Institute of Technology

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General Information

For more than a century, the Institute of Technology (IT) has provided education, research, and technology transfer in science and engineering. With 4,500 students enrolled in its undergraduate programs, 2,600 in graduate programs, and 400 faculty, IT’s 12 departments and schools and 15 research centers are committed to excellence in all they undertake.

Computer Facilities—The Institute of Technology, in cooperation with the Department of Computer Science and Engineering and the office of Academic and Distributed Computing Services, has established a number of computer laboratories for students. These laboratories provide interactive computing using either stand-alone computers and workstations or remote access to central computing facilities, including those of the Minnesota Supercomputer Institute. Laboratories are available to IT students any time during the work day and evening and weekend hours.

Students also have access through their departments to many special-purpose machines, ranging from small tabletop units for data reduction in laboratories to larger models reserved for special projects.

The Department of Computer Science offers a series of courses in Java and C++. Discipline-related computing courses are offered in some departments.

Admission

Freshman Admission

See Freshman Admission in the General Information section of this catalog and refer to the University of Minnesota, Twin Cities undergraduate application booklet for freshman admission requirements.

Appeals—Any student who believes that the circumstances concerning their application need further consideration may submit a written appeal to the Office of Admissions.

Upper Division Admission—Students entering as freshmen or sophomores must apply for admission to the upper division (junior and senior years). New freshmen and sophomores are told upon admission and at orientation what GPA might be required for entry into their desired upper division major field. (For procedure, see Upper Division under Scholastic Policies in this college section.)

Admission Without a Designated Major—Students who want to keep their options open and learn about IT fields before selecting a specific major should indicate “Undecided” on the admission application. They receive advising from the Office of Lower Division Programs until they are admitted to upper division. During that period students can use the many resources available to learn about IT fields, including mentors; peer, faculty, industry, and alumni advisers; special courses; and written materials. These resources provide information about career opportunities in IT’s various fields and other colleges and help students avoid the mistake of selecting a major for the wrong reasons.

All students are urged to take advantage of the Industry Adviser and Mentor Programs, and visit selected industries to learn about engineering and science fields with an engineer and/or scientist of their choice. Currently, more than 200 engineers and scientists from Honeywell, 3M, NSP, and many other companies serve as advisers to IT students through this program. Arrangements to participate are made by online application.

IT undecided students follow the same first-year academic program as that followed by IT students with a specified major.

Advanced Standing Admission (Transfer)

Students who have completed any postsecondary classes after high school are considered for admission with advanced standing. Students planning to transfer to IT should be pursuing a lower division engineering, science, or math program. The mathematics, chemistry, physics, and computer science courses required for the preferred major should be mostly completed at the time of application. Admission decisions are based on an overall “technical” GPA using grades in science, calculus, computer science, and engineering. Because demand for some IT programs exceeds available places, applicants are asked to indicate three majors in order of preference. Applications must include recent transcripts from all colleges attended, reflecting all college work attempted (whether satisfactorily completed or not). Applications must also include a high school transcript to show whether the preparation requirements listed have been met. Most courses transfer routinely. Equivalency for technical courses has been established between IT and most colleges and universities (see www.it.umn.edu/prospective/equiv). Technical courses in which a D has been earned do not transfer.

Dual Degree (3/2) Programs—IT has cooperative agreements with a number of public and private colleges. These programs support students who want to combine a strong liberal arts background with study in engineering—and are willing to spend another year or two achieving this goal.

Under one plan a student can complete three years of study at a private college and then transfer to IT for two additional years. Core college requirements and the pre-engineering core courses in math and science are completed at the private college. A bachelor’s degree is awarded by both the private college and IT.

The second plan requires completion of a bachelor of arts degree in math or science before coming to the University to work toward a master of science degree in engineering. This typically involves completing some undergraduate engineering coursework. This plan minimizes the amount of undergraduate coursework required. The amount of such coursework will vary by department and area of study. Participating colleges include (in Minnesota) Augsburg College, Bethany Lutheran College, Bethel College, Concordia College (Moorhead), Gustavus Adolphus College, Hamline University, Macalester College, MN State University–Moorhead, Northwestern College, the College of St. Catherine, Saint Mary’s College, St. Olaf College, St. John’s University-College of St. Benedict, St. Scholastica, University of St. Thomas, University of Minnesota, Morris; (outside Minnesota) Augustana College, SD; Carroll College, MT; Carthage College, WI; Jackson State University, MS; Lawrence University, WI; Luther College, IA; Morningside College, IA; North Central College, IL; North Park College, IL; Simpson College, IA; University of Mary, ND; University of Winnipeg, Manitoba, Canada; University of Wisconsin–Eau Claire, WI; University of Wisconsin–La Crosse, WI; University of Wisconsin–Oshkosh; University of Wisconsin–River Falls, WI; Westmont College, CA; Wheaton College, IL; Whittier College, CA.
Degrees and Programs

Undergraduate Degrees—Each of IT’s undergraduate programs provides a rigorous and stimulating education enhanced by close interaction with distinguished research faculty and access to IT’s research facilities.

Nineteen degrees are offered:
- bachelor of aerospace engineering and mechanics*
- bachelor of science in astrophysics
- bachelor of bio-based products engineering
- bachelor of biomedical engineering*
- bachelor of biosystems and agricultural engineering*
- bachelor of chemical engineering*
- bachelor of science in chemistry
- bachelor of civil engineering*
- bachelor of computer engineering*
- bachelor of science in computer science
- bachelor of electrical engineering*
- bachelor of geological engineering*
- bachelor of science in geology
- bachelor of science in geophysics
- bachelor of materials science and engineering*
- bachelor of science in mathematics
- bachelor of mechanical engineering*
- bachelor of science in physics
- bachelor of science in statistics

* Program is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET).

Graduate Degrees—The University of Minnesota is the only institution in the state that offers a full range of graduate programs in mathematics and computer science, the physical sciences, and engineering. Each IT department offers M.S. and Ph.D. degree programs in several areas within its discipline. For detailed information about the various graduate programs, consult the Graduate School Catalog.

IT and the Graduate School jointly offer a program leading to the master of engineering (M.E.) degree in any of the engineering disciplines. This program provides advanced preparation in specialized design work for recent graduates in engineering as well as for working engineers who wish to improve their technical capabilities.

The management of technology program is an executive-format graduate program that prepares working engineers and scientists for careers in technology management. It is a part-time, two-year program leading to a master of science degree in the management of technology (M.S.-M.O.T.). Similar professional masters programs are offered in infrastructure systems, and software engineering. For more information, contact the Center for the Development of Technological Leadership, 510 West Bank Office Building, 1300 S. Second Street, Minneapolis, MN 55455 (612-624-5747).

Interdisciplinary Programs—IT students can plan interdisciplinary programs tailored to their specific interests. Although a degree is approved by a single department, students can combine coursework from several departments.

Many interdisciplinary programs are possible. A few examples include acoustics, bioengineering, environmental engineering, nuclear engineering, and transportation. Students should contact their department office or visit 105 Lind Hall for more information.

Premedical Programs—Because there is no prescribed premedical major, some students plan their IT programs as preparation for medical school. The Minnesota medical schools in Duluth, Minneapolis, and Rochester give strong preference to applicants who are state residents.

The Minneapolis campus Medical School has approved the following courses to fulfill its premedical requirements.

- Biology—BIOL 1009 and 3211 and 2005. This sequence is most parallel to MCAT.
- Biochemistry—BIOC 3021, BIOC 4025 (optional lab)
- Chemistry—CHEM 1021–1022, 2301–2302 and 2311
- English and Literature—One English composition course and one literature course
- Calculus—MATH 1271 or equivalent
- Physics—PHYS 1201 and 1202 or 1301 and 1302
- Social and Behavioral Sciences and Humanities—Four courses: one course in psychology with the remaining coursework in at least two of the following areas—history, sociology, anthropology, philosophy, comparative studies, music, or art.

All math/science courses must be taken A-F. A-F grading is preferred for all coursework.

Coursework in genetics and upper level statistics is strongly recommended.

Additional academic courses to complete degree requirements.

Prerequisite courses do change occasionally. The Medical School Web sites have the most up-to-date information and can be found at:

- Duluth: http://penguin.d.umn.edu/Admissions
- Minneapolis: www.meded.umn.edu
- Rochester: www.mayo.edu/mms/md-admissions.htm

For more information, contact the Health Careers Center in 2-571/585 Moos Tower (612-624-6767) or visit the Web site at www.healthcareers.umn.edu.

Minors

Information Technology Minor Only

This interdisciplinary minor provides opportunities to students in nontechnical disciplines to supplement their major with courses focused on information technology. For more information, see the Degree Programs and Minors section.

Honors Program

The IT honors program provides special educational experiences to those students who have the ability and motivation to accept an extra challenge. Honors opportunities include a specially designed academic curriculum during the freshman and sophomore years, upper division programs leading to the cum laude degrees, close contact with instructors, opportunities for research, and a variety of elective honors courses, seminars, and colloquia offered in IT and the College of Liberal Arts.

During the freshman year, most lower division honors students take enriched mathematics, physics, and chemistry courses that provide excellent preparation for any IT major. Students also participate in the many social and cocurricular activities initiated by the IT Student Honors Group and may live in honors housing.
This special lower division academic program continues into the sophomore year offering enough flexibility so students can take the courses they need to pursue any major. For the junior and senior years, each department offers its own upper division honors program consisting of courses, research projects, and honors opportunities leading to the cum laude degrees.

**Admission to Lower Division Honors Program**—Lower division honors students begin their participation in the honors program in the fall of the freshman year. These students apply and are admitted in their senior year of high school. Selection is based on academic accomplishments in high school, scores on standardized tests, an application essay, and a recommendation usually from a teacher or counselor. The priority application deadline for freshman admission is January 15. Applications may be obtained by contacting the Office of Admissions, 240 Williamson Hall (612-625-2008).

**Admission to Upper Division Honors Programs**—Students about to enter their junior year may apply to the upper division honors program administered through their major department. Admission requirements are set by the individual departments and may be obtained from the department or the IT Honors Office. Previous enrollment in the lower division honors program is not required for participation in upper division honors programs.

**Graduation With Honors**—Enrollment in the upper division honors program is required for graduation with the honors designations cum laude, magna cum laude, and summa cum laude. Other graduation criteria include at least two years of University of Minnesota coursework, quality of the grade record, participation in honors opportunities, fulfillment of requirements designated in the major field, and an honors thesis.

**IT Honors Office**—This office provides academic advising, procedural information, and other college office services to honors students. The address is IT Honors Office, University of Minnesota, 136 Lind Hall, 207 Church Street S.E., Minneapolis, MN 55455 (612-625-2800).

**Scholastic Policies**

**Continuation in Sequences**—IT students taking the following lower division sequence courses must earn at least a C- each semester to continue in the sequence.

- CHEM 1021-1022, 2101-2111
- CHEM 2301, 2302, 2311
- EE 2001, 2011
- MATH 1155, 1271-1272*
- MATH 1371-1372
- MATH 1571-1572
- PHYS 1301, 1302
- PHYS 2303, ** 2601

* To continue in additional mathematics courses (in particular MATH 2243 or MATH 2263) or sequences, IT students must earn at least a C- in MATH 1272, 1372, or 1572.

** To continue in physics sequences, IT students must earn at least a C- in PHYS 2303.

IT students must earn at least a C- in all 1xxx and 3xxx math, physics, and chemistry courses, and all courses required by the major. All courses required by the major must be taken A-F.

**Upper Division**—The upper division corresponds to the junior and senior years.

Freshmen and sophomores must apply for entry and are told at orientation what minimum GPA might be required. Students should file an application in 105 Lind Hall before completing their sophomore year.

**Changing Majors**—To change majors within IT, upper division students must petition. Forms are available in 105 Lind Hall. A transcript must accompany the petition.

Students who graduate from IT but continue to register for courses will automatically have their status changed to nondegree unless they had previously been admitted to a second (double) major.

To change from IT to another college unit or campus within the University, students must apply for transfer through the One Stop Student Services Center, 200 Fraser Hall, as far as possible in advance of the projected transfer. Some units have transfer application deadlines. Students must meet admission requirements of the unit they plan to enter.

**Conduct and Discipline**

IT assumes that all students who enroll in its programs are serious about their education and expects them to be responsible individuals who demand of themselves high standards of honesty and good personal conduct.

IT expects the highest standards of honesty and integrity in the academic performance of its students. Any act of scholastic dishonesty is regarded as a serious offense, which may result in expulsion. IT defines scholastic dishonesty as submission of false records of academic achievement; cheating on assignments or examinations; plagiarizing; altering, forging, or misusing a University academic record; taking, acquir- ing, or using test materials without faculty permission; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement. Aiding and abetting a student in an act of scholastic dishonesty is also considered a serious offense.

All students at the University have the right to a calm, productive, and stimulating learning environment. Students who engage in behavior that disrupts the learning environment for others may be subject to disciplinary action under the Student Conduct Code, which prohibits disruptive conduct. In addition, students responsible for such behavior may be required to cancel their registration (or have their registration canceled).

All disciplinary cases that are academic and nonacademic in nature or that involve two or more colleges are referred to the Office for Student Academic Integrity, 123 University Office Plaza, 2221 University Avenue S.E., Minneapolis, MN 55414 (612-624-6073).

A student has the right to a hearing and to appeal any disciplinary action. Copies of the procedures for cases of scholastic dishonesty are available at the Office for Student Academic Integrity.

**Professional Registration**

Registration is a legal requirement for certain kinds of practice in engineering and in geoscience. A professional license is required before an individual may use the designation of engineer in any legal connection. Many engineers obtain a license to show their support for legal recognition of the professional standing of the engineer or geologist. Many also obtain a license because professional registration may be useful or required in future employment.

The license is awarded in most states to those graduates of an accredited engineering curriculum who have passed examinations in the fundamentals, principles, and practice of engineering and demonstrated their competence by a specified number of years of appropriate experience. The fundamentals of engineering examination covers materials studied in undergraduate curricula. This examination is given in the spring and fall each year and may be taken by students in their senior year. More information and applications may be obtained from
the Career Center for Science and Engineering in 50 Lind Hall or by writing to the Minnesota State Board of Architecture, Engineering, Land Surveying, Landscape Architecture, Geoscience, and Interior Design, 133 7th Street E., St. Paul, MN 55101-2333 (651-296-2388).

Advising

Advising for freshmen is coordinated by the Office of Lower Division Programs, 128 Lind Hall (612-624-2890). Every IT freshman is assigned to a team of approximately 100 students. During orientation, freshmen meet with their team adviser and plan their fall schedule. Students on each team take one or more courses together; this encourages the formation of study and support groups. Freshmen must meet with their team adviser at least once each term to discuss their progress and plan their schedule for the following semester.

All lower division students obtain advising through the Office of Lower Division Programs until admission to upper division.

Special Learning Opportunities and Resources

Student Affairs Office—Prospective and current students can discuss any questions or problems with an advising staff member in the Student Affairs Office, 105 Lind Hall (612-624-8504) or e-mail studentaff@itdean.umn.edu. This office is responsible for admission, orientation, scholastic conduct, institute-wide scholarships, degree requirements and procedures, and related functions. Appointments are encouraged.

Tutors—IT provides peer tutors for students in chemistry, mathematics, physics, and other IT courses. These teaching assistants, selected from junior and senior IT students, are trained, qualified, and willing to assist students one-on-one with problems in IT lower division courses. Tutoring is provided in various locations—in 150 Lind Hall, by appointment in 128 Lind Hall, and in all residence halls.

Mathematics graduate teaching assistants are available in 150 Lind Hall with the undergraduate teaching assistants. In addition, graduate teaching assistants provide tutoring for computer science courses in 4-205 Electrical Engineering/Computer Science.

For more information about tutors, contact the Office of Lower Division Programs, 128 Lind Hall (612-624-2890).

Paid Learning Opportunities—The Career Center for Science and Engineering (CCSE) provides information about off-campus employment related to major or career interests. Many options are available for part-time, summer internship, and cooperative education employment. Students may be eligible for part-time or summer internship opportunities as early as the end of their freshman year. Students entering upper division may be eligible to participate in cooperative education programs offered through their major department. For more information, visit the CCSE Web site or contact CCSE, 50 Lind Hall (612-624-4090).

IDEAS (Integrated Degrees in Engineering, Arts, and Sciences)—This scholarship program is for undergraduates who integrate degrees from IT and the College of Liberal Arts. IDEAS enriches students’ education by exploring how technology and society influence each other and promotes leadership in technology by providing students with educational opportunities for increased breadth and depth in liberal arts, business, and technical management. For more information, contact the IT Student Affairs Office, 105 Lind Hall, (612-624-8504).

Academic Program for Excellence in Engineering and Science (APEXES)—APEXES promotes academic excellence and the increased presence of underrepresented groups (African American, Chican@/Latino, Native American) in engineering and the physical sciences. Through its precollege, undergraduate, and graduate/faculty programs, it promotes diversity in the classroom, laboratory, and workplace to prepare IT students for careers in an ethnically diverse workforce.

Working with other IT and University offices, the program offers a variety of academic enrichment programs such as tutoring, learning assessment, career assessment, and study groups. Through collaboration with IT departments and corporate sponsors, APEXES identifies experiences outside the classroom such as internships, cooperative programs, and work teams to expose students to applications in science and engineering. These collaborations also provide merit scholarships for underrepresented students in engineering and the physical sciences who excel academically.

For more information, contact APEXES, 107 Lind Hall, 207 Church Street S.E., Minneapolis, MN 55455 (612-626-0219; e-mail APEXES@umn.edu).

