The McCormick School of Engineering and Applied Science is committed to providing leadership for the technological foundation of our society, economy, environment, and culture. The school’s mission is twofold: the personal and professional development of its students and faculty and the development and application of new technology, which is increasingly interdisciplinary.

McCormick is dedicated to a high standard of excellence in

• Teaching fundamentals of science and engineering disciplines and stimulating students to become innovative thinkers and leaders able to cope with complex issues in a changing environment
• Preparing undergraduate and graduate students capable of understanding, applying, and contributing to technology in whatever areas or careers they pursue

Undergraduate students in McCormick may follow a curriculum leading to a bachelor of science degree in any of the following fields:

• applied mathematics (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/engineering-sciences-applied-mathematics)
• biomedical engineering (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/biomedical-engineering)
• chemical engineering (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/chemical-engineering)
• civil engineering (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/civil-environmental-engineering)
• computer engineering (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/computer-engineering)
• computer science (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/computer-science)
• electrical engineering (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/electrical-computer-engineering)
• environmental engineering (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/environmental-engineering)
• industrial engineering (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/industrial-engineering-management-sciences)
• manufacturing and design engineering (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/segal-design-institute)
• materials science and engineering (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/materials-science-engineering)
• mechanical engineering (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/mechanical-engineering)

Requirements for the Degree of Bachelor of Science

Students must successfully complete all 48 units of the curriculum or have equivalent academic experience. Students who interrupt their programs of study for an extended time during which degree requirements are changed will normally be held to the new requirements. Those who encounter curricular changes during their period of enrollment may choose to follow any curriculum during that period but must meet its requirements completely.

All curricula leading to a bachelor of science degree in engineering or applied science have the same basic components: mathematics, engineering analysis and computer proficiency, basic sciences, design and communications, basic engineering, social sciences/humanities, unrestricted electives, and the major program. Courses qualifying for these components are listed within each department’s program page.

General requirements for the bachelor of science degree are as follows:

Core Courses (32 units)
Mathematics (4 units)

• Standard for all degree programs

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 220-1</td>
<td>Single-Variable Differential Calculus</td>
</tr>
<tr>
<td>MATH 220-2</td>
<td>Single-Variable Integral Calculus</td>
</tr>
<tr>
<td>MATH 228-1</td>
<td>Multivariable Differential Calculus for Engineering</td>
</tr>
<tr>
<td>MATH 228-2</td>
<td>Multivariable Integral Calculus for Engineering</td>
</tr>
</tbody>
</table>
### Basic Sciences (4 units)
- Eligible courses may vary by degree program; see program for details.
- Minimum of 4 units comprising courses from at least two of the following areas

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHYSICS 135-2</td>
<td>General Physics</td>
</tr>
<tr>
<td>&amp; PHYSICS 136-2</td>
<td>and General Physics Laboratory</td>
</tr>
<tr>
<td>PHYSICS 135-3</td>
<td>General Physics</td>
</tr>
<tr>
<td>&amp; PHYSICS 136-3</td>
<td>and General Physics Laboratory</td>
</tr>
<tr>
<td>PHYSICS 239-0</td>
<td>Foundations of Modern Physics</td>
</tr>
<tr>
<td>PHYSICS 140-2</td>
<td>Fundamentals of Physics</td>
</tr>
<tr>
<td>&amp; PHYSICS 136-2</td>
<td>and General Physics Laboratory</td>
</tr>
<tr>
<td>PHYSICS 140-3</td>
<td>Fundamentals of Physics</td>
</tr>
<tr>
<td>&amp; PHYSICS 136-3</td>
<td>and General Physics Laboratory</td>
</tr>
</tbody>
</table>

#### Biological Sciences
- Biol_Sci 215-0: Genetics and Molecular Biology
- Biol_Sci 217-0: Physiology
- Biol_Sci 219-0: Cell Biology
- Biol_Sci 220-0: Genetics and Molecular Processes Laboratory
- Biol_Sci 221-0: Cellular Processes Laboratory
- Biol_Sci 222-0: Investigative Laboratory
- CHEM_ENG 275-0: Molecular & Cell Biology for Engineers
- CIV_ENV 202-0: Biological and Ecological Principles

