work. All students also are expected to obtain teaching experience, subject to the policies of the adviser’s department or division.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students

Majoring in Other Fields—A master’s minor requires a minimum of 6 course credits in nutrition, including FScN 5621.

Ph.D.

The Ph.D. program offers three areas of specialization: human nutrition, nutritional biochemistry, and public health nutrition. Thesis work may be conducted in the laboratory, clinic, or field, either locally or internationally.

Degree Requirements

The Ph.D. requires the graduate nutrition core series (three courses), an orientation and presentation skills class, graduate-level courses in biochemistry and statistics, and presentation of the thesis. All students also are expected to obtain teaching experience, subject to the policies of the adviser’s department or division.

Language Requirements—None.

Minor Requirements for Students

Majoring in Other Fields—A doctoral minor requires 12 credits in nutrition with at least 8 credits at the 8xxx level.

Occupational Therapy

M.S.—Plan A and Plan B

The program offers academic study and clinical education for preparing occupational therapy clinicians and researchers. Emphasis is on application of the critical thinking model to diverse areas of practice and to diagnostic groups in both clinic and community settings. Clinical education is available in such areas as physical disabilities, psychosocial dysfunction, and developmental disabilities. Research emphasizes investigation of treatment effectiveness.
The program is accredited by the Accreditation Council for Occupational Therapy Education (ACOTE) of the American Occupational Therapy Association (4720 Montgomery Lane, Bethesda, MD 20814-3425; 301/652-2682). Graduates of the program may sit for the national certification exam administered by the National Board for Certification of Occupational Therapists. Most states require licensure in order to practice; however, state licenses are usually based on the results of this certification exam.

Please refer to Occupational Therapy (OT) and Physical Medicine and Rehabilitation (PMed) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
Students take 59 credits of predetermined academic coursework, 10 credits of clinical education, and 10 thesis credits (Plan A) or 4 project credits (Plan B). There is no minor or related field requirement.

Language Requirements—None
Final Exam—The final exam is oral.

Oral Biology
The oral biology graduate program is offered by the Department of Oral Science in the School of Dentistry. The program provides students with a broad understanding of the development, structure, function, and pathology of the orofacial region. Advanced coursework and research emphasize specialized areas of interest, including salivary and secretions, oral microbial ecology and physiology, immunobiology, neurobiology, mineral metabolism and nutrition, pathobiology of oral structures, physical biology of the masticatory system, and development and evaluation of dental materials. Considerable flexibility is encouraged in planning individual programs to accommodate the student’s specific areas of interest, and courses from other disciplines may be included as part of the major.

M.S.—Plan A and Plan B

Degree Requirements
The M.S. generally requires a minimum of two years, and may be taken as Plan A (with thesis) or Plan B (without thesis); both plans require a total of 30 credits. Students in both plans must complete a minimum of 14 credits in the major, including 4 credits of oral biology topics courses (8021-8028). Courses in the major may be taken from other disciplines with the approval of the adviser and the director of graduate studies. Registration and participation in the oral biology student seminar series (8030) is required each semester. Students must also complete a minor or related field program in a related nonclinical discipline (minimum 6 credits). Plan A requires 10 thesis credits and Plan B requires 10 credits of additional coursework and three Plan B papers. The Plan B papers normally consist primarily of critical reviews of the literature, but at least one must include a laboratory study. Students must maintain a GPA of at least 3.00 in both the major and minor. Only grades of A or B are acceptable in the core courses.

Language Requirements—None
Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A master’s minor in oral biology consists of 6 credits and must include OBio 8011, at least two advanced courses in oral biology, and other coursework determined in consultation with the director of graduate studies.

Ph.D.
Degree Requirements
Coursework for the Ph.D. is selected to give the student a broad background in oral biology plus advanced coursework directly related to the student’s research interests. Although there is no Graduate School minimum credit requirement for the degree, most students are expected to complete a core curriculum of 23-25 credits; all students must satisfactorily complete 8 credits of oral biology topics courses (8021-8028) and participate in the oral biology student seminar series (8030) each semester. The remaining coursework in the major curriculum is tailored to the student’s research interests and may be selected from departments/programs outside of the oral biology program with the approval of the adviser and director of graduate studies. A minor (minimum 12 credits) in a nonclinical discipline is also required. A cumulative GPA of at least 3.00 in both the major and minor is required. Only grades of A or B are acceptable in the core courses. The preliminary written exam consists of two research proposals, one representing the student’s anticipated thesis research and the other on a topic assigned by the graduate faculty. The preliminary oral exam consists primarily of a defense of the two research proposals described above. Students must also present a seminar describing their thesis research (which is attended by the final oral exam committee) no later than six months before defense of the thesis.

Language Requirements—None
Minor Requirements for Students Majoring in Other Fields—A Ph.D. minor in oral biology consists of 12 credits and must include OBio 8011, at least two advanced courses in oral biology, and other coursework in consultation with the director of graduate studies.

Otolaryngology
The master’s programs prepare students in both clinical and experimental aspects of otolaryngology. The M.S. and M.S.Otol. degrees both require a publishable thesis. Rotations at Fairview-University Medical Center, Minneapolis Veterans Administration Medical Center, St. Paul-Ramsey Medical Center, and Hennepin County Medical Center provide a wide range of opportunity for clinical education and surgical experience. Opportunities for independent research are provided in the research laboratories of audiology, auditory electrophysiology, auditory neurophysiology, biochemistry, electronmicroscopy, electrophysiology, histochemistry, morphometry, psychoacoustics, temporal bone pathology, tumor immunology, skin-flap physiology, laryngeal physiology, mandibular bone physiology, microvascular tissue transfer, and vestibular physiology. Graduates of the program have careers in teaching, research, and the professional practice of otolaryngology.

M.S.—Plan A

Degree Requirements
The M.S. (Plan A only) requires a minimum of 30 credits: 20 course credits (14 in the major and 6 in the minor or related fields) and 10 thesis credits. Each student selects an adviser and prepares a preliminary research proposal by March 1 of the first year. A full proposal in NIH style is expected by June 1. Both proposals must be reviewed by the graduate research committee. A minimum of six months in basic research begins in the second year. Students are expected to complete and publish a research paper in a peer-reviewed journal or a presentation/poster at a national scientific meeting.

Language Requirements—None
Final Exam—The final exam is oral. M.S. students also take a national exam, and those who receive less than 70 percent on the exam must complete a written exam for the degree.

Minor Requirements for Students Majoring in Other Fields—A minor is not available, but otolaryngology courses may be taken for related field credits.

M.S.Otol.—Plan A

Degree Requirements
The M.S.Otol. (Plan A only) requires a minimum of 35 credits, including 25 course credits (19 in the major and 6 in the minor or related fields) and 10 thesis credits. Some courses for the M.S.Otol. are more clinical than those for the M.S., and four years of academic preparation are expected. Each student selects an adviser and prepares a preliminary research proposal by March 1 of the first year. A full proposal in NIH style is expected by June 1. Both proposals must be reviewed by the graduate research committee. A minimum of six months in
basic research begins in the second year. Students are expected to complete and publish a research paper in a peer-reviewed journal or a presentation/poster at a national scientific meeting.

Language Requirements—None.

Final Exam—The final exam is oral. Students also take a national exam, and those who receive less than 70 percent on the exam must complete a written exam for the degree.

Minor Requirements for Students Majoring in Other Fields—A minor is not available, but otolaryngology courses may be taken for related field credits.

Ph.D.Otol.
The doctoral program prepares students in both clinical and experimental aspects of otolaryngology. The Ph.D.Otol. requires a publishable dissertation. Rotations at Fairview-University Medical Center, Minneapolis Veterans Administration Medical Center, St. Paul-Ramsey Medical Center, and Hennepin County Medical Center provide a wide range of opportunity for clinical education and surgical experience. Opportunities for independent research are provided in the research laboratories of audiology, auditory electrophysiology, auditory neurophysiology, biochemistry, electronmicroscopy, electrophysiology, histochemistry, morphometry, psychoacoustics, temporal bone pathology, tumor immunology, skin-flap physiology, laryngeal physiology, mandibular bone physiology, microvascular tissue transfer, and vestibular physiology. Graduates of the program have careers in teaching, research, and the professional practice of otolaryngology.

Degree Requirements
The Ph.D.Otol. requires a minimum of 55 credits, including 31 course credits (19 in the major and 12 in the minor or supporting program) and 24 thesis credits. Each student selects an adviser and prepares a preliminary research proposal by March 1 of the first year. A full proposal in NIH style is expected by June 1st. Both proposals must be reviewed by the graduate research committee. A minimum of six months in basic research begins in the second year. Most Ph.D.Otol. students require five to six years to complete their research and course requirements and write the dissertation. Students are expected to publish a research paper in a peer-reviewed journal.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—A minor is not available, but otolaryngology courses may be taken for supporting program credits.

