The Swenson College of Science and Engineering is committed to providing opportunities to learn through participation in research, honors programs, individual study, and special seminars.
Swenson College of Science and Engineering (SCSE)

Dean: James Riehl,
140 Engineering Building, 218-726-6397
Associate Dean: Timothy B. Holst,
140 Engineering Building, 218-726-7585

The Swenson College of Science and Engineering has a fourfold mission: to help each student develop a foundation for a career by learning the substance and methods of an academic discipline; to participate fully in the liberal education mission of the campus; to foster significant scholarly research; and to serve the well-being of the community, state, and region. The college offers students a broad range of curricula covering the natural sciences, mathematical sciences, engineering, and technology.

Each student is provided the opportunity to develop competence in a special field of knowledge by learning its principles and perspectives, mastering its methods, and acquiring much of its accumulated knowledge.

In addition to offering formal coursework, the college is committed to providing students with opportunities to learn through participation in research, honors programs, individual study, and special seminars. Such programs, which emphasize undergraduate education, are enhanced and complemented by high quality graduate programs. These graduate programs form an integral component of our commitment to scholarship.

Several departments also offer master's degrees through the Graduate School.

Admission

The college has no specific secondary school preparation requirements for admission beyond the preparation standards of the University of Minnesota. However, secondary school students contemplating a baccalaureate degree in a physical or biological science, mathematics, computer science, or engineering are strongly urged to complete a college preparatory program that includes four years (grades 9–12) each of English, mathematics, and science.

The engineering programs have specific college-level course requirements and minimum GPAs that must be satisfied before students can be admitted into the upper division (junior and senior level) program.

For general admission information, see the Policies and Procedures section of this catalog.

Dean’s List of Academic Excellence

Each semester, SCSE students are recognized for high academic achievement by being placed on the SCSE Dean's List of Academic Excellence. This honor is awarded to students who rank in the top 15% of the college based on their semester GPA. To be eligible, students must have completed at least 12 graded credits and have received no final grades of F, N, or I during that semester.

College Honors

At UMD a maximum of 15 percent of the graduating class can graduate with college honors. In SCSE the top 3 percent of the graduating class is designated summa cum laude, the next 5 percent magna cum laude, and the next 7 percent cum laude.

At the beginning of each year, the GPAs necessary to achieve these honors are posted in the Student Affairs Office, 140 Engineering Building. These GPAs are based on those of the previous spring semester’s graduating class. In addition, students receiving honors must have a coefficient of course completion of at least 90 percent. To be eligible for honors, students must earn at least 30 credits at UMD.

Honors Programs

The objective of the SCSE honors programs is to offer highly motivated students of superior ability a greater challenge than is available through the traditional curriculum. Honors opportunities provide for closer student-faculty relationships, emphasize writing and speaking skills, and offer active learning in the disciplinary and interdisciplinary components.

In the lower division, honors opportunities include seminars and special sections of lecture and lab courses. Students may participate in these by invitation or by consent of the instructor.

Honors opportunities in the upper division are available for students in all departments. Department honors candidates are selected on the basis of coursework completed and potential for independent work. A research project is required.

More information about department honors is available through the departments.
Academic Standing

Good Academic Standing
SCSE requires that its students maintain a minimum cumulative GPA to be in good academic standing. For students who have attempted 20 or more credits the minimum cumulative GPA is 2.00. Because some students have difficulty adjusting to the standards of a university education, students who have attempted fewer than 20 credits (at UMD or elsewhere) must maintain a minimum cumulative GPA of 1.80 to remain in good academic standing.

Probation
Students with a cumulative GPA lower than that required for good academic standing are placed on academic probation. If at the end of a semester on probation, the cumulative GPA is at or above 2.00, the student will be returned to good academic standing. Students also will be placed on probation if their semester GPA is less than 2.00 for two consecutive semesters, even if the cumulative GPA is above 2.00. To regain good standing, these students must achieve both a subsequent semester GPA of 2.00 and a cumulative GPA of 2.00.

Dismissal
If, after a semester of probation, a student fails to attain the required minimum GPA for good academic standing, the student is subject to dismissal. Dismissal decisions are made in the college office following fall and spring semester final exams. Dismissed students are notified immediately and their registration as a SCSE student for the next semester is canceled. Students who fail to attain the minimum GPA, yet who are making academic progress, may be granted an additional semester of probation at the discretion of the college.

