UNIVERSITY OF MINNESOTA
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Twin Cities Campus

Chemical Engineering B.Ch.E.

Chemical Engineering & Materials Science

College of Science and Engineering

- Program Type: Baccalaureate
- Requirements for this program are current for Fall 2019
- Required credits to graduate with this degree: 122
- Required credits within the major: 102 to 103
- Degree: Bachelor of Chemical Engineering

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

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

Program Delivery

This program is available:

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

Admission Requirements

Students must complete 11 courses before admission to the program.

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

Students interested in chemical engineering are encouraged to take CHEN/MATS 1001 their freshman year.

For information about University of Minnesota admission requirements, visit the Office of Admissions website.

Required prerequisites

Mathematics

MATH 1371 - CSE Calculus I [MATH] (4.0 cr)
or MATH 1271 - Calculus I [MATH] (4.0 cr)
or MATH 1571H - Honors Calculus I [MATH] (4.0 cr)
MATH 1372 - CSE Calculus II (4.0 cr)
or MATH 1272 - Calculus II (4.0 cr)
or MATH 1572H - Honors Calculus II (4.0 cr)
MATH 2374 - CSE Multivariable Calculus and Vector Analysis (4.0 cr)
or MATH 2263 - Multivariable Calculus (4.0 cr)
or MATH 2573H - Honors Calculus III (4.0 cr)

Physical Sciences

CHEM 1061 - Chemical Principles I [PHYS] (3.0 cr)
or CHEM 1071H - Honors Chemistry I [PHYS] (3.0 cr)
CHEM 1065 - Chemical Principles I Laboratory [PHYS] (1.0 cr)
or CHEM 1075H - Honors Chemistry I Laboratory [PHYS] (1.0 cr)
CHEM 1062 - Chemical Principles II [PHYS] (3.0 cr)
or CHEM 1072H - Honors Chemistry II [PHYS] (3.0 cr)
CHEM 1066 - Chemical Principles II Laboratory [PHYS] (1.0 cr)
or CHEM 1076H - Honors Chemistry II Laboratory [PHYS] (1.0 cr)

Additional Lower Division Chemistry

CHEM 2301 - Organic Chemistry I (3.0 cr)
or CHEM 2331H - Honors Elementary Organic Chemistry I (3.0 cr)

Physics

PHYS 1301W - Introductory Physics for Science and Engineering I [PHYS, WI] (4.0 cr)
or PHYS 1401V - Honors Physics I [PHYS, WI] (4.0 cr)
PHYS 1302W - Introductory Physics for Science and Engineering II [PHYS, WI] (4.0 cr)

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or PHYS 1402V - Honors Physics II [PHYS, WI] (4.0 cr)

Chemical Engineering Lower Division
CHEN 2001 - Material and Energy Balances (4.0 cr)

General Requirements

All students are required to complete general University and college requirements including writing and liberal education courses. For more information about University-wide requirements, see the liberal education requirements.Required courses for the major or minor in which a student receives a D grade (with or without plus or minus) do not count toward the major or minor (including transfer courses).

Program Requirements

Additional Mathematics
MATH 2373 - CSE Linear Algebra and Differential Equations (4.0 cr)
or MATH 2243 - Linear Algebra and Differential Equations (4.0 cr)
or MATH 2574H - Honors Calculus IV (4.0 cr)