Pharmaceutics

M.S.—Plan A

Degree Requirements
The M.S. requires 20 course credits, including 6 credits in a minor or related field; 10 thesis credits are also required. Students must take advanced courses in pharmaceutics, chemistry, mathematics, statistics, and pharmacology. A complete list of degree requirements may be obtained from the director of graduate studies.

Language Requirements—None.

Final Exam—The final exam is oral.

Ph.D.

Degree Requirements
The Ph.D. requires 33 course credits, including 12 credits in a minor or supporting program; 24 thesis credits are also required. Students must take advanced courses in pharmaceutics, chemistry, mathematics, statistics, and pharmacology. A complete list of degree program requirements may be obtained from the director of graduate studies.

Language Requirements—None.

Final Exam—The final exam is oral.

Pharmacology

Pharmacology is the study of the manner in which the function of living organisms is affected by chemical agents. Understanding of the cellular and molecular mechanisms underlying both normal function and drug action is advancing rapidly, and pharmacology addresses both these issues. The M.S. curriculum provides a solid understanding of basic pharmacology along with a highly individualized program of study that lays the foundation for performing original research in pharmacology.

M.S.—Plan A

Degree Requirements
The M.S. is offered under Plan A only. It requires a minimum of 20 course credits (14 in a core curriculum in pharmacology, along with prerequisite courses in biochemistry, physiology, and statistics, and 6 credits in a minor or related field) and 10 thesis credits.

Language Requirements—None.

Final Exam—The final exam is oral.

Ph.D.

Degree Requirements
The Ph.D. requires 21 course credits in the major, as well as physiology or neuroscience, biochemistry, and statistics courses and any other courses specified by the adviser. Students select a minor, e.g., in biochemistry, neuroscience, physiology, or psychology, or a supporting program that consists of courses from two or more disciplines relevant to the doctoral research. During the first year, students rotate through three laboratories, pick an adviser, and begin a research project.

Language Requirements—None.

Philosophy

While emphasizing a solid background in basic areas of philosophy, the program is noteworthy for its emphasis on tailoring programs to meet the interests and needs of individual students. The program offers strength in the basic areas of the history of Western philosophy, ethics, epistemology and metaphysics, and logic, and offers special strengths in philosophy of science, feminist philosophy, and aesthetics.

M.A.—Plan A and Plan B

Degree Requirements
The M.A. is offered under two plans: Plan A involves coursework and a thesis; Plan B substitutes a three-paper project and additional coursework for the thesis. Plan A requires 14 course credits in philosophy, 6 course credits outside the department, and 10 thesis credits. Plan B requires 24 course credits in philosophy, 6 course credits outside the department, and three Plan B papers.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A master’s minor requires 6 course credits in philosophy approved by the director of graduate studies in philosophy. Programs are tailored to meet the interests and needs of the student.

Ph.D.

Degree Requirements
No minimum credits are required for the Ph.D., though specific philosophy courses are required that total 26-28 credits; 24 thesis credits are also required. After a student has satisfied the logic and history course requirements and passed the three-paper exam, the student’s entire record is reviewed by the faculty. Successful review represents passing the preliminary written exam. Students then write a dissertation proposal, successful defense of which constitutes passing the preliminary oral exam.

Language Requirements—None.
Minor Requirements for Students Majoring in Other Fields—A doctoral minor requires 12 course credits in philosophy approved by the director of graduate studies in philosophy. Programs are tailored to meet the interests and needs of the student.

Physical Therapy
M.S.—Plan B, Plan A and Plan B
Physical therapy is a health-care discipline involved with the rehabilitation of impaired human movement. Movement impairments such as muscular weakness, joint stiffness, and pain can lead to functional problems affecting self care, employment, ambulation, etc. In the M.S. program, students learn the diseases and injuries that cause these impairments, as well as the evaluation and treatment to correct them. The program prepares graduates to promote proper health care and quality of living by maximizing human movement following disease or injury or by preventing its loss.

The Physical Therapy Program, a division within the Department of Physical Medicine and Rehabilitation, offers two M.S. programs: entry-level and postprofessional. The entry-level professional education program, which takes two and a half years to complete, prepares students to become physical therapists. Graduates must pass a licensure exam to begin clinical practice. The postprofessional education program trains practicing physical therapists in research skills, teaching skills, and higher clinical skills.

Please refer to Physical Therapy (PT) and Physical Medicine and Rehabilitation (PMed) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
The entry-level program (Plan B only) requires 81 major field credits, of which 68 are core academic credits and 13 are clinical internship credits. Students must maintain a cumulative GPA of 2.80. Instead of a thesis, a scholarly research project is required (in connection with PMed 8193 Research Problems). No minor or related field is required for this program.

The postprofessional Plan A program requires 24 major field credits, of which 14 are core academic credits and 10 are thesis credits; 6 elective credits outside the major are also required.

The postprofessional Plan B program requires 24 major field credits, all of which are core academic credits; 6 elective credits outside the major are also required. Instead of a thesis, a scholarly research project is required (in connection with PMed 8193 Research Problems).

Language Requirements—None.

Final Exam—The final exam is oral.

Physics
Physics is the study of the fundamental structure and interactions of matter. Research areas in the program include elementary particle physics, condensed matter physics, nuclear physics, space physics, plasma physics, statistical mechanics, biophysics, atomic and molecular physics, and mass spectroscopy. Interdisciplinary study is also available with the programs in astrophysics, chemical physics, and the history of science and technology.

M.S.—Plan A and Plan B
Degree Requirements
The M.S. requires a minimum of 20 course credits (Plan A) or 30 course credits (Plan B), including classical physics (Phys 5011-5012) or quantum mechanics (Phys 5001-5002) and a minimum of 6 credits in a minor related field. Plan A also requires 10 thesis credits. The minor or related field requirement may be satisfied by completion of courses in one or two areas outside the specialization; some or all of these courses may be in physics.

Language Requirements—There is no language requirement. However, in some instances the thesis advisor may require a reading knowledge of one or more foreign languages if justified by the nature of the topic.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A physics minor requires a background in differential and integral calculus and one year of calculus-level college physics. For the master’s minor, students must complete a minimum of 6 credits in physics.

Ph.D.
Degree Requirements
The Ph.D. requires a minimum of 40 credits, including classical physics (Phys 5011-5012), quantum mechanics (Phys 5001-5002), and two semesters of a seminar in the student’s research area. The minor or supporting program requirement may be satisfied by completion of courses in one or two areas outside the specialization; some or all of these courses may be in physics.

Language Requirements—There is no language requirement. However, in some instances the thesis advisor may require a reading knowledge of one or more foreign languages if justified by the nature of the topic.

Minor Requirements for Students Majoring in Other Fields—A physics minor requires a background in differential and integral calculus and one year of calculus-level college physics. For the doctoral minor, students must complete a minimum of 12 credits in physics, including either the classical physics sequence (Phys 5011-5012) or the quantum mechanics sequence (Phys 5001-5002).

Plant Biological Sciences
Plant biological sciences encompasses all aspects of the basic biology of both higher and lower plants. Major emphases include molecular and physiological approaches to development; physiological, structural, and functional studies at the cellular and organismal levels; systematic and evolutionary biology; and molecular genetics and applied biotechnology. Students have the opportunity to study plants from the subcellular and molecular to the whole plant and community levels of biological organization. They also have opportunities for laboratory and field research at state, national, and international levels. Each student’s program is planned to meet individual requirements within the framework of a multidisciplinary core of coursework. Seminars are an integral part of the program.

Please refer to Plant Biology (PBio) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B
Degree Requirements
Course programs are planned in consultation with an advisory committee. Students are expected to take a minimum of five courses in the major in addition to the two 1-credit current topics courses taken during their first year.

Students participate in a teacher training program and then serve as a teaching assistant for one semester. Regular attendance at the weekly Plant Biological Sciences Colloquium seminars is expected.

Plan A students write a thesis proposal and present the results of their research at a colloquium seminar. Plan B students develop a thesis proposal.

Language Requirements—None, except as specified by a faculty adviser in consultation with the student.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A master’s minor requires a minimum of 6 credits approved by the director of graduate studies.

Ph.D.
Degree Requirements
Course programs are planned in consultation with an advisory committee. Students are expected to take a minimum of five courses in the major in addition to the two 1-credit current topics courses taken during their first year.

Students participate in a teacher training program and then serve as a teaching assistant. Regular attendance at the weekly Plant Biological Sciences Colloquium seminars is expected.
A dissertation proposal and the presentation of two noncredit seminars are required.

**Language Requirements**—None, except as specified by a faculty adviser in consultation with the student.

**Minor Requirements for Students Majoring in Other Fields**—A doctoral minor requires a minimum of 12 credits approved by the director of graduate studies.

