



Duluth Campus

Aerospace Studies Minor

Aerospace Studies

Swenson College of Science and Engineering

- Program Type: Undergraduate free-standing minor
- Requirements for this program are current for Fall 2011
- Required credits in this minor: 32 to 41

The Air Force Reserve Officer Training Corps (AFROTC) is a college-level educational program that gives students the opportunity to become Air Force officers while completing their degrees. Any student may enroll in aerospace studies courses. AFROTC offers post-collegiate opportunities in more than 100 career specialties. Air Force officers are challenged with organizational responsibilities and experiences not often available to new college graduates. This program is for students who want to challenge themselves as Air Force leaders and managers while serving their country in a professional, high-tech environment.

Active-duty Air Force officers provide a curriculum that gives students insight into the mission, organization, and operation of the U.S. Air Force. Students study Air Force history, leadership, management, professionalism, and U.S. foreign policy and its relationship to defense policy. Scholarships are available on a competitive basis. High school seniors and college students can compete for five-, four-, three-, two (and sometimes one-) year scholarships that cover tuition, fees, and book expenses. Participants may qualify to receive a tax-free allowance for each month in school.

The aerospace studies minor provides preparation in areas studied by most officers early in their service careers. The minor increases future officers' performance potential in two areas in which all officers must eventually develop competence: communication skills and international affairs.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Minor Requirements

Lower Division

AIR 100 or AIR 1000 must be taken 4 times.

[AIR 1101](#) - Foundations of the U.S. Air Force (1.0 cr)

[AIR 1102](#) - Foundations of the U.S. Air Force (1.0 cr)

[AIR 2101](#) - The Evolution of the U.S. Air Force Air and Space Power (1.0 cr)

[AIR 2102](#) - The Evolution of the U.S. Air Force Air and Space Power (1.0 cr)

AIR 100 *{Inactive}*(0.0 cr)

or [AIR 1000](#) - AFROTC GMC Lead Lab (1.0 cr)

Communication

[COMM 1112](#) - Public Speaking [LE CAT3, COMM & LAN] (3.0 cr)

or [COMM 1222](#) - Interpersonal Communication [LE CAT3, LECD CAT03, COMM & LAN] (3.0 cr)

Math

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

- MATH 1xxx
- MATH 2xxx

Upper Division

AIR 3000 or AIR 3001 must be taken 4 times.

[AIR 3101](#) - Air Force Leadership Studies (3.0 cr)

[AIR 3102](#) - Air Force Leadership Studies (3.0 cr)

[AIR 4101](#) - National Security Affairs, Preparation for Active Duty (3.0 cr)

[AIR 4102](#) - National Security Affairs, Preparation for Active Duty (3.0 cr)

[AIR 3000](#) - AFROTC POC Leadership Laboratory (1.0 cr)

or [AIR 3001](#) - AFROTC POC Lead Lab (2.0 cr)

Advanced Writing

WRIT 31xx

Electives

The history and political science courses must be approved by department head.



Take 1 or more course(s) totaling 3 - 4 credit(s) from the following:

- [GEOG 4393](#) - Political Geography (3.0 cr)
- POL 3xxx
- HIST 2xxx
or HIST 3xxx

Duluth Campus

Applied Physics B.S.

UMD-Physics & Astronomy

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 120
- Required credits within the major: 75 to 77
- Degree: Bachelor of Science

The B.S. in applied physics is primarily for students planning to work in industry and offers flexibility in selection of technical electives. The physics courses emphasize conceptual foundations, problem-solving skills, and experimental and computational techniques.

Students are encouraged to participate in research, with emphasis in experimental high-energy physics and particle astrophysics; limnological research, including observational studies and modeling of lakes; and computational physics. Additional faculty interests include optics and condensed matter physics. The department also offers courses required for other science and engineering programs.

Honors Requirements: To graduate with honors, students must participate in the department honors program, complete and present a research project, and maintain a GPA above 3.00 overall and in the major. They are also expected to attend department colloquia. Interested students should contact the physics honors program coordinator.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Requirements for the B.S. in applied physics include:

* A minor or a second major in a different program.

The first math course is determined by the Math ACT score. The sample plan presupposes placement into MATH 1296.

Courses numbered above 3xxx are offered in alternate years only. Some courses suggested in the sample plan for the junior and senior years may need to be switched to match the course offerings.

Core Courses (29 cr)

The department also recommends the supplementary courses PHYS 2111 and PHYS 2112.

- PHYS 1021 - Exploring Current Topics in Physics (1.0 cr)
- PHYS 2011 *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)
- PHYS 2012 *{Inactive}*(4.0 cr)
- PHYS 2021 - Relativity and Quantum Physics (4.0 cr)
- PHYS 2022 - Classical Physics (4.0 cr)
- PHYS 2033 - Classical and Quantum Physics Lab (2.0 cr)
- PHYS 3061 - Instrumentation (3.0 cr)
- PHYS 5061 - Experimental Methods (3.0 cr)
- PHYS 5090 - Physics Seminar (1.0 cr)
- PHYS 5052 - Computational Methods in Physics (3.0 cr)
or PHYS 5053 - Data Analysis Methods in Physics (3.0 cr)

Electives (8 cr)

Take 8 or more credit(s) from the following:

- PHYS 4001 - Classical Mechanics (4.0 cr)
- PHYS 4011 - Electromagnetic Theory (4.0 cr)
- PHYS 4021 - Quantum Physics II (4.0 cr)
- PHYS 4031 - Thermal and Statistical Physics (4.0 cr)

Technical Electives (9 cr)

The computational course not selected in Core Courses may be used as a technical elective. Engineering courses approved by the department may also be used.

Take 9 or more credit(s) from the following:

- AST 4110 - Observational Astronomy (3.0 cr)
- LIM 5101 - Physical Limnology (3.0 cr)
- PHYS 5041 - Optics (3.0 cr)
- PHYS 5043 *{Inactive}*(3.0 cr)
- PHYS 5531 - Introduction to Solid State Physics (3.0 cr)
- PHYS 5541 - Fluid Dynamics (3.0 cr)
- PHYS 5052 - Computational Methods in Physics (3.0 cr)
or PHYS 5053 - Data Analysis Methods in Physics (3.0 cr)
- PHYS 3561 - Astrophysics (3.0 cr)
or PHYS 5561 - Astrophysics (3.0 cr)

Courses From Other Programs (29-31 cr)

Two semesters of chemistry are recommended.

- MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
- MATH 1297 - Calculus II [LOGIC & QR] (5.0 cr)
- MATH 3280 - Differential Equations with Linear Algebra (4.0 cr)
- MATH 3298 - Calculus III (4.0 cr)
- CHEM 1161 *{Inactive}*[LE CAT4, NAT SCI] (5.0 cr)
or CHEM 1153 - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)
CHEM 1154 - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)
- CS 1511 - Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)
or CS 1131 *{Inactive}*[LE CAT3] (3.0 cr)
- WRIT 3130 - Advanced Writing: Engineering (3.0 cr)
or WRIT 3150 - Advanced Writing: Science (3.0 cr)

**Duluth Campus****Astronomy Minor***D Earth & Environmental Sci, UMD-Physics & Astronomy***Swenson College of Science and Engineering**

- Program Type: Undergraduate free-standing minor
- Requirements for this program are current for Fall 2011
- Required credits in this minor: 34
- None

The astronomy minor enhances students' understanding of the formation, structure, and evolution of the Universe while providing a sound foundation for professional programs in the sciences. The minor program covers a wide range of topics in general astronomy, comparative planetology, stellar dynamics, astrophysics, cosmology, and techniques of astronomical observation and analysis.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Minor Requirements**Astronomy Required Courses (24 cr)**

[AST 1040](#) - Introductory Astronomy [LE CAT5, NAT SCI] (3.0 cr)

[AST 4110](#) - Observational Astronomy (3.0 cr)

PHYS 2011 *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)

PHYS 2012 *{Inactive}*(4.0 cr)

[PHYS 2021](#) - Relativity and Quantum Physics (4.0 cr)

[PHYS 3561](#) - Astrophysics (3.0 cr)

[GEOL 2120](#) - The Earth's Dynamic Interior (3.0 cr)

or [AST 2040](#) - The Solar System (3.0 cr)

Math Requirement (10 cr)

[MATH 1296](#) - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)

[MATH 1297](#) - Calculus II [LOGIC & QR] (5.0 cr)



Duluth Campus

Biochemistry and Molecular Biology B.S.

Chemistry and Biochemistry

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 120
- Required credits within the major: 86
- This program requires summer terms.
- Degree: Bachelor of Science

Biochemistry and molecular biology is the study of life at the molecular level. This field is both a life science and a chemical science, exploring the chemistry of living organisms and the molecular basis for the processes that occur in living cells. The Department of Chemistry and Biochemistry provides classroom and laboratory learning opportunities and research experiences across the discipline to meet the needs of students in engineering, liberal arts and preprofessional programs as well as those of students who wish to pursue careers or graduate studies in chemistry or related disciplines.

Honors Requirements: The Department of Chemistry and Biochemistry honors program helps outstanding biochemistry and molecular biology majors become competent, independent research workers, encourages student interest in the discipline, and aids in the transition from student to working scientist. Qualified majors may apply after the first semester of their sophomore year. Participants choose a research adviser and complete two semesters on a jointly developed project. Written reports and an oral presentation of the research are also required.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Requirements for the B.S. in biochemistry and molecular biology include:

- * A minor from another area of study is required.

* Students who earn a B.S. in biochemistry and molecular biology (BMB) will have met the requirements for the B.A. in chemistry and for the chemistry minor. The B.A. in chemistry may be declared as an additional degree with the B.S. BMB, however, this combination does not satisfy the college degree requirement for a second major or minor. A minor in chemistry cannot be declared with the B.S. BMB. The B.S. BMB major/B.S. chemistry major combination does satisfy the college degree requirement.

* Students earning a B.S. degree who wish to have their program certified by the American Chemical Society must take advanced courses that include additional hours of laboratory work.

Year One (30 cr)

High school algebra and high school chemistry are required for CHEM 1153/1154 and CHEM 1161.

This schedule presupposes placement into MATH 1296.

[BIOL 1011](#) - General Biology I [LE CAT4, NAT SCI] (5.0 cr)

[BIOL 1012](#) - General Biology II [SUSTAIN] (5.0 cr)

[MATH 1296](#) - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)

[MATH 1297](#) - Calculus II [LOGIC & QR] (5.0 cr)

[CHEM 1161](#) *{Inactive}*[LE CAT4, NAT SCI] (5.0 cr)

or [CHEM 1153](#) - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)

[CHEM 1154](#) - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)

[CHEM 1162](#) *{Inactive}*(5.0 cr)

or [CHEM 1155](#) - General Chemistry II (4.0 cr)

[CHEM 1156](#) - General Chemistry Lab II (1.0 cr)

Year Two (23-24 cr)

[BIOL 3100](#) - Cell Biology (3.0 cr)

[CHEM 2541](#) - Organic Chemistry I (3.0 cr)

[CHEM 2542](#) - Organic Chemistry II (3.0 cr)

[CHEM 2543](#) - Organic Chemistry I Laboratory (1.0 cr)

[PHYS 2011](#) *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)

[PHYS 2012](#) *{Inactive}*(4.0 cr)

[CHEM 2544](#) - Organic Chemistry II Laboratory (1.0 cr)

or [CHEM 2545](#) - Organic Chemistry II Laboratory for B.S. Chemistry Majors (2.0 cr)

[CHEM 2222](#) - Quantitative Analysis (3.0 cr)

[CHEM 2223](#) - Quantitative Analysis Laboratory (1.0 cr)

or [CHEM 2242](#) - Analytical Chemistry and the Environment in Poland (4.0 cr)

Year Three (20 cr)

[BIOL 2201](#) - Genetics (3.0 cr)

[BIOL 4231](#) - Molecular Biology (3.0 cr)

[BIOL 5232](#) - Molecular Biology Laboratory (2.0 cr)

[CHEM 4351](#) - Biochemistry I (3.0 cr)

[CHEM 4352](#) - Biochemistry II (3.0 cr)

[CHEM 4363](#) - Biochemistry Laboratory (2.0 cr)

[CHEM 4633](#) - Physical Chemistry Laboratory (1.0 cr)

[CHEM 4634](#) - Physical Chemistry (3.0 cr)

or [CHEM 4641](#) - Physical Chemistry I (3.0 cr)

[CHEM 4642](#) - Physical Chemistry II (3.0 cr)

[CHEM 4643](#) - Physical Chemistry Laboratory I (1.0 cr)

[CHEM 4644](#) - Physical Chemistry Laboratory II (1.0 cr)

Year Four (7 cr)

[CHEM 3432](#) - Descriptive Inorganic Chemistry (3.0 cr)

[CHEM 4184](#) - Undergraduate Seminar I (1.0 cr)

[CHEM 4185](#) - Undergraduate Seminar II (1.0 cr)

[CHEM 4373](#) - Physical Biochemistry (3.0 cr)

Elective (3 cr)

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

•[CHEM 4242](#) - Instrumental Analysis (3.0 cr)

•[CHEM 4436](#) - Inorganic Chemistry (3.0 cr)

•[BIOL 3502](#) - General Microbiology (4.0 cr)

•[BIOL 4503](#) *{Inactive}*(4.0 cr)

•[IBS 5101](#) - Biochemistry and Molecular Biology (3.0 cr)

•[MATH 5233](#) - Mathematical Foundations of Bioinformatics (3.0 cr)

•[BMS 5201](#) - Topics in Biochemistry (3.0 cr)



- [BMS 5202](#) - Cellular and Molecular Biology (3.0 cr)
- [BMS 5545](#) - Immunology (3.0 cr)

Advanced Writing (3 cr)

WRIT 31xx Advanced Writing

Duluth Campus

Biology B.S.

Biology

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 120
- Required credits within the major: 78 to 84
- Degree: Bachelor of Science

The B.S. in biology offers preparation for graduate school and a sound basis for professional training in the biological and health sciences. Biology is an unusually broad field, and students can tailor their programs to fit their own needs and interests. To provide flexibility in pursuing personal interests or career preparation, the student chooses 18 credits of upper division biology electives.

The Department of Biology encourages students to develop as active scholars and to participate in undergraduate research. The B.S. degree is detailed and specific with a concentration in science related coursework.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Requirements for the B.S. in biology include:

* A minor or second major from another area of study; the cell biology major may not be used to meet this requirement.

Biology Core Courses (25 cr)

[BIOL 1011](#) - General Biology I [LE CAT4, NAT SCI] (5.0 cr)

[BIOL 1012](#) - General Biology II [SUSTAIN] (5.0 cr)

[BIOL 3100](#) - Cell Biology (3.0 cr)

[BIOL 2201](#) - Genetics (3.0 cr)

[BIOL 2801](#) - General Ecology (3.0 cr)



BIOL 3987 - Communication in Biology (2.0 cr)
BIOL 3401 - Evolution [SUSTAIN] (3.0 cr)
BIOL 2102 - Cell Biology Laboratory (2.0 cr)
or BIOL 2202 - Genetics Laboratory (2.0 cr)
or BIOL 2802 - Ecology Laboratory (2.0 cr)

Chemistry Requirement (17-18 cr)

CHEM 2541 - Organic Chemistry I (3.0 cr)
CHEM 2543 - Organic Chemistry I Laboratory (1.0 cr)

General Chemistry

CHEM 1153 - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)
CHEM 1154 - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)
CHEM 1155 - General Chemistry II (4.0 cr)
CHEM 1156 - General Chemistry Lab II (1.0 cr)
or CHEM 1161 *{Inactive}*[LE CAT4, NAT SCI] (5.0 cr)
CHEM 1162 *{Inactive}*(5.0 cr)

Additional Chemistry

CHEM 2212 - Environmental Chemistry [NAT SCI, SUSTAIN] (4.0 cr)
or GEOL 3710 - Introduction to Geochemistry (3.0 cr)
or CHEM 2222 - Quantitative Analysis (3.0 cr)
CHEM 2223 - Quantitative Analysis Laboratory (1.0 cr)
or CHEM 2542 - Organic Chemistry II (3.0 cr)
CHEM 2544 - Organic Chemistry II Laboratory (1.0 cr)

Biology Electives 2xxx-5xxx (18 cr)

Must include a minimum of two lab courses or courses with a lab component. Two of the following may be used: MDBC 5501, MICB 5545, MICB 5555, PHSL 5601, PHSL 5602. Two credits of SSP 3002 - Teaching Assistant Practicum for supplemental instruction in biology may be substituted for BIOL 3993 an upper division elective with department approval.