Major Courses
CHEM 4501 - Introduction to Thermodynamics, Kinetics, and Statistical Mechanics (3.0 cr)
CHEM 2302 - Organic Chemistry II (3.0 cr)
or CHEM 2332H - Honors Elementary Organic Chemistry II (3.0 cr)
CHEM 2311 - Organic Lab (4.0 cr)
or CHEM 2312H - Honors Organic Lab (5.0 cr)
Analytical Chemistry
CHEM 3121 *{Inactive}*(3.0 cr)
Chemical Engineering Core Courses
CHEN 3005 - Transport Phenomena: Momentum and Heat (4.0 cr)
CHEN 3006 - Mass Transport and Separation Processes (4.0 cr)
CHEN 3101 - Chemical Engineering Thermodynamics (4.0 cr)
CHEN 3102 - Reaction Kinetics and Reactor Engineering (4.0 cr)
CHEN 3201 - Numerical methods in ChEn applications (3.0 cr)
CHEN 3401W - Junior Chemical Engineering Lab [WI] (3.0 cr)
CHEN 3701 - Introduction to Biomolecular Engineering (3.0 cr)
CHEN 4401W - Senior Chemical Engineering Lab [WI] (4.0 cr)
CHEN 4501W - Chemical Engineering Design [WI] (4.0 cr)
CHEN 4601 - Process Control (3.0 cr)
MATS 3011 - Introduction to Materials Science and Engineering (3.0 cr)

Technical Electives
Students must take four courses, for a total of at least 12 credits in the technical elective requirement. One course must be an engineering course. All technical electives must be taken A-F.

CHEN 4214, Polymers, is highly recommended.
Take 4 or more course(s) totaling 12 or more credit(s) from the following:
Upper Division Engineering Courses
Take 1 - 4 course(s) from the following:
- BBE 4001 - Chemistry of Biomass and Biomass Conversion to Fuels and Products [ENV] (4.0 cr)
- BBE 4301 - Applied Surface and Colloid Science (3.0 cr)
- BBE 4404 - Biopolymers and Biocomposites Engineering (3.0 cr)
- BBE 4713 - Biological Process Engineering (3.0 cr)
- BBE 4723 - Food Process Engineering (3.0 cr)
- BBE 4733 - Renewable Energy Technologies [TS] (3.0 cr)
- BBE 5303 - Introduction to Bio-based Materials Science (3.0 cr)
- BBE 5305 - Pulp and Paper Technology (3.0 cr)
- BMEN 5001 - Advanced Biomaterials (3.0 cr)
- BMEN 5041 - Tissue Engineering (3.0 cr)
- BMEN 5151 - Introduction to BioMEMS and Medical Microdevices (2.0 cr)
- BMEN 5311 - Advanced Biomedical Transport Processes (3.0 cr)
- BMEN 5501 - Biology for Biomedical Engineers (3.0 cr)
- CEGE 4502 - Water and Wastewater Treatment (3.0 cr)
- CEGE 4561 - Solids and Hazardous Wastes (3.0 cr)
- CEGE 4562 - Environmental Remediation Technologies (3.0 cr)
- CHEM 4001 - Chemistry of Biomass and Biomass Conversion to Fuels and Products [ENV] (4.0 cr)