Readmission
Students who have been academically dismissed from SCSE must present evidence of improved academic capability to the college to justify readmission. Petition forms for readmission and information concerning academic standing are available in the SCSE Student Affairs Office, 140 Engineering Building.

Student Affairs Office
Information on academic matters, including academic standing; admission; advising; academic programs; change of major, college, or adviser; grievance and appeals procedures; honors programs; undergraduate research; student clubs; and tutoring is available in the SCSE Student Affairs Office, 140 Engineering Building.

Baccalaureate Degrees
SCSE offers the bachelor of science (B.S.), bachelor of science in chemical engineering (B.S.Ch.E.), bachelor of science in civil engineering (B.S.C.E.), bachelor of science in electrical and computer engineering (B.S.E.C.E.), bachelor of science in industrial engineering (B.S.I.E.), and bachelor of science in mechanical engineering (B.S.M.E.) degrees.

B.S. Majors
Biochemistry and molecular biology
Biology
Cell and molecular biology
Chemistry
Computer information systems
Computer science
Environmental science
Geological sciences
Mathematics
Physics
Applied physics
Statistics and actuarial science

Minors
Aerospace studies (minor only)
Astronomy (minor only)
Biochemical engineering (minor only)
Biology
Chemistry
Computer information systems
Computer science
Computer science, applied (minor only)
Electrical and computer engineering
Environmental science
Environmental engineering (minor only)
Geological sciences
Mathematics
Physics

For other minors available to students pursuing a bachelor of science degree, see the Labovitz School of Business and Economics, School of Fine Arts, College of Education and Human Service Professions, and College of Liberal Arts sections of this catalog.
General Requirements
- Completion of at least 30 degree credits at UMD.
- Completion at UMD of at least 20 of the last 30 degree credits immediately before graduation.
- Compliance with general regulations governing granting of degrees.

B.S. Requirements
- Completion of at least 120 degree credits.
- Completion of a major for the bachelor of science degree and a minor or second major in a different program, with a 2.00 minimum GPA in the major, including supporting courses, and a 2.00 minimum GPA in the minor, including supporting courses.
- Completion of UMD liberal education requirements. See Liberal Education Program
- A 2.00 minimum GPA in all work attempted at UMD; a 2.00 minimum GPA in all work, including transfer credits; and successful completion of 75 percent of all work attempted.
- If there are multiple majors and/or minors, this requirement holds for each major and minor, calculated separately.

For students completing two or more majors:
- A minor is not required.
- If the majors are for different degrees (e.g., a B.S. and a B.A.), the majors must be in different programs (e.g., a student may not receive a B.S. in chemistry and a B.A. in chemistry) and students must complete requirements for both degrees.

B.S.Ch.E. Requirements
- Completion of at least 130 degree credits.
- A 2.00 minimum GPA in all work attempted at UMD; a 2.00 minimum GPA in all work, including transfer credits; and successful completion of 75 percent of all work attempted.
- Completion of UMD liberal education requirements. See the Liberal Education Program section of this catalog.
- Completion of the chemical engineering major. Admission to the upper division program of the chemical engineering major is competitive and granted on a space-available basis. Application for admission to upper division must be filed with the department upon completion of lower division requirements.
- A 2.00 minimum GPA in all courses taken in the chemical engineering major, including required courses in related fields. This GPA requirement applies to all courses in the major taken at UMD calculated separately and also to all courses in the major when transfer credits are included.

B.S.E.C.E. Requirements
- Completion of at least 128 degree credits.
- Completion of the electrical and computer engineering major. Admission to the upper division program is competitive and granted on a space available basis. A minimum GPA of 2.00 in all work attempted at UMD, successful completion (with grades of A through D, or S) of 75 percent of all work attempted, and a minimum GPA of 2.00 (C) overall (including transfer credits) are required for admission to the electrical and computer engineering (ECE) upper division program.
- Completion of UMD and ECE liberal education requirements.
- A 2.00 minimum GPA of 2.00 for all courses taken in the major, including required supporting courses. This average applies to all courses in the major taken at UMD and calculated separately and also to all courses in the major when transfer credits are included.