Take 18 or more credit(s) from the following:

- BIOL 2xxx
- BIOL 3xxx
- BIOL 4xxx
- BIOL 5xxx
- BIOL 3601 - Plant Diversity (3.0 cr)
or BIOL 3701 - Animal Diversity (4.0 cr)
or BIOL 3502 - General Microbiology (4.0 cr)
or BIOL 4503 *{Inactive}*(4.0 cr)

Courses From Other Programs (18-23 cr)

First math course is determined by students ACT math score. This schedule presupposes placement into MATH 1290/1296. Courses cannot be used to fulfill more than one category.

WRIT 3150 - Advanced Writing: Science (3.0 cr)

Mathematics requirement

MATH 1290 - Calculus for the Natural Sciences [LE CAT2, LOGIC & QR] (5.0 cr)
or MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
or MATH 1596 *{Inactive}*[LE CAT2, LOGIC & QR] (5.0 cr)
MATH 1297 - Calculus II [LOGIC & QR] (5.0 cr)
or STAT 2411 - Statistical Methods [LE CAT2, LOGIC & QR] (3.0 cr)

Physics requirement

PHYS 1001 - Introduction to Physics I [LE CAT4, NAT SCI] (5.0 cr)
or PHYS 2011 *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)
PHYS 1002 - Introduction to Physics II (5.0 cr)
or PHYS 2012 *{Inactive}*(4.0 cr)
or CS 1121 - Introduction to Programming in Visual BASIC.NET [LE CAT3, LOGIC & QR] (3.0 cr)
or MATH 1297 - Calculus II [LOGIC & QR] (5.0 cr)
or STAT 2411 - Statistical Methods [LE CAT2, LOGIC & QR] (3.0 cr)

**Duluth Campus****Biology Minor**

Biology

Swenson College of Science and Engineering

- Program Type: Undergraduate minor related to major
- Requirements for this program are current for Fall 2011
- Required credits in this minor: 35

Biology has long been recognized as basic to such important areas as environment, agriculture, and medicine.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Minor Requirements**Biology Minor Courses (22 cr)**

BIOL 1011 - General Biology I [LE CAT4, NAT SCI] (5.0 cr)

BIOL 1012 - General Biology II [SUSTAIN] (5.0 cr)

BIOL 3100 - Cell Biology (3.0 cr)

BIOL 2201 - Genetics (3.0 cr)

BIOL 2801 - General Ecology (3.0 cr)

BIOL 3401 - Evolution [SUSTAIN] (3.0 cr)

Chemistry (13 cr)

CHEM 2541 - Organic Chemistry I (3.0 cr)

CHEM 1161 *{Inactive}* [LE CAT4, NAT SCI] (5.0 cr)

or **CHEM 1153** - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)

CHEM 1154 - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)

CHEM 1162 *{Inactive}* (5.0 cr)

or **CHEM 1155** - General Chemistry II (4.0 cr)

CHEM 1156 - General Chemistry Lab II (1.0 cr)

Duluth Campus

Biomedical Sciences B.S.

Duluth School of Medicine - Adm, Pharmacy, College of - Adm, Swenson College of Science & Engineering

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 120
- Required credits within the major: 90
- Degree: Bachelor of Science

Refer to the Swenson College of Science and Engineering Student Affairs Office and the University of Minnesota Medical School Duluth Student Affairs Office or the University of Minnesota Duluth College of Pharmacy Student Services Office.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

Students must complete 90 credits before admission to the program.

Three years of an undergraduate major in SCSE including the advanced writing requirement, the UMD Liberal Education Program, all pre-med or pre-pharm courses, and the first year of medical or pharmacy school.

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

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1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

See the Swenson College of Science and Engineering Student Affairs Office, the University of Minnesota Medical School Duluth Student Affairs Office, or the University of Minnesota Duluth College of Pharmacy Student Services Office.

Individualized Program

Individualized Plan

Duluth Campus

Cell and Molecular Biology B.S.

Biology

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 120
- Required credits within the major: 81 to 91
- This program requires summer terms.
- Degree: Bachelor of Science

Cell and molecular biology are two of the most rapidly growing areas of modern biology. This major prepares students for graduate school and careers in cell biology, genetics, developmental biology, physiology, immunology, biotechnology, molecular biology and microbiology. The major is also appropriate for students considering professional schools of medicine, dentistry, pharmacy, and veterinary medicine.

The program is administered by the Department of Biology and involves faculty in both the Swenson College of Science and Engineering and the Medical School Duluth.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

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General Requirements

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3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
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6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Requirements for the B.S. in cell biology include:

* A minor or second major from another area of study; biology may not be used to satisfy this requirement.

Biology Core Courses (30-32 cr)

- [BIOL 1011](#) - General Biology I [LE CAT4, NAT SCI] (5.0 cr)
- [BIOL 1012](#) - General Biology II [SUSTAIN] (5.0 cr)
- [BIOL 3100](#) - Cell Biology (3.0 cr)

BIOL 2201 - Genetics (3.0 cr)
 BIOL 3987 - Communication in Biology (2.0 cr)
 BIOL 4231 - Molecular Biology (3.0 cr)
 BIOL 3401 - Evolution [SUSTAIN] (3.0 cr)
 BIOL 5232 - Molecular Biology Laboratory (2.0 cr)
 BIOL 2102 - Cell Biology Laboratory (2.0 cr)
 or BIOL 2202 - Genetics Laboratory (2.0 cr)
 BIOL 3703 - Animal Physiology (3.0 cr)
 or BIOL 4361 - Developmental Biology (3.0 cr)
 or BIOL 3502 - General Microbiology (4.0 cr)
 or BIOL 4503 *{Inactive}*(4.0 cr)
 or BIOL 4603 *{Inactive}*(3.0 cr)
 BIOL 5603 *{Inactive}*(2.0 cr)

Courses From Other Programs (41-49 cr)

General and organic chemistry, biochemistry, mathematics, physics, and advanced writing requirements.

General Chemistry

CHEM 1153 - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)
 CHEM 1154 - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)
 CHEM 1155 - General Chemistry II (4.0 cr)
 CHEM 1156 - General Chemistry Lab II (1.0 cr)
 or CHEM 1161 *{Inactive}*[LE CAT4, NAT SCI] (5.0 cr)
 CHEM 1162 *{Inactive}*(5.0 cr)

Organic Chemistry

CHEM 2541 - Organic Chemistry I (3.0 cr)
 CHEM 2542 - Organic Chemistry II (3.0 cr)
 CHEM 2543 - Organic Chemistry I Laboratory (1.0 cr)
 CHEM 2544 - Organic Chemistry II Laboratory (1.0 cr)

Biochemistry

CHEM 3322 - Biochemistry (3.0 cr)
 CHEM 3324 - Biochemistry Laboratory (1.0 cr)
 or CHEM 4351 - Biochemistry I (3.0 cr)
 CHEM 4352 - Biochemistry II (3.0 cr)
 CHEM 4363 - Biochemistry Laboratory (2.0 cr)

Mathematics

MATH 1290 - Calculus for the Natural Sciences [LE CAT2, LOGIC & QR] (5.0 cr)
 or MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
 or MATH 1596 *{Inactive}*[LE CAT2, LOGIC & QR] (5.0 cr)
 MATH 1297 - Calculus II [LOGIC & QR] (5.0 cr)
 or MATH 1597 *{Inactive}*[LOGIC & QR] (5.0 cr)
 or STAT 2411 - Statistical Methods [LE CAT2, LOGIC & QR] (3.0 cr)
 or STAT 3611 - Introduction to Probability and Statistics (4.0 cr)

Physics

PHYS 1001 - Introduction to Physics I [LE CAT4, NAT SCI] (5.0 cr)
 PHYS 1002 - Introduction to Physics II (5.0 cr)
 or PHYS 2011 *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)
 PHYS 2012 *{Inactive}*(4.0 cr)

Advanced composition

WRIT 3150 - Advanced Writing: Science (3.0 cr)

Electives (10 cr)

If more than one lab elective (2102, 2202) or cell biology core course(s) 3703, 4361, 4603, (4501 or 4503) are taken the excess may be used for cell biology elective credits. BIOL 3990 and 5990 are accepted for cell biology elective credits only by department approval. Two credits of SSP 3002 - TA Practicum Supplemental Instruction in Biology may be substituted for BIOL 3993 as elective credit. Courses cannot be used to fulfill more than one requirement in the major.

Take 10 or more credit(s) from the following:

Cell Biology Electives

Take 5 or more credit(s) from the following:

- BIOL 2102 - Cell Biology Laboratory (2.0 cr)
- BIOL 2202 - Genetics Laboratory (2.0 cr)
- BIOL 3101 - Molecular Biology of Cancer (3.0 cr)
- BIOL 3301 - Patterning the Embryo (3.0 cr)
- BIOL 3703 - Animal Physiology (3.0 cr)
- BIOL 4199 - Frontiers in Cell Biology (3.0 cr)
- BIOL 4361 - Developmental Biology (3.0 cr)



- BIOL 4511 - Medical Microbiology (3.0 cr)
- BIOL 4603 *{Inactive}*(3.0 cr)
- BIOL 4807 *{Inactive}*(4.0 cr)
- BIOL 5235 *{Inactive}*(4.0 cr)
- BIOL 5515 - Microbial Diversity and Phylogeny (3.0 cr)
- BIOL 5603 *{Inactive}*(2.0 cr)
- BIOL 5772 - Neural Systems and Behavior (3.0 cr)
- BIOL 5801 - Microbial Ecology (2.0 cr)
- BIOL 5802 - Microbial Ecology Laboratory (2.0 cr)
- BIOL 5868 *{Inactive}*(3.0 cr)
- BIOL 3502 - General Microbiology (4.0 cr)
or BIOL 4503 *{Inactive}*(4.0 cr)
- Non-Cell Biology Electives**
Take 0 or more course(s) totaling 0 or more credit(s) from the following:
 - BIOL 2763 *{Inactive}*[LE CAT5, LECD CAT05, NAT SCI, CDIVERSITY] (2.0 cr)
 - BIOL 3771 - Human Anatomy (4.0 cr)
 - BIOL 2801 - General Ecology (3.0 cr)
 - BIOL 2802 - Ecology Laboratory (2.0 cr)
 - BIOL 3601 - Plant Diversity (3.0 cr)
 - BIOL 3603 - Plant Taxonomy (3.0 cr)
 - BIOL 3701 - Animal Diversity (4.0 cr)
 - BIOL 3760 - Marine Biology (3.0 cr)
 - BIOL 3993 - Laboratory Teaching Experience (1.0 - 2.0 cr)
 - BIOL 3994 - Undergraduate Research (1.0 - 3.0 cr)
 - BIOL 3996 - Internship in Biology (1.0 - 2.0 cr)
 - BIOL 4731 - Entomology (3.0 cr)
 - BIOL 4761 - Ichthyology (3.0 cr)
 - BIOL 4763 - Ornithology (3.0 cr)
 - BIOL 4764 - Mammalogy (3.0 cr)
 - BIOL 4803 *{Inactive}*(4.0 cr)
 - BIOL 4805 *{Inactive}*(2.0 cr)
 - BIOL 4891 - Animal Behavior (2.0 cr)
 - BIOL 5240 - Ecological Genetics (3.0 cr)
 - BIOL 5401 *{Inactive}*(3.0 cr)
 - BIOL 5777 - Plankton Biology (2.0 cr)
 - BIOL 5805 - Fisheries Ecology and Management (3.0 cr)
 - BIOL 5807 - Mathematical Ecology (3.0 cr)
 - BIOL 5808 - Landscape Ecology: Theory and Application (3.0 cr)
 - BIOL 5811 *{Inactive}*(2.0 cr)
 - BIOL 5833 - Stream Ecology (3.0 cr)
 - BIOL 4839 - Coral Reef Field Studies (3.0 cr)
 - BIOL 5861 - Lake Ecology (3.0 cr)
 - BIOL 5862 *{Inactive}*(3.0 cr)
 - BIOL 5863 - Ecosystems Ecology (3.0 cr)
 - BIOL 5865 - Conservation Biology (2.0 cr)
 - BIOL 5866 *{Inactive}*(3.0 cr)
 - BIOL 5870 - Wetland Ecology (3.0 cr)
 - MATH 5233 - Mathematical Foundations of Bioinformatics (3.0 cr)
 - BMS 5501 - Neurobiochemistry (2.0 cr)
 - BMS 5545 - Immunology (3.0 cr)
 - BMS 5555 - Molecular Pathogenesis: Current Concepts (3.0 cr)
 - BMS 5601 - Physiology of Organ Systems I (4.0 cr)
 - BMS 5602 - Physiology of Organ Systems II (2.0 cr)

Duluth Campus

Chemical Engineering B.S.Ch.E.

Chemical Engineering

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 127
- Required credits within the major: 112
- Degree: Bachelor of Science in Chemical Engineering

Vision

The Department of Chemical Engineering strives for nationally recognized excellence in engineering education and research by using modern, hands-on, and active learning experiences to prepare undergraduate students for professional success, and to hold paramount the safety, health and welfare of the public and protect the environment in performance of their professional duties.

Mission

The Department of Chemical Engineering produces engineers with a strong foundation of technical, communication, teamwork, and problem-solving skills required for professional success, consisted with the following objectives.

1. Pursue careers where they apply their engineering and problem solving skills.
2. Pursue advanced studies or other forms of continuing education.
3. Value their UMD chemical engineering education and endorse the program and its students.

This four-year baccalaureate (B.S.Ch.E.) degree program emphasizes the development of the student's ability to analyze and design chemical processing systems. By the end of the program, the student must demonstrate the ability to solve engineering problems, a sensitivity to the social and environmental impacts of the engineering profession, and the ability to maintain a high level of competency.

Chemical engineering graduates are qualified for employment in diverse industries, ranging from those that manufacture inorganic chemicals, petrochemicals, plastics, synthetic fibers, paper and pulp, and pharmaceuticals to those that process minerals, materials, and hazardous wastes.

Graduates are qualified for assignments that include plant operations, process development, process control, project engineering, or technical sales, and frequently pursue engineering management later in their careers. They are also well qualified to continue with professional or graduate education.

The chemical engineering curriculum is based on fundamental sciences including physics, chemistry, and mathematics; traditional chemical engineering sciences such as material and energy balance, transport phenomena, and thermodynamics; and chemical engineering design courses such as reaction engineering, separations, and unit operations, with a capstone design course during the senior year. Students have an opportunity to become involved in research, through either the Undergraduate Research Opportunities Program or the department honors program.

Honors Requirement: To graduate with department honors, students must have a minimum 3.50 GPA and be nominated by the chemical engineering faculty.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

Students may declare a chemical engineering major as freshmen or sophomores.

Students must complete the majority of the program's lower division requirements (freshman and sophomore years), including CHE 2111, CHEM 2541, MATH 3280, and PHYS 2012, before applying for admission to upper division (junior and senior years). Successful completion of CHE 2111 (with a grade of C+ or better) is required for admission to upper division. Admission is competitive and applicants are admitted on a space-available basis, with priority determined by the cumulative GPA in engineering, physics, mathematics, and chemistry through CHEM 2541.