#### Chemistry
- CHEM 131-0: General Chemistry 1
- & CHEM 141-0: and General Chemistry Laboratory 1
- CHEM 132-0: General Chemistry 2
- & CHEM 142-0: and General Chemistry Laboratory 2
- CHEM 151-0: Accelerated General Chemistry 1
- & CHEM 161-0: and Accelerated General Chemistry Laboratory 1

### Engineering Analysis and Computer Proficiency (4 units)
- **Standard for all degree programs**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEN_ENG 205-1</td>
<td>Engineering Analysis I</td>
</tr>
<tr>
<td>or GEN_ENG 206-1</td>
<td>Honor Engineering Analysis</td>
</tr>
<tr>
<td>GEN_ENG 205-2</td>
<td>Engineering Analysis II</td>
</tr>
<tr>
<td>GEN_ENG 205-3</td>
<td>Engineering Analysis III</td>
</tr>
<tr>
<td>GEN_ENG 205-4</td>
<td>Engineering Analysis IV</td>
</tr>
<tr>
<td>or GEN_ENG 206-4</td>
<td>Honor Engineering Analysis IV</td>
</tr>
</tbody>
</table>

1 The Engineering Analysis I and IV requirements may be satisfied by completing either the regular courses GEN_ENG 205-1 Engineering Analysis I and GEN_ENG 205-4 Engineering Analysis IV or the honors courses GEN_ENG 206-1 Honor Engineering Analysis I and GEN_ENG 206-4 Honor Engineering Analysis IV. Engineering Analysis II and III only offer regular courses.

2 The computer science degree program requires COMP_SCI 211-0: Fundamentals of Computer Programming instead of Engineering Analysis IV.

### Design and Communications (3 units)
- **Standard for all degree programs**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSGN 106-1</td>
<td>Design Thinking and Communication</td>
</tr>
<tr>
<td>&amp; DSGN 106-2</td>
<td>and Design Thinking and Communication</td>
</tr>
<tr>
<td>ENGLISH 106-1</td>
<td>Writing in Special Contexts</td>
</tr>
<tr>
<td>&amp; ENGLISH 106-2</td>
<td>and Writing in Special Contexts</td>
</tr>
</tbody>
</table>

#### Speaking
- Select one of the following:
  - COMM_ST 102-0: Public Speaking
  - PERF_ST 103-0: Analysis & Performance of Literature
  - PERF_ST 203-0: Performance Culture and Communication
  - BMD_ENG 390-2: Biomedical Engineering Design

1 The biomedical engineering degree program requires BMD_ENG 390-2: Biomedical Engineering Design to satisfy the speaking requirement.

### Basic Engineering (5 units)
- Eligible courses may vary by degree program; see program for details.
- 5 courses from at least four of the areas below

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMP_ENG 203-0</td>
<td>Introduction to Computer Engineering</td>
</tr>
<tr>
<td>COMP_ENG 205-0</td>
<td>Fundamentals of Computer System Software</td>
</tr>
<tr>
<td>ES_APPM 346-0</td>
<td>Modeling and Computation in Science &amp; Engineering</td>
</tr>
</tbody>
</table>

#### Computer Programming
- COMP_SCI 211-0: Fundamentals of Computer Programming II
- COMP_SCI 217-0: Data Management & Information Processing
- COMP_SCI 230-0: Programming for Engineers

#### Electrical Science
- ELEC_ENG 202-0: Introduction to Electrical Engineering
- ELEC_ENG 221-0: Fundamentals of Circuits
- ELEC_ENG 222-0: Fundamentals of Signals & Systems
Major Program (16 units)
Each degree program in the McCormick School finds its depth in the major program’s 16 units. These 16 units are made up of departmental sequences that build competency in the field as well as technical electives that allow students to explore areas of interest within the discipline. Technical electives provide opportunity for individualization, but coherence in the selection of elective courses is still necessary.

