mccormick.northwestern.edu

The McCormick School of Engineering and Applied Science is dedicated 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/applied-mathematics](https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/applied-mathematics/))
- biomedical engineering ([https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/biomedical-engineering/](https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/biomedical-engineering/))
- chemical engineering ([https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/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/](https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/civil-environmental-engineering/))
- computer engineering ([https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/computer-science/](https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/computer-science/))
- computer science ([https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/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/](https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/electrical-computer-engineering/))
- environmental engineering ([https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/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/](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/](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/](https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/materials-science-engineering/))
- mechanical engineering ([https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/mechanical-engineering/](https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/mechanical-engineering/))

The programs in biomedical engineering, chemical engineering, civil engineering, computer engineering, electrical engineering, environmental engineering, manufacturing and design engineering, materials science and engineering, and mechanical engineering are accredited by the Engineering Accreditation Commission of ABET ([abet.org](http://abet.org)). For further information on ABET standards and course partitioning visit [www.mccormick.northwestern.edu/academics/undergraduate/abet/](https://www.mccormick.northwestern.edu/academics/undergraduate/abet/)

With the proper use and combination of requirements, options, and electives, students may prepare themselves for graduate work in engineering or for postbaccalaureate degrees in medicine, law, business, or other areas. Bachelor of science degrees are also awarded in approved ad hoc integrated engineering studies (p. 1) programs.

Graduate programs of study are available in all of the above fields as well as in analytics, applied physics, biotechnology, engineering design and innovation, engineering management, information technology, manufacturing management, product design and development, project management, robotics, technology and social behavior, and theoretical and applied mechanics. Programs leading to degrees at the master’s and doctoral levels are described in detail in publications of the Graduate School and engineering graduate programs.

Excellence in research is a distinguishing characteristic of the engineering faculty. Working at the frontiers of knowledge, faculty members are positioned to maintain currency in courses and curricula and to develop an atmosphere inspiring scholarship, discovery, and originality among students.

McCormick has a student body of approximately 1,850 undergraduates and 2,140 graduate students. It is housed in the Technological Institute complex, which contains nearly 2 million square feet of floor area and provides excellent educational and research facilities.

### Academic Requirements

#### 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>
</tbody>
</table>
Basic Sciences (4 units)

- Multivariable Differential Calculus for Engineering
- Multivariable Integral Calculus for Engineering

1 ES_APPM 252-1 Honors Calculus for Engineers, ES_APPM 252-2 Honors Calculus for Engineers may substitute for MATH 228-1

2 The computer science degree program requires COMP_SCI 212-0 Mathematical Foundations of Comp Science instead of MATH 228-2 Multivariable Integral Calculus for Engineering.

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>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>
</tbody>
</table>

- No more than 3 units may be from any other area.

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>
<tr>
<td>COMM_ST 102-0</td>
<td>Public Speaking</td>
</tr>
<tr>
<td>PERF_ST 103-0</td>
<td>Analysis &amp; Performance of Literature</td>
</tr>
<tr>
<td>PERF_ST 203-0</td>
<td>Performance Culture and Communication</td>
</tr>
<tr>
<td>BMD_ENG 390-2</td>
<td>Biomedical Engineering Design</td>
</tr>
</tbody>
</table>

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.

<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 345-0</td>
<td>Applied Linear Algebra</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
ELEC_ENG 223-0 Fundamentals of Solid State Engineering
ELEC_ENG 224-0 Fundamentals of Electromagnetics & Photonics
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 Probabilistic Systems
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

### 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 and 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

### 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

### 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.

### 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 (https://www.mccormick.northwestern.edu/students/undergraduate/advising-registration/course-duplicates.html)

McCormick students may use no more than 4 units of transfer credit based on work completed elsewhere within the 16-unit Major Program portion of degree requirements. Any such use of transfer credit must be approved by both the department and school. The 4-unit limit does not apply to transfer credit used to satisfy other categories within McCormick degree requirements, although all McCormick students are required to satisfy the Undergraduate Registration Requirement (URR).

### 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
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 www.mccormick.northwestern.edu/research (https://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/undergraduate-a-to-z.html (https://www.northwestern.edu/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/ (https://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.

• Architectural engineering and design (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/civil-environmental-engineering/architectural-engineering-design-minor/)
• 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/)
• Entrepreneurship (https://catalogs.northwestern.edu/undergraduate/engineering-applied-science/farley-center-entrepreneurship/entrepreneurship-minor/)
• Materials science (https://catalogs.northwestern.edu/undergraduate/arts-sciences/materials-science/materials-science-minor/) (minor offered by the Weinberg College of Arts & Sciences)
• 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.

• 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/ (https://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/ (https://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/ (https://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 (https://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 (https://www.mccormick.northwestern.edu/academics/undergraduate/student-groups.html)