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Requirements for the B.S.Ch.E:

* At least 10 credits of science or engineering electives, subject to department approval. Must be 2xxx or higher; only 1 2xxx course is allowed; at least 1 course must be 4xxx or higher; maximum of 3 credits of COOP and internship credits allowed; may not be used to satisfy advanced chemistry elective requirements.

Year One (33 cr)

First math course is determined by ACT math score. This schedule presupposes placement into MATH 1296.

[CHE 1011](#) - Introduction to Chemical Engineering. [LE CAT5] (3.0 cr)

[CS 1121](#) - Introduction to Programming in Visual BASIC.NET [LE CAT3, LOGIC & QR] (3.0 cr)

PHYS 2011 *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)

[WRIT 1120](#) - College Writing [LE CAT1, WRITING] (3.0 cr)

CHEM 1161 *{Inactive}*[LE CAT4, NAT SCI] (5.0 cr)

or [CHEM 1153](#) - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)

[CHEM 1154](#) - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)

CHEM 1162 *{Inactive}*(5.0 cr)

or [CHEM 1155](#) - General Chemistry II (4.0 cr)

[CHEM 1156](#) - General Chemistry Lab II (1.0 cr)

[MATH 1296](#) - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)

or [MATH 1596](#) *{Inactive}*[LE CAT2, LOGIC & QR] (5.0 cr)

[MATH 1297](#) - Calculus II [LOGIC & QR] (5.0 cr)

or [MATH 1597](#) *{Inactive}*[LOGIC & QR] (5.0 cr)

Year Two (28 cr)

[CHE 2111](#) - Material and Energy Balances (3.0 cr)

[CHE 2121](#) - Chemical Engineering Thermodynamics (3.0 cr)

[CHE 3031](#) - Computational Methods in Chemical Engineering (3.0 cr)

[CHEM 2541](#) - Organic Chemistry I (3.0 cr)

[CHEM 2543](#) - Organic Chemistry I Laboratory (1.0 cr)

[MATH 3280](#) - Differential Equations with Linear Algebra (4.0 cr)

PHYS 2012 *{Inactive}*(4.0 cr)

Electives

Science or engineering elective: 2xxx or higher course in the Swenson College of Science and Engineering (3 - 5 cr)

Minimum 4 credits. May not be satisfied with CHEM 4184, 4185 or 4634.

Year Three (28 cr)

[CHE 2011](#) - Design of Engineering Experiments (3.0 cr)

[CHE 3111](#) - Fluid Mechanics (3.0 cr)

[CHE 3112](#) - Heat and Mass Transfer (3.0 cr)

[CHE 3231](#) - Properties of Engineering Materials (3.0 cr)



CHE 3241 - Principles of Particle Technology (3.0 cr)

CHE 4402 - Process Dynamics and Control (3.0 cr)

Advanced Writing Requirement

Writ 3xxx - or higher advanced writing course

Electives

Advanced science or engineering elective: 3xxx or higher course in the Swenson College of Science and Engineering.

Minimum 4 credits. May not be satisfied with CHEM 4184, 4185 or 4634.

Year Four (23 cr)

CHE 3211 - Chemical Engineering Laboratory I [COMM & LAN] (3.0 cr)

CHE 4111 - Separations (3.0 cr)

CHE 4211 - Chemical Engineering Laboratory II (3.0 cr)

CHE 4301 - Chemical Reaction Engineering (3.0 cr)

CHE 4501 - Chemical Engineering Design I [SUSTAIN] (4.0 cr)

CHE 4502 - Chemical Engineering Design II (4.0 cr)

SCI or ENGR 4xxx or higher elective

Science or engineering elective 4xxx or higher in the Swenson College of Science and Engineering (3-5 cr)

Duluth Campus

Chemistry B.S.

Chemistry and Biochemistry

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 120
- Required credits within the major: 73
- This program requires summer terms.
- Degree: Bachelor of Science

Chemistry is a body of knowledge that helps explain the physical world and its processes. Chemists study substances--their composition, structures, properties, and reactions. The Department of Chemistry and Biochemistry provides classroom and laboratory learning opportunities and research experiences across the discipline designed to meet the needs of students in engineering, liberal arts and preprofessional programs as well as those who wish to pursue careers or graduate studies in chemistry or related disciplines.

Honors Requirement: The Department of Chemistry and Biochemistry honors program helps outstanding chemistry majors develop into competent, independent research workers, encourages student interest in the discipline, and aids in the transition from student to working scientist. Qualified majors may apply after the first semester of their sophomore year. Participants choose a research adviser and complete two semesters on a jointly developed project. Written reports and an oral presentation of the research are also required.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Requirements for the B.S. in chemistry include:

- * A minor from another area of study.
- * The B.S. Chemistry major/B.S. BMB major combination satisfies the college degree requirement for a second major or minor.

* Students earning a B.S. degree who wish to have their program certified by the American Chemical Society must take advanced courses that include additional hours of laboratory work.

Year One (20 cr)

High school algebra and high school chemistry are required for CHEM 1153, CHEM 1154, and CHEM 1161. This schedule presupposes placement into MATH 1296.

[MATH 1296](#) - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)

[MATH 1297](#) - Calculus II [LOGIC & QR] (5.0 cr)

[CHEM 1161](#) *{Inactive}*[LE CAT4, NAT SCI] (5.0 cr)

or [CHEM 1153](#) - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)

[CHEM 1154](#) - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)

[CHEM 1162](#) *{Inactive}*(5.0 cr)

or [CHEM 1155](#) - General Chemistry II (4.0 cr)

[CHEM 1156](#) - General Chemistry Lab II (1.0 cr)

Year Two (25 cr)

[CHEM 2541](#) - Organic Chemistry I (3.0 cr)

[CHEM 2542](#) - Organic Chemistry II (3.0 cr)

[CHEM 2543](#) - Organic Chemistry I Laboratory (1.0 cr)

[CHEM 2545](#) - Organic Chemistry II Laboratory for B.S. Chemistry Majors (2.0 cr)

[MATH 3280](#) - Differential Equations with Linear Algebra (4.0 cr)

[PHYS 2011](#) *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)

[PHYS 2012](#) *{Inactive}*(4.0 cr)

Take the following course pair or course.

[CHEM 2222](#) - Quantitative Analysis (3.0 cr)

[CHEM 2223](#) - Quantitative Analysis Laboratory (1.0 cr)

or [CHEM 2242](#) - Analytical Chemistry and the Environment in Poland (4.0 cr)

Year Three (14 cr)

[CHEM 3432](#) - Descriptive Inorganic Chemistry (3.0 cr)

[CHEM 4641](#) - Physical Chemistry I (3.0 cr)

[CHEM 4642](#) - Physical Chemistry II (3.0 cr)

[CHEM 4643](#) - Physical Chemistry Laboratory I (1.0 cr)

[CHEM 4644](#) - Physical Chemistry Laboratory II (1.0 cr)

[CHEM 3322](#) - Biochemistry (3.0 cr)

[CHEM 3324](#) - Biochemistry Laboratory (1.0 cr)

or [CHEM 4352](#) - Biochemistry II (3.0 cr)

[CHEM 4363](#) - Biochemistry Laboratory (2.0 cr)

Year Four (11 cr)

[CHEM 4184](#) - Undergraduate Seminar I (1.0 cr)

[CHEM 4185](#) - Undergraduate Seminar II (1.0 cr)

[CHEM 4242](#) - Instrumental Analysis (3.0 cr)

[CHEM 4243](#) - Instrumental Chemistry Laboratory (2.0 cr)

[CHEM 4435](#) - Inorganic Chemistry Laboratory (1.0 cr)

[CHEM 4436](#) - Inorganic Chemistry (3.0 cr)

Advanced Writing Requirement (3 cr)

Advanced Writing 31xx

Duluth Campus

Chemistry Minor

Chemistry and Biochemistry

Swenson College of Science and Engineering

- Program Type: Undergraduate minor related to major
- Requirements for this program are current for Fall 2011
- Required credits in this minor: 29 to 30

Chemistry helps explain the physical world and its processes.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Minor Requirements

Chemistry Minor Courses (29-30 cr)

- CHEM 2541 - Organic Chemistry I (3.0 cr)
- CHEM 2542 - Organic Chemistry II (3.0 cr)
- CHEM 2543 - Organic Chemistry I Laboratory (1.0 cr)
- CHEM 2544 - Organic Chemistry II Laboratory (1.0 cr)
- CHEM 1161 *{Inactive}* [LE CAT4, NAT SCI] (5.0 cr)
or CHEM 1153 - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)
CHEM 1154 - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)
- CHEM 1162 *{Inactive}* (5.0 cr)
or CHEM 1155 - General Chemistry II (4.0 cr)
CHEM 1156 - General Chemistry Lab II (1.0 cr)
- CHEM 2222 - Quantitative Analysis (3.0 cr)
CHEM 2223 - Quantitative Analysis Laboratory (1.0 cr)
or CHEM 2212 - Environmental Chemistry [NAT SCI, SUSTAIN] (4.0 cr)
or CHEM 2242 - Analytical Chemistry and the Environment in Poland (4.0 cr)

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

- CHEM 3322 - Biochemistry (3.0 cr)
- CHEM 4351 - Biochemistry I (3.0 cr)
- CHEM 4634 - Physical Chemistry (3.0 cr)
- CHEM 4641 - Physical Chemistry I (3.0 cr)

Math

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

- MATH 1250 - Precalculus Analysis [LE CAT2, LOGIC & QR] (4.0 cr)
- MATH 1290 - Calculus for the Natural Sciences [LE CAT2, LOGIC & QR] (5.0 cr)
- MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)



Duluth Campus

Civil Engineering B.S.C.E.

UMD-Civil Engineering, Dept of

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 129
- Required credits within the major: 115
- This program requires summer terms.
- None
- Degree: Bachelor of Science in Civil Engineering

The B.S.C.E. program integrates topics from chemistry, physics, advanced mathematics and statistics, geology, and core engineering science to prepare graduates to work professionally in both public and private organizations that design, develop, and construct structures; design, build, and maintain highway systems; and design, operate, and control water resource systems. Graduates are rooted in safe and efficient design skills and show respect for and strive to improve the environment wherever they work.

The program emphasizes four of the core tracks in civil engineering: transportation systems, water resource engineering, structural engineering, and geotechnical engineering. Upper division students are exposed to each of these areas and required to specialize in one by taking additional elective courses.

Civil engineering graduates are qualified for employment in a wide variety of organizations, both public and private, including design, material testing and manufacture, construction, transportation, natural resources development, and energy. Graduates are prepared to begin their first step toward professional registration by taking the FE exam before completing their collegiate degree. They also are well qualified to continue with graduate education in civil engineering or engineering management.

Students in the B.S.C.E. program have the opportunity to put their design and entrepreneurial skills to use in ASCE design competitions, projects sponsored by regional companies, and research projects in the Undergraduate Research Opportunities Program.

Honors Requirement: To graduate with department honors, a student must have a 3.40 GPA, be an active member of Tau Beta Pi or a professional engineering society (ASCE) and be nominated by a department faculty member.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

Students must complete 10 courses before admission to the program.

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

A GPA above 2.0 is preferred for the following:

- 2.50 already admitted to the degree-granting college
- 2.50 transferring from another University of Minnesota college
- 2.50 transferring from outside the University

Students need to apply to the B.S.C.E. upper division program during the second semester of their sophomore year. Those who meet the GPA requirements for admission at the end of their third semester (first semester of sophomore year) will be granted provisional admission to the upper division program pending their successful completion of all courses remaining listed below with a cumulative GPA that meets the required level (2.50).

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

Required prerequisites

Course Admission Requirements (35 cr)

Admission to the upper division B.S.C.E. program is competitive and based on performance in lower division courses and space availability. A C- or better is required in all program courses.

[CE 1025](#) - Introduction to Civil Engineering (1.0 cr)

[CE 2017](#) - Engineering Mechanics: Statics and Mechanics of Materials (5.0 cr)

[CHEM 1153](#) - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)



CHEM 1154 - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)
CS 1121 - Introduction to Programming in Visual BASIC.NET [LE CAT3, LOGIC & QR] (3.0 cr)
MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
MATH 1297 - Calculus II [LOGIC & QR] (5.0 cr)
PHYS 2011 *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)
WRIT 1120 - College Writing [LE CAT1, WRITING] (3.0 cr)
MATH 3280 - Differential Equations with Linear Algebra (4.0 cr)
or MATH 3298 - Calculus III (4.0 cr)

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

B.S.C.E. Major Requirements (40 cr)

CE 3015 - CAD & Engineering Drawing (3.0 cr)
CE 3016 - Surveying (2.0 cr)
CE 3026 - Project Management (3.0 cr)
CE 3027 - Infrastructure Materials (4.0 cr)
CE 3115 - Structural Analysis (3.0 cr)
CE 3225 - Hydraulics and Hydrology (3.0 cr)
CE 3316 - Transportation Engineering (4.0 cr)
CE 3425 *{Inactive}*(3.0 cr)
CE 3426 - Soil Mechanics (4.0 cr)
CE 4155 *{Inactive}*(4.0 cr)
CE 4255 - Senior Design (4.0 cr)
PHYS 2012 *{Inactive}*(4.0 cr)

Additional B.S.C.E. Requirements (25 cr)

MATH 3280 and MATH 3298 must be completed, whichever course was not taken for admission to the civil engineering program must be taken for the B.S.C.E.

CE 3221 - Fluid Mechanics (3.0 cr)
COMM 1112 - Public Speaking [LE CAT3, COMM & LAN] (3.0 cr)
STAT 3411 - Engineering Statistics (3.0 cr)
SW 1210 - Global Issues [LE CAT8, LEIP CAT08, SOC SCI, GLOBAL PER] (3.0 cr)
WRIT 31xx
ECON 1022 - Principles of Economics: Macro [LE CAT6, SOC SCI] (3.0 cr)
or ECON 1023 - Principles of Economics: Micro [LE CAT6, SOC SCI] (3.0 cr)
CE 3025 - Environmental Engineering [SUSTAIN] (4.0 cr)
or CHE 2001 - Introduction to Environmental Engineering (3.0 cr)
MATH 3280 - Differential Equations with Linear Algebra (4.0 cr)
or MATH 3298 - Calculus III (4.0 cr)

Civil Engineering Technical Electives



Choose 5 courses for 15 credits from the focus groups listed below. At least 2 courses must be taken from the same focus group. An additional 6 credits of general technical electives must be taken and can be chosen from any course in the Swenson College of Science and Engineering at 2xxx or above (including CE courses not already counted toward the degree). CHEM 1152 can also be used to fulfill a portion of the general technical elective requirement.

Structures Focus Group

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

- CE 4115 - Design of Steel Structures (3.0 cr)
- CE 4126 - Design of Concrete Structures (3.0 cr)
- CE 4137 - Advanced Structural Analysis and Design (3.0 cr)
- CE 4515 - Sustainable Design [SUSTAIN] (3.0 cr)
- CE 5115 - Structural Dynamics (3.0 cr)
- CE 5127 - Bridge Analysis and Design (3.0 cr)
- CE 5410 - Finite Element Methods for Civil Engineering Applications (3.0 cr)
- CE 5515 - Sustainable Design and Construction (SUSTAIN) (3.0 cr)

-OR-

Water Resources Focus Group

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

- CE 4215 - Hydraulic Design (3.0 cr)
- CE 4226 *{Inactive}*(3.0 cr)

-OR-

Transportation Engineering Focus Group

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

- CE 4315 - Design of Traffic Control Systems (3.0 cr)
- CE 4326 - Highway Planning and Design (3.0 cr)
- CE 5315 - Design of Traffic Control Systems (3.0 cr)

-OR-

Geotechnical Engineering Focus Group

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

- CE 4415 - Geotechnical Design (3.0 cr)
- CE 4426 - Rock Mechanics (3.0 cr)
- CE 4436 *{Inactive}*(3.0 cr)



Duluth Campus

Computer Information Systems B.S.