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- CHEM 4214 - Polymers (3.0 cr)
- CHEM 4223W - Polymer Laboratory [WI] (2.0 cr)
- CHEN 4214 - Polymers (3.0 cr)
- CHEN 4223W - Polymer Laboratory [WI] (2.0 cr)
- CHEN 4701 - Applied Math (3.0 cr)
- CHEN 4702 - Introduction to Rheology (2.0 cr)
- CHEN 4704 - Advanced Undergraduate Physical Rate Processes I: Transport (3.0 cr)
- CHEN 4707 *{Inactive}*(3.0 cr)
- CHEN 4708 - Advanced Undergraduate Chemical Rate Processes: Analysis of Chemical Reactors (3.0 cr)
- CHEN 5531 *{Inactive}*(3.0 cr)
- CHEN 5751 - Biochemical Engineering (3.0 cr)
- CHEN 5753 - Advanced Biomedical Transport Processes (3.0 cr)
- CHEN 5771 - Colloids and Dispersions (3.0 cr)
- EE 3015 - Signals and Systems (3.0 cr)
- EE 3161 - Semiconductor Devices (3.0 cr)
- EE 4231 - Linear Control Systems: Designed by Input/Output Methods (3.0 cr)
- EE 5171 - Microelectronic Fabrication (3.0 cr)
- EE 5173 - Basic Microelectronics Laboratory (1.0 cr)
- EE 5393 - Circuits, Computation, and Biology (3.0 cr)
- EE 5653 - Physical Principles of Magnetic Materials (3.0 cr)
- EE 5655 - Magnetic Recording (3.0 cr)
- IE 3521 - Statistics, Quality, and Reliability (4.0 cr)
- IE 5441 - Financial Decision Making (4.0 cr)
- IE 5513 - Engineering Safety (4.0 cr)
- IE 5522 - Quality Engineering and Reliability (4.0 cr)
- IE 5541 - Project Management (4.0 cr)
- IE 5551 - Production and Inventory Systems (4.0 cr)
- MATS 3012 - Metals and Alloys (3.0 cr)
- MATS 3013 - Electrical and Magnetic Properties of Materials (3.0 cr)
- MATS 4212 - Ceramics (3.0 cr)
- MATS 4214 - Polymers (3.0 cr)
- MATS 4223W - Polymer Laboratory [WI] (2.0 cr)
- MATS 4301W - Materials Processing [WI] (4.0 cr)
- MATS 5517 - Microscopy of Materials (3.0 cr)
- MATS 5531 *{Inactive}*(3.0 cr)
- ME 4431W - Energy Conversion Systems Laboratory [WI] (4.0 cr)
- ME 5113 - Aerosol/Particle Engineering (4.0 cr)
- ME 5223 - Materials in Design (4.0 cr)
- ME 5446 - Introduction to Combustion (4.0 cr)

- **Additional Technical Electives**

CHEN 4594/CHEN 4594H may count for up to two credits (one course) with prior approval of the Director of Undergraduate Studies, and the faculty research advisor.

Take 0 - 3 course(s) from the following:

- ACCT 2051 - Introduction to Financial Reporting (4.0 cr)
- BIOC 3021 - Biochemistry (3.0 cr)
- BIOC 4331 - Biochemistry I: Structure, Catalysis, and Metabolism in Biological Systems (4.0 cr)
- BIOC 4332 - Biochemistry II: Molecular Mechanisms of Signal Transduction and Gene Expression (4.0 cr)
- BIOC 4521 - Introduction to Physical Biochemistry (3.0 cr)
- BIOC 5527 *{Inactive}*(4.0 cr)
- BIOL 2005 - Animal Diversity Laboratory (2.0 cr)
- BIOL 3211 - Physiology of Humans and Other Animals (3.0 cr)
- BIOL 4003 - Genetics (3.0 cr)
- BIOL 4004 - Cell Biology (3.0 cr)
- CHEM 4011 - Mechanisms of Chemical Reactions (3.0 cr)
- CHEM 4021 - Computational Chemistry (3.0 cr)
- CHEM 4066 *{Inactive}*(3.0 cr)
- CHEM 4201 - Materials Chemistry (3.0 cr)
- CHEM 4221 - Introduction to Polymer Chemistry (3.0 cr)
- CHEM 4301 - Applied Surface and Colloid Science (3.0 cr)
- CHEM 4311W - Advanced Organic Chemistry Lab [WI] (4.0 cr)
- CHEM 4321 - Organic Synthesis (3.0 cr)
- CHEM 4322 - Advanced Organic Chemistry (3.0 cr)
- CHEM 4411 - Introduction to Chemical Biology (3.0 cr)
- CHEM 4502 - Introduction to Quantum Mechanics and Spectroscopy (3.0 cr)
- CHEM 4511W - Advanced Physical Chemistry Lab [WI] (3.0 cr)
- CHEM 4601 - Green Chemistry [ENV] (3.0 cr)