Program for Women—The mission of this program is to encourage, recruit, and retain women faculty and students in the physical sciences, mathematics, and engineering. Since its establishment in 1990, the program has been responsible for numerous activities and events for undergraduate and graduate women, women faculty, and pre-college outreach programs. The program supports a female graduate student in each academic department to encourage networking within the department and assist in recruiting more women into the program. Retention strategies focus on networking within and across the academic departments in IT both for faculty and students.

For more information visit the IT Program for Women Web site at www.it.umn.edu/students/women/ or contact Associate Dean Roberta M. Humphreys, 105 Walter Library, 612-624-2006.

UNITE Instructional Television—About 50 credit courses each semester are offered through UNITE (UNiversity-Industry Television for Education), an instructional television system for continuing education at the employee’s workplace. In addition, 25 of these courses are offered by streaming video—live as they happen in the campus—or by video-on-demand. These include both upper division and graduate courses as well as specially developed courses and seminars. Classes are held in TV studio classrooms with on-campus students in attendance. The system is interactive, enabling students at all sites to talk with the instructor and take part in class discussions. Participating companies help support the system by paying a fee based on the number of credits for which its employees are enrolled. This fee is separate from tuition, which is paid either by the student or the company, depending on company policy.

For more information, contact the Director, UNITE Instructional Television, 514 Vincent Hall, 206 Church Street S.E., Minneapolis, MN 55455 (612-624-2332).

On-campus Living Experiences for Freshmen in IT—The Explorations in Engineering and Sciences House (IT Explorations) and the Women in Science and Engineering House (WISE) are the IT residential learning environments. These houses create a smaller living-learning environment in which students can benefit from others who have similar academic and career interests in science and/or engineering. Participating students find support from their peers that can enhance their success in the classroom and on campus. Faculty and staff advisers from IT provide guidance during students’ first year on campus, on-site academic advising, access to information on career options, and coordinate various social activities such as dinner with professionals, faculty members, and student organizations.
All participants are strongly encouraged to register for IOFT 1312—Exploring Careers in Science and Engineering (2 cr). This course can be used as a freshman seminar.

IT Explorations is a co-ed community open to 140 students in Frontier Hall. The WISE House is a female first-year freshman community open to 30 students in Comstock Hall. For more information, contact the IT Student Affairs Office at 612-624-8010, e-mail kubit001@umn.edu, or visit the Housing and Residential Life Web site at www.housing.umn.edu.

International Programs
IT students have hundreds of study abroad programs to choose from. Students can study in or outside their major, study a second language, or study the history and culture of a region. Study in English is possible at various sites including Hong Kong, Sweden, Norway, England, Denmark, Australia, New Zealand, and many others. Students may spend a semester, academic year, or May session enhancing their cross-cultural skills, language ability, or professional experience. These opportunities are very affordable and the Learning Abroad Center offers more than $150,000 in scholarships for study abroad. IT has also been supportive to students with financial need. Each IT department has a list of recommended locations for study abroad. Students can learn more about these options by contacting Susan Kubitschek, 106 Lind Hall, kubit001@umn.edu, 612-624-8010.

Internship Opportunities in Technical Fields—Interested in a summer paid internship abroad? Students interested in doing an international internship in a technical field should contact the International Association for the Exchanges of Students for Technical Experience (IAESTE) in 4 Lind Hall at IAESTE@umn.edu or call 612-624-8010 to find out about this active student chapter on campus.

Other Information—For information about opportunities through the International Student Exchange Program (ISEP), IAESTE, and Institute for Study Abroad (Butler University, IN), visit the Learning Abroad Center in 230 Heller Hall. Advisers there can assist you with study and credit options, financial aid, and orientations. Attend a First Step meeting held daily for a full listing of study abroad opportunities, or visit www.UMabroad.umn.edu for more information.

Career Information
The Career Center for Science and Engineering (CCSE), 50 Lind Hall (612-624-4090) provides comprehensive career services to students and alumni from the Institute of Technology and the College of Biological Sciences.

CCSE assists students in the career exploration process as they identify and research majors and careers best suited to their skills, interests, and values. Each semester, the office offers IOFT 1312 - Exploring Careers in Science and Engineering (2 credits). This course exposes students to all aspects of the career development and job search processes.

CCSE also provides resources and programs aimed at assisting students with their search for part-time, internship, and co-op positions, or permanent jobs following graduation. The services provided by CCSE include on-campus interviewing, job postings, workshops on many job search-related topics, and individual assistance with any career issues.

CCSE also provides information regarding the Fundamentals of Engineering (FE) exam.

Student Organizations and Activities
Scientists and engineers find that membership in technical or professional societies usually helps their career development. Many of these societies have student chapters at the University. Through them students have the opportunity to participate in activities of the parent society, gain experience in conducting technical meetings, and meet senior members of the societies. In addition, regular membership in the society is facilitated upon graduation and any entrance fee is reduced or waived for former student members.

Professional Societies
Branches of the following national professional societies are maintained at the University of Minnesota by students and faculty: American Institute of Chemical Engineers, Society of Physics Students, American Society of Civil Engineers, American Society of Mechanical Engineers, Society for Engineering in Agricultural, Food, and Biological Systems, American Institute of Aeronautics and Astronautics, American Institute of Industrial Engineers, and Institute of Electrical and Electronic Engineers. Additional professional societies include the Society of Women Engineers, National Society of Black Engineers, Triangle, Theta Tau, and Alpha Sigma Kappa.

Honorary Scholastic Societies
These IT societies promote the high standards of the engineering profession by conferring memberships, awards, and other honors on undergraduates distinguished for scholastic achievement and for character. The societies normally elect members from the junior and senior classes on the basis of scholarship (as measured by class rank) and character (as judged by peers and faculty). Of these honorary societies, only Tau Beta Pi selects its members from students in all IT undergraduate departments. The others confine their membership to students from a single department: Alpha Epsilon (biosystems and agricultural engineering), Pi Tau Sigma (mechanical engineering), Eta Kappa Nu and Kappa Eta Kappa (electrical engineering), Pi Tau Sigma (mechanical engineering), and Sigma Gamma Tau (aerospace engineering and mechanics).

Plumb Bob
A senior honorary leadership and service society, Plumb Bob works to create and maintain a spirit of fellowship and cooperation among IT students and further the interests of IT and the University. Its members are chosen for their character, leadership, and service.

IT Student Board
This board is the executive body of IT students, representing them in matters affecting the general interests of IT and the University.

Student Publications
Two publications are produced by IT students. IT Connection is IT’s bi-weekly newsletter for students, staff, and faculty and includes meetings notices and information on scholarships and programs of interest. For more information contact technology@itdean.umn.edu. Minnesota Technolgy is IT’s official student magazine. Published three times a year, this 83-year-old publication features pieces written by students on science and engineering issues. For more information contact technolog@itdean.umn.edu.

The IT Student Publications selects editors and business managers and directs the overall policy of the publications. Students are encouraged to participate as publication staff members.
Directory

Office of the Dean
105 Walter Library
612-624-2006
E-mail: info@it.umn.edu

Office of the Associate Dean for Student Affairs
106 Lind Hall
612-624-5091
E-mail: studentaff@itdean.umn.edu

Office of Lower Division Programs
128 Lind Hall
612-624-2890
E-mail: itld@umn.edu

Student Affairs Office (Admissions)
105 Lind Hall
612-624-8504
E-mail: studentaff@itdean.umn.edu

Center for the Development of Technological Leadership
510 West Bank Office Building
612-624-5747
E-mail: general-cdtl@umn.edu

IT Honors Office
136 Lind Hall
612-625-2800
E-mail: honors@it.umn.edu

Career Center for Science and Engineering
50 Lind Hall
612-624-4090
E-mail: ccsce@umn.edu

Academic Program for Excellence in Engineering and Science (APEXES)
107 Lind Hall
612-626-0219
E-mail: apexes@umn.edu

Departments
Aerospace Engineering and Mechanics
107 Akerman Hall
612-625-8000
E-mail: dept@aem.umn.edu

Astronomy
356 Tate Laboratory of Physics
612-624-0211
E-mail: tjj@astro.umn.edu

Bio-based Products Engineering
203 Kaufert Laboratory
612-625-5200
E-mail: shri@umn.edu

Biomedical Engineering
7-103 Nils Hasselmo Hall
612-624-4507
E-mail: bmedus@umn.edu

Biosystems and Agricultural Engineering
213 Biosystems and Agricultural Engineering Building, St. Paul
612-625-7733
E-mail: bue@umn.edu

Chemical Engineering and Materials Science
151 Amundson Hall
612-624-1313
E-mail: williams@chem.umn.edu

Chemistry
135 Smith Hall
612-624-8008
E-mail: stathopo@chem.umn.edu

Civil Engineering
122 Civil Engineering Building
612-625-5522
E-mail: cive@umn.edu

Computer Science and Engineering
4-192 Electrical Engineering/Computer Science
612-624-4502
E-mail: ugrad_info@cs.umn.edu

Electrical and Computer Engineering
4-174 Electrical Engineering/Computer Science
612-625-3300
E-mail: undergraduate_studies@ece.umn.edu

Geology and Geophysics (Earth Sciences)
108 Pillsbury Hall
612-625-1333
E-mail: geology@umn.edu

Mathematics
115 Vincent Hall
612-625-4848
E-mail: ugrad@math.umn.edu

Mechanical Engineering
1120 Mechanical Engineering
612-625-5842
E-mail: jeanne@me.umn.edu

Physics
148 Tate Laboratory of Physics
612-624-7375
E-mail: ugrad@physics.spa.umn.edu

Statistics
313 Ford Hall
612-624-8046
E-mail: info@stat.umn.edu

IT Web Site
www.it.umn.edu
Aerospace Engineering and Mechanics B.A.E.M.

Requirements for this program are current for Fall 2006.

Required credits to graduate with this degree: 127.

Required credits within the major: 56.

Degree: Bachelor of Aerospace Engineering and Mechanics.

The mission of the bachelor of aerospace engineering and mechanics (B.A.E.M.) program is to produce graduates who are prepared to enter and sustain the practice of aerospace engineering and related fields, or to pursue advanced studies. This mission is consistent with the mission of the University of Minnesota in learning and teaching, and with the mission of the Institute of Technology: to provide a rigorous and stimulating education for its undergraduate majors and to provide programs of instruction in engineering that meet nationally accepted standards for practice of the profession of engineering.

Aerospace engineering is a multidisciplinary field that encompasses many areas of science and engineering and plays a major role in the technological advancement of society. As a constantly changing profession, aerospace engineering is concerned with a wide range of problems and the latest technologies. An aerospace engineer must have a comprehensive fundamental education in mathematics, physical sciences, and engineering sciences. The four-year program leading to the B.A.E.M. provides this broad background. The program is accredited by the Engineering Accreditation Commission of ABET.

Admission Requirements

Students must complete 9 courses before admission to the program.

Freshmen and transfer students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:
• 2.80 for students transferring from outside the University.

For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

Required Courses for Admission

Mathematics Core
MATH 1371 - IT Calculus I, MATH (4.0 cr)
MATH 1372 - IT Calculus II (4.0 cr)
MATH 1374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)
MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)

Required Courses
AEM 2011 - Statics (3.0 cr)
AEM 2012 - Dynamics (3.0 cr)
AEM 2301 - Mechanics of Flight (3.0 cr)
AEM 3031 - Deformable Body Mechanics (3.0 cr)
AEM 4201 - Fluid Mechanics (4.0 cr)
AEM 4202 - Aerodynamics (4.0 cr)
AEM 4203 - Aerospace Propulsion (4.0 cr)
AEM 4301 - Spaceflight Dynamics (3.0 cr)
AEM 4303 - Flight Dynamics and Control (3.0 cr)
AEM 4331 - Aerospace Vehicle Design I: Aircraft (3.0 cr)
AEM 4332W - Aerospace Vehicle Design II: Space Vehicles, Missions, and Systems, WI (4.0 cr)
AEM 4501 - Aerospace Structures (3.0 cr)
AEM 4502 - Computational Structural Analysis (3.0 cr)
AEM 4511 - Mechanics of Composite Materials (3.0 cr)
AEM 4581 - Mechanics of Solids (3.0 cr)
AEM 5541 - Dynamic Systems and Controls (3.0 cr)
AEM 5651 - Aeroelasticity (3.0 cr)

Technical Electives
Take at least two courses (to total 6 credits), which may include but are not limited to: any math/science course 2xxx or higher (such as AST 2001, which completes a minor in astronomy); any computation course 3xxx or higher (such as CE 3101); any STAT 3xxx or higher course (such as STAT 3021). See an adviser for other options.
Program Sub-plans
A sub-plan is not required for this program.

EIP
Students may obtain professional experience in an industry or government assignment through either an Internship or Co-op program. The internship program usually consists of one term experience often in the summer. The Co-op program consists of multiple terms off campus. The Co-op program almost always prolongs the time required to graduate. The practical engineering experience obtained through the internship or co-op programs not only enhances a student's education but also gives an edge on future employment after graduation.

Students can receive up to 3 academic credits by taking AEM 4796. These credits can be counted as a technical elective toward the BAEM Degree.

Required Courses

Internship
AEM 4796 - Professional Experience (1.0-3.0 cr)

Astrophysics B.S.Astrop.

Astronomy
Requirements for this program are current for Fall 2006.
Required credits to graduate with this degree: 120.
Required credits within the major: 43 to 45.
Degree: Bachelor of Science in Astrophysics.
The astrophysics program enables students to develop the skills necessary to tackle complex and ill-defined problems within the physical sciences. The program prepares students for careers in professional astronomy, computational astrophysics, secondary education in the physical sciences, ROTC programs in the Air Force or Navy, data analysis, or laboratory science.

Admission Requirements
Students must complete 8 courses before admission to the program.
Freshmen and transfer students are usually admitted to pre-major status before admission to this major.
For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

Required Courses for Admission

Mathematics Core
MATH 1271 - Calculus I, MATH (4.0 cr)
or MATH 1371 - IT Calculus I, MATH (4.0 cr)
MATH 1272 - Calculus II (4.0 cr)
or MATH 1372 - IT Calculus II (4.0 cr)
MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)
MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

Physics Core
PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCIL, WI (4.0 cr)
or PHYS 1401V - Honors Physics I, PHYS SCIL, WI, H (4.0 cr)
PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCIL, WI (4.0 cr)
or PHYS 1402V - Honors Physics II, PHYS SCIL, WI, H (4.0 cr)
PHYS 2303 - Physics III: Physics of Matter (4.0 cr)
or PHYS 2403H - Honors Phys III, H (4.0 cr)
or PHYS 2503 - Physics III: Foundations of Modern Physics (4.0 cr)
PHYS 2601 - Quantum Physics (4.0 cr)

Program Requirements
Students interested in astrophysics are encouraged to take AST 1011H.

Required Courses

Astrophysics Core
AST 2001 - Introduction to Astrophysics (4.0 cr)
AST 4994W - Directed Research, WI (3.0-5.0 cr)
PHYS 2605 - Quantum Physics Laboratory (3.0 cr)
PHYS 4001 - Analytical Mechanics (4.0 cr)
PHYS 4002 - Electricity and Magnetism (4.0 cr)

Take 2 or more course(s) from the following:
AST 4xxx
AST 5xxx
MATH 2283 - Sequences, Series, and Foundations (3.0 cr)
or
MATH 3xxx
or
MATH 4xxx

Astrophysics Focus
Students are required to complete one of the following course groups.

Data Analysis Specialist
This emphasis prepares students for careers in corporate and government labs and research divisions. Examples are programming, image processing, laboratory instrumentation, and general data analysis. Suggested courses are listed below.

Take 16 or more credit(s) from the following:
AST 5201 - Methods of Experimental Astrophysics (4.0 cr)
CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)
CSCI 2031 - Introduction to Numerical Computing (4.0 cr)
EE 3005 - Fundamentals of Electrical Engineering (4.0 cr)
PHYS 4051 - Methods of Experimental Physics I (5.0 cr)
PHYS 4052W - Methods of Experimental Physics II, WI (5.0 cr)

Professional Astronomer
This emphasis prepares students for graduate school in astronomy. The program is similar to doing a double major in astrophysics and physics. The program emphasizes observational astronomy.

Take 16 or more credit(s) from the following:
PHYS 4101 - Quantum Mechanics (4.0 cr)
PHYS 4201 - Statistical and Thermal Physics (3.0 cr)

Take 0 or more course(s) from the following:
AST 4xxx
AST 5xxx
Bio-Based Products Engineering
B.B.P.E.

Bio-Based Products
Requirements for this program are current for Fall 2006.
Required credits to graduate with this degree: 128.
Required credits within the major: 113.
Degree: Bachelor of Bio-Based Products Engineering.

Bio-based products are materials, chemicals, and energy derived from renewable, bio-resources including forestry, agriculture and other biomass. Many commercial products and forms of energy that come from fossil fuels can be derived from renewable, bio-resources. The molecular building blocks and components of biomass can be harnessed to heat homes, run cars, light buildings, and provide industrial and consumer products. These products include biofuels, biofibers and fiber-based products, paper, board, engineered wood, structural panels, bio-based composites, renewable plastics, and bio-derived chemicals and energy.