Computer Science

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 120
- Required credits within the major: 60
- Degree: Bachelor of Science

Professionals in the field of information systems work with information technology and must have sound technical knowledge of computers, software, and communications. Since they operate within an organizational framework, they must also understand business and business functions. The B.S. in computer information systems is a four-year program that includes formal courses in information technology (including system architecture, operating systems, interactive multimedia computing, and networking), management information systems, project organization and management, and business organizational functions. The program also includes supporting courses in communications, mathematics and statistics, and the economic, social, and ethical implications of computing. Goals of the learning process include the development of good software development and communication skills and the ability to work effectively in team environments. This program provides both the necessary foundational studies for students seeking entry-level positions in information systems and a strong basis for continued career growth.

This program is appropriate for students seeking a professional career in the computer information systems field. It is a multidisciplinary program that emphasizes the study of systems development methodology and technology for our rapidly changing information society.

Graduates are prepared for positions in the design and development of information systems as project managers, information systems center specialists, network administrators, and database administrators. This major is also appropriate preparation for information systems graduate programs or MBA professional programs.

The computer science minor and computer science applied minor are not available to computer information systems technology majors.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.



Program Requirements

Requirements for the B.S. in computer information systems include:

* Minor in business administration.

* Exit interview before graduation.

Core Courses (21 cr)

- CS 1521 - Computer Science II (5.0 cr)
- CS 2511 - Software Analysis and Design (4.0 cr)
- CS 3011 - Information Technology Hardware and Software (4.0 cr)
- FMIS 2201 - Information Technology in Business (3.0 cr)
- CS 1511 - Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)
or CS 1581 - Honors: Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)

Advanced Courses (24 cr)

- CS 3111 - Computer Ethics [HUMANITIES] (4.0 cr)
- CS 3121 - Interactive Multimedia Technology (4.0 cr)
- CS 3211 - Database System Concepts (4.0 cr)
- CS 3221 - Operating Systems Practicum (4.0 cr)
- CS 4411 - Data Communications and Network Technology (4.0 cr)
- CS 4531 - Software Engineering (4.0 cr)

Additional Requirements (15 cr)

Additional requirements also include completing a business administration minor for non-LSBE students.

- COMM 1112 - Public Speaking [LE CAT3, COMM & LAN] (3.0 cr)
- MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
- STAT 3611 - Introduction to Probability and Statistics (4.0 cr)

Advanced Writing

- WRIT 3121 - Advanced Writing: Business and Organizations (3.0 cr)
or WRIT 3130 - Advanced Writing: Engineering (3.0 cr)
or WRIT 3150 - Advanced Writing: Science (3.0 cr)



Duluth Campus

Computer Information Systems Minor

Computer Science

Swenson College of Science and Engineering

- Program Type: Undergraduate minor related to major
- Requirements for this program are current for Fall 2011
- Required credits in this minor: 29
- This program requires summer terms.

Computer information systems professionals work with information technology and must have sound technical knowledge of computers, software, and communications. Students who major in computer science may not minor in computer information systems.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Minor Requirements

Core Courses (21 cr)

- CS 1511 - Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)
- CS 1521 - Computer Science II (5.0 cr)
- CS 2511 - Software Analysis and Design (4.0 cr)
- CS 3011 - Information Technology Hardware and Software (4.0 cr)
- FMIS 2201 - Information Technology in Business (3.0 cr)

Electives (8 cr)

Take 2 or more course(s) totaling at most 8 credit(s) from the following:

- CS 3121 - Interactive Multimedia Technology (4.0 cr)
- CS 3211 - Database System Concepts (4.0 cr)
- CS 3221 - Operating Systems Practicum (4.0 cr)
- CS 4411 - Data Communications and Network Technology (4.0 cr)
- CS 4531 - Software Engineering (4.0 cr)



Duluth Campus

Computer Science Applied Minor

Computer Science

Swenson College of Science and Engineering

- Program Type: Undergraduate free-standing minor
- Requirements for this program are current for Fall 2011
- Required credits in this minor: 27

The computer science applied minor provides a thorough introduction to the use of computers as tools and complements studies in other disciplines.

The computer science minor and computer science applied minor are not available to computer information systems technology majors.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Minor Requirements

Minor Courses (14 cr)

[CS 1521](#) - Computer Science II (5.0 cr)

[CS 2511](#) - Software Analysis and Design (4.0 cr)

[CS 1511](#) - Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)

or [CS 1581](#) - Honors: Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)

Electives (13 cr)

6 credits of approved electives from computer science or other departments with a significant computing component

CS 2xxx-5xxx

Take 7 or more credit(s) from the following:

- CS 2xxx
- CS 3xxx
- CS 4xxx
- CS 5xxx



Duluth Campus

Computer Science B.S.

Computer Science

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 120
- Required credits within the major: 89 to 94
- Degree: Bachelor of Science

Computer science is a discipline that requires understanding the design of computers and computational processes. The B.S. in computer science is an accredited, four-year program that provides a solid foundation in mathematics and statistics, computational problem solving, software design and analysis, programming languages, algorithms, data structures, and computer organization and architecture. The program also requires that students acquire significant knowledge in several subdisciplines of computer science, thus enabling them to apply and situate their knowledge of computer science fundamentals. Goals of the learning process include highly developed programming skills, an understanding of the context in which computing activities occur, and an ability to communicate effectively. The program provides the necessary foundational studies for students preparing for graduate school as well as those seeking careers in industry.

The program is accredited by the Computing Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: 410-347-7700.

Honors Requirement: Program candidates submit an application to the department honors committee. Participants must maintain a 3.00 cumulative GPA and a 3.30 GPA in the major and complete an honors research project supervised by a faculty member; credit for the project can be earned in CS 4994 - Honors Project.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Requirements for the B.S. in computer science include:

* Senior survey, contact the computer science office for details.

* A minor or a second major from another department.

Core Courses (22 cr)

- CS 1521 - Computer Science II (5.0 cr)
- CS 2511 - Software Analysis and Design (4.0 cr)
- CS 2521 - Computer Organization and Architecture (4.0 cr)
- EE 1315 - Digital Logic (4.0 cr)
- CS 1511 - Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)
or CS 1581 - Honors: Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)

Advanced Courses (20 cr)

- CS 3111 - Computer Ethics [HUMANITIES] (4.0 cr)
- CS 3512 - Computer Science Theory (4.0 cr)
- CS 4531 - Software Engineering (4.0 cr)
- CS 5631 - Operating Systems (4.0 cr)
- CS 5621 - Computer Architecture (4.0 cr)
or CS 5651 - Computer Networks (4.0 cr)

Advanced Course Electives (12 cr)

Either CS 5621 or CS 5651 must be taken (under Advanced Courses); if both courses are taken, the second course fulfills the requirement of one Advanced Course Elective.

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

- CS 4511 *{Inactive}*(4.0 cr)
- CS 4521 *{Inactive}*(4.0 cr)
- CS 4611 - Database Management Systems (4.0 cr)
- CS 4821 - Computer Security (4.0 cr)
- CS 5541 - Artificial Intelligence (4.0 cr)
- CS 5551 - User Interface Design (4.0 cr)
- CS 5641 - Compiler Design (4.0 cr)
- CS 5721 - Computer Graphics (4.0 cr)
- CS 5741 *{Inactive}*(4.0 cr)
- CS 5751 - Introduction to Machine Learning and Data Mining (4.0 cr)
- CS 5761 - Introduction to Natural Language Processing (4.0 cr)

Courses From Other Programs (23 cr)

- COMM 1112 - Public Speaking [LE CAT3, COMM & LAN] (3.0 cr)
- MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
- MATH 1297 - Calculus II [LOGIC & QR] (5.0 cr)
- STAT 3611 - Introduction to Probability and Statistics (4.0 cr)
- MATH 2326 *{Inactive}*(3.0 cr)
or MATH 3326 - Vectors and Matrices (3.0 cr)
or MATH 4326 - Linear Algebra (3.0 cr)

Advanced Writing

- WRIT 3130 - Advanced Writing: Engineering (3.0 cr)
- or WRIT 3150 - Advanced Writing: Science (3.0 cr)

Lab Science Sequences (8-13 cr)

Complete one of the following lab science sequences:

- BIOL 1011 - General Biology I [LE CAT4, NAT SCI] (5.0 cr)
- BIOL 1012 - General Biology II [SUSTAIN] (5.0 cr)
- CHEM 1153 - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)
- CHEM 1154 - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)
- CHEM 1155 - General Chemistry II (4.0 cr)
- CHEM 1156 - General Chemistry Lab II (1.0 cr)
- or CHEM 1161 *{Inactive}*[LE CAT4, NAT SCI] (5.0 cr)
- CHEM 1162 *{Inactive}*(5.0 cr)
- or GEOL 1110 - Geology and Earth Systems [LE CAT4, NAT SCI, SUSTAIN] (4.0 cr)
- GEOL 2311 - Mineralogy (4.0 cr)
- GEOL 2312 - Petrology (5.0 cr)
- or PHYS 2011 *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)
- PHYS 2012 *{Inactive}*(4.0 cr)



Electives From Other Programs (4 cr)

Additional approved courses from physics, chemistry, biology, astronomy and geology (4 cr). The total number of credits for the additional science course and the science sequence must be at least 12 credits.

Additional science course that is either in category 4 of the liberal education program or has a category 4 prerequisite.



Duluth Campus

Computer Science Minor

Computer Science

Swenson College of Science and Engineering

- Program Type: Undergraduate minor related to major
- Requirements for this program are current for Fall 2011
- Required credits in this minor: 30

Computer science is a discipline that requires understanding the design of computers and computational processes.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Minor Requirements

* The computer science minor and computer science applied minor are not available to computer information systems technology majors.

Minor Courses (19 cr)

- CS 1521 - Computer Science II (5.0 cr)
- CS 2511 - Software Analysis and Design (4.0 cr)
- MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
- CS 1511 - Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)
- or CS 1581 - Honors: Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)

Electives (11 cr)

CS courses must be at 35xx or above.

Take 11 or more credit(s) from the following:

- CS 3xxx
- CS 4xxx
- CS 5xxx
- EE 4341 - Digital Systems (4.0 cr)
- EE 4305 - Computer Architecture (4.0 cr)
- CS 2521 - Computer Organization and Architecture (4.0 cr)
- or EE 2325 - Microprocessor Systems (4.0 cr)

Duluth Campus

Electrical and Computer Engineering B.S.E.C.E.

Electrical Engineering

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 135
- Required credits within the major: 117 to 119
- Degree: Bachelor of Science in Elect and Compt Engineering

The mission of the Department of Electrical and Computer Engineering (ECE) is to provide a high quality educational opportunity for students by delivering a program with a strong hands-on laboratory and design component in conjunction with a thorough foundation in theory and to provide students with the tools and skills to be lifelong contributors to their profession and society as a whole. The B.S.E.C.E. program combines traditional electrical engineering topics with current computer design and analysis topics. The program is concerned with the theory, design, and application of electrical phenomena and digital computers, including electronic circuits, signal analysis, system design, and computer architecture. The department displays strengths in such diverse areas as electronics, signal processing, electromagnetics, digital computer systems, communications, and controls. Faculty specialize in areas such as VLSI design, microprocessor systems, image processing, robust control, solid state devices, optoelectronics, nanostructures, robotics, instrumentation, neural networks, and fuzzy logic. The program balances theoretical and practical experience in electrical and computer engineering through analysis, synthesis, and experimentation, using facilities that include major instructional and research laboratories.

Electrical and computer engineering program educational objectives:

1. Develop a productive career.
2. Advance knowledge in their field through technical innovations and scholarly research.
3. Integrate the impact ethical foundation, creative purpose, and technical knowledge into responsible citizenship.
4. Contribute to the well-being of their community.
5. Pursue lifelong learning.

Honors Requirement: To receive department honors upon graduation, students must finish the program with an overall GPA of at least 3.50, satisfactorily complete a research project under the guidance of a faculty member, and convey the results in an oral and written presentation to the department.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

Students who enter the electrical and computer engineering program as freshmen must follow the lower division program.

Students should complete the lower division ECE program before applying to the upper division program. Admission is competitive and on a space-available basis. A minimum GPA of 2.00 is required for admission to the upper division program. See department for details.

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

Required prerequisites

Lower Division (22 cr)

- [EE 1001](#) - Introduction to Electrical Engineering (2.0 cr)
- [EE 1315](#) - Digital Logic (4.0 cr)
- [EE 2006](#) - Electrical Circuit Analysis (4.0 cr)
- [EE 2111](#) - Linear Systems and Signal Analysis (4.0 cr)
- [EE 2212](#) - Electronics I (4.0 cr)
- [EE 2325](#) - Microprocessor Systems (4.0 cr)

Lower Division From Other Programs (37 cr)



First math course is determined by math ACT score. This schedule presupposes placement into MATH 1296.

[CS 1511](#) - Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)

[CS 1521](#) - Computer Science II (5.0 cr)

[MATH 1296](#) - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)

[MATH 1297](#) - Calculus II [LOGIC & QR] (5.0 cr)

[MATH 3280](#) - Differential Equations with Linear Algebra (4.0 cr)

[PHYS 2011](#) *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)

[PHYS 2012](#) *{Inactive}*(4.0 cr)

[CHEM 1153](#) - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)

[CHEM 1154](#) - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)

General Requirements

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2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Requirements for the B.S.E.C.E. in electrical and computer engineering include:

* Completion of the ECE program as outlined satisfies the requirements for a computer science minor.

* ECE majors must meet with their advisers each semester. See department for details.

* Completion of the ECE "Exit Survey," and a one-to-one exit interview with the ECE department head.

* Final Project: Completion of a capstone team design project integrating the knowledge from their academic career. Project must involve the design of hardware or software to meet specifications agreed upon by the student and the faculty project adviser. Oral and written reports are required.

Upper Division (30 cr)

[EE 3151](#) - Control Systems (4.0 cr)

[EE 3235](#) - Electronics II (4.0 cr)

[EE 4341](#) - Digital Systems (4.0 cr)

[EE 3445](#) - Electromagnetic Fields (3.0 cr)

[EE 4611](#) - Introduction to Solid-State Semiconductors (3.0 cr)

[EE 4305](#) - Computer Architecture (4.0 cr)

[EE 4951](#) - Design Workshop (4.0 cr)

or [EE 4899](#) - Senior Design Project I (1.0 cr)

[EE 4999](#) - Senior Design Project II (3.0 cr)

ECE Technical Electives

NOT including 4899, 4951, 4991, 4999

Take 5 or more credit(s) from the following:

- ECE 4xxx
- ECE 5xxx



Upper Division From Other Programs (28-30 cr)

[CS 2511](#) - Software Analysis and Design (4.0 cr)

[CS 5631](#) - Operating Systems (4.0 cr)

[MATH 3298](#) - Calculus III (4.0 cr)

[PHIL 3242](#) - Values and Technology [LE CAT8, HUMANITIES] (3.0 cr)

[STAT 3611](#) - Introduction to Probability and Statistics (4.0 cr)

[WRIT 3130](#) - Advanced Writing: Engineering (3.0 cr)

[ECON 1023](#) - Principles of Economics: Micro [LE CAT6, SOC SCI] (3.0 cr)

or [ECON 1022](#) - Principles of Economics: Macro [LE CAT6, SOC SCI] (3.0 cr)

Engineering outside of ECE elective requirement

[CE 2017](#) - Engineering Mechanics: Statics and Mechanics of Materials (5.0 cr)

or [CHE 2001](#) - Introduction to Environmental Engineering (3.0 cr)

or [CHE 2011](#) - Design of Engineering Experiments (3.0 cr)

or [CHE 2111](#) - Material and Energy Balances (3.0 cr)

or [ME 2105](#) - Introduction to Material Science for Engineers (3.0 cr)



Duluth Campus

Electrical and Computer Engineering Minor

Electrical Engineering

Swenson College of Science and Engineering

- Program Type: Undergraduate minor related to major
- Requirements for this program are current for Fall 2011
- Required credits in this minor: 42

The electrical and computer engineering minor provides a complete introduction to both analog circuit design and digital computer circuit design and analysis.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Minor Requirements

Lower Division (38 cr)

For computer science majors: CS 2521 may be substituted for ECE 2325

- EE 1315 - Digital Logic (4.0 cr)
- EE 2006 - Electrical Circuit Analysis (4.0 cr)
- EE 2111 - Linear Systems and Signal Analysis (4.0 cr)
- EE 2212 - Electronics I (4.0 cr)
- EE 2325 - Microprocessor Systems (4.0 cr)
- MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
- MATH 1297 - Calculus II [LOGIC & QR] (5.0 cr)
- PHYS 2011 *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)
- PHYS 2012 *{Inactive}*(4.0 cr)

Upper Division (4 cr)

- MATH 3280 - Differential Equations with Linear Algebra (4.0 cr)



Duluth Campus

Environmental Engineering Minor

Chemical Engineering

Swenson College of Science and Engineering

- Program Type: Undergraduate free-standing minor
- Requirements for this program are current for Fall 2011
- Required credits in this minor: 43 to 46
- This program requires summer terms.