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- CHEM 4701 - Inorganic Chemistry (3.0 cr)
- CHEM 4711W - Advanced Inorganic Chemistry Lab [WI] (3.0 cr)
- CHEM 4725 - Organometallic Chemistry (3.0 cr)
- CHEM 4745 - Advanced Inorganic Chemistry (3.0 cr)
- CHEM 5210 - Materials Characterization (4.0 cr)
- CHEN 4594 - Directed Research (1.0 - 4.0 cr)
- CHEN 4594H *{Inactive}*(1.0 - 4.0 cr)
- CSCI 4041 - Algorithms and Data Structures (4.0 cr)
- CSCI 5304 - Computational Aspects of Matrix Theory (3.0 cr)
- CSCI 5451 - Introduction to Parallel Computing: Architectures, Algorithms, and Programming (3.0 cr)
- FINA 3001 - Finance Fundamentals (3.0 cr)
- FSCN 4112 - Food Chemistry and Functional Foods (3.0 cr)
- FSCN 4121 - Food Microbiology (3.0 cr)
- FSCN 4122 - Food Fermentations and Biotechnology (2.0 cr)
- FSCN 4311 - Chemical Reactions in Food Systems (2.0 cr)
- FSCN 4332 *{Inactive}*(3.0 cr)
- FSCN 5441 *{Inactive}*(2.0 cr)
- FSCN 5461 - Food Packaging (2.0 cr)
- MATH 2283 *{Inactive}*(3.0 cr)
- MATH 3283W - Sequences, Series, and Foundations: Writing Intensive [WI] (4.0 cr)
- MATH 4065 - Theory of Interest (4.0 cr)
- MATH 4242 - Applied Linear Algebra (4.0 cr)
- MATH 4428 - Mathematical Modeling (4.0 cr)
- MATH 4512 - Differential Equations with Applications (3.0 cr)
- MATH 4567 - Applied Fourier Analysis (4.0 cr)
- MATH 4603 - Advanced Calculus I (4.0 cr)
- MATH 5251 - Error-Correcting Codes, Finite Fields, Algebraic Curves (4.0 cr)
- MATH 5378 - Differential Geometry (4.0 cr)
- MATH 5445 - Mathematical Analysis of Biological Networks (4.0 cr)
- MATH 5485 - Introduction to Numerical Methods I (4.0 cr)
- MATH 5486 - Introduction To Numerical Methods II (4.0 cr)
- MATH 5525 - Introduction to Ordinary Differential Equations (4.0 cr)
- MATH 5535 - Dynamical Systems and Chaos (4.0 cr)
- MATH 5587 - Elementary Partial Differential Equations I (4.0 cr)
- MATH 5616H - Honors: Introduction to Analysis II (4.0 cr)
- MATH 5651 - Basic Theory of Probability and Statistics (4.0 cr)
- ME 3041 - Industrial Assignment I (2.0 cr)
- ME 4043W - Industrial Assignment II [WI] (4.0 cr)
- MGMT 4080W - Applied Technology Entrepreneurship [WI] (4.0 cr)
- MICB 3301 - Biology of Microorganisms (5.0 cr)
- MICB 4131 - Immunology (3.0 cr)
- MOT 5001 - Technological Business Fundamentals (2.0 cr)
- MOT 5002 - Creating Technological Innovation (3.0 cr)
- MOT 5003 - Technological Business Planning Workshop (1.0 cr)
- NSCI 3101 - Neurobiology I: Molecules, Cells, and Systems (3.0 cr)
- PDES 3711 - Product Innovation Lab (4.0 cr)
- PDES 5711 - Product Innovation Lab (4.0 cr)
- PHAR 6164 - Biopharmaceutics (3.0 cr)
- PHAR 6224 - Advanced Pharmacogenomics and Precision Medicine (2.0 cr)
- PHCL 4020 - Chemotherapy: from current anticancer drugs to future cancer therapeutics (3.0 cr)
- PHSL 3061 - Principles of Physiology (4.0 cr)
- PHSL 5061 - Principles of Physiology for Biomedical Engineering (4.0 cr)
- PHYS 4511 - Introduction to Nuclear and Particle Physics (3.0 cr)
- PHYS 4911 - Introduction to Biopolymer Physics (3.0 cr)
- PMB 4121 - Microbial Ecology and Applied Microbiology (3.0 cr)
- PUBH 6161 - Regulatory Toxicology (2.0 cr)
- SCO 3001 - Sustainable Supply Chain and Operations (3.0 cr)
- STAT 5101 - Theory of Statistics I (4.0 cr)