B.S.I.E. Requirements
- Completion of at least 128 degree credits.
- Grades of C- or better are required in all program courses. Transfer grades must be a C or better.
- A 2.00 minimum GPA (C) in all work attempted at UMD; a 2.00 minimum GPA in all work, including transfer credits; and successful completion of 75 percent of all work attempted.
- Completion of UMD liberal education requirements. See the Liberal Education Program section of this catalog. Courses for Categories 9 and 10 must have different designators.
- Completion of the industrial engineering major. Admission to the upper division program of the industrial engineering major is competitive and granted on a space-available basis. Application for admission to the upper division must be filed with the department upon completion of lower division requirements.
- A 2.00 minimum GPA in all courses taken in the industrial engineering major, including required courses in related fields. This GPA requirement applies to all courses in the major taken at UMD calculated separately and also to all courses in the major when transfer credits are included.
B.S.M.E. Requirements

- Completion of at least 128 degree credits.
- Grades of C- or better is required in all program courses. Transfer grades must be a C or better.
- A 2.00 minimum GPA (C) in all work attempted at UMD; a 2.00 minimum GPA in all work, including transfer credits; and successful completion of 75 percent of all work attempted.
- Completion of UMD liberal education requirements. See the Liberal Education Program section of this catalog. Courses for Categories 9 and 10 courses must have different designators.
- Completion of the mechanical engineering major. Admission to the upper division program of the mechanical engineering major is competitive and granted on a space-available basis. Application for admission to upper division must be filed with the department upon completion of lower division requirements.
- A 2.00 minimum GPA in all courses taken in the mechanical engineering major, including required courses in related fields. This GPA requirement applies to all courses in the major taken at UMD calculated separately and also to all courses in the major when transfer credits are included.

the cost of education and a monthly stipend are available on a merit basis.

Biology

E-mail: biol@d.umn.edu
Web site: www.d.umn.edu/biology/

Biology is one of the largest programs at UMD, with more than 600 undergraduate majors, more than 30 active graduate students, and 20 full-time faculty. We offer bachelor of science degrees in biology and cell and molecular biology and master of science degrees with concentrations in botany, zoology, environmental biology, cellular and physiological biology. In addition we provide pre-professional preparation for students interested in dentistry, fishery and wildlife management, medicine, optometry, pharmacy, and veterinary medicine. We also serve students seeking bachelor of arts degrees in biology through the College of Liberal Arts (CLA) and those seeking bachelor of applied science (B.A.Sc.) degrees in life science teaching through the College of Education and Human Service Professions. The faculty are actively involved in research supported by more than $8 million in external grants. This funding allows the department to offer all qualified undergraduate students the opportunity to participate in faculty research.

Swenson College of Science and Engineering Departments

Aerospace Studies

E-mail: air@d.umn.edu
Web site: www.d.umn.edu/air/
Professor: Lieutenant Colonel Al Chromy; Assistant Professors: Major Tim Allen, Captain Eric Fraser

The Aerospace Studies Department offers a curriculum to all students looking for insight into the mission, organization, and operation of the United States Air Force. Students study Air Force history, leadership, management, and professionalism as well as U.S. foreign and defense policy. The Department offers most of the courses required for an aerospace studies minor. Students have the opportunity to participate in the Air Force Reserve Officer Training Corps (AFROTC) and prepare for an Air Force commission as soon as they earn their academic degrees. Real-world application of organizational leadership and management skills is the backbone of their professional development. Scholarships covering

Chemical Engineering

E-mail: che@d.umn.edu
Web site: www.d.umn.edu/che
Professors: Richard A. Davis, A. Rashid Hasan (department head); Associate Professors: Keith Lodge, Steven Sternberg; Assistant Professors: Michael Rother, Gregory Rutkowski; Instructor: Carol Horabik

The Department of Chemical Engineering offers students a high quality educational experience that includes engineering theory, application, experimentation, and design. It is dedicated to achieving recognition for excellence in engineering education by continually improving its program, contributing to the body of knowledge through research, providing an environment for professional development, and serving the profession.
The Department of Chemistry and Biochemistry provides classroom and laboratory learning opportunities and research experiences across the discipline to meet the needs of students in engineering, liberal arts, and pre-professional programs, as well as those of students who wish to pursue careers or graduate studies in chemistry or related disciplines.