Admission Requirements
Students must complete 15 courses before admission to the program.
Freshmen and transfer students are usually admitted to pre-major status before admission to this major.
For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

Required Courses for Admission
Preparatory Courses
BP 1001 - Bio-based Products Orientation (1.0 cr)
BP 1002 - Wood and Fiber Science (3.0 cr)
BP 1003 - Wood and Fiber Science Lab (1.0 cr)
BIOL 1009 - General Biology, BIOL SCI/L (4.0 cr)
or BIOL 1009H - Honors: General Biology, BIOL SCI/L, H (4.0 cr)
Mathematics
MATH 1271 - Calculus I, MATH (4.0 cr)
or MATH 1371 - IT Calculus I, MATH (4.0 cr)
MATH 1272 - Calculus II (4.0 cr)
or MATH 1372 - IT Calculus II (4.0 cr)
MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)
MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)
Physical Sciences
CHEM 1211 - Chemical Principles I, ENVT, PHYS SCI/L (4.0 cr)
or CHEM 121H - Honors Chemistry I, ENVT, PHYS SCI/L, H (4.0 cr)
CHEM 122 - Chemical Principles II, ENVT, PHYS SCI/L (4.0 cr)
or CHEM 122H - Honors Chemistry II, ENVT, PHYS SCI/L, H (4.0 cr)
CHEM 2301 - Organic Chemistry I (3.0 cr)
CHEM 2302 - Organic Chemistry II (3.0 cr)
CHEM 3501 - Physical Chemistry I (3.0 cr)
PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4.0 cr)
or PHYS 1401V - Honors Physics I, PHYS SCI/L, WI, H (4.0 cr)
PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4.0 cr)
or PHYS 1402V - Honors Physics II, PHYS SCI/L, WI, H (4.0 cr)

Technical Electives
Select 16 credits in consultation with your adviser.
General Requirements
Recommended freshman writing course(s) for this program:
RHET 1101

Program Requirements
Required Courses
Major Courses
BP 3001 - Statics, Mechanics, and Structural Design (4.0 cr)
BP 4504W - Bio-based Products Development and Management, WI (3.0 cr)

Engineering Courses
BAE 3013 - Engineering Principles of Molecular and Cellular Processes (3.0 cr)
BAE 4013 - Transport in Biological Systems (4.0 cr)
CE 3502 - Fluid Mechanics (4.0 cr)
CHEN 4001 - Material and Energy Balances (4.0 cr)
CHEN 4101 - Chemical Engineering Thermodynamics (4.0 cr)
BP 4001 - Chemistry of Plant Materials (4.0 cr)
BP 4301 - Surface and Colloid Science in Bio-based Products Manufacturing (3.0 cr)
BP 4302 - Organisms Impacting Bio-based Products (3.0 cr)
BP 4401 - Bio-based Products Engineering (4.0 cr)
BP 4402 - Bio-based Products Engineering Lab I (1.0 cr)
BP 4403 - Bio-based Products Engineering Lab II (1.0 cr)
BP 4404 - Bio-based Composites Engineering (3.0 cr)
BP 4405 - Process Control and Simulation (3.0 cr)
BP 4501 - Process and Product Design I (2.0 cr)
BP 4502W - Process and Product Design II, WI (3.0 cr)

Biomedical Engineering B.Bm.E.
Biomedical Engineering Institute
Requirements for this program are current for Fall 2006.
Required credits to graduate with this degree: 125.
Required credits within the major: 30.
Degree: Bachelor of Biomedical Engineering.
Biomedical engineers apply the fundamentals of mathematics, physics, chemistry, and biology to solve medically-relevant problems. Examples of biomedical engineering activities include medical device design, fabrication and testing, prosthesis fabrication, ergonomics and human factors, physiological function monitoring, home health care technology development, biomedical informatics, functional imaging and tomography, biomaterial development and biocompatibility, artificial tissue and organ fabrication, cell- and biomolecule-based sensors and therapeutics, gene therapy development, and biomedical microsystems.
Admission Requirements
Students must complete 14 courses before admission to the program.
Freshmen and transfer students are usually admitted to pre-major status before admission to this major.
A GPA above 2.00 is preferred for the following:
• 2.70 for students already admitted to the degree-granting college.
• 2.70 for students transferring from another University of Minnesota college.

For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

Required Courses for Admission
Mathematics
MATH 1271 - Calculus I, MATH (4.0 cr)
or MATH 1371 - IT Calculus I, MATH (4.0 cr)
MATH 1272 - Calculus II (4.0 cr)
or MATH 1372 - IT Calculus II (4.0 cr)
MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)
MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

Physical Sciences
CHEM 1021 - Chemical Principles I, ENVT, PHYS SCI/L (4.0 cr)
or CHEM 1031H - Honors Chemistry I, ENVT, PHYS SCI/L, H (4.0 cr)
CHEM 1022 - Chemical Principles II, ENVT, PHYS SCI/L (4.0 cr)
or CHEM 1032H - Honors Chemistry II, ENVT, PHYS SCI/L, H (4.0 cr)
CHEM 2301 - Organic Chemistry I (3.0 cr)
PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4.0 cr)
or PHYS 1401V - Honors Physics I, PHYS SCI/L, WI, H (4.0 cr)
PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4.0 cr)
or PHYS 1402V - Honors Physics II, PHYS SCI/L, WI, H (4.0 cr)

Preparatory Courses
CSCI 1107 - Introduction to FORTRAN Programming for Scientists and Engineers (3.0 cr)
STAT 3021 - Introduction to Probability and Statistics (3.0 cr)
BIOC 3021 - Biochemistry (3.0 cr)
or CHEM 3501 - Physical Chemistry I (3.0 cr)
BIOL 1009 - General Biology, BIOL SCI/L (4.0 cr)
or BIOL 1009H - Honors: General Biology, BIOL SCI/L, H (4.0 cr)

Program Requirements
Required Courses
Major Courses
BMEN 2501 - Cellular and Molecular Biology for Biomedical Engineers (4.0 cr)
BMEN 2601 - Biomedical Engineering Undergraduate Seminar I (1.0 cr)
BMEN 2602 - Biomedical Engineering Undergraduate Seminar II (1.0 cr)
BMEN 3001 - Biomechanics (4.0 cr)
BMEN 3101 - Biomedical Transport Processes (4.0 cr)
BMEN 3201 - Bioelectricity and Bioinstrumentation (4.0 cr)
BMEN 3301 - Biomaterials (4.0 cr)
BMEN 3701 - Physiology Lab (2.0 cr)
BMEN 4001W - Biomedical Engineering Design I, WI (3.0 cr)
BMEN 4002W - Biomedical Engineering Design II, WI (3.0 cr)
PHSL 3061 - Principles of Physiology (4.0 cr)

Technical Electives
Take 24 credits of technical electives approved by an adviser. A maximum of 10 credits of science courses and a maximum of 6 credits of research may be counted toward the total.
Biosystems and Agricultural Engineering B.B.A.E.

Dept of Biosystems and Agricultural Engineering

Requirements for this program are current for Fall 2006.

Required credits to graduate with this degree: 128.

Required credits within the major: 30.

Degree: Bachelor of Biosystems and Agricultural Engr.

The mission of the Department of Biosystems and Agricultural Engineering is to conduct research and educate people to solve engineering problems in agricultural and biological environments. Educational objectives for the program are to produce graduates with the following:

- A broad fundamental engineering background including mathematics, physical science, biological science, engineering science, and computational skills needed for their future practice of biosystems and agricultural engineering.
- The skills necessary to carry out an effective design process including the ability to think creatively, work cooperatively, formulate problems, synthesize information, develop and evaluate alternatives, implement solutions, and communicate effectively at all stages of the process.
- The ability to address issues of ethics, safety, professionalism, and social and economic impacts in engineering practice and design.
- Specific abilities to pursue careers that integrate engineering and biology to design efficient, economical systems to produce and deliver high quality, safe food to consumers; to design sustainable systems that protect the environment, humans, plants, and animals; and to design safe and efficient machines, processes, and practices for biological systems.
- Opportunities to develop in-depth background in one of the following areas of emphasis: Bioprocessing and Food, Environment, or Machinery Systems.

Admission Requirements

Students must complete 10 courses before admission to the program.

Freshmen and transfer students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:

- 2.50 for students transferring from outside the University.

For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

Required Courses for Admission

Mathematics

MATH 1271 - Calculus I, MATH (4.0 cr)

or MATH 1371 - IT Calculus I, MATH (4.0 cr)

MATH 1272 - Calculus II (4.0 cr)

or MATH 1372 - IT Calculus II (4.0 cr)

MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)

or MATH 2273 - IT Linear Algebra and Differential Equations (4.0 cr)

MATH 2263 - Multivariable Calculus (4.0 cr)

or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

Biological and Physical Sciences

BIOL 1009 - General Biology, BIOL SCI/L (4.0 cr)

or BIOL 1009H - Honors: General Biology, BIOL SCI/L, H (4.0 cr)

CHEM 1021 - Chemical Principles I, ENVT, PHYS SCI/L (4.0 cr)

or CHEM 1031H - Honors Chemistry I, ENVTS, PHYS SCI/L, H (4.0 cr)

CHEM 1022 - Chemical Principles II, ENVT, PHYS SCI/L (4.0 cr)

or CHEM 1032H - Honors Chemistry II, ENVTS, PHYS SCI/L, H (4.0 cr)

PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, W (4.0 cr)

or PHYS 1401V - Honors Physics I, PHYS SCI/L, W, H (4.0 cr)

PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, W (4.0 cr)

or PHYS 1402V - Honors Physics II, PHYS SCI/L, W, H (4.0 cr)

Statics and Dynamics

Take 1 or more course(s) from the following:

AEM 2011 - Statics and Dynamics (4.0 cr)

Take the following course pair

AEM 2011 - Statics (3.0 cr)

AEM 2012 - Dynamics (3.0 cr)

Program Requirements

Required Courses

Major Courses

BAE 1011 - Biosystems and Agricultural Engineering Orientation (1.0 cr)

BAE 2113 - Introduction to Design (3.0 cr)

BAE 3013 - Engineering Principles of Molecular and Cellular Processes (3.0 cr)

BAE 3023 - Engineering Principles of Soil-Water-Plant Processes (3.0 cr)

BAE 4013 - Transport in Biological Systems (4.0 cr)

BAE 4023 - Instrumentation and Control for Biological Systems (3.0 cr)

BAE 4114W - Capstone Design Project, WI (4.0 cr)

BAE 5212 - Safety and Environmental Health Issues in Plant and Animal Production and Processing, C/PE, ENVTS, H (3.0 cr)

AEM 3031 - Deformable Body Mechanics (3.0 cr)

CE 3502 - Fluid Mechanics (4.0 cr)

EE 3005 - Fundamentals of Electrical Engineering (4.0 cr)

ME 3331 - Thermal Sciences (3.0 cr)

RHET 3562W - Technical and Professional Writing, WI (4.0 cr)

STAT 3021 - Introduction to Probability and Statistics (3.0 cr)

Electives

Students who wish to have a concentration within their elective coursework may take at least two courses belonging to the same designated emphasis. The designated emphases and the courses which comprise them are as follows: Bioprocessing and Food (BAE 4713, 4723); Environment (BAE 4523, 4533, 5513); and Machinery Systems (BAE 4313, 4323).

Take 3 or more course(s) from the following:

BAE 4313 - Design of Machine Systems (3.0 cr)

BAE 4323 - Machinery Elements (3.0 cr)

BAE 4523 - Water Management Engineering (3.0 cr)

BAE 4533 - Agricultural Waste Management Engineering (3.0 cr)

BAE 4713 - Bioprocess Engineering (3.0 cr)

BAE 4723 - Food Process Engineering (3.0 cr)

BAE 5513 - Watershed Engineering (3.0 cr)

Technical Electives

Complete 8 credits of engineering electives, 6 credits of biology electives, and at least 3 credits of technical electives (computer science or 3 additional credits of engineering or biology electives). Any of the emphases (sub-plans) may be met as part of the requirement. See an adviser for a list of courses that fulfill electives or visit www.bae.umn.edu/teaching/ugrad/electives.html.
Program Sub-plans
A sub-plan is not required for this program.

Bioprocessing and Food
Processing of agricultural and biological materials yields many important products, from foods to pharmaceuticals. In this emphasis, students are prepared for careers in the design and development of systems for processing, storing, and distributing food and agricultural products; processes to recover and purify products such as proteins produced through biotechnology; processes to make products such as biodegradable plastics from biological materials; new food products as a member of a team of food scientists and marketing specialists; and systems to ensure food safety and quality.

With completion of an additional 3 credits, this sub-plan fulfills the Technical Electives requirement.

Required Courses

Engineering Electives
Take any non-required BAE course not used as a BAE elective.

Take 8 or more credit(s) from the following:
- CHEN 5754 - Food Processing Technology (3.0 cr)
- CHEN 5759 - Principles of Mass Transfer in Engineering and Biological Engineering (2.0 cr)
- EE 5821 - Biological System Modeling and Analysis (3.0 cr)
- IE 5531 - Engineering Optimization I, H (4.0 cr)
- IE 5541 - Project Management (4.0 cr)
- MATS 3011 - Introduction to Materials Science and Engineering (3.0 cr)
- ME 5381 - Biological Transport Processes (4.0 cr)

Biology Electives
See an adviser for other options.

Take 6 or more credit(s) from the following:
- BIOC 3021 - Biochemistry (3.0 cr)
- CHEM 2301 - Organic Chemistry I (3.0 cr)
- FSCN 4111 - Food Chemistry (3.0 cr)
- FSCN 4121 - Food Microbiology and Fermentations (3.0 cr)
- VBS 2022 - General Microbiology (2.0-3.0 cr)
- VBS 2032 - General Microbiology With Laboratory (4.0 cr)

EIP
This option provides students with a hands-on work experience after the freshman year of the degree program. Students can take up to two semesters of intern work with one or more employers. An example may be two summers and one semester. This may be adjusted to suit individual needs. Students have an opportunity to assist in design work and apply their knowledge to practical problem solving. The experience helps students choose a career and select electives for the degree.

During the academic portion of the intern program students are expected to take a normal load of 11-13 credits. Graduation may be delayed because of the intern experience. It is important to plan ahead, since biosystems and agricultural engineering classes are usually offered only once per year, and in some cases in alternating years. Students registering for BAE 4900 must first submit a proposed plan of study with the intern coordinator.

Required Courses

Internship
A total of 4 BAE 4900 intern Experience credits may be taken and applied toward the degree program as general engineering electives, but not as BAE electives.

BAE 4900 - Intern Reports (2.0 cr)

Environment
The world is faced with important environmental and natural resource issues affecting soil, water, and air. In this emphasis, students are prepared for careers in the design or development of systems to control runoff and flooding in agricultural and small urban watersheds; systems to manage water (drainage or irrigation) to enhance crop production; practices to improve water quality and control soil erosion; plans and practices to restore wetlands; systems to store, treat, and use livestock or food processing wastes; and processes for bioremediation of polluted areas.

With completion of an additional 3 credits, this sub-plan fulfills the Technical Electives requirement.

Required Courses

Engineering Electives
See an adviser for other options.

Take 8 or more credit(s) from the following:
- CE 1202 - Surveying and Mapping (2.0 cr)
- CE 3301 - Soil Mechanics I (3.0 cr)
- CE 3402 - Construction Materials (3.0 cr)
- CE 3501 - Environmental Engineering, C/PE, ENVT (3.0 cr)
- CE 4301 - Soil Mechanics II (3.0 cr)
- CE 4351 - Groundwater Mechanics (3.0 cr)
- CE 4501 - Hydrologic Design (4.0 cr)
- CE 4502 - Water and Wastewater Treatment (3.0 cr)
- CE 4511 - Hydraulic Structures (4.0 cr)
- CE 4512 - Open Channel Hydraulics (4.0 cr)

Biology Electives
See an adviser for other options.

Take 6 or more credit(s) from the following:
- BIOL 3007W - Plant Biology: Diversity and Adaptation, WI (4.0 cr)
- BIOL 3407 - Ecology, ENVT (3.0 cr)
- EEB 3001 - Ecology and Society, ENVT (3.0 cr)
- EEB 4601 - Limnology (3.0 cr)
- ES 3612W - Soil and Environmental Biology, WI (3.0 cr)
- SOIL 3416 - Plant Nutrients in the Environment (3.0 cr)

Machinery Systems
Machines are important components of systems for production and processing of food and other biological materials. In this emphasis, students are prepared for careers in the design and development of machines for agricultural, horticultural, and landscape industries; machines and systems that incorporate operator safety, health, and comfort; machines for food processing and handling; automated systems for identification, sorting, or grading; agricultural and other off-road vehicles to improve performance and minimize adverse impact to the soil; and systems for precision agriculture that use technologies such as global positioning systems and geographical information systems.

With completion of an additional 3 credits, this sub-plan fulfills the Technical Electives requirement.

Required Courses

Engineering Electives
See an adviser for other options.

Take 8 or more credit(s) from the following:
- MATS 2001 - Introduction to the Science of Engineering Materials (3.0 cr)
- ME 3221 - Design and Manufacturing I: Engineering Materials and Manufacturing Processes (4.0 cr)
- ME 3222 - Design and Manufacturing II (4.0 cr)
- ME 3281 - System Dynamics and Control (4.0 cr)
- ME 5243 - Advanced Mechanism Design (4.0 cr)
Degree Programs

Chemical Engineering & Materials Science

Chemical Engineering B.Ch.E.

Requirements for this program are current for Fall 2006.

Required credits to graduate with this degree: 128.

Degree: Bachelor of Chemical Engineering.

Chemical engineering deals with operations such as materials handling, mixing, fluid flow and metering, extrusion, coating, heat exchange, filtration, drying, evaporation, distillation, absorption, extraction, ion exchange, combustion, catalysis, and processing in chemical and biochemical reactors.

Because many industries are based on some chemical or physical transformation of matter, chemical engineers are much in demand. They may work in the manufacture of inorganic products (fertilizers, paints, ceramics, electronic materials); in the manufacture of organic products (polymers, films, papers, petrochemicals); in the manufacture of batteries and fuel cells; in the processing of minerals and materials; in food processing and fermentation; or in the production of antibiotics and biochemical products.