### Plant Pathology

Plant pathology interfaces with such disciplines as plant biology, microbiology, ecology, molecular biology, food science, and veterinary medicine. Areas of concentration include biological control, microbial ecology, epidemiology, physiological and molecular plant-microbe interactions, disease resistance genetics and breeding, mycology, virology, forest pathology, microbial degradation of wood, mycotoxidology, environmental pollution, and climate change.

**M.S.—Plan A and Plan B**

**Degree Requirements**

Plan A (thesis) and Plan B (non-thesis) both require a minimum of 16 course credits in plant pathology and 6 course credits in a minor or related field. In addition, Plan A requires 10 thesis credits and Plan B requires 8 project or elective credits.

**Language Requirements**—A foreign language is generally not required. However, knowledge of a foreign language may be necessary for students doing research in non-English-speaking countries.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—A minimum of 6 credits is required for a master’s minor.

### Ph.D.

**Degree Requirements**

The Ph.D. requires a minimum of 21 course credits in plant pathology, 12 credits in a minor or supporting program, and 24 thesis credits.

**Language Requirements**—A foreign language is generally not required. However, knowledge of a foreign language may be necessary for students doing research in non-English-speaking countries.

**Minor Requirements for Students Majoring in Other Fields**—A minimum of 12 credits is required for a doctoral minor.

### Political Science

**M.A.—Plan B**

This program is for secondary school teachers, journalists, government employees, political professionals, and others who would like to cover broad areas of study in political science and related disciplines without the depth and extensive research emphasized in the Ph.D. program. Students may choose among several subfields, including political theory, comparative politics, international relations, American politics, and formal models and methodology.

**Degree Requirements**

The M.A. degree, Plan B (without thesis), requires 34 credits, distributed between major courses and minor or related field courses; three research papers, usually written in connection with coursework, are also required.

**Final Exam**—The final exams are written and oral.

### Psychology

**M.A.—Plan A and Plan B**

Except for the psychometrics specialization and in special circumstances, students are admitted only for the Ph.D. However, a number of Ph.D. subareas require a Plan A master’s as part of the Ph.D. to ensure that research training starts early. See the Ph.D. program description for information on emphases, tracks, and concentrations.

**Degree Requirements**

Each student’s program is planned in consultation with an adviser. Plan A requires a minimum of 20 course credits (a minimum of 14 in the major and 6 in the minor/related field) and 10 thesis credits; Plan B requires 30 course credits (a minimum of 20 in the major and 10 in the minor/related field).

**Language Requirements**—None.

**Final Exam**—For Plan A, the final exam is oral; for Plan B, it may be written, oral, or both.

**Minor Requirements for Students Majoring in Other Fields**—A master’s minor requires a minimum of 6 credits, with specific courses determined in consultation with an adviser and other faculty.
Degree Requirements

Students must satisfy the general area distribution requirement of selected courses in four areas (total of 24-26 credits) outside their specialization. There are no other general department course requirements. Each student’s program is individually planned in consultation with an adviser to meet both the individual’s goals and the area requirements. The programs in clinical psychology and counseling psychology include specific requirements for applied coursework and practicum and internship experience. Each specialization also requires completion of a series of Ph.D.-level seminars covering scholarship and research skills.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—The doctoral minor requires a minimum of 12 credits and is designed according to student needs.

Public Affairs

M.P.A.—Coursework Only

The master of public affairs (M.P.A.) is intended for midcareer professionals and is beneficial for working professionals seeking new skills and understandings. It is a broad, generalist program that emphasizes leadership. Learners may also choose to become more expert in specific policy and skill areas. Completion of degree requirements should be possible within a calendar year (two semesters and a summer) of full-time work, or two years of part-time work. Structured concentrations include advanced policy analysis methods; economic and community development; foreign policy and international affairs; social policy, or other related courses; 6 credits in skills courses; and 3 credits of free electives. All students must take one synthesis seminar (4 credits), one synthesis workshop (4 credits), and the seminar PA 5941—Leadership for the Common Good (4 credits). The rest of the program consists of courses that participants choose with their adviser’s consent in light of the assessment completed at the time of enrollment. Participants have the option to pursue a minor or related field offered by Another University college.

Language Requirements—None.

Final Exam—Projects in the synthesis seminar and workshop take the place of a Plan B paper and final oral exam.

Public Health

Freestanding Minor

The public health minor is available to master’s (M.A. and M.S.) and doctoral students.

Degree Requirements

The master’s minor requires a minimum of 8 graduate credits; the doctoral minor a minimum of 14 graduate credits. Courses must be selected from those offered by the School of Public Health and must include PubH 5320 Fundamentals of Epidemiology, PubH 5414 Biostatistical Methods, and PubH 5200 Environmental Health. Elective courses should be selected in consultation with a faculty adviser assigned by the director of graduate studies in public health. Early planning is important, as public health courses frequently have prerequisites or enrollment limitations.

Public Policy

M.P.P.—Plan B

The master of public policy (M.P.P.) curriculum is built upon a core of required theoretical and methodological courses. In remaining courses, students choose either to emphasize more advanced study of analysis or management, or to focus on a particular substantive area of public policy. Structured concentrations include advanced policy analysis methods, economic and community development, foreign policy and international affairs, public and nonprofit leadership and management, science and technology policy, social policy, and women and public policy. Students have multiple opportunities to apply the concepts learned in their coursework to real-life policy problems—through cases presented in courses, through their internships, and in the capstone seminar or workshop.

Please refer to Public Affairs (PA) in the course section of this catalog for courses pertaining to this program.
Recreation, Park, and Leisure Studies

M.A.—Plan A and Plan B
Recreation, park, and leisure studies M.A. students specialize in leisure services management, outdoor education/recreation, sport management, or therapeutic recreation.

Degree Requirements
The M.A. is offered under Plan A and Plan B. Plan A requires 30 credits, including at least 14 credits in RPLS, 6 credits in a minor or related field, and 10 thesis credits (Rec 8777). Plan B also requires 30 credits, including at least 14 credits in RPLS, 6 credits in a minor or related field, 4 credits of a research project (Rec 8995), and 6 additional credits in any of these areas. A 3.00 minimum GPA is required to maintain good standing and to graduate.

Language Requirements—None.
Final Exam—The final exam is oral.

Rehabilitation Science
Physical rehabilitation optimizes recovery from disease or injury. The program prepares individuals with a critical mind and research skills that will advance this clinical science, offering two emphasis areas: neurological rehabilitation and musculoskeletal rehabilitation.

Please refer to Rehabilitation Science (RSc) and Physical Medicine and Rehabilitation (PMed) in the course section of this catalog for courses pertaining to this program.

M.S.

Degree Requirements
Plan A (thesis) requires a minimum of 33 credits: a minimum of 14 credits in the major, including 6 credits of rehabilitation science seminars (PMed 5100, 8101, and 8102) and a research design course in rehabilitation science; a minimum of 6 credits in a minor or related fields; a statistics course (EPsy 5261 or equivalent); and a minimum of 10 thesis credits (RSc 8777).
Plan B (nonthesis) requires a minimum of 30 credits: a minimum of 14 credits in the major, including 6 credits of rehabilitation science seminars (PMed 5100, 8101, and 8102) and a research design course in rehabilitation science; a minimum of 6 credits in a minor or related fields; a statistics course (EPsy 5261 or equivalent); the balance of courses chosen in consultation with an adviser; and a Plan B project.
Students must maintain a 3.00 minimum GPA for all coursework taken in the program.

Language Requirements—None.
Final Exam—For Plan A, the final exam is oral; for Plan B, it may be written, oral, or both.

Ph.D.

Degree Requirements
The Ph.D. requires a minimum of 36 course credits: 16 credits in core courses (including 6 credits of rehabilitation science seminars), 12 credits in a minor or supporting program, and 8 credits in statistics (credits earned in core courses and statistics cannot be applied to the minor or supporting program); 24 thesis credits are also required.
Students must maintain a 3.00 minimum GPA for all coursework taken in the program.

Language Requirements—None.

Religious Studies

Freestanding Minor
Note: This semester-based program had not been finally approved at the time this publication went to press. Contact the program director of graduate studies for information on the status of the semester-based program.

The minor in religious studies is available to master’s (M.A. and M.S.) and doctoral students in relevant fields, such as history, classics, English, anthropology, philosophy, and American studies and is under the general direction of members of the graduate faculty, who represent a broad spectrum of disciplines.

Please refer to Religions in Antiquity (RelA) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
A master’s minor requires 9 credits in approved courses in at least two areas of study. A doctoral minor requires 15 credits in approved courses in at least three areas of study. The minor program is shaped to suit the particular needs and interests of the student. Courses are selected in consultation with the director of graduate studies from a list of 5xxx religious studies courses and appropriate 8xxx courses in adjacent fields.