Computer Science
E-mail: cs@d.umn.edu
Web site: www.d.umn.edu/cs/
Professors: Donald B. Crouch, Carolyn J. Crouch, Douglas J. Dunham, Richard Maclin (department head); Associate Professors: Timothy R. Colburn, Linda L. Deneen, Theodore D. Pedersen, Christopher Prince, Gary M. Shute, C. Hudson Turner; Assistant Professors: James Allert, Peter Willemsen; Instructor: Steven Holtz

The Department of Computer Science provides instruction and research experiences for undergraduate and graduate students in preparation for careers in industry or for continuing on in graduate school. The department also provides instruction in computer literacy and software design for non-major students as part of a liberal education.

Electrical and Computer Engineering
E-mail: ece@d.umn.edu
Web site: www.d.umn.edu/ece
Professors: Stanley Burns (department head), Taek Mu Kwon, Marian Stachowicz, Jiann-Shiou Yang; Associate Professors: Christopher Carroll, Mohammed Hasan, Imran Hayee; Assistant Professors: Hua Tang, G. Lee Zimmerman; Instructor: Scott Norr

The goals of the Department of Electrical and Computer Engineering are to provide high-quality educational opportunities in electrical and computer engineering for students of the region by delivering a program with a strong hands-on laboratory and design component in conjunction with a thorough foundation in theory; and to provide students with the tools and skills to be major life-long contributors to their professions and society as a whole.

Geological Sciences
E-mail: geol@d.umn.edu
Web site: www.d.umn.edu/geology
Professors: Erik T. Brown, Steven M. Colman, John W. Goode, Vicki L. Hansen, Timothy B. Holst, Thomas C. Johnson, Howard D. Mooers (department head), Ronald L. Morton; Associate Professors: Christina Gallup, Penelope Morton, John B. Swenson, Nigel J. Wattrus

The Department of Geological Sciences offers three undergraduate programs: a bachelor of science program providing training for a career as a professional geologist, which usually requires graduate study; a liberal arts bachelor of arts program through the College of Liberal Arts; and a program for those interested in teaching earth sciences through the College of Education and Human Service Professions.

Mathematics and Statistics
E-mail: math@d.umn.edu
Web site: www.d.umn.edu/math
Professors: Joseph A. Gallian, Richard F. Green, Barry R. James (department head), Kang L. James, Zhuangyi Liu, Ronald R. Regal, Harlan W. Stech; Associate Professors: Guihua Fei, Dalibor Froneck, John R. Greene, Carmen Latterell, Kathryn E. Lenz, Robert L. McFarland, Bruce B. Peckman, Steven A. Trogdon; Assistant Professors: Marshall Hampton, Yongcheng Qi; Instructors: Anna C. Jacobson, Karl K. Kruppstadt, Chad Pierson, Deanna L. Riley, Angela M. Sharp

The Department of Mathematics and Statistics offers undergraduate degree programs in mathematics and statistics/actuarial science. These programs prepare students for careers in business, industry, government, and teaching, as well as for graduate studies in mathematics, statistics, and biostatistics.

Mechanical and Industrial Engineering
E-mail: mie@d.umn.edu
Web site: www.d.umn.edu/mie
Professors: Mark A. Fugelso, Richard R. Lindeke, David A. Wyrick (department head); Associate Professor: Ryan G. Rosandick; Assistant Professors: Seraphin C. Abou, Emmanuel U. Enemuoh, Robert Feyen, Bachel Han, William E. Pedersen, Daniel N. Pope, John C. Voss, Xun Yu; Instructors: Hongyi Chen, David Keranen, Hossain Khoroosi

The Department of Mechanical and Industrial Engineering (MIE) will be internationally recognized as the premier engineering department in the Great Lakes Region for its high quality undergraduate education, applied master’s level programs in environmental health and safety and engineering management, and integrated outreach activities in regional economic development,
international partnerships, and applied research, thus enabling the growth of our students, faculty, alumni, industry, and economy.

Physics
E-mail: phys@d.umn.edu
Web site: www.d.umn.edu/physics
Professors: John R. Hiller (department head), Michael Sydor; Associate Professors: Alec T. Habig; Assistant Professors: Jay A. Austin, Richard W. Gran, Jonathan Maps; Instructor: Darrin E. Johnson

The Department of Physics offers two bachelor of science degrees that provide professional preparation in pure and applied physics as well as a liberal arts degree (B.A.). Students participate in research focused primarily on theoretical physics, instrumentation, experimental solid state and high energy physics, and physical oceanography. The department also offers courses required for such professional and pre-professional programs as engineering and medicine.