Admission Requirements

Students must complete 11 courses before admission to the program.

Freshmen and transfer students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:

- 2.60 for students already admitted to the degree-granting college.
- 2.60 for students transferring from another University of Minnesota college.
- 2.60 for students transferring from outside the University.

For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

Required Courses for Admission

Mathematics

MATH 1271 - Calculus I, MATH (4.0 cr)
MATH 1272 - Calculus II (4.0 cr)
MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
MATH 2234 - Linear Algebra and Differential Equations (4.0 cr)

Chemistry B.S.Chem.

Chemistry

Requirements for this program are current for Fall 2006.

Required credits to graduate with this degree: 120.

Degree: Bachelor of Science in Chemistry.

The mission of the Department of Chemistry is to enrich the science of chemistry through the education of students from all disciplines, the training of future professional chemists, and the pursuit of knowledge.

Chemistry probes the fundamental concepts of nature and helps us understand the world around us. It deals with all substances at the molecular level: their composition, their properties, and how they are transformed into new substances.

Physical Sciences

CHEM 1021 - Chemical Principles I, ENVT, PHYS SCI/L (4.0 cr)
or CHEM 1031H - Honors Chemistry I, ENVT, PHYS SCI/L, H (4.0 cr)
CHEM 1022 - Chemical Principles II, ENVT, PHYS SCI/L (4.0 cr)
or CHEM 1032H - Honors Chemistry II, ENVT, PHYS SCI/L, H (4.0 cr)
CHEM 2301 - Organic Chemistry I (3.0 cr)
CHEM 2302 - Organic Chemistry II (3.0 cr)
PHYS 1401V - Honors Physics I, PHYS SCI/L, WI, H (4.0 cr)
PHYS 1402V - Honors Physics II, PHYS SCI/L, WI, H (4.0 cr)

Program Requirements

Students interested in chemical engineering are encouraged to take CHEN 1001.

Required Courses

Major Courses

CHEM 3501 - Physical Chemistry I (3.0 cr)
CHEM 3502 - Physical Chemistry II (3.0 cr)
CHEM 4121 - Process Analytical Chemistry (3.0 cr)
CHEM 2311 - Organic Lab (4.0 cr)
or CHEM 2312 - Honors Organic Lab, H (5.0 cr)
CHEN 3701 - Introduction to Biomolecular Engineering (3.0 cr)
CHEN 4001 - Material and Energy Balances (4.0 cr)
CHEN 4005 - Transport Phenomena: Momentum and Heat (4.0 cr)
CHEN 4006 - Mass Transport and Separation Processes (4.0 cr)
CHEN 4101 - Chemical Engineering Thermodynamics (4.0 cr)
CHEN 4102 - Reaction Kinetics and Reactor Engineering (4.0 cr)
CHEN 4201 - Numerical methods in ChEn applications (3.0 cr)
CHEN 4401W - Chemical Engineering Lab I, WI (3.0 cr)
CHEN 4402W - Chemical Engineering Lab II, WI (2.0 cr)
CHEN 4501W - Chemical Engineering Process Design, WI (3.0 cr)
CHEN 4502W - Chemical Engineering Process Design II, WI (2.0 cr)
CHEN 4601 - Process Control (3.0 cr)
MATS 3011 - Introduction to Materials Science and Engineering (3.0 cr)

Technical Electives

Take 17 credits of electives. These normally include CHEN 4214 and 3 other courses selected with the aid of an adviser.

Biology Electives

See an adviser for other options.

Take 6 or more credit(s) from the following:

AGRO 4005 - Applied Crop Physiology and Development (4.0 cr)
AGRO 4605 - Management Strategies for Crop Production (4.0 cr)
BIOL 2022 - General Botany (3.0 cr)
BIOL 3007W - Plant Biology: Diversity and Adaptation, WI (4.0 cr)
BIOL 3407 - Ecology, ENV (3.0 cr)
EES 3001 - Ecology and Society, ENV (3.0 cr)
ES 3612W - Soil and Environmental Biology, WI (3.0 cr)
SOIL 3416 - Plant Nutrients in the Environment (3.0 cr)

Chemistry

Chemistry B.S.Chem.

Chemistry

Chemistry probes the fundamental concepts of nature and helps us understand the world around us. It deals with all substances at the molecular level: their composition, their properties, and how they are transformed into new substances.
Chemistry is a central science of great importance to society. It provides a broad range of opportunities in many specialized fields, including biotechnology, polymer chemistry, environmental chemistry, materials chemistry, and medicine.

After graduating with a bachelor’s degree, many chemistry majors go on to graduate or professional schools to pursue advanced degrees. Other graduates find employment in industry, education, or government.

Admission Requirements

Students must complete 10 courses before admission to the program.

Freshmen and transfer students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:
• 2.80 for students transferring from outside the University.

For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

Required Courses for Admission

Mathematics
MATH 1271 - Calculus I, MATH (4.0 cr)
or MATH 1371 - IT Calculus I, MATH (4.0 cr)
MATH 1272 - Calculus II (4.0 cr)
or MATH 1372 - IT Calculus II (4.0 cr)
MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)
MATH 1271 - Calculus I, MATH (4.0 cr)
or MATH 1272 - Calculus II (4.0 cr)
or MATH 1371 - IT Calculus I, MATH (4.0 cr)
or MATH 1372 - IT Calculus II (4.0 cr)

Physical Sciences
CHEM 1021 - Chemical Principles I, ENVT, PHYS SCI/L (4.0 cr)
or CHEM 1031H - Honors Chemistry I, ENVT, PHYS SCI/L, H (4.0 cr)
or CHEM 1032H - Honors Chemistry II, ENVT, PHYS SCI/L, H (4.0 cr)
CHEM 2101 - Introductory Analytical Chemistry Lecture (3.0 cr)
CHEM 2111 - Introductory Analytical Chemistry Lab (2.0 cr)
PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4.0 cr)
or PHYS 1401V - Honors Physics I, PHYS SCI/L, WI, H (4.0 cr)
PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4.0 cr)
or PHYS 1402V - Honors Physics II, PHYS SCI/L, WI, H (4.0 cr)

Additional Math, Science, or Statistics
If a student completes the Honors Math sequence this requirement is automatically fulfilled.

MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)
or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

Program Requirements

Required Courses

Major Courses
CHEM 2301 - Organic Chemistry I (3.0 cr)
CHEM 3501 - Physical Chemistry I (3.0 cr)
CHEM 3502 - Physical Chemistry II (3.0 cr)
CHEM 4701 - Inorganic Chemistry (3.0 cr)
CHEM 2302 - Organic Chemistry II (3.0 cr)
Lab can be taken concurrent with or after taking CHEM 2302
CHEM 2311 - Organic Lab (4.0 cr)
or CHEM 2312 - Honors Organic Lab, H (5.0 cr)

Electives
Take 3 or more course(s) from the following:
CHEM 4094W - Directed Research, WI (1.0-5.0 cr)
CHEM 4111W - Intermediate Analytical Chemistry Lab, WI (2.0 cr)
CHEM 4311W - Advanced Organic Chemistry Lab, WI (2.0 cr)
CHEM 4511W - Advanced Physical Chemistry Lab, WI (2.0 cr)
CHEM 4711W - Advanced Inorganic Chemistry Lab, WI (2.0 cr)
CHEM 5223W - Polymer Laboratory, WI (2.0 cr)
Select one course (3 credits) from any non-required upper division course in chemistry.
CHEM 4xxx
or
CHEM 5xxx

Technical Electives
Take two 3xxx or higher courses of 3 credits or more in any field of science (at least 6 credits).
Technical Elective 1
Technical Elective 2

Civil Engineering B.C.E.

Civil Engineering

Requirements for this program are current for Fall 2006.
Required credits to graduate with this degree: 128.
Required credits within the major: 64.
This program requires summer terms.
Degree: Bachelor of Civil Engineering.

Civil engineering deals with the science and art of engineering applied to solving problems and designing systems related to infrastructure and the environment. Principal fields within civil engineering are structural engineering, environmental engineering, water resources engineering, transportation engineering, and geotechnical engineering. The upper division civil engineering program requires students to take introductory courses in all of the above areas. In addition, students may emphasize a special interest in one of the areas by selecting appropriate technical electives in consultation with their adviser.

Admission Requirements

Students must complete 10 courses before admission to the program.

Freshmen and transfer students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:
• 2.80 for students transferring from outside the University.

It is recommended that students take GEO 1001 and CE 1101, but these courses are not required to be admitted to the program.

For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

Required Courses for Admission

Mathematics
MATH 1271 - Calculus I, MATH (4.0 cr)
or MATH 1371 - IT Calculus I, MATH (4.0 cr)
MATH 1272 - Calculus II (4.0 cr)
or MATH 1372 - IT Calculus II (4.0 cr)
MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)
MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

**Physical Science and Mechanics**

AEM 2011 - Statics (3.0 cr)  
AEM 3031 - Deformable Body Mechanics (3.0 cr)  
CHEM 1021 - Chemical Principles I, ENVT, PHYS SCI/L (4.0 cr)  
or CHEM 1031H - Honors Chemistry I, ENVT, PHYS SCI/L, H (4.0 cr)  
CHEM 1022 - Chemical Principles II, ENVT, PHYS SCI/L (4.0 cr)  
or CHEM 1032H - Honors Chemistry II, ENVT, PHYS SCI/L, H (4.0 cr)  
PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4.0 cr)  
or PHYS 1401V - Honors Physics I, PHYS SCI/L, WI, H (4.0 cr)  
PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4.0 cr)  
or PHYS 1402V - Honors Physics II, PHYS SCI/L, WI, H (4.0 cr)

**Program Requirements**

**Required Courses**

**Major Courses**

AEM 2012 - Dynamics (3.0 cr)  
CE 3201 - Transportation Engineering (3.0 cr)  
CE 3202 - Surveying and Mapping (2.0 cr)  
CE 3301 - Soil Mechanics I (3.0 cr)  
CE 3401 - Linear Structural Analysis (3.0 cr)  
CE 3402 - Construction Materials (3.0 cr)  
CE 3501 - Environmental Engineering, C/PE, ENVT (3.0 cr)  
CE 3502 - Fluid Mechanics (4.0 cr)  
CE 4101W - Project Management, WI (3.0 cr)  
CE 4102W - Capstone Design, WI (3.0 cr)  
CE 4301 - Soil Mechanics II (3.0 cr)  
CE 4401 - Steel and Reinforced Concrete Design (4.0 cr)  
CE 4501 - Hydrologic Design (4.0 cr)  
CE 4502 - Water and Wastewater Treatment (3.0 cr)

**Computer Applications/Programming**

A substitution for CE 3101 may be made with approval of the director of undergraduate studies.  
CE 3101 - Computer Applications in Civil Engineering I (3.0 cr)  
or CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)  
or CSCI 1107 - Introduction to FORTRAN Programming for Scientists and Engineers (3.0 cr)  
or CSCI 1103 - Introduction to Computer Programming in Java (4.0 cr)

**Statistics**

Stat 3021 may be substituted for CE 3102 with approval of the director of undergraduate studies.  
CE 3102 - Uncertainty and Decision Analysis in Civil Engineering (3.0 cr)  
or STAT 3021 - Introduction to Probability and Statistics (3.0 cr)

**Technical Electives**

Students must take 17 credits of Technical Electives, approved by an adviser. Technical Electives may be directed to focus on an area of emphasis in construction, environmental, geomechanics, public works, structural, transportation, or water resources engineering. See the section below for a list of possible courses, but consult your adviser before taking them.

Students are required to complete one of the following course groups.

**General**

Consult your adviser for additional courses to total 17 credits.

- **General**
  - CE 1101 - Civil Engineering Orientation (1.0 cr)  
  - CE 3111 - CADD for Civil Engineers (2.0 cr)  
  - CE 4190 - Engineering Co-op Assignment (2.0-6.0 cr)

**Environmental Engineering**

Consult your adviser about selecting courses to meet this requirement.

- **Environmental Engineering**
  - Take 1 or more course(s) from the following:
    - BIOL 3407 - Ecology, ENVT (3.0 cr)  
    - CE 4352 - Groundwater Modeling (3.0 cr)  
    - CE 4562 - Environmental Remediation Technology (3.0 cr)  
    - CE 5541 - Environmental Water Chemistry (3.0 cr)  
    - CE 5551 - Environmental Microbiology Laboratory (4.0 cr)  
    - CE 4591 - Environmental Law for Engineers (3.0 cr)  
    - CHEM 2301 - Organic Chemistry I (3.0 cr)  
    - CHEN 4005 - Transport Phenomena: Momentum and Heat (4.0 cr)  
    - CHEN 4101 - Chemical Engineering Thermodynamics (4.0 cr)  
    - CHEN 4102 - Reaction Kinetics and Reactor Engineering (4.0 cr)  
    - EEB 4601 - Limnology (3.0 cr)  
    - GEO 5108 - Principles of Environmental Geology (3.0 cr)  
    - GEO 5701 - General Hydrogeology (3.0 cr)  
    - STAT 5021 - Statistical Analysis (4.0 cr)

**Geomechanics Engineering**

Consult your adviser about selecting courses to meet this requirement.

- **Geomechanics Engineering**
  - Take 1 or more course(s) from the following:
    - AEM 4581 - Mechanics of Solids (3.0 cr)  
    - CE 3111 - CADD for Civil Engineers (2.0 cr)  
    - CE 4121 - Computer Applications in Civil Engineering II (3.0 cr)  
    - CE 4311 - Rock Mechanics II (3.0 cr)  
    - CE 4341 - Engineering Geostatistics (3.0 cr)  
    - CE 4351 - Groundwater Mechanics (3.0 cr)  
    - CE 4352 - Groundwater Modeling (3.0 cr)  
    - CE 5311 - Experimental Geomechanics (3.0 cr)  
    - CE 5321 - Geomechanics (3.0 cr)  
    - CE 5331 - Geomechanics Modeling (3.0 cr)  
    - GEO 4203 - Principles of Geophysical Exploration (3.0 cr)  
    - GEO 4501 - Structural Geology (3.0 cr)  
    - MATH 4457 - Methods of Applied Mathematics I (4.0 cr)  
    - MATH 4458 - Methods of Applied Mathematics II (4.0 cr)  
    - MATH 4567 - Introduction to Fourier Analysis (4.0 cr)  
    - MATH 5583 - Complex Analysis (4.0 cr)

**Public Works Engineering**

Consult your adviser about selecting courses to meet this requirement.

- **Public Works Engineering**
  - Take 1 or more course(s) from the following:
    - CE 4111 - Engineering Systems Analysis (3.0 cr)  
    - CE 4201 - Highway Design (3.0 cr)  
    - CE 4232 - Cemement Materials (3.0 cr)  
    - CE 5211 - Traffic Engineering (3.0 cr)  
    - CE 5231 - Pavement Management and Rehabilitation (3.0 cr)
Institute of Technology

Consult your adviser about selecting courses to meet this requirement.

Take 1 or more course(s) from the following:

- OR -

**Water Resources Engineering**

- OR -

**Structural Engineering**

Consult your adviser about selecting courses to meet this requirement.

Take 1 or more course(s) from the following:

- OR -

**Transportation Engineering**

Consult your adviser about selecting courses to meet this requirement.

Take 1 or more course(s) from the following:

- OR -

**Computer Engineering B.Comp.E.**

**Computer Science and Engineering**

Requirements for this program are current for Fall 2006.

Required credits to graduate with this degree: 126.

Required credits within the major: 78.

Degree: Bachelor of Computer Engineering.

The mission of the computer engineering program is to educate students in the core topics as well as in a broad set of specialties of computer engineering, to impart students with professional attributes that characterize a well-schooled engineer and citizen, and to provide students with opportunities for research experience in one of the leading computer engineering centers of scholarship.

The field of computer engineering resulted from the tremendous development of computers and, in particular, the evolution of microprocessors. The design process for almost every electronic system includes the specification and development of the control program for the system's microprocessor. A particular computer engineering job can be more closely related to hardware or software, to functional design or detailed design. The B.Comp. Eng. degree provides the background necessary for persons, however, provide highly specialized knowledge in any particular subfield.

**Admission Requirements**

Students must complete 10 courses before admission to the program.

For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.
Required Courses for Admission

Mathematics
MATH 1271 - Calculus I, MATH (4.0 cr)
or MATH 1371 - IT Calculus I, MATH (4.0 cr)
MATH 1272 - Calculus II (4.0 cr)
or MATH 1372 - IT Calculus II (4.0 cr)
MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)
MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

Physics
PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, WI, H (4.0 cr)
or PHYS 1401V - Honors Physics I, PHYS SCI/L, WI, H (4.0 cr)
PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4.0 cr)
or PHYS 1402V - Honors Physics II, PHYS SCI/L, WI, H (4.0 cr)

Preparatory Courses
CSCI 1901 - Structure of Computer Programming I (4.0 cr)
CSCI 1902 - Structure of Computer Programming II (4.0 cr)
EE 2001 - Introduction to Electronic and Electrical Circuits (3.0 cr)
EE 2002 - Introductory Circuits and Electronics Laboratory (1.0 cr)
EE 2011 - Linear Systems and Circuits (3.0 cr)

Take all of the following in the same term:
EE 2301 - Introduction to Digital System Design (4.0 cr)
EE 301 - Introduction to Digital System Design: Discussion (0.0 cr)

Take all of the following in the same term:
EE 2361 - Introduction to Microcontrollers (4.0 cr)
EE 361 - Introduction to Microcontrollers: Discussion (0.0 cr)

Program Requirements

Students interested in pursuing computer engineering or electrical engineering as a major are encouraged to take EE 1001 during their first year.