Rhetoric and Scientific and Technical Communication
This program focuses on applying rhetorical theory to research in scientific and technical communication in industry or government and prepares students to teach. Technical communication scholars study theories of rhetoric, science, cognition, social construction, feminism, and information design and apply these to advanced teaching, training, and research. Technical communication scholars and teachers/trainers work at universities, research and development divisions, multimedia development firms, and government agencies.
Required courses include classical rhetoric, research methods, and pedagogy. Please refer to Rhetoric (Rhet) in the course section of this catalog for courses pertaining to this program.

M.A.—Plan A, Plan B
Required courses include classical rhetoric, research methods, and pedagogy.

Degree Requirements
The M.A. requirements for Plan A and Plan B are the same except that Plan A requires a thesis (10 credits) and Plan B requires a project (5 credits). Students take six courses (18 credits) in theory, research, and practice in rhetoric and scientific and technical communication and in a minor or related field. An internship (3 credits) is required for those intending to pursue research or specialist positions in industry. Minor or related fields (6 credits) may focus on areas such as speech-communication, English, curriculum and instruction, women’s studies, cognitive psychology, and history of science. Students take additional electives in rhetoric to complete 30 credits.

Language Requirements—Students must demonstrate proficiency in a foreign language of their choice either by taking 3 credits or passing the General Extension Special Course Exam.
Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—The Department of Rhetoric participates in the freestanding minor in composition, literacy, and rhetorical studies. For requirements, see the description for the minor in this catalog.

Ph.D.

The program has five core areas: rhetorical theory; science and rhetoric; feminist theory in science, technology, and communication; scientific and technical communication pedagogy; and technology and culture.

Degree Requirements
A minimum of 42 credits is required. Students take two courses (6 credits) in rhetorical theory beyond the M.A. requirements; choose two additional core areas and take two courses (6 credits) from each; and take a minimum of three methodology courses (9 credits), including Rhet 8011. An internship (3 credits) is required for those intending to pursue research or specialist positions in industry. Minor or supporting programs (15 credits) may focus on areas such as speech-communication, English, curriculum and instruction, women’s studies, cognitive psychology, and history of science. Students may fulfill 18 credits of Ph.D. work in completing M.A. requirements (usually
includes two courses in rhetorical theory and three courses in other core areas). Twenty-four thesis credits are also required.

Language Requirements—Students must demonstrate proficiency in a foreign language of their choice either by taking 3 credits or passing the General Extension Special Course Exam.

Minor Requirements for Students Majoring in Other Fields—The Department of Rhetoric participates in the freestanding minor in composition, literacy, and rhetorical studies. For requirements, see the description for the minor in this catalog.

**Russian Area Studies**

**M.A.—Plan A and Plan B**
The program provides student with the knowledge to better understand the Russian world, its history, culture, and restructuring in the post-Soviet era. As Russia redefines its place in the world, and as trade and cultural links between Russian and the United States grow, Russian area specialists are increasingly needed. Areas of concentration include Russian history, Russian literature, and twentieth-century Russia.

Please refer to Russian Area Studies (RAS), Russian (Russ), Area Studies (Area), Central Asian Studies (CAS), Polish (Psh), and Slavic (Slav) in the course section of this catalog for courses pertaining to this program.

**Degree Requirements**
The M.A. program uses an interdisciplinary approach involving both the humanities and the social sciences. Students must complete required coursework, master appropriate theoretical frameworks, and acquire a concise understanding of topic(s) developed in the Plan A thesis or in three Plan B papers. The thesis/papers must show a broad knowledge of the Russian area, methodological sophistication, and clear evidence of research in Russian language sources. Students must also demonstrate advanced Russian language proficiency.

All students complete six distribution courses (18 credits), including two courses on Russian literature (Russ 5421—Literature: Middle Ages to Dostoevsky in Translation and Russ 5422—Literature: Tolstoy to the Present in Translation), one course in social science (Geog 5181—Russia and Environs), two graduate-level courses in Russian history, and a scope and methods course (Area 8061). Plan A students must complete three additional courses (9 credits) in their declared area of concentration and 10 thesis credits. Plan B students must complete four additional courses (12 credits) in their declared area of concentration.

**Language Requirements**—Students must demonstrate advanced Russian language proficiency by passing a special exam or by earning a B or higher average in Russ 3101-02 or the equivalent.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—The master's minor requires intermediate proficiency in the Russian language (as demonstrated by passing a special exam or by earning a B or higher average in Russ 3001-02 or the equivalent) and completion of three courses (9 credits) in the field, including at least two semesters of seminars/proseminars.

**Scandinavian Studies**

**M.A.—Plan B**
The M.A. offers students the opportunity to do advanced work in the field and prepares them with the adequate theoretical and practical tools to enter a Ph.D. program in the field or embark on a career that requires specialized knowledge of Scandinavia. Please refer to German, Scandinavian, and Dutch (GSD) and Scandinavian (Scan) in the course section of this catalog for courses pertaining to this program.

**Degree Requirements**
The M.A. requires 35 credits, including a course in contemporary literary and cultural theory (CLit 8001), a course introducing students to graduate studies in Scandinavian, five courses in different periods of Scandinavian literature/culture, a course in Old Norse or Scandinavian linguistics, a pedagogy course, and two courses outside the Scandinavian program.

**Language Requirements**—The program requires advanced competency in one Scandinavian language or Finnish, and reading knowledge of two other Scandinavian languages. A reading knowledge of one modern, non-Scandinavian, foreign language is also required.

**Final Exam**—The final exam is written and oral.

**Minor Requirements for Students Majoring in Other Fields**—A master's minor requires three courses in Scandinavian literature (all electives).

**Ph.D.**
The Ph.D. offers students the opportunity to do advanced work in Scandinavian studies and prepares them with the adequate theoretical and practical tools to serve as researchers, scholars, and teachers in the field. Please refer to German, Scandinavian, and Dutch (GSD) and Scandinavian (Scan) in the course section of this catalog for courses pertaining to this program.

**Degree Requirements**
The Ph.D. requires 33 course credits, including a course in either Old Norse or Scandinavian linguistics, six courses in Scandinavian literature, a pedagogy course, the dissertation seminar, and three courses outside the Scandinavian program; 24 thesis credits are also required.

**Language Requirements**—The program requires a thorough reading and speaking knowledge of the two other Scandinavian languages not chosen as the main language; reading knowledge of Old Norse; reading knowledge of German or French; reading knowledge of one other non-Scandinavian language.

**Minor Requirements for Students Majoring in Other Fields**—A doctoral minor requires four courses in Scandinavian literature (all electives).

**Science, Technology, and Environmental Policy**

**M.S.—Plan A and Plan B**
The M.S. program provides students with an understanding of 1) the role of science and technology in food and health, the economy, energy and the environment, security, and education; 2) the impact of science and technology on the political and economic relationships among nations; and 3) the analysis and design of policies for appropriate promotion and regulation of science and technology regionally, nationally, and internationally. The program educates students with natural and social science backgrounds to assume roles in public policy development.

Please refer to Public Affairs (PA) in the course section of this catalog for courses pertaining to this program.

**Final Exam**—The final exam is oral.

**Degree Requirements**
The M.S., which is offered under both Plan A (thesis) and Plan B (non-thesis), requires 40 credits, including 22.5 credits in five core areas: 12 credits in the area of science, technology, and environmental policy and 10.5 credits in the areas of intellectual foundations of public action, the politics of public affairs, economic reasoning, and empirical analysis. Students should take an additional 6 credits to complement their previous training: appropriate courses in natural or engineering science or its history or philosophy for those with social science backgrounds, appropriate courses in the social sciences for those with natural or engineering science backgrounds. Plan A also requires 10 thesis credits. Plan B requires a capstone seminar or workshop (3 credits), in which the Plan B paper is completed. The remaining elective credits (Plan A—1.5; Plan B—8.5) are chosen in consultation with the student’s adviser.
**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Scientific and Technical Communication

**M.S.—Plan A and Plan B**

This program focuses on applying basic theory and research to the practice of scientific and technical communication in the workplace. It is for those planning to be technical communicators or information developers in business and industry. Technical communicators look at technology and its accompanying documentation from the user’s viewpoint and make the information understandable, useful, and meaningful. Technical communicators work in laboratories, software and hardware companies, multimedia development firms, public relations offices, television stations, hospitals, pharmaceutical companies, law firms, government agencies, bioengineering firms, agribusiness, telephone companies, hospitals, banks, and insurance companies.

Required courses cover audience analysis, new media, message design, human factors and usability research, strategic planning, and technical training. Elective courses can focus on areas such as corporate video, editing and style, managing large projects and proposals, managerial and organizational communication, and international and intercultural contexts.

Please refer to Rhetoric (Rhet) in the course section of this catalog for courses pertaining to this program.