Each department maintains its own set of major program requirements which can be found on the program specific pages of this catalog. Students must meet both the school’s and the major program’s curricular requirements.

Taking courses regarded as duplicates will increase the number of requirements needed to earn a McCormick degree. For a list of course duplicates visit: www.mccormick.northwestern.edu/students/undergraduate/advising-registration/course-duplicates.html

Grade Requirements
A grade point average (GPA) of not less than 2.0 is required for all units presented for the degree. Students must have received a grade of C or higher in any course taken elsewhere and used to fulfill a McCormick degree requirement. The GPA in the 16 units in the major program must also be at least 2.0; no more than 2 of these units may carry grades of D. Grades for courses fulfilling a minor must be C– or higher, and none of them may be a P.

Every candidate for a degree must file an application for the degree a year in advance of the date of graduation. This application is submitted directly within the McCormick Advising System.

In addition to and independent of the requirements set by McCormick, all students must satisfy the Undergraduate Registration Requirement (https://catalogs.northwestern.edu/undergraduate/requirements-policies/undergraduate-registration-requirement).

Integrated Engineering Studies Program
The McCormick Integrated Engineering Studies (MIES) Program provides an alternative for students whose particular interests and goals cannot be satisfied by a regular program in engineering or applied science. To be eligible, students must have a cumulative GPA of 3.25 or above. They may apply as early as the end of their first year but no later than 3½ quarters before completing the degree. Applicants must prepare a compelling argument for qualifying for this customized degree program. Examples of these ad hoc degrees from recent years include public health, engineering physics, biomedical engineering and molecular biology, analytics, and mechanical design. Students who complete this program are awarded a bachelor of science in integrated engineering studies, and their transcripts specify the themes of their courses of study. For additional details, visit the MIES webpage: www.mccormick.northwestern.edu/academics/undergraduate/programs/integrated-engineering-studies.html

Academic Policies
Pass/No Credit Option
The following requirements apply to the pass/no credit (P/N) option:

No more than 8 units taken P/N may be counted toward the 48 units required for the degree.
Only 1 unit per quarter may be taken P/N during the first and second years.
Core courses: Any 300-level course, but no more than 4 100- or 200-level courses, may be taken P/N to satisfy the 7-unit requirement in the

Unrestricted Electives (5 units)
Standard for all degree programs: students may take any credit course in the University to explore or extend technical or nontechnical interests.

Social Sciences/Humanities (Theme) (7 units)
- Standard for all degree programs
- Following is a partial list of requirements; a complete list is available via the McCormick Advising System.
  - 7 social sciences/humanities courses
  - Maximum of 5 credits from either category
  - At least 3 courses must be thematically related
  - No more than 3 100-level courses
    - Students who transfer from another university or who earn study abroad credit may petition to exceed the 100-level course limit.
    - AP, IB, and transfer credits are eligible to count toward this requirement

Thermodynamics
BMD_ENG 250-0 Thermodynamics
CHEM_ENG 211-0 Thermodynamics
MAT_SCI 314-0 Thermodynamics of Materials
MAT_SCI 315-0 Phase Equilibria & Diffusion of Materials
MECH_ENG 222-0 Thermodynamics & Statistical Mechanics - I
MECH_ENG 322-0 Thermodynamics & Statistical Mechanics - II

1 MECH_ENG 222-0 Thermodynamics & Statistical Mechanics - I may not be taken with CHEM 342-1 Thermodynamics or CHEM_ENG 211-0 Thermodynamics

ELEC_ENG 223-0 Fundamentals of Solid State Engineering
ELEC_ENG 224-0 Fund of Electromagnetics & Photonics
ELEC_ENG 270-0 Applications of Electronic Devices
MECH_ENG 233-0 Electronics Design