Required Courses

Major Courses
CSCI 2011 - Discrete Structures of Computer Science (4.0 cr)
CSCI 4041 - Algorithms and Data Structures (4.0 cr)
CSCI 4061 - Introduction to Operating Systems (4.0 cr)
EE 3015 - Signals and Systems (3.0 cr)
EE 3025 - Statistical Methods in Electrical and Computer Engineering (3.0 cr)
EE 3101 - Circuits and Electronics Laboratory I (2.0 cr)
EE 3102 - Circuits and Electronics Laboratory II (2.0 cr)
EE 3115 - Analog and Digital Electronics (4.0 cr)
EE 4363 - Computer Architecture and Machine Organization (4.0 cr)

Electives
With adviser approval, courses from areas outside of EE/CSCI may be substituted to meet up to 12 credits of this requirement (i.e., the technical electives). Courses taken as part of the EIP program may be used to meet the technical elective requirement. Courses may not be used to meet both the core and the elective requirements. Courses used to fulfill other requirements will not count as lab experiences.

Take 26 or more credit(s).

Take 3 or more course(s) from the following:
EE 4951W - Senior Design Project, WI (2.0 cr)
or
Honors Project
EE 4981H - Senior Honors Project I, H (2.0 cr)
EE 4982V - Senior Honors Project II, WI, H (2.0 cr)

Degree Programs

Computer Science B.S. Comp.Sc.

Computer Science and Engineering

Requirements for this program are current for Fall 2006.
Required credits to graduate with this degree: 124.
Required credits within the major: 45.
Degree: Bachelor of Science in Computer Science.
Computer science is concerned with the study of the hardware, software, and theoretical aspects of high-speed computing devices and with the application of these devices to scientific, technological, and business problems.
A bachelor’s degree gives students a basic understanding of computer science. After completing a required set of fundamental courses, students arrange their subsequent work around one of several upper division emphases within either computer science or an interdisciplinary area involving computer applications. The degree prepares students for graduate work or for various industrial, governmental, and business positions involving the use of computers.
Admission Requirements
Students must complete 6 courses before admission to the program.
Freshmen and transfer students are usually admitted to pre-major status before admission to this major.
A GPA above 2.00 is preferred for the following:
• 2.40 for students already admitted to the degree-granting college.
• 2.40 for students transferring from another University of Minnesota college.
• 2.80 for students transferring from outside the University.
For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

Required Courses for Admission
Mathematics Core
MATH 1371 - IT Calculus I, MATH (4.0 cr)
or MATH 1271 - Calculus I, MATH (4.0 cr)
MATH 1372 - IT Calculus II (4.0 cr)
or MATH 1272 - Calculus II (4.0 cr)
MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)
or MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)

Computer Science Introductory Core
CSCI 1901 - Structure of Computer Programming I (4.0 cr)
CSCI 1902 - Structure of Computer Programming II (4.0 cr)
CSCI 2011 - Discrete Structures of Computer Science (4.0 cr)

Program Requirements
Required Courses
Physics Core
PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4.0 cr)
or PHYS 1401V - Honors Physics I, PHYS SCI/L, WI, H (4.0 cr)
PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4.0 cr)
or PHYS 1402V - Honors Physics II, PHYS SCI/L, WI, H (4.0 cr)

Computer Science Core
CSCI 2021 - Machine Architecture and Organization (4.0 cr)
CSCI 2031 - Introduction to Numerical Computing (4.0 cr)
CSCI 3081W - Program Design and Development, WI (4.0 cr)
CSCI 4011 - Formal Languages and Automata Theory (4.0 cr)
CSCI 4041 - Algorithms and Data Structures (4.0 cr)
CSCI 4061 - Introduction to Operating Systems (4.0 cr)
MATH 4xxx
STAT 3021 - Introduction to Probability and Statistics (3.0 cr)

Computer Science Emphases (Technical Electives)
17 credits of approved 4xxx and 5xxx electives that form a coherent academic program in an area of computer science or its applications; it must include at least 9 credits of computer science electives and no more than 3 credits from CSCI 59xx or CSCI 4970 or outside independent study. The emphases listed below represent possible options; students should consult with their adviser before choosing their technical electives.

Students are required to complete one of the following course groups.

Computer Architecture
Consult your adviser for additional courses to meet the 17-credit requirement.
CSCI 4203 - Computer Architecture (4.0 cr)
CSCI 5204 - Advanced Computer Architecture (3.0 cr)
CSCI 5283 - Computer-Aided Design I (3.0 cr)

Artificial Intelligence
Take 17 or more credit(s) from the following:
CSCI 5511 - Artificial Intelligence I (3.0 cr)
CSCI 5512W - Artificial Intelligence II, WI (3.0 cr)
CSCI 5521 - Pattern Recognition (3.0 cr)
CSCI 5551 - Introduction to Intelligent Robotic Systems (3.0 cr)
CSCI 5561 - Computer Vision (3.0 cr)
PSY 5031W - Perception, WI (3.0 cr)
PSY 5038W - Introduction to Neural Networks, WI (3.0 cr)

Hardware
Take 17 or more credit(s) from the following:
CSCI 4203 - Computer Architecture (4.0 cr)
CSCI 4211 - Introduction to Computer Networks (3.0 cr)
CSCI 5204 - Advanced Computer Architecture (3.0 cr)
CSCI 5283 - Computer-Aided Design I (3.0 cr)
EE 4341 - Microprocessor and Microcontroller System Design (4.0 cr)

Computational Biology
Consult your adviser for additional courses to meet the 17-credit requirement.
CSCI 5481 - Computational Techniques for Genomics (3.0 cr)

Databases
Consult your adviser for additional courses to meet the 17-credit requirement.
CSCI 4707 - Practice of Database Systems (3.0 cr)
CSCI 5708 - Architecture and Implementation of Database Management Systems (3.0 cr)
CSCI 5421 - Advanced Algorithms and Data Structures (3.0 cr)

Graphics
Take 17 or more credit(s) from the following:
CSCI 4707 - Practice of Database Systems (3.0 cr)
CSCI 5707 - Principles of Database Systems (3.0 cr)
CSCI 5108 - Fundamentals of Computer Graphics II (3.0 cr)
CSCI 5109 - Visualization (3.0 cr)
CSCI 5115 - User Interface Design, Implementation and Evaluation (3.0 cr)
CSCI 5116 - GUI Toolkits and Their Implementation (3.0 cr)
PSY 5031W - Perception, WI (3.0 cr)
Management of Information Systems
Consult your adviser for additional courses to meet the 17-credit requirement.
CSCI 4707 - Practice of Database Systems (3.0 cr)
CSCI 5708 - Architecture and Implementation of Database Management Systems (3.0 cr)
IDSC 4441 - Electronic Commerce (2.0 cr)
-OR-

Network Security
Consult your adviser for additional courses to meet the 17-credit requirement.
CSCI 4211 - Introduction to Computer Networks (3.0 cr)
CSCI 5103 - Operating Systems (3.0 cr)
CSCI 5471 - Modern Cryptography (3.0 cr)
MATH 5248 - Cryptology and Number Theory (4.0 cr)
-OR-

Programming
Consult your adviser for additional courses to meet the 17-credit requirement.
CSCI 4131 - Internet Programming (3.0 cr)
CSCI 5106 - Programming Languages (3.0 cr)
CSCI 5801 - Software Engineering I (3.0 cr)
-OR-

Software Engineering
Consult your adviser for additional courses to meet the 17-credit requirement.
CSCI 5801 - Software Engineering I (3.0 cr)
CSCI 5802 - Software Engineering II (3.0 cr)
CSCI 5106 - Programming Languages (3.0 cr)
-OR-

Theory
Consult your adviser for additional courses to meet the 17-credit requirement.
Take 4 or more course(s) from the following:
CSCI 5421 - Advanced Algorithms and Data Structures (3.0 cr)
CSCI 5403 - Computational Complexity (3.0 cr)
CSCI 5451 - Introduction to Parallel Computing: Architectures, Algorithms and Programming (3.0 cr)
CSCI 5481 - Computational Techniques for Genomics (3.0 cr)
MATH 4707 - Introduction to Combinatorics and Graph Theory (4.0 cr)
-OR-

User Interfaces
Consult your adviser for additional courses to meet the 17-credit requirement.
CSCI 5115 - User Interface Design, Implementation and Evaluation (3.0 cr)
CSCI 5116 - GUI Toolkits and Their Implementation (3.0 cr)
PSY 501W - Psychology of Human-Machine Interaction, WI (3.0 cr)
KIN 5001 - Foundations of Human Factors/Ergonomics (3.0 cr)

Electrical Engineering B.E.
Electrical and Computer Engineering
Requirements for this program are current for Fall 2006.
Required credits within the major: 78.
Degree: Bachelor of Electrical Engineering.
The mission of the electrical engineering program is to educate students in the core topics as well as in a broad set of specialties of electrical engineering, to impart students with professional attributes that characterize a well-schooled engineer and citizen, and to provide students with opportunities for research experience in one of the leading electrical engineering centers of scholarship.
Electrical engineers work in highly diverse areas such as computers, telecommunications, semiconductors, electric energy, consumer and entertainment electronics, biomedical technology, defense and aerospace systems, and automotive electronics. They design and develop components, software, and systems; carry out analysis; and work in research, management, and sales. The bachelor of electrical engineering prepares students for immediate entry into professional work, for graduate study and further specialization in engineering, for advanced work in business and management, or for study in a different direction such as medicine.

Admission Requirements
Students must complete 9 courses before admission to the program.
Freshmen and transfer students are usually admitted to pre-major status before admission to this major.
A GPA above 2.00 is preferred for the following:
• 2.30 for students already admitted to the degree-granting college.
• 2.30 for students transferring from another University of Minnesota college.
• 2.80 for students transferring from outside the University.
Students interested in pursuing a degree in computer engineering or electrical engineering are encouraged to take EE 1001 in their first year.
For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

Required Courses for Admission
Mathematics
MATH 1271 - Calculus I, MATH (4.0 cr)
or MATH 1371 - IT Calculus I, MATH (4.0 cr)
MATH 1272 - Calculus II (4.0 cr)
or MATH 1372 - IT Calculus II (4.0 cr)
MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
Institute of Technology

or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)
or MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

**Physical Sciences**
CHEM 1021 - Chemical Principles I, ENV, PHYS SCI/L (4.0 cr)
or CHEM 1031H - Honors Chemistry I, ENV, PHYS SCI/L, H (4.0 cr)
CHEM 1022 - Chemical Principles II, ENV, PHYS SCI/L (4.0 cr)
or CHEM 1032H - Honors Chemistry II, ENV, PHYS SCI/L, H (4.0 cr)
or PHYS 2303 - Physics III: Physics of Matter (4.0 cr)
or PHYS 2311 - Modern Physics (4.0 cr)
or PHYS 2403H - Honors Phys III, H (4.0 cr)
PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4.0 cr)
or PHYS 1401V - Honors Physics I, PHYS SCI/L, WI, H (4.0 cr)
PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4.0 cr)
or PHYS 1402V - Honors Physics II, PHYS SCI/L, WI, H (4.0 cr)

**Preparatory Courses**
EE 2001 - Introduction to Electronic and Electrical Circuits (3.0 cr)
EE 2002 - Introductory Circuits and Electronics Laboratory (1.0 cr)
EE 2011 - Linear Systems and Circuits (3.0 cr)
CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)
or EE 1301 - Introduction to Computing Systems (4.0 cr)

Take all of the following in the same term:
EE 301 - Introduction to Digital System Design: Discussion (0.0 cr)
EE 2301 - Introduction to Digital System Design (4.0 cr)

Take all of the following in the same term:
EE 361 - Introduction to Microcontrollers: Discussion (0.0 cr)
EE 2361 - Introduction to Microcontrollers (4.0 cr)

**Program Requirements**

**Required Courses**

**Major Courses**
EE 3015 - Signals and Systems (3.0 cr)
EE 3025 - Statistical Methods in Electrical and Computer Engineering (3.0 cr)
EE 3101 - Circuits and Electronics Laboratory I (2.0 cr)
EE 3102 - Circuits and Electronics Laboratory II (2.0 cr)
EE 3115 - Analog and Digital Electronics (4.0 cr)
EE 3161 - Semiconductor Devices (3.0 cr)
EE 3601 - Transmission Lines, Fields, and Waves (3.0 cr)

**Electives**
With adviser approval, courses from areas outside of EE/CSCI may be substituted to meet up to 12 credits of this requirement (i.e., the technical electives). Courses taken as part of the EIP program may be used to meet the technical elective requirement. Courses may not be used to meet both the core and the elective requirements.

Take 26 or more credit(s).

Courses used to fulfill other requirements will not count as lab experiences.

Take 3 or more course(s) from the following:
EE 4951W - Senior Design Project, WI (2.0 cr)
or

**Honors Project**
EE 4981H - Senior Honors Project I, H (2.0 cr)
EE 4982V - Senior Honors Project II, WI, H (2.0 cr)

Take 1 or more course(s) from the following:
EE 4111 - Advanced Analog Electronics Design (4.0 cr)
EE 4235 - Linear Control Systems Laboratory (1.0 cr)
EE 4237 - State Space Control Laboratory (1.0 cr)
EE 4301 - Digital Design With Programmable Logic (4.0 cr)
EE 4341 - Microprocessor and Microcontroller System Design (4.0 cr)
EE 4505 - Communications Systems Laboratory (1.0 cr)
EE 4703 - Electric Drives Laboratory (1.0 cr)
EE 4721 - Introduction to Power System Analysis (4.0 cr)
EE 4743 - Switch-Mode Power Electronics Laboratory (2.0 cr)
EE 5141 - Introduction to Microsystem Technology (4.0 cr)
EE 5173 - Basic Microelectronics Laboratory (1.0 cr)
EE 5327 - VLSI Design Laboratory (3.0 cr)
EE 5545 - Digital Signal Processing Design (3.0 cr)
EE 5613 - RF/Microwave Circuit Design Laboratory (2.0 cr)
EE 5622 - Physical Optics Laboratory (1.0 cr)
EE 5627 - Optical Fiber Communication (3.0 cr)
EE 5811 - Biomedical Instrumentation (3.0 cr)

Take 0 or more course(s) from the following:
CSCI 4xxx
CSCI 5xxx
EE 4xxx
EE 5xxx

**Program Sub-plans**
A sub-plan is not required for this program.

**EIP**
Internship/Cooperative learning program.
Take EE 3961 (1 cr) and then EE 4961 (2 cr), with the possibility of a third course, EE 4962 (2 cr).
EE 3961 and EE 4961 are also listed in Sr Electives and may not be used to fulfill both requirements simultaneously.

**Required Courses**

**Internship**
EE 3961 - Industrial Assignment I (1.0 cr)
EE 4961 - Industrial Assignment II (2.0 cr)

**Geological Engineering B.Geo.E.**

**Civil Engineering**

Requirements for this program are current for Fall 2006.
Required credits to graduate with this degree: 128.
Required credits within the major: 40.
This program requires summer terms.
Degree: Bachelor of Geo-Engineering.
The mission of the geological engineering program comprises three overlapping and mutually supportive components:
• Prepare students to become productive engineers and contributing members of their professional community
• Prepare students for continual learning and professional development
• Prepare students for formal advanced education.
The program has four core objectives:
1. To produce graduates with a strong fundamental scientific and technical knowledge base and critical thinking skills required for engineering problem formulation and problem solving.
2. To produce graduates with the ability to work as a professional team member. This includes the ability to communicate effectively through both oral and written language.
3. To produce graduates with an understanding of their obligations as professional geological engineers to protect human health, welfare, and the environment.

4. To ensure that graduates have had opportunities to complement their academic studies with scholarly (research) investigations, co-ops, and internships.

Admission Requirements
Students must complete 11 courses before admission to the program.

Freshmen and transfer students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:
- 2.80 for students transferring from outside the University.

For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

Required Courses

Mathematics and Statistics
- STAT 3021 - Introduction to Probability and Statistics (3.0 cr)
- MATH 1271 - Calculus I, MATH (4.0 cr)
or MATH 1371 - IT Calculus I, MATH (4.0 cr)
- MATH 1272 - Calculus II (4.0 cr)
or MATH 1372 - IT Calculus II (4.0 cr)
- MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)
- MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

Mechanics
- AEM 2011 - Statics (3.0 cr)
- AEM 3031 - Deformable Body Mechanics (3.0 cr)

Physical Sciences
- CHEM 1021 - Chemical Principles I, ENVT, PHYS SCI/L (4.0 cr)
or CHEM 1031H - Honors Chemistry I, ENVT, PHYS SCI/L, H (4.0 cr)
- CHEM 1022 - Chemical Principles II, ENVT, PHYS SCI/L (4.0 cr)
or CHEM 1032H - Honors Chemistry II, ENVT, PHYS SCI/L, H (4.0 cr)
- PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4.0 cr)
or PHYS 1401V - Honors Physics I, PHYS SCI/L, WI, H (4.0 cr)
- PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4.0 cr)
or PHYS 1402V - Honors Physics II, PHYS SCI/L, WI, H (4.0 cr)

Program Requirements

Required Courses

Major Courses
- GEO 1001 - Earth and Its Environments, ENVT, PHYS SCI/L (4.0 cr)
- GEO 2301 - Mineralogy (3.0 cr)
- GEO 2302 - Petrology (3.0 cr)
- GEO 4501 - Structural Geology (3.0 cr)
- GEO 3911 - Introductory Field Geology (4.0 cr)
or GEO 4971 - Field Hydrogeology (4.0 cr)
- GEO 4203 - Principles of Geophysical Exploration (3.0 cr)
or GEO 4211 - Solid Earth Geophysics I (3.0 cr)
- GEO 4602 - Sedimentology and Stratigraphy (3.0 cr)
or GEO 4701 - Geomorphology (3.0-4.0 cr)
or GEO 4703 - Glacial Geology (4.0 cr)

Geology B.S.Geol.