The environmental engineering minor develops a student's ability to understand and address environmental concerns. Coursework provides broad-based science and engineering knowledge suited to pollution prevention and waste management. The minor enhances degrees in science or other engineering fields.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Minor Requirements

Lower Division (37-38 cr)

[CHE 2111](#) - Material and Energy Balances (3.0 cr)

[MATH 1297](#) - Calculus II [LOGIC & QR] (5.0 cr)

[PHYS 2011](#) *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)

Chemical Engineering

[CHE 1011](#) - Introduction to Chemical Engineering. [LE CAT5] (3.0 cr)

or [CHE 2001](#) - Introduction to Environmental Engineering (3.0 cr)

Chemistry I

[CHEM 1161](#) *{Inactive}*[LE CAT4, NAT SCI] (5.0 cr)

or [CHEM 1153](#) - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)

[CHEM 1154](#) - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)

Chemistry II

[CHEM 1162](#) *{Inactive}*(5.0 cr)

or [CHEM 1155](#) - General Chemistry II (4.0 cr)

[CHEM 1156](#) - General Chemistry Lab II (1.0 cr)

Analytical Chemistry

[CHEM 2212](#) - Environmental Chemistry [NAT SCI, SUSTAIN] (4.0 cr)

or [CHEM 2222](#) - Quantitative Analysis (3.0 cr)

[CHEM 2223](#) - Quantitative Analysis Laboratory (1.0 cr)

Math

[MATH 1290](#) - Calculus for the Natural Sciences [LE CAT2, LOGIC & QR] (5.0 cr)

or [MATH 1296](#) - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)

Electives

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

- [CHE 2011](#) - Design of Engineering Experiments (3.0 cr)
- [STAT 2411](#) - Statistical Methods [LE CAT2, LOGIC & QR] (3.0 cr)
- [STAT 3411](#) - Engineering Statistics (3.0 cr)
- [STAT 3611](#) - Introduction to Probability and Statistics (4.0 cr)

Upper Division (6-8 cr)

Other upper division electives may be substituted subject to department approval.

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

- [BIOL 5807](#) - Mathematical Ecology (3.0 cr)
- [CE 3225](#) - Hydraulics and Hydrology (3.0 cr)
- [CHE 4601](#) - Biochemical Engineering I (3.0 cr)
- [CHE 4615](#) *{Inactive}*(4.0 cr)
- [ES 3500](#) - Ecological Economics (3.0 cr)
- [ESCI 3101](#) - Nonrenewable Resources (3.0 cr)
- [ESCI 3102](#) - Renewable Resources (3.0 cr)
- [GEOL 5240](#) - Physical Hydrogeology (4.0 cr)



- [GEOL 5250](#) - Hydrogeology (4.0 cr)

Duluth Campus

Environmental Science B.S.

Swenson College of Science & Engineering

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 120
- Required credits within the major: 101 to 105
- Degree: Bachelor of Science

The B.S. in environmental science is designed for students that want a multidisciplinary science education focusing on aspects of the environment. This environmental science program requires a broad base of knowledge in the basic sciences and mathematics, physics, chemistry, biology, Earth sciences, and statistics. In addition, prudent study of environmental science requires understanding of economic, political, and ethical considerations. Environmental science features an intense grounding in resource issues (including courses in renewable and non-renewable resources) and builds on the strength of UMD in freshwater issues. In addition, the capstone course deals with sources, distribution, and ultimate fate of air, water, and solid waste pollution. Elective courses from areas, such as habitats, climate processes, environmental chemistry, quantitative methods, and global resources are also required.

The program is predicated on the belief that a student graduating with a B.S. in environmental science should have a firm background in physical and life sciences and a basic understanding of 1) existing environmental policies and regulations and the legislative process of their formation; 2) the major environmental issues including water, global climate, energy, pollution, and population; 3) techniques of environmental monitoring and prediction; and 4) economics and business organization.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

For entering freshmen, the only admission requirement is acceptance into the College of Science and Engineering. Transfer students must meet campus and college requirements and are accepted into the program at the level corresponding to credits completed, based on existing transfer manuals and on faculty judgment when courses are not in existing manuals.

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Required Environmental Science Core (20 cr)

- ESCI 2210 - Environmental Characterization and Monitoring (4.0 cr)
- ESCI 3101 - Nonrenewable Resources (3.0 cr)
- ESCI 3102 - Renewable Resources (3.0 cr)
- ESCI 4102 - Environmental Assessment (3.0 cr)
- CHE 4615 *{Inactive}*(4.0 cr)
or ESCI 4101 *{Inactive}*(3.0 cr)

Required Courses From Other Programs (63-64 cr)

- BIOL 1011 - General Biology I [LE CAT4, NAT SCI] (5.0 cr)
- BIOL 1012 - General Biology II [SUSTAIN] (5.0 cr)
- BIOL 2801 - General Ecology (3.0 cr)
- BIOL 2802 - Ecology Laboratory (2.0 cr)
- GEOL 1110 - Geology and Earth Systems [LE CAT4, NAT SCI, SUSTAIN] (4.0 cr)
- MATH 1297 - Calculus II [LOGIC & QR] (5.0 cr)
- PHYS 2011 *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)
- PHYS 2012 *{Inactive}*(4.0 cr)
- WRIT 3150 - Advanced Writing: Science (3.0 cr)

Chemistry I

- CHEM 1161 *{Inactive}*[LE CAT4, NAT SCI] (5.0 cr)
or CHEM 1153 - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)
CHEM 1154 - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)

Chemistry II

- CHEM 1162 *{Inactive}*(5.0 cr)
or CHEM 1155 - General Chemistry II (4.0 cr)
CHEM 1156 - General Chemistry Lab II (1.0 cr)

Analytical Chemistry

- CHEM 2212 - Environmental Chemistry [NAT SCI, SUSTAIN] (4.0 cr)
or CHEM 2222 - Quantitative Analysis (3.0 cr)
CHEM 2223 - Quantitative Analysis Laboratory (1.0 cr)

Economics

- ECON 1022 - Principles of Economics: Macro [LE CAT6, SOC SCI] (3.0 cr)
or ECON 1023 - Principles of Economics: Micro [LE CAT6, SOC SCI] (3.0 cr)

Climate

- GEOL 3100 - Earth's Climate and Environment: Past and Future (3.0 cr)
or GEOG 3401 - Weather and Climate (3.0 cr)

Calculus

- MATH 1290 - Calculus for the Natural Sciences [LE CAT2, LOGIC & QR] (5.0 cr)
or MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)

Statistics

- STAT 2411 - Statistical Methods [LE CAT2, LOGIC & QR] (3.0 cr)
or STAT 3411 - Engineering Statistics (3.0 cr)
or STAT 3611 - Introduction to Probability and Statistics (4.0 cr)

Water Science Electives (8-11 cr)

Must include three courses, at least one course each from Group A and B. Courses used to satisfy a water science elective may not be used to satisfy a concentration elective. At least one course used to fill the water science electives or the concentration electives must have a laboratory or field component.

Take 3 or more course(s) totaling 8 - 11 credit(s) from the following:

Group A Groundwater

- Take 1 - 2 course(s) from the following:
 - GEOL 5240 - Physical Hydrogeology (4.0 cr)
 - GEOL 5250 - Hydrogeology (4.0 cr)
 - GEOL 4710 - Aqueous Geochemistry (4.0 cr)

Group B Surface Water

- Take 1 - 2 course(s) from the following:
 - BIOL 5805 - Fisheries Ecology and Management (3.0 cr)
 - BIOL 5833 - Stream Ecology (3.0 cr)
 - BIOL 5861 - Lake Ecology (3.0 cr)
 - GEOG 4446 - Water Processes and Management (3.0 cr)
 - LIM 5004 - Field Limnology (2.0 cr)
 - LIM 5101 - Physical Limnology (3.0 cr)
 - LIM 5102 - Chemical Limnology (3.0 cr)
 - LIM 5103 - Geological Paleolimnology (3.0 cr)
 - BIOL 4839 - Coral Reef Field Studies (3.0 cr)

or GEOL 4839 *{Inactive}*(3.0 cr)

Concentration Electives (10 cr)

Courses can be distributed among the groups in any combination. Discuss with adviser the benefits of breadth (credits in several concentrations) versus depth (credits in a particular concentration).

Take at most 10 credit(s) from the following:

Climate Processes

Take 0 - 10 credit(s) from the following:

- GEOG 3401 - Weather and Climate (3.0 cr)
- GEOG 3422 - Natural Hazards (3.0 cr)
- GEOG 4446 - Water Processes and Management (3.0 cr)
- GEOL 3210 - Geomorphology (4.0 cr)
- GEOL 5210 - Glacial and Quaternary Geology (4.0 cr)
- GEOL 5220 - Advances in Paleoclimatology (3.0 cr)
- LIM 5103 - Geological Paleolimnology (3.0 cr)

Environmental Chemistry

Take 0 - 10 credit(s) from the following:

- BIOL 5868 *{Inactive}*(3.0 cr)
- CHEM 2541 - Organic Chemistry I (3.0 cr)
- CHEM 2542 - Organic Chemistry II (3.0 cr)
- CHEM 2543 - Organic Chemistry I Laboratory (1.0 cr)
- CHEM 2544 - Organic Chemistry II Laboratory (1.0 cr)
- GEOL 3710 - Introduction to Geochemistry (3.0 cr)
- GEOL 4710 - Aqueous Geochemistry (4.0 cr)
- LIM 5102 - Chemical Limnology (3.0 cr)

Global Resources

Take 0 - 10 credit(s) from the following:

- ECON 3721 - Natural Resource and Energy Economics (3.0 cr)
- ECON 3777 - Environmental Economics (3.0 cr)
- GEOG 3461 - Geography of Global Resources [SUSTAIN] (3.0 cr)
- GEOG 4451 - The Geography of Soils (4.0 cr)
- GEOL 5240 - Physical Hydrogeology (4.0 cr)
- GEOL 5250 - Hydrogeology (4.0 cr)
- GEOL 4355 - Economic Geology (4.0 cr)

Habitats

Take 0 - 10 credit(s) from the following:

- BIOL 4805 *{Inactive}*(2.0 cr)
 - BIOL 5777 - Plankton Biology (2.0 cr)
 - BIOL 5801 - Microbial Ecology (2.0 cr)
 - BIOL 5802 - Microbial Ecology Laboratory (2.0 cr)
 - BIOL 5805 - Fisheries Ecology and Management (3.0 cr)
 - BIOL 5808 - Landscape Ecology: Theory and Application (3.0 cr)
 - BIOL 5833 - Stream Ecology (3.0 cr)
 - BIOL 5861 - Lake Ecology (3.0 cr)
 - BIOL 5863 - Ecosystems Ecology (3.0 cr)
 - BIOL 5865 - Conservation Biology (2.0 cr)
 - BIOL 5870 - Wetland Ecology (3.0 cr)
 - BIOL 4839 - Coral Reef Field Studies (3.0 cr)
- or GEOL 4839 *{Inactive}*(3.0 cr)

Quantitative Methods

Take 0 - 10 credit(s) from the following:

- BIOL 5807 - Mathematical Ecology (3.0 cr)
- CHE 2111 - Material and Energy Balances (3.0 cr)
- CHE 2121 - Chemical Engineering Thermodynamics (3.0 cr)
- CHE 3111 - Fluid Mechanics (3.0 cr)
- CHE 5022 - Transport Processes in Wells and Pipelines (3.0 cr)
- GIS 5572 - Environmental Application of GIS (4.0 cr)
- GIS 5581 - Digital Image Processing and Analysis (4.0 cr)
- GEOL 5215 *{Inactive}*(3.0 cr)
- LIM 5004 - Field Limnology (2.0 cr)
- LIM 5101 - Physical Limnology (3.0 cr)
- MATH 3280 - Differential Equations with Linear Algebra (4.0 cr)
- PHYS 5043 *{Inactive}*(3.0 cr)
- PHYS 5053 - Data Analysis Methods in Physics (3.0 cr)
- PHYS 5541 - Fluid Dynamics (3.0 cr)



- [STAT 5411](#) - Analysis of Variance (3.0 cr)

**Duluth Campus****Environmental Science Minor***Swenson College of Science & Engineering***Swenson College of Science and Engineering**

- Program Type: Undergraduate minor related to major
- Requirements for this program are current for Fall 2011
- Required credits in this minor: 30
- None

The environmental science minor enhances a student's understanding of the scope of environmental problems, the biochemical and physical processes of environmental degradation, the sciences of non-renewable and renewable resources, and economic and political issues surrounding environmental problems. The minor provides valuable background for many environmental careers and applications.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Minor Requirements**ES Minor Requirements (26 cr)**

[GEOL 1110](#) - Geology and Earth Systems [LE CAT4, NAT SCI, SUSTAIN] (4.0 cr)

[ESCI 2210](#) - Environmental Characterization and Monitoring (4.0 cr)

[ESCI 3101](#) - Nonrenewable Resources (3.0 cr)

[ESCI 3102](#) - Renewable Resources (3.0 cr)

[CHEM 1153](#) - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)

[CHEM 1154](#) - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)

[CHEM 1155](#) - General Chemistry II (4.0 cr)

[CHEM 1156](#) - General Chemistry Lab II (1.0 cr)

or [CHEM 1161](#) *{Inactive}*[LE CAT4, NAT SCI] (5.0 cr)

[CHEM 1162](#) *{Inactive}*(5.0 cr)

Minor Electives (4 cr)

Take 2 or more courses totaling 4 or more credits from the following:

[ESCI 4101](#) *{Inactive}*(3.0 cr)

or [ESCI 4102](#) - Environmental Assessment (3.0 cr)

or ESci Water Science Electives from Environmental Science B.S.

or ESci Concentration Electives from Environmental Science B.S.

Duluth Campus

Geological Sciences B.S.

D Earth & Environmental Sci

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 120
- Required credits within the major: 78 to 93
- This program requires summer terms.
- Degree: Bachelor of Science

The study of geology provides ways of understanding and appreciating dynamic earth processes, our physical environment, and our place in the long and complex history of the planet and solar system. It is by nature interdisciplinary and attracts students with broad interest in earth science, archaeology, astronomy, biology, chemistry, engineering, environmental science, applied mathematics, oceanography, limnology and/or physics. The B.S. degree in geological sciences can lead to rewarding careers in industry, government, conservation, law, business, and academia.