Collegiate Graduate Program

Master of Environmental Health and Safety
Assistant Professors: Seraphin C. Abou, Robert Feyen, Bachel Han, Daniel N. Pope

The M.E.H.S. program prepares graduates for professional careers in environmental health and safety, which include occupational safety, industrial hygiene, ergonomics, risk management, and environmental health. The coursework includes analysis of occupational safety and health problems; accompanying problem-solving and decision-making techniques; and the application of established principles and practices of accident prevention, control, and reduction in occupational settings.

Admission Requirements
Applicants must have a baccalaureate degree from an accredited college or university, preferably with a major in science, engineering, or another appropriate field. Baccalaureate degree holders with different majors who have relevant backgrounds or qualifications are also considered. If deficiencies exist, candidates may be accepted into the program contingent upon successful completion of courses designed to correct them. All applicants must take the Graduate Record Examination (GRE) General Test and have an official report of the results sent to the mechanical and industrial engineering graduate programs office as part of their application for admission; minimum scores of 1,000 on the verbal and quantitative sections and 4.0 on the analytical writing are preferred. Because this test is given at limited times and places during the year, applicants are advised to register early for the examination. Applicants must furnish official transcripts showing that they have completed their baccalaureate degree before they will be admitted or allowed to enroll in any M.E.H.S. courses. Students may apply for admission during their last semester of undergraduate work, but they will not be formally admitted or allowed to begin M.E.H.S. coursework until the baccalaureate degree is completed.

Application Procedure
A completed admission application should be submitted prior to the year of anticipated enrollment. Information and applications are available from the M.E.H.S. program office, 229 Voss-Kovach Hall. The admission decision is based on an evaluation by the applicant screening committee of the undergraduate scholastic record, past work experience, GRE results, and letters of recommendation. International students must present a TOEFL score of 550 or above. Applicants are responsible for obtaining information on all admission deadlines and requirements and for submitting all required admission materials before the first day of classes or they will be denied admission and must reapply to the program.

Degree Requirements
Requirements for the M.E.H.S. include:
• 36 course credits in the M.E.H.S. program and maintenance of an overall minimum GPA of 3.00;
• a minimum of two semesters for the residence requirement;
• an additional 3-credit industrial internship with a Plan B type project, which must be fulfilled within six months following completion of coursework, unless a formal extension is requested and granted.

Required Courses
Core (29 credits)
SAFE 6002—Regulatory Standards and Hazard Control (3 cr)
SAFE 6011—System Safety and Loss Control Techniques (3 cr)
SAFE 6012—Risk Management and Workers’ Compensation (2 cr)
SAFE 6051—Construction Safety Management (3 cr)
SAFE 6101—Principles of Industrial Hygiene (3 cr)
SAFE 6111—Industrial Noise and Ventilation Control (3 cr)
SAFE 6301—Occupational Biomechanics and Work Physiology (2 cr)
SAFE 6302—Occupational Ergonomics and Injury Management (3 cr)
SAFE 6401—Environmental Safety and Legal Implications (2 cr)
SAFE 6802—Leadership, Teamwork, Behavior in EHS (3 cr)
Or EMGT 5160—Quality Management (3 cr)
Or EMGT 5110—Management of Engineers and Technology (3 cr)
SAFE 6821—Organization and Administration of Safety Programs (2 cr)
Electives (7 credits)
EMGT 5120—Advanced Project Management (3 cr)
EMGT 5995—Special Topics (1–3 cr)
IE 5315—Organizational Control Methods (3 cr)
IE 5325—Advanced Engineering Economics (3 cr)
SAFE 6102—Advanced Industrial Hygiene and Health Physics (2 cr)
SAFE 6121—Epidemiology and Industrial Toxicology (2 cr)
SAFE 6201—Fire Prevention and Emergency Preparedness (2 cr)
SAFE 6211—Transportation Safety (2 cr)
SAFE 6291—Independent Study in Industrial Safety (1–3 cr)
SAFE 6295—Special Topics (1–3)
Final Project (3 credits)
Upon completing program coursework on campus, students are required to complete a cooperative internship in an industrial, governmental, or other organization that has an established safety program or is implementing one. Students are required to complete SAFE 6997 a Plan B type project for the firm.