Geology & Geophysics
Requirements for this program are current for Fall 2006.

Required credits to graduate with this degree: 120.

Required credits within the major: 52.

This program requires summer terms.

Degree: Bachelor of Science in Geology.

Geology is the study of the composition, structure, and history of the Earth and of the processes that operate on and within it, with emphasis on the crust, oceans, and atmosphere. The department's programs emphasize applications of physics, chemistry, and biology to understanding the Earth.

Geologists and geophysicists are employed in a wide range of fields, including exploration for and development of natural resources (hydrocarbons, minerals, groundwater); environmental science; urban planning; education; and oceanography. Potential employers include the oil, gas, and minerals industries; environmental consultants; federal and private research institutions; universities; schools; and government agencies. An advanced degree is usually required for a career in research or teaching.

Admission Requirements
Students must complete 5 courses before admission to the program.
Freshmen and transfer students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:

-• 2.50 for students transferring from outside the University.

Students interested in geology as a major may want to consider taking geology 1001, which can be counted as an elective.

For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

**Required Courses for Admission**

**Mathematics**

MATH 1271 - Calculus I, MATH (4.0 cr)

or MATH 1371 - IT Calculus I, MATH (4.0 cr)

MATH 1272 - Calculus II (4.0 cr)

or MATH 1372 - IT Calculus II (4.0 cr)

Multivariable Calculus may be substituted.

MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)

or MATH 2263 - Multivariable Calculus (4.0 cr)

or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)

or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

**Physical Sciences**

CHEM 1021 - Chemical Principles I, ENV, PHYS SCI/L (4.0 cr)

or CHEM 1031H - Honors Chemistry I, ENV, PHYS SCI/L, H (4.0 cr)

CHEM 1022 - Chemical Principles II, ENV, PHYS SCI/L (4.0 cr)

or CHEM 1032H - Honors Chemistry II, ENV, PHYS SCI/L, H (4.0 cr)

*One course of Physics I and one course of Physics II must be completed before admission to upper division.*

PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4.0 cr)

or PHYS 1401V - Honors Physics I, PHYS SCI/L, WI, H (4.0 cr)

PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, WI, H (4.0 cr)

PHYS 1402V - Honors Physics II, PHYS SCI/L, WI, H (4.0 cr)

**Program Requirements**

**Required Courses**

**Major Courses**

GEO 2201 - Geodynamics I: The Solid Earth (3.0 cr)

GEO 2301 - Mineralogy (3.0 cr)

GEO 2302 - Petrology (3.0 cr)

GEO 2303W - Geochronology and Earth History (3.0 cr)

GEO 2304 - Geochronology and Earth History (3.0 cr)

GEO 2305 - Structural Geology (3.0 cr)

GEO 2306 - Sedimentology and Stratigraphy (3.0 cr)

GEO 2307W - Earth Systems: Geosphere/Biosphere Interactions, WI (3.0 cr)

**Workshops and Advanced Fieldwork**

Take one course in advanced field geology during the summer after the junior year.

*Take 2 or more course(s) from the following:*

GEO 3870 - Modeling Workshop (1.0 cr)

GEO 3880 - Laboratory Workshop (1.0 cr)

GEO 3890 - Field Workshop (1.0 cr)

GEO 4911 - Advanced Field Geology (4.0 cr)

or GEO 4971 - Field Hydrogeology (4.0 cr)

**Electives**

Take at least 12 additional credits of geology during the junior and senior years, with no more than 4 credits from 1xxx and 3 credits from 2xxx.

*Take 12 or more credit(s) from the following:*

GEO 1xxx

GEO 2xxx

GEO 3xxx

GEO 4xxx

GEO 5xxx

**Technical Electives**

Take 8 credits of additional elective courses in physical and natural sciences or mathematics, chosen in consultation with an adviser.

**Geophysics B.S. Geop.**

**Geology & Geophysics**

Requirements for this program are current for Fall 2006.

Required credits to graduate with this degree: 120.

Required credits within the major: 52.

This program requires summer terms.

Degree: Bachelor of Science in Geophysics.

Geophysics is the study of the physical structure and properties of the Earth through application of the principles and techniques of classical physics. Major topics include the physical properties of rocks and minerals, the origin and dynamics of the Earth’s gravity and magnetic fields, earthquakes and the propagation of waves in the Earth (seismology), and the dynamics of the Earth’s crust, mantle, and deep interior.

Geologists and geophysicists are employed in a wide range of fields, including exploration for and development of natural resources (hydrocarbons, minerals, groundwater); environmental science; urban planning; education; and oceanography. Potential employers include the oil, gas, and minerals industries; environmental consultants; federal and private research institutions; universities; schools; and government agencies. An advanced degree is usually required for a career in research or teaching.

**Admission Requirements**

Students must complete 11 courses before admission to the program.

A GPA above 2.00 is preferred for the following:

• 2.50 for students transferring from outside the University.

Students interested in a geophysics major may want to consider taking GEOG 1001, which can be counted as a geology elective.

For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

**Required Courses for Admission**

**Mathematics**

MATH 1271 - Calculus I, MATH (4.0 cr)

or MATH 1371 - IT Calculus I, MATH (4.0 cr)

MATH 1272 - Calculus II (4.0 cr)

or MATH 1372 - IT Calculus II (4.0 cr)

MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)

or MATH 2263 - Multivariable Calculus (4.0 cr)

or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)

or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

or MATH 2375 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

or MATH 2376 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

or MATH 2263 - Multivariable Calculus (4.0 cr)

or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)

or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)
Physical Sciences
CHEM 1021 - Chemical Principles I, ENVT, PHYS SCI/L (4.0 cr)
or CHEM 1031H - Honors Chemistry I, ENVT, PHYS SCI/L, H (4.0 cr)
CHEM 1022 - Chemical Principles II, ENVT, PHYS SCI/L (4.0 cr)
or CHEM 1032H - Honors Chemistry II, ENVT, PHYS SCI/L, H (4.0 cr)
PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, W1 (4.0 cr)
or PHYS 1401V - Honors Physics I, PHYS SCI/L, W1, H (4.0 cr)
PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, W1 (4.0 cr)
or PHYS 1402V - Honors Physics II, PHYS SCI/L, W1, H (4.0 cr)
PHYS 2303 - Physics III: Physics of Matter (4.0 cr)

Program Requirements

Required Courses

Major Courses
GEO 2201 - Geodynamics I: The Solid Earth (3.0 cr)
GEO 2301 - Mineralogy (3.0 cr)
GEO 2302 - Petrology (3.0 cr)
GEO 2303W - Geochronology and Earth History (3.0 cr)
GEO 3911 - Introductory Field Geology (4.0 cr)
GEO 4011 - Field Hydrogeology (4.0 cr)

Take 2 or more course(s) from the following:
GEO 3870 - Modeling Workshop (1.0 cr)
GEO 3880 - Laboratory Workshop (1.0 cr)
GEO 3890 - Field Workshop (1.0 cr)

Take 9 or more credit(s) from the following:
GEO 4211 - Solid Earth Geophysics I (3.0 cr)
GEO 4212 - Solid Earth Geophysics II (3.0 cr)
GEO 4203 - Principles of Geophysical Exploration (3.0 cr)
GEO 4204 - Geomagnetism and Paleomagnetism (3.0 cr)
GEO 5203 - Mineral and Rock Physics (3.0 cr)

Electives
Take 9 additional credits of GEO courses, with no more than 4 credits of 1xxx and 3 credits of 2xxx.

Take 9 or more credit(s) from the following:
GEO 1xxx
GEO 2xxx
GEO 3xxx
GEO 4xxx
GEO 5xxx

Technical Electives
Take 9 additional credits of math or science approved by adviser.

Information Technology Minor

Computer Science and Engineering

Requirements for this program are current for Fall 2006.

Required credits in this minor: 16.

This interdisciplinary minor requires at least 16 credits, including two core courses from the Institute of Technology and three breadth courses from the Colleges of Design and Liberal Arts. The minor enables students in nontechnical disciplines to supplement their major with a practical set of courses focused on information technology.

Program Requirements

Required Courses

Core Courses
Take 2 or more course(s) from the following:
CSCI 1001 - Overview of Computer Science (4.0 cr)
CSCI 1103 - Introduction to Computer Programming in Java (4.0 cr)
CSCI 1121 - Introduction to the Internet 1 (4.0 cr)

Breadth Courses
Note: DHA 2334 is a prerequisite for more advanced graphic design courses; although these courses are limited to graphic design majors, admission can be obtained through permission of the instructor.

Take 3 or more course(s) from the following:
COMM 3201 - Introduction to Electronic Media Production (4.0 cr)
COMM 3211 - Introduction to U.S. Electronic Media (3.0 cr)
COMM 4231 - Comparing Electronic Media Systems, IP (3.0 cr)
COMM 4235 - Electronic Media and Ethnic Minorities--A World View, IP (3.0 cr)
COMM 4291 - New Telecommunication Media (3.0 cr)
COMM 5233 - Electronic Media and National Development (3.0 cr)
DHA 2334 - Computer Applications I: Digital Composition for Design (3.0 cr)
DHA 4334 - Computer Applications II: Design for the Digital Environment (3.0 cr)
DHA 4384 - Interactive Media (3.0 cr)
DHA 5381 - Digital Illustration (3.0 cr)
DHA 5382 - Digital Sound and Video (3.0 cr)
DHA 5383 - Digital Illustration and Animation (4.0 cr)
DHA 5385 - Internet-Based Media (3.0 cr)
DHA 5399 - Theory of Electronic Design (3.0 cr)
ENGC 3632 - Electronic Texts (3.0 cr)
GEOG 3561 - Principles of Geographic Information Science (4.0 cr)
GEOG 5563 - Advanced Geographic Information Science (3.0 cr)
GEOG 5564 - Urban Geographic Information Science and Analysis (3.0 cr)
JOUR 3004 - Information for Mass Communication (3.0 cr)
JOUR 3776 - Mass Communication Law (3.0 cr)
Materials Science and Engineering B.Mat.S.E.

Chemical Engineering & Materials Science

Requirements for this program are current for Fall 2006.

Required credits to graduate with this degree: 128.

Required credits within the major: 38.

Degree: Bachelor of Materials Science and Engineering.

The program in materials science and engineering leads to a bachelor’s degree that enables students to immediately enter the profession. The program develops an understanding of the properties and the origin of these properties in a broad range of materials, including metals, ceramics, semiconductors, polymers, and composites. Because the program is broadly based, graduates find employment across a broad range of industries, including the automotive, chemical, electronics, energy, and medical technology industries. Graduates also find positions in consulting, research, technical management, and teaching.

The materials science and engineering (MSE) program provides educational experiences that challenge students to:

- learn the scientific and engineering principles underlying the four major elements of materials engineering: structure, properties, processing, and performance of engineering materials (including metals and alloys, ceramics, polymers, and composites).
- apply and integrate knowledge of the above four elements to identify, formulate, and solve materials selection problems and design problems.
- learn experimental, statistical, and computational techniques in the context of MSE.
- design and conduct experiments, as well as analyze and interpret data.
- prepare for an engineering career by developing communication and teamwork skills and an understanding of the importance of lifelong learning, professionalism, and ethical responsibility.

Admission Requirements

Students must complete 11 courses before admission to the program.

Freshmen and transfer students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:

- 2.80 for students transferring from outside the University.

Students interested in materials science and engineering are recommended to take MATS 1001/CHEN 1001 in order to learn more about the field.

For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

Required Courses for Admission

Mathematics

Mathematics

MATH 1271 - Calculus I, MATH (4.0 cr)
MATH 1272 - Calculus II (4.0 cr)
MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
MATH 2237 - IT Linear Algebra and Differential Equations (4.0 cr)
MATH 2263 - Multivariable Calculus (4.0 cr)
MATH 2371 - IT Calculus I, MATH (4.0 cr)
MATH 1371 - IT Calculus I, MATH (4.0 cr)
CHEM 1021 - Chemical Principles I, ENVT, PHYS SCI/L (4.0 cr)
CHEM 1022 - Chemical Principles II, ENVT, PHYS SCI/L (4.0 cr)
CHEM 2301 - Organic Chemistry I (3.0 cr)
PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4.0 cr)
PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4.0 cr)
PHYS 2303 - Physics III: Physics of Matter (4.0 cr)
PHYS 2403H - Honors Phys III, H (4.0 cr)

Program Requirements

Required Courses

Major Courses

AEM 3031 - Deformable Body Mechanics (3.0 cr)
AEM 4511 - Mechanics of Composite Materials (3.0 cr)
CE 3101 - Computer Applications in Civil Engineering I (3.0 cr)
MATS 3011 - Introduction to Materials Science and Engineering (3.0 cr)
MATS 3012 - Metals and Alloys, WI (3.0 cr)
MATS 3801 - Structural Characterization Lab (2.0 cr)
MATS 3851W - Materials Properties Lab, WI (2.0 cr)
MATS 4001 - Thermodynamics of Materials (4.0 cr)
MATS 4002 - Mass Transport and Kinetics (4.0 cr)
MATS 4013 - Electrical and Magnetic Properties of Materials (3.0 cr)
MATS 4212 - Ceramics (3.0 cr)
MATS 4214 - Polymers (3.0 cr)
MATS 4221 - Materials Design and Performance (4.0 cr)
MATS 4301W - Materials Processing, WI (4.0 cr)
MATS 4400 - Senior Design Project (3.0 cr)

Technical Electives

Students must take 13 credits of technical electives. See an adviser for a list of possible courses.

Mathematics B.S.Math.

School of Mathematics

Requirements for this program are current for Fall 2006.

Required credits to graduate with this degree: 120.

Required credits within the major: 56.

Degree: Bachelor of Science in Mathematics.

The mission of the program is to provide high-quality mathematics instruction in a stimulating intellectual atmosphere. The goal is to educate students at all levels to provide cultural enrichment, to give them the analytic tools they need to become responsible citizens, and to prepare them for careers involving mathematics.

The School of Mathematics offers a program leading to the bachelor of science degree. The course of study is flexible and may be adapted to satisfy a wide variety of interests and needs. Students may prepare for graduate study in mathematics or emphasize various fields of interest, such as preparation for secondary school teaching, actuarial science, or programs in the secondary school teaching, actuarial science, or programs in applied mathematics, including industrial mathematics, biology, mathematics applicable to computer science, and numerical analysis. Programs for specializations in actuarial science, preparation for teaching in the secondary school, and
mathematics applicable to computer science earn a designation that appears on the diploma.

**Admission Requirements**

Students must complete 8 courses before admission to the program.

Freshmen and transfer students are usually admitted to pre-major status before admission to this major.

For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at [http://admissions.tc.umn.edu](http://admissions.tc.umn.edu).

**Required Courses for Admission**

**Mathematics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 1271 - Calculus I, MATH (4.0 cr)</td>
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<tr>
<td>or MATH 1371 - IT Calculus I, MATH (4.0 cr)</td>
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<tr>
<td>MATH 1272 - Calculus II (4.0 cr)</td>
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<tr>
<td>or MATH 1372 - IT Calculus II (4.0 cr)</td>
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</tr>
<tr>
<td>MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)</td>
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<tr>
<td>or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)</td>
<td></td>
</tr>
<tr>
<td>MATH 2263 - Multivariable Calculus (4.0 cr)</td>
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<tr>
<td>or MATH 2274 - IT Multivariable Calculus and Vector Analysis (4.0 cr)</td>
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<tr>
<td>MATH 2283 - Sequences, Series, and Foundations (3.0 cr)</td>
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<tr>
<td>or MATH 3283W - Sequences, Series, and Foundations: Writing Intensive, WI (4.0 cr)</td>
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</tbody>
</table>

**Physics**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4.0 cr)</td>
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<tr>
<td>or PHYS 1401V - Honors Physics I, PHYS SCI/L, WI, H (4.0 cr)</td>
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</tr>
<tr>
<td>PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4.0 cr)</td>
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<tr>
<td>or PHYS 1402V - Honors Physics II, PHYS SCI/L, WI, H (4.0 cr)</td>
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</tbody>
</table>

**Program Requirements**

Students must complete eight upper division math courses at 4xxx or above and two technical elective courses, which can be mathematics courses.

The School of Mathematics will accept STAT 5101 and 5102 as part of the eight-course upper division mathematics requirement. The content of STAT 5101 is the same as MATH 5651. No other courses from other departments may be used as part of the eight-course math requirement, though other courses may be used as technical electives.

MATH 4512 may not be used to satisfy part of the eight course upper division math requirement, though it may be used as technical elective. MATH 3113, 3116, 3118, 4113, 4116, 4118, 3283W, and 4005 may not be used to satisfy part of the eight-course upper division math requirement or as technical electives.

In addition to the specializations described below, students who wish to pursue a pure mathematics track or are planning to go to graduate school in mathematics should consult their adviser about appropriate course choices.

**Specializations in Mathematics**

Students are required to complete one of the following course groups.

**Mathematics (No Specialization)**

Students who do not choose one of the other specializations complete the basic requirements listed here. For the Technical Electives requirement, students must take at least 6 credits from courses that meet the following criteria: prerequisite of calculus; 3xxx or higher; courses form a coherent part of the student’s program.

Take 2 or more course(s).