Geology requires a solid base of knowledge in related sciences (chemistry and physics) and mathematics, as well as a solid core of geology courses. A summer course in field mapping is also required.

The B.S. degree with the exploration and mining track is designed for students interested in a career in the exploration and mining industries. The track includes a solid core of geoscience courses with a focus on courses related to exploration and mining geology. A summer course in field mapping is also required.

Honors Requirements: To attain department honors, students must undertake an independent research project and maintain a cumulative overall GPA of 3.00. The research can be part of a UROP, directed research, independent study, or an internship with a faculty member. Students must either make a brief oral presentation to the department summarizing their results and produce a research paper (minimum 10 pages) OR give an oral or poster presentation of their research results at a regional or national meeting (e.g., GSA, AGU, ILSG, or similar campus event).

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Requirements for the B.S. in geological sciences include:

* Minor or double major.

Geology Core Courses (42-43 cr)

- GEOL 2110 - Earth History (4.0 cr)
- GEOL 2120 - The Earth's Dynamic Interior (3.0 cr)
- GEOL 2311 - Mineralogy (4.0 cr)
- GEOL 2312 - Petrology (5.0 cr)
- GEOL 3210 - Geomorphology (4.0 cr)
- GEOL 3420 - Sedimentology and Stratigraphy (4.0 cr)
- GEOL 3800 - Principles of Geophysics (4.0 cr)
- GEOL 4450 - Structural Geology (5.0 cr)
- GEOL 4500 - Field Geology (6.0 cr)
- GEOL 1110 - Geology and Earth Systems [LE CAT4, NAT SCI, SUSTAIN] (4.0 cr)
or GEOL 1130 - Introduction to Environmental Science [LE CAT4, LEIP CAT04, NAT SCI, SUSTAIN] (4.0 cr)
or GEOL 1610 - Oceanography [LE CAT5, NAT SCI, SUSTAIN] (3.0 cr)
or GEOG 1414 - Physical Geography [LE CAT4, NAT SCI, SUSTAIN] (4.0 cr)

Advanced Electives (4-9 cr)

With the exception of GEOL 4110, take 4-9 credits of electives as listed below. GEOG 3563 and 3564 (6 credit total) may be substituted for 4 credits of advanced electives. Six credits of limnology courses may be substituted for advanced electives.

Students pursuing the exploration and mining track are required to take 4 credits, all other students are required to take 9 credits.

Take 4 or more credit(s) from the following:

- AST 4110 - Observational Astronomy (3.0 cr)
- GEOL 3xxx
- GEOL 4xxx
- GEOL 5xxx

Courses Required From Other Programs (27-28 cr)

WRIT 3150 - Advanced Writing: Science (3.0 cr)

Math requirement

- MATH 1290 - Calculus for the Natural Sciences [LE CAT2, LOGIC & QR] (5.0 cr)
or MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
- MATH 1297 - Calculus II [LOGIC & QR] (5.0 cr)

Physics requirement

- PHYS 1001 - Introduction to Physics I [LE CAT4, NAT SCI] (5.0 cr)
- PHYS 1002 - Introduction to Physics II (5.0 cr)
- or PHYS 2011 *{Inactive}* [LE CAT4, NAT SCI] (4.0 cr)
- PHYS 2012 *{Inactive}* (4.0 cr)

Chemistry requirement

- CHEM 1153 - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)
- CHEM 1154 - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)
- CHEM 1155 - General Chemistry II (4.0 cr)
- CHEM 1156 - General Chemistry Lab II (1.0 cr)
- or CHEM 1161 *{Inactive}* [LE CAT4, NAT SCI] (5.0 cr)
- CHEM 1162 *{Inactive}* (5.0 cr)

Program Sub-plans

A sub-plan is not required for this program.

Exploration and Mining Geology

The exploration and mining geology track is designed for students interested in a career in the exploration and/or mining industries. The track includes a solid core of geoscience courses with a focus on courses related to exploration and mining geology. The track includes a course in field mapping.

Students completing the exploration and mining geology track are required to take the 43-44 credits of geology core courses required of all students. They are only required to take 4 credits of advanced electives along with 27-28 credits of courses required from other



programs (listed above). They must also complete the requirements below.

Core Courses (11 cr)

[GEOL 3000](#) - Geologic Maps (3.0 cr)

[GEOL 4355](#) - Economic Geology (4.0 cr)

[GEOL 4360](#) - Geologic, Geophysical, and Geochemical Methods of Exploration (4.0 cr)

Courses from other programs (7 cr)

[GIS 3563](#) - Geographic Information Science I: Theory and Analysis (4.0 cr)

[STAT 3611](#) - Introduction to Probability and Statistics (4.0 cr)



Duluth Campus

Geological Sciences Minor

D Earth & Environmental Sci

Swenson College of Science and Engineering

- Program Type: Undergraduate minor related to major
- Requirements for this program are current for Fall 2011
- Required credits in this minor: 28 to 30

The geological sciences minor enhances the student's understanding of and familiarity with earth materials and processes, and provides valuable background for many environmental careers and applications.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Minor Requirements

Minor Courses (24-25 cr)

- [GEOL 2110](#) - Earth History (4.0 cr)
- [GEOL 2111](#) *(Inactive)* (1.0 cr)
- [GEOL 2120](#) - The Earth's Dynamic Interior (3.0 cr)
- [GEOL 2311](#) - Mineralogy (4.0 cr)
- [GEOL 3210](#) - Geomorphology (4.0 cr)
- [GEOL 1110](#) - Geology and Earth Systems [LE CAT4, NAT SCI, SUSTAIN] (4.0 cr)
or [GEOL 1130](#) - Introduction to Environmental Science [LE CAT4, LEIP CAT04, NAT SCI, SUSTAIN] (4.0 cr)
or [GEOL 1610](#) - Oceanography [LE CAT5, NAT SCI, SUSTAIN] (3.0 cr)
or [GEOG 1414](#) - Physical Geography [LE CAT4, NAT SCI, SUSTAIN] (4.0 cr)
- [CHEM 1113](#) - Introduction to General, Organic, and Biological Chemistry I [LE CAT4, NAT SCI] (5.0 cr)
or [CHEM 1153](#) - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)
• [CHEM 1154](#) - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)

Electives (4-5 cr)

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

- [GEOL 2312](#) - Petrology (5.0 cr)
- [GEOL 3420](#) - Sedimentology and Stratigraphy (4.0 cr)
- [GEOL 5240](#) - Physical Hydrogeology (4.0 cr)
- [GEOL 5250](#) - Hydrogeology (4.0 cr)
- [GEOL 4450](#) - Structural Geology (5.0 cr)



Duluth Campus

Industrial Engineering B.S.I.E.

UMD Mechanical/Industrial Engineering

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 130
- Required credits within the major: 115
- Degree: Bachelor of Science in Industrial Engineering

The mission of the bachelor of science in industrial engineering program is to deliver a hands-on, laboratory-intensive undergraduate education that provides students with the tools and skills to excel in the profession, as they pursue lifelong learning and make positive contributions to society. With an emphasis on integrated systems and a strategic partnership with Luleå University of Technology in Sweden, the B.S.I.E. program offers unique opportunities for study abroad, undergraduate research, and technical electives to develop an enhanced global perspective.

The educational objectives of the industrial engineering program are to produce graduates who are able to:

1. Solve industrial engineering problems by applying contemporary engineering tools to propose and implement effective solutions.
2. Design, develop, implement, and improve integrated systems that include people, materials, information, equipment, and energy.
3. Contribute as informed, ethical, and responsible members of the engineering profession and society as a whole.
4. Continue lifelong professional development throughout their career.
5. Collaborate and communicate effectively with others as a member or leader of an engineering or multidisciplinary team in an international setting.

Industrial engineering integrates topics from manufacturing, management, service, and traditional design. Industrial engineers are proficient in the design, improvement, and management of complex systems of people, materials, equipment, and energy. They study and adapt product designs and the associated plant facilities to optimize production, while considering economic, technical, and human factors.

The curriculum rounds out the learning experience by providing skills in the mathematical and physical sciences, economics, composition, and humanities and social sciences.

The industrial engineering program is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: 410-347-7700. The program emphasizes manufacturing engineering and engineering management.

The international engineering concentration requires a senior year exchange with the Department of Materials and Manufacturing Engineering at Luleå University of Technology in Sweden and provides students with the opportunity to experience engineering in the global community.

The industrial and systems engineering concentration emphasizes the overall perspective of people and productivity, in any type of system, including manufacturing, service, health care, transportation, communication, and agriculture. The international engineering concentration offers a unique opportunity to study engineering in another culture; space is limited. Courses are taught in English and opportunities for travel and externally-focused projects abound.

Honors Requirements: To graduate with department honors, a student must graduate with a 3.40 GPA, be an active member of Tau Beta Pi or a professional engineering society (ASME, ASSE, IIE, or MSPE), and be nominated by a department faculty member.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

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

Freshman, sophomores, and transfer students may declare an IE major and admitted to lower division status. Admission to upper division B.S.I.E. program is competitive and based on performance in lower division courses and space availability. To be considered students must complete the MIE Application to Upper Division. The following requirements must be met:

* Completion of the following courses or their transfer equivalents:

- WRIT 1120
- CS 1121 or 1511 or 2121
- IE 1225
- CE 2017
- ME 2105
- MATH 3280

* A cumulative UMD GPA of 2.50 or above

* Successful completion with grades of C- or better of all required program course taken at UMD or within the University of Minnesota system.

* Successful completion with grades of C or better of all required program courses transferred from outside the University of Minnesota system.

Applicants not meeting these requirements may be admitted to the upper division B.S.I.E. program on a space-available basis.

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Requirements for the B.S.I.E. include:

* Successful completion with grades of C- or better, or S, of all required program courses taken at UMD or within the University of Minnesota system.

* Successful completion with grades of C or better of all required program course transferred from outside the University of Minnesota system.

* Acceptance to the upper division BSIE program and either the Industrial and System Engineering or International Engineering sub-plan.

Maintenance Standards: Continuation of upper division status requires students to be in good academic standing. BSIE upper division students placed on academic probation or who have been academically dismissed by the Swenson College of Science and Engineering will also be removed from upper division BSIE status.

Program Sub-plans

Students are required to complete one of the following sub-plans.

Industrial and Systems Engineering Program

The industrial and systems engineering concentration emphasizes the overall perspective of people and productivity in any type of system, including manufacturing, service, health care, transportation, communication, and agriculture. Concentration electives allow students to study systems of interest to them.

Industrial and Systems Engineering Core Courses (49 cr)

Required courses include fundamental material in engineering science, engineering management, industrial engineering, and mechanical engineering. Concepts are delivered in lecture and reinforced in lab experiences.

- EMGT 4110 - Engineering Professionalism and Practice (2.0 cr)
- IE 1225 *{Inactive}*(4.0 cr)
- IE 3115 - Operations Research (4.0 cr)
- IE 3122 - Materials Engineering Laboratory (2.0 cr)
- IE 3125 - Engineering Economic Analysis [SOC SCI] (3.0 cr)
- IE 3130 - Materials Processing Engineering (3.0 cr)
- IE 3140 - Human Factors and Ergonomic Design (3.0 cr)
- IE 3222 - Occupational Systems Laboratory (2.0 cr)
- IE 4010 - Six Sigma Quality Control (3.0 cr)
- IE 4020 - Lean Production Management (3.0 cr)
- IE 4115 - Facility Planning and Simulation (4.0 cr)
- IE 4222 - Systems Integration Laboratory (2.0 cr)
- IE 4230 - Systems Integration (3.0 cr)
- IE 4255 - Multidisciplinary Senior Design (4.0 cr)
- IE 4993 - Industrial Engineering Seminar (1.0 cr)
- ME 2105 - Introduction to Material Science for Engineers (3.0 cr)
- ME 2226 - Dynamics (3.0 cr)

Courses From Other Programs (51 cr)

These courses help engineers develop a foundation of mathematics, sciences, economics, statistics, and communication skills.

- CE 2017 - Engineering Mechanics: Statics and Mechanics of Materials (5.0 cr)
- CHEM 1153 - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)
- CHEM 1154 - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)
- EE 2006 - Electrical Circuit Analysis (4.0 cr)
- MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
- MATH 1297 - Calculus II [LOGIC & QR] (5.0 cr)
- MATH 3280 - Differential Equations with Linear Algebra (4.0 cr)
- PHYS 2011 *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)
- PHYS 2012 *{Inactive}*(4.0 cr)
- STAT 3411 - Engineering Statistics (3.0 cr)
- WRIT 1120 - College Writing [LE CAT1, WRITING] (3.0 cr)

Economics

- ECON 1022 - Principles of Economics: Macro [LE CAT6, SOC SCI] (3.0 cr)
- or ECON 1023 - Principles of Economics: Micro [LE CAT6, SOC SCI] (3.0 cr)

Business

- ACCT 2005 *{Inactive}*[LE CAT8] (3.0 cr)
- or BLAW 2001 - The Legal Environment [LE CAT8, HUMANITIES] (3.0 cr)
- COMM 1112 - Public Speaking [LE CAT3, COMM & LAN] (3.0 cr)
- or PSY 1003 - General Psychology [LE CAT6, SOC SCI] (4.0 cr)
- or ACCT 2001 - Principles of Financial Accounting (3.0 cr)
- or INTB 3201 *{Inactive}*(3.0 cr)

Advanced Writing

WRIT 3130 is preferred

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

- WRIT 3130 - Advanced Writing: Engineering (3.0 cr)
- WRIT 3150 - Advanced Writing: Science (3.0 cr)
- WRIT 3180 - Honors: Advanced Writing (3.0 cr)

Computer Science Elective (3 cr)

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

- CS 1121 - Introduction to Programming in Visual BASIC.NET [LE CAT3, LOGIC & QR] (3.0 cr)
- CS 1511 - Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)
- CS 2121 - Introduction to Programming in Java [LE CAT3, LOGIC & QR] (3.0 cr)

Industrial and Systems Engineering Electives (6 cr)



These courses help an industrial engineer develop systems skills in technical areas. (Cannot count credits from other requirement categories.)

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

- IE 4495 *{Inactive}*(1.0 - 4.0 cr)
- IE 5305 - Supply Chain Management (3.0 cr)
- IE 5315 - Organizational Control Methods (3.0 cr)
- IE 5325 - Advanced Engineering Economics (3.0 cr)
- IE 5335 - Engineered Products and Services (3.0 cr)
- ME 3111 - Fluid Mechanics (3.0 cr)
or CHE 3111 - Fluid Mechanics (3.0 cr)

Additional Electives (6 cr)

(Cannot count credits from other requirement categories.)