Grading System
The M.E.H.S. program uses two grading systems, mandatory A-B-C-D-F and S-N. The course syllabus identifies the grading system used for each course. The temporary grade I (incomplete) is assigned only when a student has made an agreement with the instructor to complete the requirements for a course before the instructor submits final grades for a semester. The I remains in effect for nine weeks after the beginning of the next semester during which the student is in attendance, unless a different time period has been arranged between the student and instructor. At the end of this period, the I is changed to an N or F unless the instructor has submitted a change of grade or has agreed to an extension of the incomplete. If an extension is permitted, it is the responsibility of the student to get an Extension of Incomplete form, the instructor’s signature, and submit the form to the program office before the deadline.

A student with an excessive number of incompletes may be denied further registration until some of them have been removed.
The program discourages retaking courses to improve grades. Permission from the course instructor and the major adviser is required to retake courses. If a course is retaken, all registrations for it remain on the student’s record.

Pre-Professional Programs
The college offers programs and special advising services for students who plan to enter professional schools. These programs offer preparation in pre-professional coursework as well as a broad background in mathematics, biological and physical sciences, humanities, and social science. Some professional requirements can be fulfilled in two or three years; others take four years with the completion of a baccalaureate degree. In any case, students are encouraged to avoid narrow specialization during their undergraduate years. The basic programs are described below. Variations in a curriculum may be arranged upon agreement among the student, pre-professional adviser, and admissions office of the pertinent professional school. Students are encouraged to seek admissions details from the professional school of their choice, see their advisers regularly, learn of visits by representatives of various professional schools, and receive help with course planning. UMD also offers preparatory courses for other health sciences professions.

Pre-Dentistry
The University of Minnesota’s School of Dentistry requires at least three years of college, including:
BIOL 1011*—General Biology I (5 cr)
BIOL 1012—General Biology II (5 cr)
CHEM 1151*—General Chemistry I (5 cr)
CHEM 1152—General Chemistry II (5 cr)
CHEM 2541—Organic Chemistry I (3 cr)
CHEM 2543—Organic Chemistry I Lab (1)
CHEM 2542—Organic Chemistry II (3 cr)
CHEM 2544—Organic Chemistry II Lab (1 cr)
CHEM 3322—Biochemistry (3 cr)
COMP/WRIT 1120*—College Writing (3 cr)
COMP/WRIT 3xxx—Advanced Writing (3 cr)
MATH 1250*—Precalculus Analysis (4 cr)
PHYS 1001*—Introduction to Physics I (5 cr)
PHYS 1002—Introduction to Physics II (5 cr)
PSY 1003*—General Psychology (4 cr)
Electives especially recommended are art, cell biology, human anatomy, microbiology, and physiology. Additional electives can be selected from courses in business, biology, chemistry, social sciences, and the humanities.

It is also strongly recommended that students complete additional credits to achieve as broad and liberal an education as possible. About 80 percent of successful dental school candidates have a baccalaureate degree. Applicants to dental school must apply before December 1 for entry the following fall. The American Dental Association Admissions Test (DAT) is required and the official DAT score report must also be submitted by December 1 of the year before matriculation. The computerized DAT can be taken at any time, but students must first apply through the Dental Admission Testing Program.

* Courses that may be used to fulfill UMD liberal education program requirements.

Pre-Medicine

Students admitted to medical school must complete four-year degrees before they begin medical studies. There is no prescribed pre-medical major—any recognized college major is acceptable. Admission requirements vary, however, and students should plan their academic programs with the assistance of a pre-medicine adviser. Students also should read and complete the specific admission requirements of the medical schools in which they are interested. The following courses are prerequisites for admission to many medical schools.

BIOL 1011*—General Biology I (5 cr)
BIOL 1012—General Biology II (5 cr)
CHEM 1151*—General Chemistry I (5 cr)
CHEM 1152—General Chemistry II (5 cr)
CHEM 2541—Organic Chemistry I (3 cr)
CHEM 2543—Organic Chemistry I Lab (1)
CHEM 2542—Organic Chemistry II (3 cr)
CHEM 2544—Organic Chemistry II Lab (1 cr)
CHEM 3322—Biochemistry (3 cr)
COMP/WRIT 1120*—College Writing (3 cr)
COMP/WRIT 3xxx—Advanced Writing (3 cr)
MATH 1296*—Calculus I (5 cr)
PHYS 1001*—Introduction to Physics I (5 cr)
PHYS 1002—Introduction to Physics II (5 cr)
PSY 1003*—General Psychology (4 cr)
Additional required or recommended courses may include cell biology, genetics, humanities, literature, microbiology, quantitative analysis, and social sciences.