**Take 1 or more course(s) from the following:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 4281 - Introduction to Modern Algebra (4.0 cr)</td>
<td></td>
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<tr>
<td>MATH 5248 - Cryptology and Number Theory (4.0 cr)</td>
<td></td>
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<tr>
<td>MATH 5251 - Error-Correcting Codes, Finite Fields, Algebraic Curves (4.0 cr)</td>
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</tr>
<tr>
<td>MATH 5285H - Honors: Fundamental Structures of Algebra I, H (4.0 cr)</td>
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<tr>
<td>MATH 5286H - Honors: Fundamental Structures of Algebra II, H (4.0 cr)</td>
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</tr>
<tr>
<td>MATH 5385 - Introduction to Computational Algebraic Geometry (4.0 cr)</td>
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</tbody>
</table>

**Take 0 or more course(s) from the following:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 4242 - Applied Linear Algebra (4.0 cr)</td>
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<tr>
<td>MATH 5705 - Enumerative Combinatorics (4.0 cr)</td>
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<tr>
<td>MATH 5707 - Graph Theory and Non-enumerative Combinatorics (4.0 cr)</td>
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<tr>
<td>MATH 5711 - Linear Programming and Combinatorial Optimization (4.0 cr)</td>
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</tr>
<tr>
<td>MATH 5485 - Introduction to Numerical Methods I (4.0 cr)</td>
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</tbody>
</table>

**Take 2 or more course(s) from the following:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 4606 - Advanced Calculus (4.0 cr)</td>
<td></td>
</tr>
<tr>
<td>MATH 5486 - Introduction To Numerical Methods II (4.0 cr)</td>
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<tr>
<td>MATH 5525 - Introduction to Ordinary Differential Equations (4.0 cr)</td>
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<tr>
<td>MATH 5535 - Dynamical Systems and Chaos (4.0 cr)</td>
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<tr>
<td>MATH 5583 - Complex Analysis (4.0 cr)</td>
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<tr>
<td>MATH 5587 - Elementary Partial Differential Equations I (4.0 cr)</td>
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<tr>
<td>MATH 5588 - Elementary Partial Differential Equations II (4.0 cr)</td>
<td></td>
</tr>
<tr>
<td>MATH 5652 - Introduction to Stochastic Processes (4.0 cr)</td>
<td></td>
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<tr>
<td>MATH 5654 - Prediction and Filtering (4.0 cr)</td>
<td></td>
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<tr>
<td>MATH 5615H - Honors: Introduction to Analysis I, H (4.0 cr)</td>
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<tr>
<td>MATH 5616H - Honors: Introduction to Analysis II, H (4.0 cr)</td>
<td></td>
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<tr>
<td>MATH 5651 - Basic Theory of Probability and Statistics (4.0 cr)</td>
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<tr>
<td>or STAT 5101 - Theory of Statistics (4.0 cr)</td>
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<tr>
<td>CSCI 1103 - Introduction to Computer Programming in Java (4.0 cr)</td>
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<tr>
<td>or CSCI 1107 - Introduction to FORTRAN Programming for Scientists and Engineers (3.0 cr)</td>
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<tr>
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<tr>
<td>or CSCI 1901 - Structure of Computer Programming I (4.0 cr)</td>
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<tr>
<td>or CSCI 1902 - Structure of Computer Programming II (4.0 cr)</td>
<td></td>
</tr>
<tr>
<td>PHYS 2303 - Physics III: Physics of Matter (4.0 cr)</td>
<td></td>
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<tr>
<td>or PHYS 2311 - Modern Physics (4.0 cr)</td>
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</tr>
<tr>
<td>or PHYS 2503 - Physics III: Foundations of Modern Physics (4.0 cr)</td>
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</tr>
</tbody>
</table>

Complete 6 credits of technical electives selected in consultation with your adviser.

**-OR-**

**Mathematical Biology Specialization**

Students select one of three options: environmental science, genomics, or physiology. Consult an adviser for more information.

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 4428 - Mathematical Modeling (4.0 cr)</td>
<td></td>
</tr>
<tr>
<td>MATH 4242 - Applied Linear Algebra (4.0 cr)</td>
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</tr>
</tbody>
</table>

**Take 1 or more course(s) from the following:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>MATH 4281 - Introduction to Modern Algebra (4.0 cr)</td>
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</tr>
<tr>
<td>MATH 5248 - Cryptology and Number Theory (4.0 cr)</td>
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<tr>
<td>MATH 5251 - Error-Correcting Codes, Finite Fields, Algebraic Curves (4.0 cr)</td>
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<tr>
<td>MATH 5285H - Honors: Fundamental Structures of Algebra I, H (4.0 cr)</td>
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</tr>
<tr>
<td>MATH 5286H - Honors: Fundamental Structures of Algebra II, H (4.0 cr)</td>
<td></td>
</tr>
<tr>
<td>MATH 5385 - Introduction to Computational Algebraic Geometry (4.0 cr)</td>
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</tbody>
</table>

**BIOL 1009 - General Biology, BIOL SCI/L (4.0 cr)**

or

**take the following course pair**

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIOL 1001 - Introductory Biology I: Evolutionary and Ecological Perspectives, BIOL SCI/L, ENVT (4.0 cr)</td>
<td></td>
</tr>
<tr>
<td>BIOL 1002W - Introductory Biology II: Molecular, Cellular, and Developmental Perspectives, WI (5.0 cr)</td>
<td></td>
</tr>
<tr>
<td>CSCI 1103 - Introduction to Computer Programming in Java (4.0 cr)</td>
<td></td>
</tr>
<tr>
<td>or CSCI 1107 - Introduction to FORTRAN Programming for Scientists and Engineers (3.0 cr)</td>
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</tr>
</tbody>
</table>
Institute of Technology

ECON 1102 - Principles of Macroeconomics, IP, SSCI (4.0 cr)
ECON 1101 - Principles of Microeconomics, IP, SSCI (4.0 cr)

MATH 5651 - Basic Theory of Probability and Statistics (4.0 cr)

Senior seminar (1 credit)
Complete an approved research internship for at least 4 credits.
Complete the requirements for the environmental science or genomics or physiology option. See your adviser for specifics.

-OR-

Actuarial Specialization
Complete the requirements for the actuarial sub-plan.

-OR-

Mathematics Education Specialization
Complete the requirements for the mathematics education sub-plan.

-OR-

Computer Applications Specialization
Complete the requirements for the computer applications sub-plan.

Program Sub-plans
A sub-plan is not required for this program.

Actuarial Science
Students should take 6 courses of mathematics or statistics and math electives in economics, accounting, insurance, and finance. For the computer science requirement, only 1103 or 1113 should be chosen.

Required Courses
Math and Computer Science
These courses will fulfill both the analysis course requirement and one of the algebra course requirements.

MATH 4065 - Theory of Interest (3.0 cr)
MATH 5067 - Actuarial Mathematics I (4.0 cr)
MATH 5068 - Actuarial Mathematics II (4.0 cr)
MATH 4242 - Applied Linear Algebra (4.0 cr)

Take 1 or more course(s) from the following:
MATH 4281 - Introduction to Modern Algebra (4.0 cr)
MATH 5248 - Cryptology and Number Theory (4.0 cr)
MATH 5251 - Error-Correcting Codes, Finite Fields, Algebraic Curves (4.0 cr)
MATH 5252 - Introduction to Ordinary Differential Equations (4.0 cr)
MATH 5253 - Dynamical Systems and Chaos (4.0 cr)
MATH 5286H - Honors: Fundamental Structures of Algebra II, H (4.0 cr)
MATH 5285H - Honors: Fundamental Structures of Algebra I, H (4.0 cr)
MATH 5385 - Introduction to Computational Algebraic Geometry (4.0 cr)
MATH 5166 - Mathematical Logic II (4.0 cr)
MATH 5535 - Dynamical Systems and Chaos (4.0 cr)
MATH 5525 - Introduction to Ordinary Differential Equations (4.0 cr)
MATH 4606 - Advanced Calculus (4.0 cr)
MATH 5486 - Introduction to Numerical Methods I (4.0 cr)
MATH 5487 - Elementary Partial Differential Equations I (4.0 cr)
MATH 5488 - Complex Analysis (4.0 cr)
MATH 5583 - Complex Analysis (4.0 cr)
MATH 5584 - Elementary Partial Differential Equations II (4.0 cr)
MATH 5585 - Introduction to Computational Algebraic Geometry (4.0 cr)
MATH 5586 - Introduction to Stochastic Processes (4.0 cr)
MATH 5587 - Elementary Partial Differential Equations I (4.0 cr)
MATH 5588 - Complex Analysis (4.0 cr)
MATH 5589 - Elementary Partial Differential Equations II (4.0 cr)
MATH 5591 - Theory of Statistics I (4.0 cr)
MATH 5592 - Theory of Statistics II (4.0 cr)
MATH 5593 - Complex Analysis (4.0 cr)
MATH 5594 - Elementary Partial Differential Equations I (4.0 cr)
MATH 5595 - Complex Analysis (4.0 cr)
MATH 5596 - Elementary Partial Differential Equations II (4.0 cr)
MATH 5597 - Theory of Statistics I (4.0 cr)
MATH 5598 - Complex Analysis (4.0 cr)
MATH 5599 - Elementary Partial Differential Equations II (4.0 cr)

Economics and Business
ECON 1101 - Principles of Microeconomics, IP, SSCI (4.0 cr)
ECON 1102 - Principles of Macroeconomics, IP, SSCI (4.0 cr)

or
ECON 1104 - Principles of Microeconomics, IP, SSCI (4.0 cr)
ECON 1105 - Principles of Macroeconomics, IP, SSCI (4.0 cr)
ACCT 2050 - Introduction to Financial Reporting (4.0 cr)
ECON 3101 - Intermediate Microeconomics (4.0 cr)
FINA 3001 - Finance Fundamentals (3.0 cr)
ECON 4751 - Financial Economics (3.0 cr)
FINA 4241 - Corporate Financing Decisions (4.0 cr)

Take 2 or more course(s) from the following:
INS 4100 - Corporate Risk Management (2.0 cr)
INS 4101 - Employee Benefits (2.0 cr)
INS 4200 - Insurance Theory and Practice (2.0 cr)

Computer Applications
Take at least 24 credits of math/computer science courses relating to computer applications. Students who complete the computer application emphasis will also satisfy the requirements for a minor in computer science.

Required Courses

Math and Computer Science
MATH 5486 may be used toward the analysis distribution requirement and MATH 5485 toward the algebra requirement.

MATH 5111 - Discrete Structures of Computer Science (4.0 cr)
MATH 5165 - Mathematical Logic I (4.0 cr)
MATH 5485 - Introduction to Numerical Methods I (4.0 cr)
MATH 5486 - Introduction To Numerical Methods II (4.0 cr)
CSCI 1103 - Introduction to Computer Programming in Java (4.0 cr)
CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)
CSCI 1901 - Structure of Computer Programming I (4.0 cr)
CSCI 1902 - Structure of Computer Programming II (4.0 cr)

Additional Algebra

Take 1 or more course(s) from the following:
MATH 4281 - Introduction to Modern Algebra (4.0 cr)
MATH 5248 - Cryptology and Number Theory (4.0 cr)
MATH 5251 - Error-Correcting Codes, Finite Fields, Algebraic Curves (4.0 cr)
MATH 5252 - Introduction to Ordinary Differential Equations (4.0 cr)
MATH 5253 - Dynamical Systems and Chaos (4.0 cr)
MATH 5285H - Honors: Fundamental Structures of Algebra I, H (4.0 cr)
MATH 5286H - Honors: Fundamental Structures of Algebra II, H (4.0 cr)
MATH 5385 - Introduction to Computational Algebraic Geometry (4.0 cr)

Additional Analysis

Take 1 or more course(s) from the following:
MATH 4606 - Advanced Calculus (4.0 cr)
MATH 5255 - Introduction to Ordinary Differential Equations (4.0 cr)
MATH 5535 - Dynamical Systems and Chaos (4.0 cr)
MATH 5583 - Complex Analysis (4.0 cr)
MATH 5584 - Elementary Partial Differential Equations I (4.0 cr)
MATH 5585 - Introduction to Computational Algebraic Geometry (4.0 cr)
MATH 5586 - Introduction to Stochastic Processes (4.0 cr)
MATH 5587 - Elementary Partial Differential Equations II (4.0 cr)
MATH 5591 - Theory of Statistics I (4.0 cr)
MATH 5592 - Theory of Statistics II (4.0 cr)

Additional Computing-Related Mathematics
A course chosen from this group that also meets the algebra distribution requirement must be taken in addition to the two courses required for all majors.

MATH 4242 - Applied Linear Algebra (4.0 cr)
MATH 5166 - Mathematical Logic II (4.0 cr)
MATH 5248 - Cryptology and Number Theory (4.0 cr)
MATH 5251 - Error-Correcting Codes, Finite Fields, Algebraic Curves (4.0 cr)
or MATH 525H - Honors: Fundamental Structures of Algebra I, H (4.0 cr)
or MATH 526H - Honors: Fundamental Structures of Algebra II, H (4.0 cr)
or MATH 5385 - Introduction to Computational Algebraic Geometry (4.0 cr)
or MATH 5487 - Computational Methods for Differential and Integral Equations in Engineering and Science I (4.0 cr)
or MATH 5705 - Enumerative Combinatorics (4.0 cr)
or MATH 5707 - Graph Theory and Nonenumerative Combinatorics (4.0 cr)
or MATH 5711 - Linear Programming and Combinatorial Optimization (4.0 cr)

Computer Science
Upper level computer science courses may be counted as technical electives.

Take 3 or more course(s) from the following:
CSCI 4041 - Algorithms and Data Structures (4.0 cr)
CSCI 5107 - Fundamentals of Computer Graphics I (3.0 cr)
CSCI 5108 - Fundamentals of Computer Graphics II (3.0 cr)
CSCI 5403 - Computational Complexity (3.0 cr)
CSCI 5421 - Advanced Algorithms and Data Structures (3.0 cr)
CSCI 5511 - Artificial Intelligence I (3.0 cr)
CSCI 5521 - Pattern Recognition (3.0 cr)
CSCI 8442 - Computational Geometry and Applications (3.0 cr)
CSCI 5512W - Artificial Intelligence II, WI (3.0 cr)
or CSCI 5519 - Artificial Intelligence II (non-WI) (3.0 cr)

Physics
A physics course from the following list should be taken in the third semester (fall semester of the second year).
PHYS 2303 - Physics III: Physics of Matter (4.0 cr)
or PHYS 2311 - Modern Physics (4.0 cr)
or PHYS 2503 - Physics III: Foundations of Modern Physics (4.0 cr)

Mathematics Education
Preparation for teaching in secondary education
Courses that are recommended but not required for this specialization include MATH 5652 Stochastic Processes or STAT 5102 Theory of Statistics II; and MATH 5336 Geometry II. IT majors can satisfy the technical elective requirement with courses in mathematics education. These may include two of MATH 5011, MATH 5021 and MATH 5031, but the mathematics adviser should be consulted to approve the technical elective.

Required Courses
These courses fulfill the both the algebra and analysis requirements.
MATH 5335 - Geometry I (4.0 cr)
MATH 4242 - Applied Linear Algebra (4.0 cr)
or MATH 4281 - Introduction to Modern Algebra (4.0 cr)
or MATH 525H - Honors: Fundamental Structures of Algebra I, H (4.0 cr)
MATH 4707 - Introduction to Combinatorics and Graph Theory (4.0 cr)
or MATH 5705 - Enumerative Combinatorics (4.0 cr)
or MATH 5707 - Graph Theory and Nonenumerative Combinatorics (4.0 cr)
MATH 5651 - Basic Theory of Probability and Statistics (4.0 cr)
or STAT 5101 - Theory of Statistics I (4.0 cr)

Computer Science
CSCI 1103 - Introduction to Computer Programming in Java (4.0 cr)
or CSCI 1107 - Introduction to FORTRAN Programming for Scientists and Engineers (3.0 cr)
or CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)
or CSCI 1901 - Structure of Computer Programming I (4.0 cr)
or CSCI 1902 - Structure of Computer Programming II (4.0 cr)

Physics
Take one of the following physics courses in the third semester (fall semester of the second year).
PHYS 2303 - Physics III: Physics of Matter (4.0 cr)
or PHYS 2311 - Modern Physics (4.0 cr)
or PHYS 2503 - Physics III: Foundations of Modern Physics (4.0 cr)

School Mathematics
Consult an adviser before completing this requirement.

Take 2 or more course(s) from the following:
MTHE 5011 - Arithmetic Structures in School Mathematics (3.0 cr)
MTHE 5021 - Algebraic Structures in School Mathematics (3.0 cr)
MTHE 5031 - Geometric Structures in School Mathematics (3.0 cr)

Mechanical Engineering B.M.E.

Mechanical Engineering
Requirements for this program are current for Fall 2006.
Required credits to graduate with this degree: 128.
Required credits within the major: 49.
Degree: Bachelor of Mechanical Engineering.
The Department of Mechanical Engineering is committed to offering undergraduate and graduate education of the highest quality in mechanical and industrial engineering, to conducting significant basic and applied research in selected areas, and to providing professional service to the appropriate constituencies of a major land grant university.
Mechanical engineering is involved in most technological activities of society and dominates many, including automotive, transportation and materials handling, environmental and pollution control systems, refrigeration and cryogenics, power systems design, automation, system dynamics and control, computer-aided design and manufacturing, and machinery/consumer products production. A mechanical engineer may be engaged in design, development, research, testing, manufacturing, administration, marketing, consulting, or education.