Take 2 or more course(s) totaling 6 or more credit(s) from the following:

- CHE 2111 - Material and Energy Balances (3.0 cr)
- CS 1521 - Computer Science II (5.0 cr)
- EE 1315 - Digital Logic (4.0 cr)
- EE 2111 - Linear Systems and Signal Analysis (4.0 cr)
- EE 2212 - Electronics I (4.0 cr)
- EE 2325 - Microprocessor Systems (4.0 cr)
- EE 3151 - Control Systems (4.0 cr)
- EE 5995 - Special Topics: (Various Titles to be Assigned) (1.0 - 3.0 cr)
- IE 4196 - Cooperative Education (1.0 cr)
- IE 4491 - Independent Study (1.0 - 4.0 cr)
- IE 4495 *{Inactive}*(1.0 - 4.0 cr)
- IE 4993 - Industrial Engineering Seminar (1.0 cr)
- IE 5305 - Supply Chain Management (3.0 cr)
- IE 5315 - Organizational Control Methods (3.0 cr)
- IE 5325 - Advanced Engineering Economics (3.0 cr)
- IE 5335 - Engineered Products and Services (3.0 cr)
- IE 5991 - Independent Study in Industrial Engineering (1.0 - 4.0 cr)
- MATH 3298 - Calculus III (4.0 cr)
- MATH 3355 - Discrete Mathematics (4.0 cr)
- ME 3140 - System Dynamics and Control (3.0 cr)
- ME 2211 - Thermodynamics [SUSTAIN] (3.0 cr)
- ME 4135 - Robotics and Controls (3.0 cr)
- ME 4145 - CAD/CAM (4.0 cr)
- ME 4175 - Machine Design (3.0 cr)
- ME 4245 *{Inactive}*(4.0 cr)
- ME 4495 - Special Topics: (Various Titles to be Assigned) (1.0 - 4.0 cr)
- ME 5315 - Nondestructive Evaluation of Engineering Materials (3.0 cr)
- ME 5325 - Sustainable Energy System (3.0 cr)
- MGTS 4472 - Entrepreneurship (3.0 cr)
- STAT 5411 - Analysis of Variance (3.0 cr)
- STAT 5511 - Regression Analysis (3.0 cr)
- ME 3111 - Fluid Mechanics (3.0 cr)
or CHE 3111 - Fluid Mechanics (3.0 cr)

International Engineering

The international engineering concentration offers a unique opportunity to study engineering in another culture; space is limited. Courses are taught in English and opportunities for travel and externally-focused projects abound.

Final Project: Students taking the senior year at Luleå University of Technology must take its equivalent capstone design course.

International Engineering Core Courses (33 cr)

Required courses include fundamental material in engineering science, industrial engineering, and mechanical engineering. Courses in Sweden build on these fundamentals, frequently in the context of significant projects.

- IE 1225 *{Inactive}*(4.0 cr)
- IE 3115 - Operations Research (4.0 cr)
- IE 3122 - Materials Engineering Laboratory (2.0 cr)
- IE 3125 - Engineering Economic Analysis [SOC SCI] (3.0 cr)
- IE 3130 - Materials Processing Engineering (3.0 cr)
- IE 3140 - Human Factors and Ergonomic Design (3.0 cr)
- IE 3222 - Occupational Systems Laboratory (2.0 cr)
- IE 4010 - Six Sigma Quality Control (3.0 cr)



- IE 4020 - Lean Production Management (3.0 cr)
- ME 2105 - Introduction to Material Science for Engineers (3.0 cr)
- ME 2226 - Dynamics (3.0 cr)

Courses From Other Programs (45 cr)

These courses help engineers develop a foundation of mathematics, sciences, economics, statistics, and communication skills. International engineering emphasizes the culture, historical perspective, and current events and issues in a foreign setting.

- CE 2017 - Engineering Mechanics: Statics and Mechanics of Materials (5.0 cr)
- CHEM 1153 - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)
- CHEM 1154 - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)
- EE 2006 - Electrical Circuit Analysis (4.0 cr)
- MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
- MATH 1297 - Calculus II [LOGIC & QR] (5.0 cr)
- MATH 3280 - Differential Equations with Linear Algebra (4.0 cr)
- PHYS 2011 *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)
- PHYS 2012 *{Inactive}*(4.0 cr)
- STAT 3411 - Engineering Statistics (3.0 cr)
- WRIT 1120 - College Writing [LE CAT1, WRITING] (3.0 cr)

Economics

- ECON 1022 - Principles of Economics: Macro [LE CAT6, SOC SCI] (3.0 cr)
- or ECON 1023 - Principles of Economics: Micro [LE CAT6, SOC SCI] (3.0 cr)

Advanced Writing

WRIT 3130 is preferred

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

- WRIT 3130 - Advanced Writing: Engineering (3.0 cr)
- WRIT 3150 - Advanced Writing: Science (3.0 cr)
- WRIT 3180 - Honors: Advanced Writing (3.0 cr)

Computer Science Elective (3 cr)

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

- CS 1121 - Introduction to Programming in Visual BASIC.NET [LE CAT3, LOGIC & QR] (3.0 cr)
- CS 1511 - Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)
- CS 2121 - Introduction to Programming in Java [LE CAT3, LOGIC & QR] (3.0 cr)

Industrial Engineering Elective (3 cr)

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

- IE 4495 *{Inactive}*(1.0 - 4.0 cr)
- IE 5305 - Supply Chain Management (3.0 cr)
- IE 5315 - Organizational Control Methods (3.0 cr)
- IE 5325 - Advanced Engineering Economics (3.0 cr)
- IE 5335 - Engineered Products and Services (3.0 cr)
- ME 3111 - Fluid Mechanics (3.0 cr)

Courses Taken in Luleå, Sweden (31 cr)

- FST 1816 - Introduction to Scandinavia (LE-8) (3 cr)
- * Simulation of production systems (4 cr)
- * Automation (4 cr)
- * CAD (4 cr)
- * Intergrated manufacturing systems (8 cr)
- * Approved technical, manufacturing, or business electives (8 cr)

Duluth Campus

Mathematics B.S.

Mathematics & Statistics

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 120
- Required credits within the major: 51
- Degree: Bachelor of Science

The program in mathematics develops competence in mathematical techniques and sharpens mathematical insight. Mathematics is fundamental to solving problems in physics, chemistry, biology, medicine, business, engineering, and technology. The mathematics major prepares students for careers in business, industry, and government and for further graduate studies.

Note: the B.S. in statistics and actuarial science is listed separately.

Honors Requirements: To graduate with department honors, a student must complete the program with an overall and department GPA of 3.50, satisfactorily complete a research project under the guidance of a department faculty member, and convey research results in a public presentation.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Requirements for the B.S. in mathematics include:

* Minor or second major from another area of study.

Introduction to Calculus Courses (10 cr)

Calculus I

Take one of the following three Calculus I courses:

[MATH 1290](#) - Calculus for the Natural Sciences [LE CAT2, LOGIC & QR] (5.0 cr)
or [MATH 1296](#) - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
or [MATH 1596](#) *{Inactive}*[LE CAT2, LOGIC & QR] (5.0 cr)

Take one of the following two Calculus II courses:

[MATH 1297](#) - Calculus II [LOGIC & QR] (5.0 cr)
or [MATH 1597](#) *{Inactive}*[LOGIC & QR] (5.0 cr)

Mathematics Core Courses (20 cr)

Core courses cannot count as electives.

Take the following six courses:

[MATH 3280](#) - Differential Equations with Linear Algebra (4.0 cr)
[MATH 3355](#) - Discrete Mathematics (4.0 cr)
[MATH 3941](#) - Undergraduate Colloquium (1.0 cr)
[MATH 4201](#) - Elementary Real Analysis (4.0 cr)
[MATH 4326](#) - Linear Algebra (3.0 cr)
[STAT 3611](#) - Introduction to Probability and Statistics (4.0 cr)

Required From Other Departments (5 cr)

[CS 1511](#) - Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)
WRIT 31xx

Electives (16 cr)

Core courses cannot count as electives.

MATH elective courses must be at least 3100.

STAT elective courses must be at least 5000.

At least 10 credits of MATH and/or STAT electives must be 4xxx or above.

At least 6 credits of electives must have MATH prefix and be 4xxx or above.

Only one credit of MATH 3120 may count toward the math major.

MATH 3326 or 4371 cannot be counted toward the major.

MATH

Take 0 - 6 credit(s) from the following:

- MATH 3xxx

MATH/STAT 4xxx-5xxx

Take 10 - 16 credit(s) from the following:

- MATH 4xxx
- MATH 5xxx
- STAT 5xxx

Double Majors ONLY

-A student pursuing a second major in statistics and actuarial science cannot apply STAT courses as electives.

-A student with a second major other than statistics and actuarial science may substitute courses from the approved nondepartmental list (below) on a one elective MATH credit for two outside credits exchange basis for up to seven MATH elective credits.

Approved Nondepartmental List:

Take 0 - 14 credit(s) from the following:

- [BIOL 5807](#) - Mathematical Ecology (3.0 cr)
- [CHE 4301](#) - Chemical Reaction Engineering (3.0 cr)
- [CHE 4402](#) - Process Dynamics and Control (3.0 cr)
- [CHEM 4641](#) - Physical Chemistry I (3.0 cr)
- [CHEM 4642](#) - Physical Chemistry II (3.0 cr)
- [CS 4511](#) *{Inactive}*(4.0 cr)
- [CS 4521](#) *{Inactive}*(4.0 cr)
- [CS 5541](#) - Artificial Intelligence (4.0 cr)
- [CS 5721](#) - Computer Graphics (4.0 cr)
- [CS 5751](#) - Introduction to Machine Learning and Data Mining (4.0 cr)
- [EE 5151](#) - Digital Control System Design (3.0 cr)
- [EE 5741](#) - Digital Signal Processing (3.0 cr)
- [EE 5831](#) - Fuzzy Set Theory and Its Application (3.0 cr)
- [GEOL 5240](#) - Physical Hydrogeology (4.0 cr)
- [ME 4112](#) - Heat and Mass Transfer (3.0 cr)
- [ME 4135](#) - Robotics and Controls (3.0 cr)
- [PHYS 4001](#) - Classical Mechanics (4.0 cr)
- [PHYS 4011](#) - Electromagnetic Theory (4.0 cr)
- [PHYS 4021](#) - Quantum Physics II (4.0 cr)
- [PHYS 4031](#) - Thermal and Statistical Physics (4.0 cr)



- PHYS 5052 - Computational Methods in Physics (3.0 cr)
- PHYS 5501 - Advanced Classical Mechanics (3.0 cr)
- PHYS 5541 - Fluid Dynamics (3.0 cr)

Program Areas of Emphasis

Mathematics includes a wide variety of areas in which students can specialize: traditional mathematics (preparation for Graduate School), applied analysis, computational mathematics, discrete mathematics, and mathematics education. Although no area is required for the MATH major, students are encouraged to work with their advisers to develop a coherent major plan. See the Department of Mathematics and Statistics Web page: <http://www.d.umn.edu/math> for descriptions of elective course groups.

**Duluth Campus****Mathematics Minor***Mathematics & Statistics***Swenson College of Science and Engineering**

- Program Type: Undergraduate minor related to major
- Requirements for this program are current for Fall 2011
- Required credits in this minor: 23

The minor in mathematics is based on the completion of the traditional core of calculus, differential equations, and elementary linear algebra commonly required of undergraduate physical science, engineering, and mathematics degrees. Additional, more advanced, elective classes are required, as well. The minor in mathematics certifies a student's quantitative, problem-solving, and critical thinking skills.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Minor Requirements**Core Courses (14 cr)****Calculus I**

[MATH 1296](#) - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
or [MATH 1596](#) *{Inactive}*[LE CAT2, LOGIC & QR] (5.0 cr)

Calculus II

[MATH 1297](#) - Calculus II [LOGIC & QR] (5.0 cr)
or [MATH 1597](#) *{Inactive}*[LOGIC & QR] (5.0 cr)

Core Course

[MATH 3280](#) - Differential Equations with Linear Algebra (4.0 cr)

Electives (9 cr)

Each course must be a minimum of 3 credits. Only one of STAT 3411 and STAT 3611 may count toward the math minor.

Take 3 or more course(s) totaling 9 or more credit(s) from the following:

- MATH 3xxx
- MATH 4xxx
- STAT 3xxx
- STAT 4xxx



Duluth Campus

Mechanical Engineering B.S.M.E.

UMD Mechanical/Industrial Engineering

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 127
- Required credits within the major: 112
- Degree: Bachelor of Science in Mechanical Engineering

The mission of the bachelor of science in mechanical engineering program is to deliver a laboratory-intensive, undergraduate mechanical engineering education that provides students with the tools and skills to excel in the engineering profession, as they pursue lifelong learning and make positive contributions to society. The student learning experience offers unique opportunities for study abroad, undergraduate research, and electives outside of mechanical engineering to develop an enhanced global perspective.

Mechanical engineering program educational objectives:
B.S.M.E. graduates will

1. Solve mechanical engineering problems by applying contemporary engineering tools to propose and implement effective solutions.
2. Design, develop, implement and improve thermal and mechanical systems.
3. Contribute as informed, ethical, and responsible members of the engineering profession and society as a whole.
4. Continue lifelong professional development throughout their career.
5. Collaborate and communicate effectively with others as a member or leader of an engineering or multidisciplinary team in an international setting.

The B.S.M.E. program integrates topics from chemistry, physics, advanced mathematics and statistics, and core engineering science to prepare graduates to work professionally in both thermal and mechanical systems, from design, development, manufacture, and use of products involving mechanical and thermal elements.

The program emphasizes the production engineering approach to mechanical and thermal systems design and development. Upper division courses provide students with a strong understanding of mechanical and thermal systems, and the skills to design, develop, and implement these systems. The mechanical engineering program is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, telephone: 410-347-7700.

Mechanical engineering graduates are qualified for employment in a wide variety of industries including design, manufacturing, materials, aerospace, transportation, natural resources, and energy. Graduates may pursue assignments in design, development, manufacturing, operations, project engineering, or sales, and frequently move into engineering management. They are also well qualified to continue with graduate education.

Students in the B.S.M.E. program have the opportunity to put their design and entrepreneurial skills to use in ASME design competitions, projects sponsored by regional companies, and research projects in the Undergraduate Research Opportunities Program.

Honors Requirements: To graduate with department honors, a student must have a 3.40 GPA, be an active member of Tau Beta Pi or a professional engineering society (ASME, ASSE, IIE, or MSPE), and be nominated by a department faculty member.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

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

Freshman, sophomores, and transfer students may declare a ME major and be admitted to lower division status. Admission to the upper division B.S.M.E. program is competitive and based on performance in lower division courses and space availability. To be considered students must complete the MIE Application to upper division. The following requirements must be met:



* Completion of the following courses or their transfer equivalents:

- WRIT 1120
- CS 1121 or 1511 or 2121
- IE 1225
- CE 2017
- ME 2105
- MATH 3280

* A cumulative UMD GPA of 2.50 or above.

* Successful completion with grades of C- or better of all required program courses taken at UMD or within the University of Minnesota system.

* Successful completion with grades of C or better of all required program courses transferred from outside the University of Minnesota system.

Applicants not meeting these requirements may be admitted to the upper division B.S.M.E. program on a space-available basis.

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Requirements for the B.S.M.E. include:

* Successful completion, with grades of C- or better or S, in all required program courses taken at UMD or within the University of Minnesota system.

* Successful completion with grades of C or better of all required program course transferred from outside the University of Minnesota system.

* Acceptance to the upper division BSME program.

Maintenance Standards: Continuation of upper division status required students to be in good academic standing. BSME upper division students placed on academic probation or who have been academically dismissed by the Swenson College of Science and Engineering will also be removed from upper division BSME status.

B.S.M.E Core Courses (51 cr)

Courses include fundamental material in engineering management, engineering science, industrial engineering, and mechanical engineering. Concepts are delivered in lecture and reinforced in lab experiences.

[EMGT 4110](#) - Engineering Professionalism and Practice (2.0 cr)

[IE 1225](#) (*Inactive*)(4.0 cr)



IE 3122 - Materials Engineering Laboratory (2.0 cr)
IE 3125 - Engineering Economic Analysis [SOC SCI] (3.0 cr)
IE 3130 - Materials Processing Engineering (3.0 cr)
IE 4993 - Industrial Engineering Seminar (1.0 cr)
ME 2105 - Introduction to Material Science for Engineers (3.0 cr)
ME 2226 - Dynamics (3.0 cr)
ME 3140 - System Dynamics and Control (3.0 cr)
ME 2211 - Thermodynamics [SUSTAIN] (3.0 cr)
ME 3222 - Controls and Kinematics Laboratory (2.0 cr)
ME 3230 - Kinematics and Mechatronics (3.0 cr)
ME 4112 - Heat and Mass Transfer (3.0 cr)
ME 4122 - Heat Transfer, Thermodynamics and Fluid Mechanics Laboratory (2.0 cr)
ME 4145 - CAD/CAM (4.0 cr)
ME 4175 - Machine Design (3.0 cr)
ME 4255 - Multidisciplinary Senior Design (4.0 cr)
ME 3111 - Fluid Mechanics (3.0 cr)
or CHE 3111 - Fluid Mechanics (3.0 cr)

Courses From Other Programs (49 cr)

These courses help engineers develop a foundation of mathematics, sciences, economics, statistics, and communication skills.