* Courses that may be used to fulfill UMD liberal education program requirements.

The Medical College Admission Test (MCAT) should be taken in the spring of the junior year or, at the latest, in the summer before the senior year. Students are advised to apply to medical school as early as possible after June 15 of the year preceding anticipated fall entrance. Most application deadlines are between October 1 and November 15.

Current information about admission requirements for all American medical schools can be found in Medical School Admission Requirements. Information on admission requirements for the three Minnesota medical schools is in the Handbook on Pre-Medical Studies, available from any pre-medicine adviser or the college's Student Affairs Office, 140 Engineering Building.

Pre-Optometry

Admission requirements for optometry colleges vary considerably. The following program satisfies pre-optometry requirements for most of these colleges. It is suggested that students begin application procedures during their third year of college study. Applicants are selected on a competitive basis and academic work is weighed heavily. In addition to GPA, admission is based on Optometry College Admission Test (OCAT) scores, letters of recommendation, volunteer or work experience in optometry, interview evaluations, and other supporting documents.

BIOL 1011*—General Biology I (5 cr)
BIOL 1012—General Biology II (5 cr)
BIOL 2101—Cell Biology (3 cr)
CHEM 1151*—General Chemistry I (5 cr)
CHEM 2541—Organic Chemistry I (3 cr)
CHEM 2543—Organic Chemistry I Lab (1)
CHEM 2544—Organic Chemistry II Lab (1 cr)
COMP/WRIT 1120*—College Writing (3 cr)
COMP/WRIT 3xxx—Advanced Writing (3 cr)
MATH 1296*—Calculus I (5 cr)
PHYS 1001*—Introduction to Physics I (5 cr)
PHYS 1002—Introduction to Physics II (5 cr)
PSY 1003*—General Psychology (4 cr)
STAT 1411*—Introduction to Statistics (3 cr)
Additional required or recommended courses may include anatomy, biochemistry, communications, computer science, genetics, humanities, microbiology, physiology, and social sciences. Students should read and complete the specific admission requirements of the optometry school in which they are interested.

* Courses that may be used to fulfill UMD liberal education program requirements.
Pre-Pharmacy

Students wishing to enter the four-year doctor of pharmacy (Pharm.D.) program in the College of Pharmacy on the Duluth or Minneapolis campus may complete their prerequisites with the coursework listed below. The Pharmacy College Admission Test (PCAT) is also required.

**BIOL 1011**—General Biology I (5 cr)
**BIOL 1012**—General Biology II (5 cr)
**BIOL 2769**—Human Anatomy (4 cr)
**BIOL 2101**—Cell Biology (3 cr)
**BIOL 4501**—General Microbiology (4 cr)
**CHEM 1151**—General Chemistry I (5 cr)
**CHEM 1152**—General Chemistry II (5 cr)
**CHEM 2541**—Organic Chemistry I (3 cr)
**CHEM 2543**—Organic Chemistry I Lab (1)
**CHEM 2542**—Organic Chemistry II (3 cr)
**CHEM 2544**—Organic Chemistry II Lab (1 cr)
**COMM 1112**—Public Speaking (3 cr)
**COMP/WRIT 1120**—College Writing (3 cr)
**COMP/WRIT 3150**—Advanced Writing: Science (3 cr)
**MATH 1296**—Calculus I (5 cr)
**PHYS 1001**—Introduction to Physics I (5 cr)
**PHYS 1002**—Introduction to Physics II (5 cr)

Two courses dealing with human behavior in society (psychology or sociology courses)

*Courses that may be used to fulfill UMD liberal education program requirements.

In addition to the pre-pharmacy course requirements, students must complete at least 30 credits of general education (nonscience, nonmathematics, nonprofessional) courses. Pre-pharmacy credits earned in behavioral sciences, English composition, economics, and public speaking apply toward this general education requirement.

Although admission to pharmacy is possible after three years of undergraduate study, it is recommended that students pursue a baccalaureate degree while preparing for admission to the College of Pharmacy.