### Degree Requirements

Students take six courses in theory, research, and practice in technical communication. An internship is required for any student who has not yet worked as a technical communicator in industry. Minor or related fields include cognitive psychology, computer science, curriculum and instruction, health sciences, and speech-communication. Students take additional electives in rhetoric to complete 34 credits for Plan A (includes 10 thesis credits) or 30 credits for Plan B (includes 5 credits for the Plan B project).

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—The Department of Rhetoric participates in the freestanding minor in composition, literacy, and rhetorical studies. For requirements, see the description for the minor in this catalog.

### Scientific Computation

This program focuses on the principles for using intensive computation to support research in the physical, biological, and social sciences and engineering. Emphasis is on research issues, state-of-the-art methods, and applying these methods to problems in fields that use scientific computation, numerical analysis and algorithm development, symbolic and logic analysis, high-performance computing tools, supercomputing and heterogeneous networks, and visualization.

**M.S.—Plan A**

### Degree Requirements

The program is offered under Plan A (thesis), which includes a minimum of 20 course credits and 10 thesis credits.

The course credits must include at least 14 credits from the scientific computation core or supplementary courses (with at least 6 credits from the core courses) and at least 6 credits in a minor. A core or supplementary course that is also in the minor area may be counted toward either requirement but not toward both; however, a maximum of 3 credits in such courses may be counted toward the core/supplementary requirement.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—The master’s minor requires approval of the director of graduate studies and a minimum of 6 credits in a minor or related field and at least 6 credits in a core course.

**Ph.D.**

### Degree Requirements

A minimum of 32 course credits is required with a minimum of 16 credits in core courses; 24 thesis credits are also required. Students have two options:

1) Ph.D. with supporting program. In addition to the core credits, this option requires 10 credits in subjects that support computational science (these can include core credits beyond the required 16) and 6 credits of interdisciplinary coursework.

2) Ph.D. with minor. In addition to the core credits, this option requires 12 credits for the minor and an additional 4 course credits. Many minor programs have greater requirements; in such cases, the greater requirements will be in effect. The minor field must be declared before the student takes the preliminary oral exam.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—A doctoral minor requires approval of the director of graduate studies and a minimum of 12 credits (a minimum of 8 of these in core courses and any remaining credits from supplementary courses). If a minor course is also in the student’s major field, a student may use that course for the minor provided no more than one such course is used for the minor, there is no rule prohibiting this in the student’s major field, and other courses are used to satisfy the major requirement.

### Social and Administrative Pharmacy

The graduate program in social and administrative pharmacy focuses on drug use from a societal and individual perspective. At the societal level, the program emphasizes the exam of the system and environment in which pharmacists, patients, and other health-care providers interact. At the individual level, the program emphasizes the interaction of pharmaceutical and socio-behavioral sciences with direct patient care to assure the safe, appropriate, and economic use of drugs in patients.

**M.S.—Plan B**

### Degree Requirements

The M.S. program is offered under Plan A and Plan B. Plan A requires at least 32 credits, including 16 credits in the major field, at least 6 credits in a minor or related field, and 10 thesis credits. Plan B requires at least 30 credits, including 16 credits in the major field and at least 6 credits in a minor or related field; the balance of coursework is determined by agreement between the student and adviser. Plan B also requires two papers of publishable quality; one paper must include a research component with an analysis of data.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—A master’s minor requires 6 credits in program courses, which is determined in consultation with the director of graduate studies.

**Ph.D.**

### Degree Requirements

The Ph.D requires 36 credits in the major, 12 credits in a minor or supporting program, and 24 thesis credits. Two preliminary written exams are required: one concentrates on research design, methodological issues, and statistical analysis, the other on material specific to social and administrative pharmacy. Students must also pass a preliminary oral exam.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—A doctoral minor requires a minimum of 12 credits in program courses determined in consultation with the director of graduate studies.
Social and Philosopher Studies of Education

Freestanding Minor
The minor in social and philosophic studies of education provides master’s (M.A.) and doctoral students with a multidisciplinary foundation for the study of education in the perspectives of history, philosophy, and the social sciences. The program is shaped to suit the particular needs and interests of the student.

Please contact the minor program office for information on relevant coursework.

Degree Requirements
M.A. students must complete at least 9 graduate credits (at least one course each) in the two areas of study below. Doctoral students must complete at least 12 graduate credits (at least two courses each) in the two areas of study. Courses are selected in consultation with the coordinator for the minor.

Area I, history and philosophy of education: EdPA 5021, 5023, 5024, 5028, 5032, Phil 4324, WoSt 5103.

Area II, social sciences and education: EdPA 5041, 5044, 5103, 5128, 5302, 5352, 8104.

Social Work

M.S.W.—Coursework Only
This degree prepares students for advanced social work practice. A 50-credit program and a 34-credit advanced standing program are available. Concentrations include practice in two areas: direct practice and human services management. Three dual programs are also available: M.S.W/master of public health, M.S.W/master of arts in public affairs, and M.S.W/M.Plan.

Please refer to Social Work (SW) and Youth Development and Research (YoSt) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
The M.S.W. requires 50 credits; a 34-credit advanced standing program is available to graduates of undergraduate social work programs accredited by the Council on Social Work Education. All credits must be completed within five years of the date of the earliest coursework students want to apply to their degree.

The 50-credit program includes a set of required foundation courses (25 credits), courses from a selected concentration, two field internships, and social work electives. A maximum of 24 credits may be transferred from the following sources with School of Social Work approval: up to 20 credits of graduate-level coursework from University College; up to 8 credits of work at graduate level and quality completed as an adult special student at the University; up to 24 credits from another regionally and professionally accredited school of social work, if the student was registered as a graduate student in the program; and up to 8 credits of non-social work electives taken as a graduate student at another university.

The 34-credit advanced standing program includes courses from a selected concentration, one field internship, and social work electives. A maximum of 16 credits may be transferred from the following sources with School of Social Work approval: 16 credits completed as a graduate student in another accredited M.S.W. program; up to 12 credits of graduate-level coursework from University College; and up to 8 credits of non-social work electives taken as a graduate student at another university.

Language Requirements—None.

Final Exam—None.

Ph.D.
The Ph.D. program prepares students to provide intellectual leadership for the social work profession through advanced scholarship, research, theory development, and policy analysis. Students are expected to acquire skill in research design and statistics. Interdisciplinary study is required as well as comprehensive knowledge of social work and social welfare history, theory, and policy. The program does not focus on the development of advanced skills for clinical practice, although students gain knowledge of practice theory and research related to social work practice is encouraged. Many graduates assume positions as university faculty. Consequently, the program offers opportunities for students to acquire skills in research, teaching, and curriculum development.

Please refer to Social Work (SW) and Youth Development and Research (YoSt) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
Degree requirements vary according to background and educational goals. A minimum of 34 course credits beyond the M.S.W. are ordinarily required; 24 thesis credits are required of all students.

Required courses include core seminars in social work research, social welfare history, social welfare policy, and theory and model development; a research internship; social work teaching courses; supporting program courses; and statistics courses. Students must also have teaching experience in the School of Social Work while in the program and fulfill the computer skills requirement.

Language Requirements—None.

Sociology
Sociology is concerned with the study of human societies and social life. The program offers substantive training in five areas of specialization: family and life course; law, criminology, and deviance; organizations and work; political sociology and social movements; and stratification: race, class, and gender. Methodological training is available in historical and comparative research, survey research, network analysis, advanced statistical analysis, and qualitative research.

M.A.—Plan A and Plan B
Students are admitted only for the Ph.D.; the M.A. is an optional degree for students in the doctoral program.

Degree Requirements
Students take four required courses or their equivalent (13 credits) and two additional substantive courses in sociology (6 credits). Substantive courses are chosen in consultation with the adviser and program committee to meet the student’s educational and professional goals. Students must also complete a minimum of 6 credits in a minor or related field. Plan B students submit two papers, at least one of which is empirical. Plan A requires 10 thesis credits.

Language Requirements—None

Final Exam—The final exam is oral.

Ph.D.
The doctoral program is for students planning to do research or teach.

Degree Requirements
Students take four required courses or their equivalent (13 credits), including a course on professional skills development. Beyond that, each student’s program is individually planned in consultation with the adviser and program committee to meet both the student’s goals and broad program requirements. Those requirements include four substantive courses in sociology (12-credit minimum) and at least one semester of training in advanced methods (3-credit minimum). Students must also complete a minimum of 12 credits in a minor or supporting program and 24 thesis credits. Students who enter the program with an M.A. in sociology must earn a minimum of 18 credits in the department regardless of the number of courses for which they have petitioned equivalents from other institutions.

Language Requirements—Coursework in a foreign language may be used as outside coursework for those students who plan research in comparative sociology.