CE 2017 - Engineering Mechanics: Statics and Mechanics of Materials (5.0 cr)
EE 2006 - Electrical Circuit Analysis (4.0 cr)
MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
MATH 1297 - Calculus II [LOGIC & QR] (5.0 cr)
MATH 3280 - Differential Equations with Linear Algebra (4.0 cr)
MATH 3298 - Calculus III (4.0 cr)
PHYS 2011 *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)
PHYS 2012 *{Inactive}*(4.0 cr)
STAT 3411 - Engineering Statistics (3.0 cr)
CHEM 1153 - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)
CHEM 1154 - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)
ECON 1022 - Principles of Economics: Macro [LE CAT6, SOC SCI] (3.0 cr)
or ECON 1023 - Principles of Economics: Micro [LE CAT6, SOC SCI] (3.0 cr)

Advanced Writing Requirement

WRIT 3130 is preferred

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

- WRIT 3130 - Advanced Writing: Engineering (3.0 cr)
- WRIT 3150 - Advanced Writing: Science (3.0 cr)
- WRIT 3180 - Honors: Advanced Writing (3.0 cr)

Computer Science Elective (3 cr)

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

- CS 1121 - Introduction to Programming in Visual BASIC.NET [LE CAT3, LOGIC & QR] (3.0 cr)
- CS 1511 - Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)
- CS 2121 - Introduction to Programming in Java [LE CAT3, LOGIC & QR] (3.0 cr)

Mechanical Engineering Advanced Electives (3 cr)

These courses help a mechanical engineer develop skills in a particular technical area.

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

- ME 4135 - Robotics and Controls (3.0 cr)
- ME 4245 *{Inactive}*(4.0 cr)
- ME 4495 - Special Topics: (Various Titles to be Assigned) (1.0 - 4.0 cr)
- ME 5305 - Computational Fluid Dynamics (3.0 cr)
- ME 5315 - Nondestructive Evaluation of Engineering Materials (3.0 cr)
- ME 5325 - Sustainable Energy System (3.0 cr)
- ME 5335 - Introduction to Finite Element Analysis (3.0 cr)
- ME 5345 - Smart Materials and Structures (3.0 cr)
- ME 5355 - Gas Turbines (3.0 cr)

Mechanical Engineering Technical Electives (6 cr)

Take 2 or more course(s) totaling 6 or more credit(s) from the following:

- CHE 4301 - Chemical Reaction Engineering (3.0 cr)
- CHE 4621 *{Inactive}*(3.0 cr)
- CHE 5022 - Transport Processes in Wells and Pipelines (3.0 cr)
- EE 2111 - Linear Systems and Signal Analysis (4.0 cr)



- EE 2212 - Electronics I (4.0 cr)
- EE 3151 - Control Systems (4.0 cr)
- EE 3235 - Electronics II (4.0 cr)
- EE 3445 - Electromagnetic Fields (3.0 cr)
- EE 4611 - Introduction to Solid-State Semiconductors (3.0 cr)
- EE 4501 - Power Systems (4.0 cr)
- EE 5995 - Special Topics: (Various Titles to be Assigned) (1.0 - 3.0 cr)
- IE 3115 - Operations Research (4.0 cr)
- IE 4010 - Six Sigma Quality Control (3.0 cr)
- IE 4020 - Lean Production Management (3.0 cr)
- IE 4495 *{Inactive}*(1.0 - 4.0 cr)
- IE 4993 - Industrial Engineering Seminar (1.0 cr)
- IE 5315 - Organizational Control Methods (3.0 cr)
- IE 5325 - Advanced Engineering Economics (3.0 cr)
- ME 4135 - Robotics and Controls (3.0 cr)
- ME 4196 - Cooperative Education (1.0 cr)
- ME 4245 *{Inactive}*(4.0 cr)
- ME 4491 - Independent Study in Mechanical Engineering (1.0 - 4.0 cr)
- ME 4495 - Special Topics: (Various Titles to be Assigned) (1.0 - 4.0 cr)
- ME 5305 - Computational Fluid Dynamics (3.0 cr)
- ME 5315 - Nondestructive Evaluation of Engineering Materials (3.0 cr)
- ME 5325 - Sustainable Energy System (3.0 cr)
- ME 5335 - Introduction to Finite Element Analysis (3.0 cr)
- ME 5345 - Smart Materials and Structures (3.0 cr)
- ME 5355 - Gas Turbines (3.0 cr)
- ME 5991 - Independent Study in Mechanical Engineering (1.0 - 4.0 cr)
- MGTS 4472 - Entrepreneurship (3.0 cr)
- PHYS 2021 - Relativity and Quantum Physics (4.0 cr)
- PHYS 4021 - Quantum Physics II (4.0 cr)
- PHYS 4031 - Thermal and Statistical Physics (4.0 cr)

Duluth Campus

Natural History Minor

D Earth & Environmental Sci, Biology

Swenson College of Science and Engineering

- Program Type: Undergraduate free-standing minor
- Requirements for this program are current for Fall 2011
- Required credits in this minor: 34
- None

The natural history minor enhances students understanding of the ecology and geology of the natural world. It places particular emphasis on courses with field labs. The minor program covers a wide range of topics in earth's history, geomorphology, ecology, ornithology, entomology, ichthyology, mammalogy, animal behavior, and field interpretation for education, as well as other topics.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Minor Requirements

Required Courses (21 cr)

- BIOL 1011 - General Biology I [LE CAT4, NAT SCI] (5.0 cr)
- BIOL 1012 - General Biology II [SUSTAIN] (5.0 cr)
- BIOL 2801 - General Ecology (3.0 cr)
- GEOL 1110 - Geology and Earth Systems [LE CAT4, NAT SCI, SUSTAIN] (4.0 cr)
- GEOL 2110 - Earth History (4.0 cr)
- BIOL 4992 - Senior Seminar: Classic Readings in Natural History (1.0 cr)

Electives (13 cr)

Must take at least 1 additional BIOL and 1 additional GEOL course.

At least 10 credits of electives MUST be 3xxx or above.

Take 13 or more credit(s) from the following:

- BIOL 3601 - Plant Diversity (3.0 cr)
- BIOL 3603 - Plant Taxonomy (3.0 cr)
- BIOL 3701 - Animal Diversity (4.0 cr)
- BIOL 3760 - Marine Biology (3.0 cr)
- BIOL 4731 - Entomology (3.0 cr)
- BIOL 4761 - Ichthyology (3.0 cr)
- BIOL 4763 - Ornithology (3.0 cr)
- BIOL 4764 - Mammalogy (3.0 cr)
- BIOL 4803 *{Inactive}*(4.0 cr)
- BIOL 4891 - Animal Behavior (2.0 cr)
- BIOL 4839 - Coral Reef Field Studies (3.0 cr)
- ENED 3341 - Field Interpretive Techniques I (3.0 cr)
- ENED 3342 - Field Interpretive Techniques II (3.0 cr)
- FST 3236 - Icelandic Geology & the New Society (3.0 cr)
- GEOL 1140 *{Inactive}*[LE CAT5, LEIP CAT05] (3.0 cr)
- GEOL 2350 - Earth's Resources [LE CAT5, LEIP CAT05, NAT SCI] (3.0 cr)
- GEOL 3100 - Earth's Climate and Environment: Past and Future (3.0 cr)
- GEOL 3210 - Geomorphology (4.0 cr)
- GEOL 4839 *{Inactive}*(3.0 cr)

Duluth Campus

Physics B.S.

UMD-Physics & Astronomy

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 120
- Required credits within the major: 71 to 73
- Degree: Bachelor of Science

The B.S. in physics is primarily for students planning to work toward an advanced degree in physics or a related area. The physics courses emphasize conceptual foundations, problem-solving skills, and experimental techniques.

Students are encouraged to participate in research, with emphasis in experimental high-energy physics and particle astrophysics; limnological research, including observational studies and modeling of lakes; and computational physics. Additional faculty interests include optics and condensed matter physics. The department also offers courses required for other science and engineering programs.

Honors Requirements: To graduate with honors, students must participate in the department honors program, complete and present a research project, and maintain a GPA above 3.00 overall and in the major. They are also expected to attend department colloquia. Interested students should contact the physics honors program coordinator.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Requirements for the B.S. in physics include:

* A minor or a second major in a different program.

The first math course is determined by ACT math score. The sample plan presupposes placement into MATH 1296.

Courses numbered above 3xxx will be offered in alternate years only. Some courses suggested in the sample plans in the junior and senior years may need to be switched to match the course offerings.

Students interested in teaching 9-12 physics may enroll concurrently in the Department of Education and apply for admission to the Secondary Teacher Education Program.

Core Courses (42 cr)

The department also recommends the supplementary courses PHYS 2111 and PHYS 2112.

- PHYS 1021 - Exploring Current Topics in Physics (1.0 cr)
- PHYS 2011 *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)
- PHYS 2012 *{Inactive}*(4.0 cr)
- PHYS 2021 - Relativity and Quantum Physics (4.0 cr)
- PHYS 2022 - Classical Physics (4.0 cr)
- PHYS 2033 - Classical and Quantum Physics Lab (2.0 cr)
- PHYS 3061 - Instrumentation (3.0 cr)
- PHYS 4001 - Classical Mechanics (4.0 cr)
- PHYS 4011 - Electromagnetic Theory (4.0 cr)
- PHYS 4021 - Quantum Physics II (4.0 cr)
- PHYS 4031 - Thermal and Statistical Physics (4.0 cr)
- PHYS 5061 - Experimental Methods (3.0 cr)
- PHYS 5090 - Physics Seminar (1.0 cr)

Required Courses From Other Programs (29-31 cr)

Two semesters of chemistry are recommended.

- MATH 1296 - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)
- MATH 1297 - Calculus II [LOGIC & QR] (5.0 cr)
- MATH 3280 - Differential Equations with Linear Algebra (4.0 cr)
- MATH 3298 - Calculus III (4.0 cr)
- CHEM 1161 *{Inactive}*[LE CAT4, NAT SCI] (5.0 cr)
 - or CHEM 1153 - General Chemistry I [LE CAT5, NAT SCI] (4.0 cr)
 - CHEM 1154 - General Chemistry Lab I [LE CAT4, NAT SCI] (1.0 cr)
- CS 1511 - Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)
 - or CS 1131 *{Inactive}*[LE CAT3] (3.0 cr)
- WRIT 3130 - Advanced Writing: Engineering (3.0 cr)
 - or WRIT 3150 - Advanced Writing: Science (3.0 cr)



Duluth Campus

Physics Minor

UMD-Physics & Astronomy

Swenson College of Science and Engineering

- Program Type: Undergraduate minor related to major
- Requirements for this program are current for Fall 2011
- Required credits in this minor: 32

The physics minor provides an introduction to classical and quantum physics.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Minor Requirements

Physics Minor Courses (32 cr)

[MATH 1296](#) - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)

[MATH 1297](#) - Calculus II [LOGIC & QR] (5.0 cr)

[PHYS 1021](#) - Exploring Current Topics in Physics (1.0 cr)

[PHYS 2011](#) *{Inactive}*[LE CAT4, NAT SCI] (4.0 cr)

[PHYS 2012](#) *{Inactive}*(4.0 cr)

[PHYS 2021](#) - Relativity and Quantum Physics (4.0 cr)

[PHYS 2022](#) - Classical Physics (4.0 cr)

[PHYS 2033](#) - Classical and Quantum Physics Lab (2.0 cr)

PHYS 3xxx-5xxx

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

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

Duluth Campus

Statistics and Actuarial Science B.S.

Mathematics & Statistics

Swenson College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2011
- Required credits to graduate with this degree: 120
- Required credits within the major: 50 to 51
- Degree: Bachelor of Science

The science of statistics is concerned with generating and analyzing data. Actuarial science applies statistical methods to assess risk in the insurance and financial industries. The statistics and actuarial science major trains students for careers in a wide variety of fields from banking and government to health care. Advisers have information on the national actuarial examinations.

Honors Requirements: To graduate with department honors, a student must complete the program with an overall and department GPA of 3.50, satisfactorily complete a research project under the guidance of a faculty member, and convey research results in a public presentation.

Program Delivery

This program is available:

- via classroom (the majority of instruction is face-to-face)

Admission Requirements

For information about University of Minnesota admission requirements, visit the [Office of Admissions website](#).

General Requirements

The Board of Regents, on recommendation of the faculty, grants degrees from the University of Minnesota. Requirements for an undergraduate degree from University of Minnesota Duluth include the following:

1. Students must meet all course and credit requirements of the departments and colleges or schools in which they are enrolled including an advanced writing course. Students seeking two degrees must fulfill the requirements of both degrees. However, two degrees cannot be awarded for the same major.
2. Students must complete all requirements of the [Liberal Education Program](#).
3. Students must complete a minimum of 120 semester credits.
4. At least 30 of the last 60 degree credits earned immediately before graduation must be awarded by UMD.
5. Students must complete at least half of their courses at the 3xxx-level and higher at UMD. Study-abroad credits earned through courses taught by UM faculty and at institutions with which UMD has international exchange programs may be used to fulfill this requirement.
6. If a minor is required, students must take at least three upper division credits in their minor field from UMD.
7. The minimum cumulative UM GPA required for graduation will be 2.00 and will include only University of Minnesota coursework. A minimum UM GPA of 2.00 is required in each UMD undergraduate major and minor. No academic unit may impose higher grade point standards to graduate.
8. Diploma, transcripts, and certification will be withheld until all financial obligations to the University have been met.

Program Requirements

Requirements for the B.S. in statistics and actuarial science include:

* A minor in an area other than mathematics or a second major.

Introduction to Calculus Courses (10 cr)

Calculus I

Take one of the following Calculus I courses:

[MATH 1290](#) - Calculus for the Natural Sciences [LE CAT2, LOGIC & QR] (5.0 cr)
or [MATH 1296](#) - Calculus I [LE CAT2, LOGIC & QR] (5.0 cr)



or MATH 1596 *(Inactive)*[LE CAT2, LOGIC & QR] (5.0 cr)

Calculus II

Take one of the following Calculus II courses:

MATH 1297 - Calculus II [LOGIC & QR] (5.0 cr)

or MATH 1597 *(Inactive)*[LOGIC & QR] (5.0 cr)

Statistics and Actuarial Science Core Courses (40-41 cr)

CS 1511 - Computer Science I [LE CAT3, LOGIC & QR] (5.0 cr)

MATH 3298 - Calculus III (4.0 cr)

MATH 3355 - Discrete Mathematics (4.0 cr)

MATH 3280 - Differential Equations with Linear Algebra (4.0 cr)

MATH 3941 - Undergraduate Colloquium (1.0 cr)

STAT 3611 - Introduction to Probability and Statistics (4.0 cr)

STAT 5511 - Regression Analysis (3.0 cr)

STAT 5531 - Probability Models (4.0 cr)

STAT 5571 - Probability (4.0 cr)

STAT 5572 - Statistical Inference (4.0 cr)

Take one of the following two courses:

MATH 4201 - Elementary Real Analysis (4.0 cr)

or MATH 4326 - Linear Algebra (3.0 cr)

Advanced Writing Requirement (3 cr)

Advanced Writing - 31xx