Fluids and Solids
BMD_ENG 270-0 Fluid Mechanics
BMD_ENG 271-0 Introduction to Biomechanics
CHEM_ENG 321-0 Fluid Mechanics
CIV_ENV 216-0 Mechanics of Materials I
MECH_ENG 241-0 Fluid Mechanics I

Materials Science and Engineering
MAT_SCI 201-0 Introduction to Materials
MAT_SCI 301-0 Materials Science Principles

Probability, Statistics, and Quality Control
BMD_ENG 220-0 Introduction to Biomedical Statistics
CHEM_ENG 312-0 Probability and Statistics for Chemical Engineering
CIV_ENV 306-0 Uncertainty Analysis
ELEC_ENG 302-0 Uncertainty Analysis
IEMS 201-0 Introduction to Statistics
IEMS 303-0 Statistics
MECH_ENG 359-0 Reliability Engineering

Systems Engineering and Analysis
CHEM_ENG 210-0 Analysis of Chemical Process Systems
CIV_ENV 205-0 Economics and Finance for Engineers
CIV_ENV 304-0 Civil and Environmental Engineering Systems Analysis
IEMS 310-0 Operations Research
IEMS 313-0 Foundations of Optimization
social sciences/humanities. No courses may be taken P/N in the required mathematics, engineering analysis and computer proficiency, basic sciences, design and communications, and basic engineering areas. Major program: Consult the responsible department office (http://www.mccormick.northwestern.edu/students/undergraduate/advising-registration/pass-no-credit-option.html) or the Undergraduate Engineering Office regarding the regulations for use of P/N in each departmental program. Credits earned under a P/N grading scheme at another institution may be applied toward McCormick requirements only if the P/N option is permissible for that requirement.

Advanced Placement and Exemptions
Advanced placement and college credit may be granted on the basis of the College Entrance Examination Board (CEEB) Advanced Placement tests (or other appropriate international examinations), or special examinations in subject areas. Students may be exempted from certain McCormick requirements (with a corresponding reduction in degree requirements) on the basis of proficiency exams, or analysis of coursework completed elsewhere. These stipulations regarding placement, exemption, and degree requirements may differ from those of other schools of the University. Students receiving credit from AP examinations and other such programs must still meet the Undergraduate Registration Requirement.

Academic Options
Students in the McCormick School have many opportunities to enhance their educational experience by pursuing additional programs and opportunities.

Undergraduate Honors Program
Students with good scholastic records may apply to the Undergraduate Honors Program any time during their junior or pre-senior years. Students within three quarters of graduation are past this admission point. At the time of admission to the honors program, they must have a cumulative GPA of 3.5 or better. Courses used to meet the honors requirements must also be used toward requirements for the bachelor’s degree.

Honors students participating in the program must:

- Complete at least 3 units of approved advanced study (including courses normally accepted at the graduate level) with an average grade of B or better.
- Complete an extended independent study project (at least 2 quarters on the same topic) leading to an acceptable report.

Successful completion of the honors program will be noted on the student's transcript. Recognition also will be given in the Commencement program. If his or her performance is not judged to meet the honors standards, the student will still receive course grades and credits as earned.

Undergraduate Research
Opportunities for Undergraduate Research (https://catalogs.northwestern.edu/undergraduate/undergraduate-research) are made available and encouraged. Each field of study offers independent study courses for research enrollment on an elective basis. Funding of undergraduate research is provided by faculty-directed programs and several McCormick School and University sources.

The McCormick Student Advisory Board holds an annual competition for the Harold B. Gotaas Award, which honors a graduating McCormick senior who has demonstrated excellence in undergraduate research.

Students normally perform undergraduate research projects under the direction of faculty doing research in their department and in laboratories throughout the University, including McCormick research centers. For more on McCormick’s research activities, see mccormick.northwestern.edu/research.