Minor Requirements for Students

Majoring in Other Fields
A doctoral minor requires four courses in sociology, at least one of which is 8xxx. Course choices are subject to the approval of the director of graduate studies.
Software Engineering

M.S.S.E.—Plan B
The master of science in software engineering provides a thorough understanding of the fundamental issues related to software development and the software development process. It fosters an awareness of the problems and opportunities associated with software-intensive systems and explains the methods for quickly evaluating, adopting, and taking advantage of emerging technologies. This program introduces emerging technologies and their applications and lays the foundation for lifelong learning and professional development in a rapidly changing field. The M.S.S.E. is an interdisciplinary program involving the Institute of Technology’s Center for the Development of Technological Leadership and the Department of Computer Science and Engineering.

Degree Requirements
The M.S.S.E. requires 30 credits, including 27 credits of regular coursework and 3 credits for the Plan B project. Students take seven core courses, two or three industrial seminar courses, two or three elective courses, and a capstone course (final project) where students tackle a challenging industrial project.

Language Requirements—None.
Final Exam—The final exam is oral.

Soil Science

The soil science program offers two tracks: soil science and climatology. This multidisciplinary program encompasses aspects of chemistry, physics, biology, atmospheric sciences, and geology. The discipline is divided into five subdisciplines: climatology, soil chemistry/fertility, soil classification/genesis, soil microbiology/biochemistry, and soil physics.

The soil science track requires competence in a minimum of three of the subdisciplines listed above for Plan A (thesis) and four subdisciplines for Plan B (non-thesis). The program is for individuals planning careers in regulatory agencies, consulting companies, and agricultural industries, and those wishing to pursue a Ph.D. in soil science.

The climatology track focuses on the interdisciplinary study of earth-atmosphere interactions as well as climate variability as it applies to environmental and agricultural issues. This track requires competence in both atmospheric sciences and related areas of soil science.

Degree Requirements

M.S. —Plan A and Plan B

Language Requirements—None.
Final Exam—The final exam is oral.

South Asian Languages

M.A. and Ph.D.

Note: This program’s semester-based description was not available in time to be included in this publication. No new students are currently being accepted to this program. Contact the Graduate School for information on the status of the semester-based program.

Speech-Communication

Speech-communication involves the study of communicative dimensions of human experience using humanistic and social scientific methods. This program prepares students to become researchers and teachers, offering two concentrations: communication theory and rhetorical studies.

Coursework in communication theory has a social scientific orientation. Most students focus on a subarea such as small group, organizational, intercultural, electronic media, interpersonal communication, or problems (e.g., decision making, conflict resolution, information diffusion).

Coursework outside the department is usually concentrated in one or more of the behavioral sciences. Students are expected to develop a command of research techniques and a thorough knowledge of statistics. Interdisciplinary programs are encouraged.

Coursework in rhetoric and public address emphasizes humanistic methods and includes argumentation and persuasion, media studies, ethics, rhetorical theory and criticism, and American public address. Students may also pursue special interests in rhetorical philosophies, movements and campaigns, popular culture, or historical and contemporary political speaking. The program should be supplemented by coursework outside the department. An understanding of history, political science, sociology, or other social sciences is recommended.

M.A.—Plan A and Plan B

Degree Requirements

The degree is offered under Plan A (thesis) and Plan B (nonthesis). Both plans require a minimum of 14 course credits in speech-communication, including Spch 5421 and Spch 5615, and a minimum of 6 course credits in a minor or related fields. Plan A also requires 10 thesis credits, and Plan B requires a Plan B paper.

Language Requirements—None.
Ph.D.

Degree Requirements
The program requires no set number of course credits, but students are urged to submit programs consisting of at least 60 course credits (which may include 30 credits from the M.A. and an additional 30 credits of doctoral coursework); 24 thesis credits are required.

The program should include about 12 credits in research tools relevant for completing the degree and continuing a scholarly career. Under certain circumstances, foreign language courses may be used to satisfy this requirement. Twelve credits is a guide indicating extent, rather than a specific count.

Language Requirements—None.

Statistics
Statistics is the application of probabilistic methods to data analysis and inductive inference. The School of Statistics contains the Departments of Applied Statistics and Theoretical Statistics.

M.S.—Plan B
The program prepares students for Ph.D.-level study and for jobs in industry and the public sector.

Degree Requirements
During the first year, students take a two-semester theory sequence and a two-semester applied sequence. In addition, they usually take two courses from other departments. During the second year, students take an additional 9 credits of approved 5xxx or 8xxx statistics courses; some of this requirement can be satisfied by taking approved courses with heavy statistical content from other departments. Students also take a 1-credit statistical consulting course and complete their Plan B project, which requires 30 course credits.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A master’s minor requires at least 9 credits of 5xxx or 8xxx statistics courses.

Ph.D.

Degree Requirements
Students entering the program with a bachelor’s degree must take 60 course credits; students entering with a master’s degree must take 43; 24 thesis credits are also required. Students take 41 credits in core courses (27 in statistics, 14 in mathematics), an additional 18 credits of approved 8xxx statistics courses (some of which can be satisfied by taking approved courses with heavy statistical content from other departments), and a 1-credit statistical consulting course.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—A doctoral minor requires a theory sequence (Stat 4101-4102 or Stat 5101-5102) and familiarity with various statistical methods. Typical programs include 14 to 18 credits of graduate-level statistical courses.

Studies in Africa and the African Diaspora
Freestanding Minor
The minor in studies in Africa and the African diaspora at the master’s (M.A. and M.S.) and doctoral levels provides a multidisciplinary, integrated foundation in the study of Africa and peoples of African descent. The minor is based on core courses concentrating in either the humanities and the arts or the social and behavioral sciences. Please refer to Afro-American Studies (Afro) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
Students develop their program in consultation with the directors of graduate studies in studies in Africa and the African diaspora and in their major. All courses must be outside the student’s major field of study. The master’s minor requires a minimum of 9 graduate credits, including the seminar Afro 8101 Studies in Africa and the African Diaspora. Remaining courses are selected from one of the following two areas: 1) humanities and the arts or 2) behavioral and social sciences. The doctoral minor requires a minimum of 15 graduate credits, including the seminar Afro 8101 Studies in Africa and the African Diaspora. Students take one additional seminar that focuses on the study of Africa and peoples of African descent. Remaining courses are selected from one of the two areas listed above.

Studies of Science and Technology
Freestanding Minor
This minor is available to master’s (M.A. and M.S.) and doctoral students. Studies of science and technology (SST) deals with a rapidly expanding field that seeks to understand the conceptual foundations, historical development, and social context of science and technology. SST faculty are drawn from five units: the Departments of Philosophy, History of Science and Technology, and History of Medicine; the Center for Philosophy of Science; and the Charles Babbage Institute for the History of Information Processing. The minor should be particularly valuable for students who plan to teach in science or engineering, or for those majoring in philosophy of science or in history of science and technology.

The SST minor provides introductory core courses in historiography and philosophy of science, followed by team-taught research seminars and elective courses in four main research areas: models, theories, and reality; physical science; biological and biomedical sciences; and science, technology, and society. Seminar topics vary in accordance with faculty and student interest.

Degree Requirements
A master’s minor requires 7 graduate credits and a doctoral minor requires 12 graduate credits. Both minors must include HSci 8111; one of either Phil 8601, 8602, or 8605; and SST 8000 Colloquium (one semester for master’s, two for doctoral students). Doctoral students must also take one of the SST seminars (SST 8100, 8200, 8300, or 8400) in an area primarily outside the student’s major.

Surgery
The general surgery program trains medical doctors for the practice of surgery and for academic positions. See the Medical School Catalog for professional degree requirements; see below for academic degree requirements. Trainees spend two to three years in laboratory research, either in a basic science or in surgery, after which they begin their senior residency and chief residency training. The Medical School’s laboratory departments offer many graduate courses closely related to surgery (see the graduate programs in anatomy, biochemistry, molecular biology and biophysics; cellular and integrative physiology; microbiology, immunology, and molecular pathobiology; and pharmacology). These fields also offer opportunities for research work. The Department of Surgery offers supervised work in its experimental research laboratories, as well as in its hospital and outpatient departments, in the areas of surgical diagnosis and operative surgery and in some surgical specialties (such as colon and rectal surgery, transplantation, thoracic and cardiovascular surgery, and pediatric surgery).

M.S.Surg.—Plan A

Degree Requirements
The M.S.Surg. is offered Plan A only. Students spend two to three years in the Medical School’s general surgery program. A minimum of 33 course credits (47 in the major plus 6 in the minor or related fields) plus 10 thesis credits are required for a total of 63 credits.

Language Requirements—None.

Final Exam—The final exam is oral.
**Ph.D. Surg.**

**Degree Requirements**
Students spend two to three years in the Medical School’s general surgery program. A minimum of 79 course credits (67 in the major plus 12 to 16 in the minor or supporting program) is required; 24 thesis credits are also required.