Pre-Veterinary Medicine

The pre-veterinary program at UMD is part of the preparation for entry into the College of Veterinary Medicine on the St. Paul campus. Students may apply for entry after their third year at UMD. Required courses must be completed A-F.

Students should apply for admission to the veterinary college no later than November 1 for entry the following fall. The Graduate Record Examination (GRE) is also required for admission.

*Pre-Veterinary Medicine students should complete the following courses:

**BIOL 1011**—General Biology I (5 cr)
**BIOL 1012**—General Biology II (5 cr)
**BIOL 2101**—Cell Biology (3 cr)
**BIOL 4501**—General Microbiology (4 cr)
**CHEM 1151**—General Chemistry I (5 cr)
**CHEM 1152**—General Chemistry II (5 cr)
**CHEM 2541**—Organic Chemistry I (3 cr)
**CHEM 2543**—Organic Chemistry I Lab (1)
**CHEM 2542**—Organic Chemistry II (3 cr)
**CHEM 2544**—Organic Chemistry II Lab (1 cr)
**CHEM 3322**—Biochemistry (3 cr)
**COMP/WRIT 1120**—College Writing (3 cr)
**COMP/WRIT 3xxx**—Advanced Writing (3 cr)
**MATH 1250**—Precalculus Analysis (4 cr)
**PHYS 1001**—Introduction to Physics I (5 cr)
**PHYS 1002**—Introduction to Physics II (5 cr)

Arts and humanities electives
History and social sciences electives
Additional recommended electives include courses in business management, communications, economics, public speaking, and statistics.

*Courses that may be used to fulfill UMD liberal education program requirements.

Note: Students who choose to complete a degree at UMD before transferring to a veterinary college may do so within the usual four-year enrollment if they carefully select electives to fulfill pre-veterinary requirements and the requirements of their chosen major. Additional biology, chemistry, or mathematics coursework, for example, can lead to majors in these areas.

Pre-Engineering

Students who are undecided on the specific engineering program they would like to pursue may be declared pre-engineering students. During their freshman year they should select a specific program from UMD’s chemical, electrical and computer, industrial, or mechanical engineering programs, or from UMD’s pre-aerospace engineering or pre-civil engineering programs. Students selecting one of the pre-programs may transfer to the Institute of Technology (IT) on the Minneapolis campus or other baccalaureate degree-granting institutions at the end of their sophomore year to complete their studies in those engineering fields.

Students are encouraged to select their engineering program as early as possible because programs commonly share only mathematics, physics, and college writing courses in the first year. Other required courses, such as chemistry, computer programming, economics, and engineering graphics differ between engineering programs.
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programs even in the first year. After selecting a specified field, students are assigned advisers with the appropriate background who can advise them to take the proper courses. Students should choose a field of engineering before the beginning of their sophomore year.

Recommended Lower Division Courses for Students Who Wish to Transfer to IT or Another University

The course recommendations below have been designed to closely match the lower division programs (i.e., the first two years) at the University’s Institute of Technology (IT). Students who wish to transfer to another engineering school can, with the aid of their engineering adviser, plan a program fulfilling the basic requirements for the first two years. Programs in engineering specialties at other schools normally do not differ markedly from those listed below; they usually concentrate on mathematics and the basic sciences.

Pre-Aerospace Engineering
CHEM 1151*—General Chemistry I (5 cr)
COMP/WRIT 1120*—College Writing (3 cr)
CS 1131*—Introduction to Programming in FORTRAN (3 cr)
or CS 1511*—Computer Science I (5 cr)
ENGR 2015—Statics (3 cr)
ENGR 2016—Mechanics of Materials (3 cr)
ENGR 2026—Dynamics (3 cr)
MATH 1296*—Calculus I (5 cr)
MATH 1297—Calculus II (5 cr)
MATH 3280—Differential Equations With Linear Algebra (4 cr)
MATH 3298—Calculus III (4 cr)
ME 2105—Introduction to Material Science for Engineers (3 cr)
PHYS 2011*—General Physics I (4 cr)
PHYS 2012—General Physics II (4 cr)
PHYS 2021—Relativity and Quantum Physics (4 cr)
Liberal education courses that complete Minnesota Transfer Curriculum or meet requirements of transfer institution
* Courses that may be used to fulfill UMD liberal education program requirements.

Other Engineering Specialties
Consult the SCSE Student Affairs Office, 140 Engineering Building.