Second Field of Specialization
Elective opportunities in McCormick curricula may be used in a departmental program in another school of the University as long as the secondary program also allows doubling counting of credits. Satisfactory completion of the requirements for the second program, verified by the appropriate department, will be noted on the student’s transcript. Carefully planned electives will normally enable students to obtain a second field of specialization within the 48-unit requirement for the BS degree. For a complete list of major, minor, and certificate programs offered at Northwestern visit: www.northwestern.edu/academics/undergraduate-a-to-z.html

Multiple BS Degrees in McCormick
Students with wide-ranging interests may work toward two or more bachelor of science degrees in McCormick by satisfying the full requirements for each degree. At least 6 additional units of credit, or the equivalent, must be presented for each additional degree, and the work in multiple areas does not need to be completed at the same time. Each department or program must approve the course plan for its degree no later than two academic quarters before work for the second degree is completed but no earlier than junior year. Students pursuing two BS degrees within McCormick are held to the same Undergraduate Registration Requirement (URR) (https://catalogs.northwestern.edu/undergraduate/requirements-policies/undergraduate-registration-requirement) used for single degree seeking undergraduates.

Accelerated Master's Program
Qualified McCormick undergraduate students may work simultaneously toward the bachelor of science and master of science degrees in engineering. Integrated planning of coursework makes it possible to take graduate-level courses during the third and fourth years. The requirements remain unchanged for the two degrees. The McCormick requirement for the BS is 48 units, and the requirement for the MS is specified by the individual department (9–12 units). No course used for the MS requirement may be counted toward the BS requirement.

Application for admission to concurrent BS/MS study must be approved by the appropriate department and the Graduate School. A department may require that students do additional work beforehand.

For additional information, including how to apply, visit: www.mccormick.northwestern.edu/academics/undergraduate/programs/honors-and-combined-degrees/combined-bachelors-masters-program/

Dual Bachelor's Degree Programs with other NU Undergraduate Schools
Qualified students may earn bachelor’s degrees from two different undergraduate schools in Northwestern. Five years of full-time study are usually required. Students may pursue dual bachelor’s degree programs between the McCormick School of Engineering and Applied Science and...
the Weinberg College of Arts and Sciences, the Bienen School of Music, or the School of Communication.

For additional details on these programs see Dual Bachelor’s Degrees (https://catalogs.northwestern.edu/undergraduate/dual-bachelors-degrees). For information on applying to one of these programs see Application to Dual Bachelor’s Degree Programs (https://catalogs.northwestern.edu/undergraduate/admission/#applicationtodualbachelordegreeprogram).

Minors
McCormick students are able to pursue the following minors in addition to a bachelor’s degree. See the program pages for descriptions and requirements. Of special note: Guidelines on certificates issued by Northwestern’s Office of the Provost state that "a certificate requires academic course work of at least four units that are not applied to a major or minor." Individual certificate programs may set more stringent rules.

- Biotechnology and biochemical engineering (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/chemical-engineering/biotechnology-biochemical-engineering-minor)
- Computer science (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/computer-science/computer-science-minor)
- Environmental engineering (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/civil-environmental-engineering/environmental-engineering-minor)
- Transportation and logistics (https://catalogs.northwestern.edu/undergraduate/additional-baccalaureate-options/minors/programs-centers-minors) (minor offered by the Transportation and Logistics Program)

Additional minors are available from other Northwestern schools and may be pursued by engineering students; that information may be found under Minors (https://catalogs.northwestern.edu/undergraduate/additional-baccalaureate-options/minors/mccormick-minors) in the Additional Baccalaureate Options section.

Certificates
McCormick students are able to pursue the following McCormick certificates in addition to a bachelor’s degree. See the program pages for descriptions and requirements. Of special note: Guidelines on certificates issued by Northwestern’s Office of the Provost state that "a certificate requires academic course work of at least four units that are not applied to a major or minor." (In McCormick, ‘major’ refers to the 16-unit Major Program.) Individual certificate programs may set more stringent rules.

- Architectural Engineering and Design Certificate (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/civil-environmental-engineering/architectural-engineering-design-certificate): This program prepares engineering students for collaborative careers in the building industry—as architects, structural designers, builders, project managers, or developers.
- Segal Design Certificate (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/segal-design-institute/segal-design-certificate): This certificate program, administered by the Segal Design Institute, develops a set of design skills valuable across the entire spectrum of careers available to McCormick graduates.