**Language Requirements**—None.

## Sustainable Agriculture Systems

### Freestanding Minor

The minor in sustainable agriculture systems offers master’s (M.A. and M.S.) and doctoral students an interdisciplinary curriculum that considers the biological, sociological, and economic aspects of agriculture. The minor emphasizes a holistic perspective to designing farming and food systems and solving problems in agriculture. The importance of yield and profitability are balanced by considerations of the environment and the health and social well-being of producers, consumers, and communities. The minor complements graduate programs in the College of Agricultural, Food, and Environmental Sciences as well as those in natural resources, ecology, conservation biology, sociology, political science, and public affairs.

### Degree Requirements

The master’s minor requires 6 graduate credits from the core curriculum; the doctoral minor requires 12 graduate credits. All students must take SAgR 8010 and 8020. The other core courses are Agro 8205 Agroecology and Ent 5321 Ecology of Agriculture. A unique component of the minor is an eight-week on-site internship with growers, grassroots organizations, or public agencies working in sustainable agriculture.

## Theatre Arts

Theatre arts programs provide practical and theoretical education for the performer, artist, educator, scholar, and audience member. Training the historian, theorist, artist, and crafts-person is linked to and centered in the laboratory experience of live performance as well as in the academic classroom. The programs serve the dual roles of examining the various historical and contextual relationships of past and present theatre while educating audiences and theatre artisans/educators of tomorrow. The programs prepare students for careers in professional or academic theatre and related artistic fields.

Please refer to Theatre Arts (Th) and Dance (Dnce) in the course section of this catalog for courses pertaining to this program.

### M.A.—Plan A and Plan B

The M.A. degree emphasizes academic pursuits and is considered a prerequisite for the Ph.D. The five areas of study in both the M.A. and Ph.D. programs are theatre history/dramatic theory, dramatic literature, acting, directing, and design and technical production. Candidates must complete coursework in both academic and performance areas.

### Degree Requirements

For both Plan A and B, 8 credits of graduate work must be selected from history, theory, and dramatic literature; 8 credits from acting, design, directing, playwriting, and/or practicum; 6 credits from outside the department; and 8 elective credits (30 credits total). For Plan A, 10 additional thesis credits and an oral defense of the thesis are required. For Plan B, three papers are required. There is an 8-credit limit on the number of credits in practicum and performance courses that may be used to satisfy M.A. degree requirements.

### Language Requirements

The M.A. leads to the Ph.D.; therefore, language requirements for the Ph.D. apply.

### Final Exam

For Plan A, the final exam is written and oral. For Plan B, the final exam is written; an oral exam typically is not required, but one may be requested by the M.A. committee.

### Minor Requirements for Students

**Majoring in Other Fields**—A master’s minor requires a minimum of 9 credits as approved by the director of graduate studies.

### M.F.A.

The three-year, performance-oriented M.F.A. offers two areas of specialization: directing, and design and technical production. The M.F.A. in directing focuses on developing intellectual and artistic skills and leadership talent through an intensive course of study with an emphasis on performance. For the M.F.A. in design and technical production, all areas of design are studied in order to increase understanding in specialization areas, and technology is studied as an essential part of design. Students are expected to achieve proficiency in at least two areas (scenery/properties, costuming, lighting, sound) and a level of expertise in at least one of these areas. The M.F.A. degree is considered a terminal degree in these areas of theatre arts.

### Degree Requirements

The M.F.A. requires 66 graduate credits, although a particular program’s requirements may exceed this minimum. The program requires 6 credits of theatre history, which may be fulfilled by Th 5171 and Th 5172; 6 credits of dramatic literature, which are fulfilled by Th 4177 and Th 4178; and a minimum of 6 credits from outside the department (at least 3 credits of which must be a University course that contributes substantially to the degree program). Each program requires a final performance practicum and written record of it. For specific program requirements, contact the director of graduate studies.

### Language Requirements

None.

### Final Exam

Students must take a final oral exam related to the final creative project and must submit a written record of the project and the research related to it.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires a minimum of 12 credits as approved by the director of graduate studies.

### Ph.D.

The Ph.D. certifies the mastery of a body of knowledge in the history, theory, and literature of theatre arts and the facility for applying and communicating that knowledge. The five areas of study in the Ph.D. program are theatre history/dramatic theory, dramatic literature, acting, directing, and design and technical production. Students must take coursework in both academic and performance areas.

### Degree Requirements

Students must take seven core courses: six consecutive courses in history, theory, and literature of theatre and one course in theatre historiography (21 credits); coursework in a supporting program or a minor (12 credits); and 24 thesis credits, for a minimum total of 57 credits beyond the B.A. Various seminars support the core courses.

There is a 16-credit limit on the number of credits in practicum and performance courses that may be used to satisfy Ph.D. requirements.

### Language Requirements

Ph.D. students are expected to demonstrate proficiency in at least one foreign language, as certified by the adviser or program faculty in the language. The language may serve as the research technique for the dissertation, if appropriate. In some cases a disciplinary research methodology is more appropriate than a language. Options may include statistics, psychology, women’s studies, economics, political history, or anthropology. Note: Research technique credits are not the same as supporting program or minor credits.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires a minimum of 12 credits as approved by the director of graduate studies.
Toxicology
This University-wide program provides comprehensive training in the broad scope of toxicology. Toxicology, the science of poisons, is devoted to identifying and quantifying potential noxious agents in our environment. Although most chemical agents at sufficiently large doses may be toxic, not all present a significant risk to human health or to environmental organisms or ecosystems. Accordingly, the essence of the science of toxicology is defining the fine line which distinguishes a risk from a residue. To accomplish this requires scientific expertise in such areas as analytical and environmental chemistry, biology, and mathematics. Advanced courses and research are also available in such subdisciplines as human health risk assessment; epidemiology; environmental chemistry and engineering; ecotoxicology; food additives and nutritional toxicology; biochemical and physiological mechanisms; histopathology; diagnostic and analytical toxicology; drug metabolism; chemical carcinogenesis; behavioral toxicology; and the toxicity of noxious agents to various organ systems (e.g., nervous, heart, liver, kidneys).

M.S.—Plan A and Plan B
Degree Requirements
The M.S. is offered under Plan A and Plan B. Plan A requires 22 course credits and 10 thesis credits; Plan B requires 30 course credits. A core curriculum of 8 credits in toxicology (Txcl 8012, 8013, and 8100) is required for both plans. Additional courses are arranged on an individual basis.

Language Requirements—None.
Final Exam—The final exam is oral.

Ph.D.
Degree Requirements
The Ph.D. requires core courses in physiology (4 credits), biochemistry (6 credits), statistics (2 credits), and toxicology (10 credits). Students must also complete 12 credits in a minor or supporting program and 24 thesis credits. Because the program spans the Duluth and Twin Cities campuses, the required courses differ on each campus.

Additional advanced courses in toxicology or related fields may be specified by the adviser. Students must complete and defend an original research project.

Language Requirements—None.

Minor Requirements for Students
Majoring in Other Fields—A minor is available at the doctoral level and requires 12 credits: 8 credits of core courses and 4 credits of advanced toxicology courses.

Urban and Regional Planning
M.U.R.P.—Plan B
The Humphrey Institute is rare among U.S. public affairs programs in providing education in three public policy professional areas: urban and regional planning, public policy analysis, and public and nonprofit management. It draws upon a strong metropolitan and regional heritage of civic engagement and public policy and institutional innovation.

The master of urban and regional planning (M.U.R.P.) program provides students with the knowledge and skill for forecasting and designing the future of neighborhoods, communities, and regions. Students focus not only on these abilities but also on the means for developing fair and equitable ways for involving citizens in the design process and in implementing the planning process. The program emphasizes professional education whereby graduates have a distinctive capability to play an active role in building communities. The curriculum stresses the need to mediate between competing interests and to be an advocate for voices not usually heard in the community-building process. Structured concentrations include land use and human settlements; economic development; housing, social planning, and community development; environmental and ecological planning; transportation planning; urban and landscape design; and planning process design and implementation.

Please refer to Public Affairs (PA) in the course section of this catalog for courses pertaining to this program.

Degree Requirements
The M.U.R.P. requires 48 credits, including Humphrey Institute core courses (16.5 credits), planning core courses (16.5 credits), a capstone course (3 credits), specialization electives (9 credits), and 3 credits of free electives. A noncredit internship is usually required.

Language Requirements—None.
Final Exam—The final oral exam is completed in connection with a capstone workshop or seminar, in which students work alone or as part of a team working for a community client concerned with a major development issue.

Veterinary Medicine
The veterinary medicine graduate program encompasses all the clinical and applied graduate education of the College of Veterinary Medicine. The program is divided into five specialty tracks: internal medicine; population medicine; infectious disease; surgery, radiology, and anesthesiology; and theriogenology. Program faculty are drawn from all the departments of the college as well as from other colleges within the University.