Admission Requirements
Students must complete 9 courses before admission to the program.
Freshmen and transfer students are usually admitted to pre-major status before admission to this major.
A GPA above 2.00 is preferred for the following:
• 2.50 for students already admitted to the degree-granting college.
• 2.50 for students transferring from another University of Minnesota college.
• 3.00 for students transferring from outside the University.
For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.
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Required Courses for Admission

Mathematics
MATH 1271 - Calculus I, MATH (4.0 cr)
or MATH 1371 - IT Calculus I, MATH (4.0 cr)
MATH 1272 - Calculus II (4.0 cr)
or MATH 1372 - IT Calculus II (4.0 cr)
MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)
MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

Physical Sciences
CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)
CHEM 1021 - Chemical Principles I, ENVT, PHYS SCI/L (4.0 cr)
or CHEM 1031H - Honors Chemistry I, ENVT, PHYS SCI/L, H (4.0 cr)
PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4.0 cr)
or PHYS 1401V - Honors Physics I, PHYS SCI/L, WI, H (4.0 cr)
PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4.0 cr)
or PHYS 1402V - Honors Physics II, PHYS SCI/L, WI, H (4.0 cr)

Statics and Dynamics
AEM 2011 - Statics (3.0 cr)
or take the following course pair
AEM 2011 - Statics (3.0 cr)
AEM 2012 - Dynamics (3.0 cr)

Program Requirements

Required Courses

Major Courses
AEM 3031 - Deformable Body Mechanics (3.0 cr)
EE 3005 - Fundamentals of Electrical Engineering (4.0 cr)
EE 3006 - Fundamentals of Electrical Engineering Laboratory (1.0 cr)
IE 4521 - Statistics, Quality, and Reliability (4.0 cr)
MATS 2001 - Introduction to the Science of Engineering Materials (3.0 cr)
ME 2011 - Introduction to Engineering (4.0 cr)
ME 3221 - Design and Manufacturing I: Engineering Materials and Manufacturing Processes (4.0 cr)
ME 3222 - Design and Manufacturing II (4.0 cr)
ME 3281 - System Dynamics and Control (4.0 cr)
ME 3331 - Thermal Sciences I (3.0 cr)
ME 3332 - Thermal Sciences II (3.0 cr)
ME 3333 - Thermal Sciences III (3.0 cr)
ME 4031W - Basic Mechanical Measurements Laboratory, WI (4.0 cr)
ME 4054W - Design Projects, WI (4.0 cr)

Electives
ME 4131W - Thermal Environmental Engineering Laboratory, WI (4.0 cr)
or ME 4231 - Motion Control Laboratory (4.0 cr)
or ME 4232 - Fluid Power Control Lab (4.0 cr)
or ME 4331 - Thermal Engineering Laboratory (4.0 cr)
or ME 4431W - Energy Conversion Systems Laboratory, WI (4.0 cr)
or ME 5133 - Aerosol Measurement Laboratory (4.0 cr)
or ME 5231 - Digital and Analog Control Laboratory (4.0 cr)

Technical Electives
Complete 16 credits of upper division technical electives, with at least 8 credits in ME/IE. Students may choose options in power and propulsion, design and manufacturing, thermodynamics and heat transfer, or environment or select electives in consultation with their adviser.

Program Sub-plans

A sub-plan is not required for this program.

EIP

ME EIP program (engineering intern program or co-op program) is available during the last two years of study. Upper division status and a satisfactory GPA are required for admission. The co-op program provides applied engineering training in selected established industries during semesters of supervised assignments that alternate with semesters of University studies. Students in the ME EIP program (engineering intern program or Co-op program) register for three industrial assignment courses. ME 3041 (2 credits), ME 4042 (2 credits), and ME 4043W (4 credits) for a total of 8 credits. These courses are used in place of two technical electives.

Students register for industrial assignments as they would for regular classes. Requirements for the course include writing a summary of an article in a technical journal, attending a workshop (ME 3041, ME 4043), submitting a report draft, and writing a final report. The course grade is based on writing; work performance cannot be considered in assigning a grade. The last industrial assignment, ME 4043, is oriented toward solving a design problem and fulfills a 4-credit intensive writing course requirement. Cooperation from company personnel is required in accomplishing most reports, particularly the ME 4043 reports.

Required Courses

Internship
ME 3041 - Industrial Assignment I (2.0 cr)
ME 4042 - Industrial Assignment II (2.0 cr)
ME 4043W - Industrial Assignment III, WI (4.0 cr)

Industrial Engineering

The IE option gives students an understanding of managerial and human factor issues involved in designing products and running manufacturing, logistics, and service operations. Students also learn additional skills for analysis, optimization, and simulation of large-scale systems such as factories, logistical systems, and organizational networks.

Students who select the IE option complete the same set of required courses as other mechanical engineering students, but their technical electives are selected from the industrial engineering course options and in consultation with a faculty adviser.

Required Courses

Technical Electives
Take 4 Courses (16 credits) from the following list. Choose one course from each area.

Tech Elective - Human Factors
or IE 5511 - Human Factors and Work Analysis (4.0 cr)
or IE 5512 - Applied Ergonomics (4.0 cr)
or IE 5513 - Engineering Safety (4.0 cr)
**Tech Elective - Engineering Management**
- or IE 5441 - Engineering Cost Accounting and Cost Control (4.0 cr)
- or IE 5522 - Quality Engineering and Reliability (4.0 cr)
- or IE 5541 - Project Management (4.0 cr)
- Tech Elective - Production Systems
  - or IE 5551 - Production Planning and Inventory Control (4.0 cr)
  - or IE 5552 - Design and Analysis of Manufacturing Systems (4.0 cr)

**Tech Elective - Operations Research**
- or IE 5531 - Engineering Optimization I, H (4.0 cr)
- or IE 5553 - Simulation (4.0 cr)

**Industrial Engineering EIP**
The Engineering Intern Program (EIP or co-op program) for industrial engineering students is offered through an industrial engineering option. Students complete the same set of required courses as other mechanical engineering students, but their technical electives must be selected from an approved list and in consultation with a faculty adviser. Students selecting the option may also apply to the co-op program.

Technical electives should be taken in the IE department. Students should also take the necessary course in conjunction with their internship/co-op program.

**Required Courses**

**Technical Electives**
Choose 4 courses (16 credits) from the following list. Choose one course from each area.

**Tech Elective - Human Factors**
- or IE 5511 - Human Factors and Work Analysis (4.0 cr)
- or IE 5512 - Applied Ergonomics (4.0 cr)
- or IE 5513 - Engineering Safety (4.0 cr)

**Tech Elective - Engineering Management**
- or IE 5441 - Engineering Cost Accounting and Cost Control (4.0 cr)
- or IE 5522 - Quality Engineering and Reliability (4.0 cr)
- or IE 5541 - Project Management (4.0 cr)

**Tech Elective - Production Systems**
- or IE 5551 - Production Planning and Inventory Control (4.0 cr)
- or IE 5552 - Design and Analysis of Manufacturing Systems (4.0 cr)

**Tech Elective - Operations Research**
- or IE 5531 - Engineering Optimization I, H (4.0 cr)
- or IE 5553 - Simulation (4.0 cr)

**Internship**
- ME 3041 - Industrial Assignment I (2.0 cr)
- ME 4042 - Industrial Assignment II (2.0 cr)
- ME 4043W - Industrial Assignment III, WI (4.0 cr)

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**Physics B.S. Phys.**

**School of Physics & Astronomy**
Requirements for this program are current for Fall 2006.
Required credits to graduate with this degree: 120.
Required credits within the major: 38 to 41.
Degree: Bachelor of Science in Physics.

The physics program prepares students for employment, often in industrial or governmental laboratories, or for further study at graduate or professional schools in physics, engineering, biophysics, medicine, education, law, or business.

The program integrates a broad foundation in physics that can be flexibly combined with coursework in other technical disciplines or used to specialize in physics. Students should consult a physics adviser to help formulate objectives for study.

**Admission Requirements**
Students must complete 7 courses before admission to the program.
Freshmen and transfer students are usually admitted to pre-major status before admission to this major.
A GPA above 2.00 is preferred for the following:
- 2.50 for students transferring from another University of Minnesota college.
- 2.80 for students transferring from outside the University.

For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

**Required Courses for Admission**

**Preparatory Mathematics**
Math 1571-1572-2573 (Honors math sequence) may be taken in place of the listed courses.
- MATH 1271 - Calculus I, MATH (4.0 cr)
- or MATH 1371 - IT Calculus I, MATH (4.0 cr)
- MATH 1272 - Calculus II (4.0 cr)
- or MATH 1372 - IT Calculus II (4.0 cr)
- MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
- or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)
- MATH 2263 - Multivariable Calculus (4.0 cr)
- or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

**Preparatory Physics**
- PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4.0 cr)
- or PHYS 1401V - Honors Physics I, PHYS SCI/L, WI, H (4.0 cr)
- PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4.0 cr)
- or PHYS 1402V - Honors Physics II, PHYS SCI/L, WI, H (4.0 cr)
- PHYS 2403H - Honors Phys III, H (4.0 cr)
- or PHYS 2503 - Physics III: Foundations of Modern Physics (4.0 cr)

**Program Requirements**
In addition to the official concentrations in physics (biological physics, engineering physics, physics for teaching), students may also complete a focus in either computational physics or professional physics.
For computational physics, students must take the two remaining courses they did not use to satisfy the major core requirements from the list of PHYS 4001, 4002, 4101, and 4201 noted above. Students must also take 19 credits of technical electives, chosen in consultation with an adviser. Any course in the sciences, math, or engineering may be used to fulfill these requirements. Students intending to pursue graduate study in physics are strongly encouraged to take PHYS 4303.

**Required Courses**

**Major Courses**

- PHYS 2601 - Quantum Physics (4.0 cr)
- PHYS 2605 - Quantum Physics Laboratory (3.0 cr)
- PHYS 4051 - Methods of Experimental Physics I (5.0 cr)
- PHYS 4052W - Methods of Experimental Physics II, WI (5.0 cr)

**Technical Electives or Specializations**

Complete 19 credits of technical electives or one of the optional specializations (sub-plans).

Students are required to complete one of the following course groups.

**Specialization**

Complete the requirements listed in the any of the following physics subplans: computational physics, biological, engineering, or teaching.

-OR-

**Technical Electives**

Select at least 19 credits of technical electives in consultation with your adviser.

-OR-

**Professional Physics**

For students who want the strongest possible grounding in physics, are interested in fundamental physics or astrophysics or applying physics to the workplace, or plan to continue physics education in graduate school.

- PHYS 4001 - Analytical Mechanics (4.0 cr)
- PHYS 4002 - Electricity and Magnetism (4.0 cr)
- PHYS 4101 - Quantum Mechanics (4.0 cr)
- PHYS 4201 - Statistical and Thermal Physics (3.0 cr)

Take an additional 19 credits of approved technical electives from the sciences, math, or engineering.

**Take 3 or more credit(s) from the following:**

- MATH 3xxx
- MATH 4xxx
- MATH 5xxx

**Take 1 or more course(s) totaling 3 or more credit(s) from the following:**

- PHYS 3xxx
- PHYS 4xxx
- PHYS 5xxx

**Program Sub-plans**

A sub-plan is not required for this program.

**Biological**

For students with an interest in the biological applications of physics.

**Required Courses**

**Physics for Biology**

- BIOL 3021 - Biochemistry (3.0 cr)
- BIOL 1009 - General Biology, BIOL SCI/L (4.0 cr)
- CHEM 1021 - Chemical Principles I, ENVT, PHYS SCI/L (4.0 cr)
- CHEM 1022 - Chemical Principles II, ENVT, PHYS SCI/L (4.0 cr)
- CHEM 2301 - Organic Chemistry I (3.0 cr)
- PHYS 4001 - Analytical Mechanics (4.0 cr)
- PHYS 4002 - Electricity and Magnetism (4.0 cr)

Complete 14 credits of technical electives with a biology emphasis, chosen in consultation with your adviser.

- CHEM 3501 - Physical Chemistry I (3.0 cr)
- or PHYS 4201 - Statistical and Thermal Physics (3.0 cr)
- CHEM 3502 - Physical Chemistry II (3.0 cr)
- or PHYS 4101 - Quantum Mechanics (4.0 cr)

**Computational Physics**

For students who are interested in the practical application of physics and computational methods, but who want a less specialized education than they would find in a computer science department.

Consult with a physics adviser for selection of at least 19 credits of technical electives.

**Required Courses**

Select 19 credits of technical electives in consultation with your adviser.

**Engineering**

For students interested in physics as applied in engineering professions.

Take the two remaining courses you did not use to satisfy the major core requirements from the list of PHYS 4001, 4002, 4101, and 4201.

**Required Courses**

**Physics for Engineering**

- CHEM 1021 - Chemical Principles I, ENVT, PHYS SCI/L (4.0 cr)
- PHYS 4101 - Quantum Mechanics (4.0 cr)

Complete 25 credits of technical electives in various engineering fields, physical sciences, or math, in consultation with your adviser.

- AEM 2021 - Statics and Dynamics (4.0 cr)
- or PHYS 4001 - Analytical Mechanics (4.0 cr)

or take the following course pair

- AEM 2111 - Statics (3.0 cr)
- AEM 2112 - Dynamics (3.0 cr)
- EE 3601 - Transmission Lines, Fields, and Waves (3.0 cr)
- or PHYS 4002 - Electricity and Magnetism (4.0 cr)
- ME 3321 - Thermodynamics (4.0 cr)
- or ME 3324 - Introduction to Thermal Science (3.0 cr)
- or PHYS 4201 - Statistical and Thermal Physics (3.0 cr)

**Teaching**

For students with an interest in teaching the physical sciences at the primary or secondary levels.

Requirements for this program are current for Fall 2006.

Required credits to graduate with this degree: 120.

Required credits within the major: 38.

Degree: Bachelor of Science in Statistics.

The program gives students an understanding of the theory of statistics, trains them in basic use of the most important types of statistical methods, and prepares them for graduate work or for jobs in such diverse areas as marketing analysis, quality management, and support for scientific research.

The program provides a broad foundation in statistics that can be combined with coursework in other technical disciplines or as a basis for further specialization in statistics.

Admission Requirements

Students must complete 4 courses before admission to the program.

Freshmen and transfer students are usually admitted to pre-major status before admission to this major.

A GPA above 2.00 is preferred for the following:
- 2.50 for students transferring from outside the University.

For information about University of Minnesota admission requirements, visit the Office of Admissions Web site at http://admissions.tc.umn.edu.

Required Courses for Admission

Mathematics

MATH 1271 - Calculus I, MATH (4.0 cr)
or MATH 1371 - IT Calculus I, MATH (4.0 cr)
MATH 1272 - Calculus II (4.0 cr)
or MATH 1372 - IT Calculus II (4.0 cr)
MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
or MATH 2373 - IT Linear Algebra and Differential Equations (4.0 cr)
MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2374 - IT Multivariable Calculus and Vector Analysis (4.0 cr)

Program Requirements

Required Courses

Major Courses

STAT 3011 - Introduction to Statistical Analysis, MATH (4.0 cr)
or STAT 3021 - Introduction to Probability and Statistics (3.0 cr)
MATH 4242 - Applied Linear Algebra (4.0 cr)
STAT 3022 - Data Analysis (4.0 cr)
STAT 4893W - Senior Paper, WI (1.0 cr)

Take one of the following pairs of courses.
STAT 4101 - Theory of Statistics I (4.0 cr)
or
STAT 5101 - Theory of Statistics I (4.0 cr)
STAT 4102 - Theory of Statistics II (4.0 cr)
or
STAT 5102 - Theory of Statistics II (4.0 cr)

Electives

Take 10 or more credit(s) from the following:
STAT 5031 - Statistical Methods for Quality Improvement (4.0 cr)
STAT 5041 - Bayesian Decision Making (3.0 cr)
STAT 5201 - Sampling Methodology in Finite Populations (3.0 cr)
STAT 5302 - Applied Regression Analysis (4.0 cr)
STAT 5303 - Designing Experiments (4.0 cr)
STAT 5401 - Applied Multivariate Methods (3.0 cr)
STAT 5421 - Analysis of Categorical Data (3.0 cr)
STAT 5601 - Nonparametric Methods (3.0 cr)
Computer and Physical Sciences
CSCI 1103 - Introduction to Computer Programming in Java (4.0 cr)
or CSCI 1107 - Introduction to FORTRAN Programming for Scientists and Engineers (3.0 cr)
or CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)

Students must complete 3 science courses with a lab component, chosen from at least 2 of the fields of physics, chemistry, biology.

Take 3 or more course(s) including 2 or more sub-requirement(s).

Take 0 - 1 course(s) from the following:
BIOL 1009 - General Biology, BIOL SCI/L (4.0 cr)
BIOL 1009H - Honors: General Biology, BIOL SCI/L, H (4.0 cr)

Take 0 - 2 course(s) from the following:
CHEM 1021 - Chemical Principles I, ENVT, PHYS SCI/L (4.0 cr)
or CHEM 1031H - Honors Chemistry I, ENVT, PHYS SCI/L, H (4.0 cr)
CHEM 1022 - Chemical Principles II, ENVT, PHYS SCI/L (4.0 cr)
or CHEM 1032H - Honors Chemistry II, ENVT, PHYS SCI/L, H (4.0 cr)

Take 0 - 2 course(s) from the following:
PHYS 1301W - Introductory Physics for Science and Engineering I, PHYS SCI/L, WI (4.0 cr)
or PHYS 1401V - Honors Physics I, PHYS SCI/L, WI, H (4.0 cr)
PHYS 1302W - Introductory Physics for Science and Engineering II, PHYS SCI/L, WI (4.0 cr)
or PHYS 1402V - Honors Physics II, PHYS SCI/L, WI, H (4.0 cr)

Technical Electives
Students complete 10 credits of adviser-approved courses in computer science, biostatistics, industrial engineering, mathematics, or other areas.