Cooperative Engineering Education Program
The Walter P. Murphy Cooperative Engineering Education Program alternates periods of paid industrial experience with academic studies for full-time students in all departments of engineering and applied science. Students apply theory while gaining practical experience and develop an understanding of the responsibilities of their future professional careers.

There are two options for completing the Co-op Program:

- **Single Employer Option**: Students complete a minimum of 9 months (three quarters) with the same employer. The schedule must contain at least one six month (two quarter) work term.
- **Two Employer Option**: Students complete two six month (two quarter) work terms with two different employers. This is a minimum of 12 months (4 quarters) of work experience overall.

Students are registered for their work quarters, thus remaining enrolled at Northwestern. No tuition or fees are charged during co-op periods. At the end of each work period, employers are asked to evaluate student performance and progress.

In addition to the academic degree, students who successfully complete the schedule of school and work receive recognition as co-op students upon graduation from McCormick.

Learn more about the co-op program at: www.mccormick.northwestern.edu/career-development/programs/co-op/

Honors Program in Medical Education
The Honors Program in Medical Education (HPME) is designed for unusually gifted high school students who seek careers in medicine or medical science. It provides a plan whereby students entering Northwestern are admitted simultaneously to McCormick, Weinberg College, or the School of Communication and to the Feinberg School of Medicine. HPME students then participate in a challenging program, with the first three or four years in undergraduate study and the last four years in the Feinberg School. Thus, the period of formal training may be reduced by one year.

Students who meet the entrance requirements of McCormick may pursue a program leading to the bachelor of science degree in biomedical engineering after five years and the doctor of medicine degree after seven years. See Honors Program in Medical Education (https://catalogs.northwestern.edu/undergraduate/dual-graduate-undergraduate-degrees/honors-program-medical-education) for more information on HPME and Admission (https://catalogs.northwestern.edu/undergraduate/admission/#hpmeadmission) for information on applying to the program.

Student Resources
McCormick strives to create an enriching academic environment where students are able to engage with a variety of resources and organizations.
Tutorial Program
Northwestern offers academic support resources in the form of small-group mentoring, coaching, workshops, peer-guided study groups, and tutoring. For detailed information on available programs, including locations and hours, visit Academic Support and Learning Advancement: www.northwestern.edu/academic-support-learning/

Faculty Advisers
Entering McCormick students are assigned a first-year adviser. By the beginning of the sophomore year most students will have selected a program of study and will be reassigned an adviser in that area. Advisers assist in planning the program of study, but students retain the responsibility of meeting overall graduation requirements.

First-year students can find helpful information and first-year advisers' contact details by visiting www.mccormick.northwestern.edu/students/undergraduate/first-year/. Sophomores, juniors, and seniors can find their advisers listed in the McCormick Advising System. Advice on other subjects may be obtained by emailing mccormick-school@northwestern.edu.

McCormick Advising System
All students have access to the McCormick Advising System (MAS), the online service through which they can track their degree progress, document consultations with their faculty advisers, and manage other transactions related to being a McCormick student. MAS can be accessed by visiting mas.mccormick.northwestern.edu. Questions about getting an audit updated, degree requirements, or general issues with MAS should be directed to mccormick-school@northwestern.edu.

Organizations for Engineering Students
The McCormick Student Advisory Board is composed of representatives from each class in engineering and from approved McCormick organizations. It is the recognized representative body of undergraduate engineering students and as such serves as a link between the students and the faculty and administration. It encourages and coordinates the activities of engineering students and student groups.

Student groups at McCormick provide an important opportunity for undergraduates to develop leadership skills and create opportunities to network with faculty, staff, and professionals in the field. For information on McCormick student groups and honor societies visit: www.mccormick.northwestern.edu/academics/undergraduate/student-groups.html