The program emphasizes quality clinical training with state-of-the-art research in areas of animal disease at the individual and population levels. All species of domestic animals are the subject of both teaching and research, the program being particularly strong in population-based medicine and epidemiology. Other areas of strength include feline and canine urology, radiology, molecular epidemiology, microbiology, and immunology. The program also has a long-standing record of quality research and teaching in the area of theriogenology.

M.S.—Plan A and Plan B
Degree Requirements
The M.S. is offered under Plan A and Plan B. Plan A requires 30 credits: a minimum of 14 credits in the major, 6 credits in a minor or related field, and 10 thesis credits. Plan B requires 30 course credits, of which at least 14 must be in the major, at least 6 in the minor or related field, and an additional 10 chosen in consultation with the adviser. Three papers are also required which include a case report, a research project, and a literature review.

Language Requirements—None.
Final Exam—The final exam is oral.

Minor Requirements for Students
Majoring in Other Fields—A master’s minor requires 6 course credits taken from recommended courses in the veterinary medicine major.

Ph.D.
Degree Requirements
The Ph.D. requires 30 course credits beyond the M.S. degree, of which at least 12 credits must be in the minor or supporting program. In addition, 24 thesis credits are required.

Language Requirements—None.

Minor Requirements for Students
Majoring in Other Fields—A doctoral minor requires 12 course credits taken from recommended courses in the veterinary medicine major.
Water Resources Science

This interdisciplinary program produces scientists with strong technical skills in disciplines relevant to water resources science and promotes a broad understanding of 1) the hydrologic cycle and associated ecosystems, 2) the interconnectedness of the sciences involved in managing aquatic resources, and 3) the interplay between the biophysical sciences and social sciences in developing and implementing public policies related to water.

The program involves the Twin Cities campus Departments of Anthropology; Applied Economics; Biosystems and Agricultural Engineering; Civil Engineering; Ecology, Evolution, and Behavior; Entomology; Environmental and Occupational Health; Fisheries and Wildlife; Forest Resources; Geography; Horticultural Science; Geology and Geophysics; Landscape Architecture; Plant Biology; and Soil, Water, and Climate; and the Humphrey Institute of Public Affairs. It also involves the Duluth campus Departments of Biology, Chemical Engineering, Chemistry, Economics, Geography, and Physics.

M.S.—Plan A and Plan B

Degree Requirements

Students may choose Plan A, which requires a thesis, or Plan B, which requires additional coursework and a major project. Both plans incorporate courses offered on the Twin Cities and Duluth campuses.

Students must complete five courses in four core areas (hydrology; environmental/water chemistry; limnology; water resources policy, law, and administration) and at least three electives (in emphasis areas such as aquatic biology, hydrologic science, watershed management, and water quality engineering). One elective must be from an approved list of technical courses dealing with water quality science/management; two electives must be in the student’s focus area within aquatic science. Related field credits should be in courses outside of aquatic science.

If a student has had none of the core courses in previous studies, a minimum of 28 course credits (plus 10 thesis credits) is required for Plan A and a minimum of 30 credits is required for Plan B (up to 3 credits of independent study may be used for the Plan B project). If a student has met some core course requirements, the minimum number of credits for Plan A may be reduced proportionately, but never to less than the Graduate School minimum of 20 course credits.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A master’s minor requires 10 credits, including WRS 5101 (3 credits), WRS 8100 (1 credit), a core course from one of the program’s emphasis areas, and an elective within that field of specialization. In aquatic biology and limnology, the core course is EEB 4601; in hydrological science, watershed management, and water engineering, the core course is in hydrology.

Ph.D.

Coursework is tailored to student interests, and many areas of specialization are possible. Core courses are offered on both the Twin Cities and Duluth campuses or are available in both regions through interactive video.

Degree Requirements

Students complete coursework equivalent to that of an M.S. in water resources science, with additional coursework in an area of specialization. There are no specific credit requirements in the major, but Ph.D. programs normally include at least 40 course credits beyond the B.S. level, including relevant coursework taken for a master’s degree and a required minimum of 12 credits in a minor or supporting program.

Language Requirements—None.

Minor Requirements for Students Majoring in Other Fields—Doctoral students must complete 14 credits, including WRS 5101 (3 credits), WRS 8100 (1 credit), a core course from one of the program’s emphasis areas, and two electives within one field of specialization. In aquatic biology and limnology, the core course is EEB 4601; in hydrological science, watershed management, and water engineering, the core course is in hydrology.

Wildlife Conservation

This program combines basic biology and ecology with other academic areas and with applied problem solving in natural resource management and conservation areas such as animal behavior, population modeling, habitat management, integrated resource management, and animal physiology.

Please refer to Fisheries and Wildlife (FW) in the course section of this catalog for courses pertaining to this program.

M.S.—Plan A and Plan B

Degree Requirements

Plan A is recommended; Plan B is available under special circumstances. Students must become familiar with factors underlying wildlife population and habitat ecology, management techniques, and how management agencies function. Academic work includes coursework in animal ecology, wildlife management, and statistics. The Plan A thesis should involve at least one field season but no more than two. Plan B students complete one to three projects involving field, laboratory, or planning work.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students Majoring in Other Fields—A master’s minor requires a minimum of 6 credits as approved by the director of graduate studies.

Ph.D.

Degree Requirements

Degree programs include basic wildlife biology, development of analytical skills, and one or more areas of specialization.

Language Requirements—A foreign language is required only when the advisory committee determines that a language is needed to support the student’s research objectives. Symbolic language (computer programming) is recommended for all students.

Minor Requirements for Students Majoring in Other Fields—A doctoral minor requires a minimum of 12 credits as approved by the director of graduate studies.

Work, Community, and Family Education

Ed.D.

The Ed.D. offers specializations in adult education, agricultural education and extension, business and industry education, family education, human resource development, and comprehensive work, community, and family education. Students combine study and related experiences to develop, apply, analyze, synthesize, and evaluate knowledge of the purposes, practices, issues, and problems of work, community, and family education; social, economic, historical, political, cultural, educational, technological, and psychological contexts within which work, community, and family education exist; and types of research that contribute to or apply that knowledge to the specialization.

See also Education—Work, Community, and Family Education for information about the M.A. and Ph.D. degrees.

Please refer to Adult Education (AdEd), Agricultural Education and Extension (AgEE), Business and Industry Education (BIE), Family Education (FE), Human Resource Development (HRD), and Work, Community, and Family Education (WCFE) in the course section of this catalog for courses pertaining to this program.

Degree Requirements

The Ed.D. requires 60 course credits and 24 field study credits (thesis credits). Course credits include a minimum of 12 credits in general aspects, a minimum of 10 credits in research, and a minimum of 28 credits in the
specialization, 4 of which must be internship credits. Course credits must also include 12 credits from outside the department, which may overlap with those in general aspects, research, and the specialization.

Language Requirements—None.

Final Exam—A written preliminary exam in each of the program areas (general aspects, research, and specialization) and a final oral exam are required.

Minor Requirements for Students

Majoring in Other Fields—A doctoral minor requires a minimum of 12 credits in one of the specializations, approved by the director of graduate studies.

Zoology

Emphases in vertebrate and invertebrate zoology are available, with opportunities for field research in various parts of the world as well as locally. Seminars and tutorials are an important part of student programs. Graduate faculty are drawn from the Departments of Ecology, Evolution, and Behavior; Entomology; Fisheries and Wildlife; and Veterinary Pathobiology; the Bell Museum of Natural History; and the Medical School.

M.S.—Plan A and Plan B

Degree Requirements

At least 15 credits of biological science, chemistry through organic, one year of physics, and mathematics through calculus are required. Deficiencies in this work must be made up during the first year of graduate study.

The degree is offered under Plan A (thesis) and Plan B (non-thesis), both of which require a minimum of 14 course credits in the major and a minimum of 6 course credits in one or more related fields. Plan A also requires 10 thesis credits, and Plan B requires 10 additional course credits and one to three research papers, which may be written in conjunction with graduate courses. Degree programs are planned by the student, an advisory committee of three faculty, and the director of graduate studies to meet the student’s interests and needs.

Language Requirements—None.

Final Exam—The final exam is oral.

Minor Requirements for Students

Majoring in Other Fields—A master’s minor requires a minimum of 7 credits in general biology.

Ph.D.

Degree Requirements

At least 15 credits of biological science, chemistry through organic, one year of physics, and mathematics through calculus are required. Deficiencies in this work must be made up during the first year of graduate study.

Students are expected to acquire knowledge in organismal biology, animal physiology, and animal cellular biology. Breadth of field is expected together with depth in the specialty area. Significant field experience and competence in statistics, including hypothesis testing, regression, and correlation, are required. Degree programs are planned by the student, an advisory committee of three faculty, and the director of graduate studies to meet the student’s interests and needs.

Language Requirements—Reading proficiency in one foreign language is required.

Minor Requirements for Students

Majoring in Other Fields—A doctoral minor requires a minimum of 12 credits.