- **Computer Programming & Algorithms**

Take 0 - 2 course(s) from the following:

- CSCI 1113 - Introduction to C/C++ Programming for Scientists and Engineers (4.0 cr)
- CSCI 1133 - Introduction to Computing and Programming Concepts (4.0 cr)
- CSCI 1133H - Honors Introduction to Computing and Programming Concepts (4.0 cr)
- CSCI 1913 - Introduction to Algorithms, Data Structures, and Program Development (4.0 cr)
- CSCI 1933 - Introduction to Algorithms and Data Structures (4.0 cr)
- CSCI 1933H - Honors Introduction to Algorithms and Data Structures (4.0 cr)

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•Science, Technology and Society Technical Electives
Take 0 - 1 course(s) from the following:
•APEC 5721 - Economics of Science and Technology Policy (3.0 cr)
•CSCL 3323 - Science and Culture [AH] (3.0 cr)
•ESPM 3601 - Sustainable Housing--Community, Environment, and Technology [TS] (3.0 cr)
•HMED 3075 - Technology and Medicine in Modern America [HIS, TS] (3.0 cr)
•HSCI 3331 - Technology and American Culture [HIS, TS] (3.0 cr)
•HSCI 3332 - Science in the Shaping of America [HIS, DSJ] (3.0 cr)
•HSCI 3715 - History of Modern Technology: Waterwheels to the Web [HIS, TS] (3.0 - 4.0 cr)
•PA 5711 - Science, Technology & Environmental Policy (3.0 cr)
•PHIL 3600 *{Inactive}*(3.0 cr)
•SOC 4305 - Environment & Society: An Enduring Conflict [ENV] (3.0 cr)
•SUST 3003 - Sustainable People, Sustainable Planet [ENV] (3.0 cr)
•SUST 3480 - Topics in Sustainability (1.0 - 4.0 cr)
•SUST 4004 - Sustainable Communities (3.0 cr)
•WRIT 4431W - Science, Technology, and the Law [CIV, WI] (3.0 cr)

•Learning Abroad
Take 0 - 1 course(s) from the following:
•CEGE 4581 - Design for Sustainable Development - India [GP, TS] (3.0 cr)
•CEGE 4583 *{Inactive}*[GP, TS] (3.0 cr)
•CEGE 5570 *{Inactive}*(3.0 - 9.0 cr)
•ME 4583 - Design for Life: Water in Tanzania [GP, TS] (3.0 cr)

Upper Division Writing Intensive within the major
Students are required to take one upper division writing intensive course within the major. If that requirement has not been satisfied within the core major requirements, students must choose one course from the following list. Some of these courses may also fulfill other major requirements.
Take 0 - 1 course(s) from the following:
•CHEM 4223W - Polymer Laboratory [WI] (2.0 cr)
•CHEM 4311W - Advanced Organic Chemistry Lab [WI] (4.0 cr)
•CHEM 4511W - Advanced Physical Chemistry Lab [WI] (3.0 cr)
•CHEM 4711W - Advanced Inorganic Chemistry Lab [WI] (3.0 cr)
•CHEN 3401W - Junior Chemical Engineering Lab [WI] (3.0 cr)
•CHEN 4223W - Polymer Laboratory [WI] (2.0 cr)
•CHEN 4401W - Senior Chemical Engineering Lab [WI] (4.0 cr)
•CHEN 4501W - Chemical Engineering Design [WI] (4.0 cr)
•MATS 4223W - Polymer Laboratory [WI] (2.0 cr)
•MATS 4301W - Materials Processing [WI] (4.0 cr)
•ME 4431W - Energy Conversion Systems Laboratory [WI] (4.0 cr)

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