Chemical and Biochemical Engineering, MS

The Department of Chemical and Biochemical Engineering provides a stimulating academic community where students engage in a highly personalized learning and research environment. The graduate program provides qualified students with deeper and broader training than is possible at the undergraduate level. The Master of Science program provides students with opportunities to obtain specialized knowledge and expertise through advanced coursework in chemical engineering and related disciplines, to engage in interdisciplinary research opportunities (thesis option), and to impact their communities through service learning.

Faculty within the department have focused research projects in biological and pharmaceutical systems, clean energy and water, air quality and climate, polymers and advanced materials, quantum chemical simulation, machine learning, and remote sensing; see Graduate Program on the Department of Chemical and Biochemical Engineering website.

Learning Outcomes

Graduates will:

- demonstrate a mastery of advanced chemical engineering concepts;
- effectively communicate scientific concepts and/or research results in both written and oral formats to scientific and general audiences; and
- demonstrate knowledge of and commitment to safe and ethical behavior through adherence to best safety practices and academic integrity principles.

Students completing the program with thesis will additionally demonstrate the ability to:

- perform independent research, critically identify and solve research problems, summarize disciplinary information, and evaluate research findings.

Requirements

The Master of Science program in chemical and biochemical engineering requires a minimum of 30 s.h. and is offered with and without thesis. All students must maintain a Graduate College program grade-point average (GPA) of at least 3.00.

Students entering with a degree other than chemical engineering may need to take additional coursework to attain proficiency in core areas of chemical engineering.

The MS in chemical and biochemical engineering requires the following coursework.

Core Courses

Students must maintain a GPA of at least 3.25 in the five core courses. All core courses must be taken on an A–F graded basis.

Course #	Title	Hours
One of these:		
CBE:5104	Introduction to Literature Review and Technical Writing (MS without thesis)	3
CBE:5105	Introduction to Literature Review and Proposal Writing (MS with thesis)	3
All of these:		
CBE:5110/ME:5210	Intermediate Thermodynamics	3
CBE:5115	Transport Phenomena I	3
CBE:5120	Data Science in Chemical and Engineering Systems	3
One of these:		
CBE:3205	Introduction to Biochemical Engineering	3
CBE:5315	Polymer Chemistry	3
CBE:5425/CEE:5115	Atmospheric Chemistry and Physics	3

Elective Courses

Students complete 15 s.h. of elective courses. All electives must be taken on an A–F graded basis, with the exception of CBE:5999 for students completing a thesis. Students supplement the core curriculum with electives tailored to their interests and chosen in conjunction with their advisor.

Students completing a thesis are permitted, but not required, to take a maximum of 6 s.h. in CBE:5999 MS Thesis Research: Chemical and Biochemical Engineering and apply it toward the elective requirement. This course can be taken on either an A–F or S/U graded basis. Students completing the program without thesis may not apply this course toward elective requirements.

Students select electives from courses numbered 3000 or above in the subjects listed below, excluding independent study courses.

Course #	Title	Hours
Subjects in the College of Engineering		
Chemical and biochemical engineering (prefix CBE), excluding CBE:3998, CBE:5000, CBE:5100, and CBE:7999		
Biomedical engineering (prefix BME), excluding BME:3995, BME:3998, BME:5998, BME:5999, and BME:7999		
Civil and environmental engineering (prefix CEE), excluding CEE:3998, CEE:5998, CEE:5999, CEE:7999		
Core engineering courses (prefix ENGR), excluding ENGR:4000 and ENGR:4001		
Electrical and computer engineering (prefix ECE), excluding ECE:3998, ECE:5998, ECE:5999, and ECE:7999		
Industrial and systems engineering (prefix ISE), excluding ISE:3998, ISE:5998, ISE:5999, ISE:7998, and ISE:7999		
Mechanical engineering (prefix ME), excluding ME:4098, ME:6198, ME:6199, and ME:7299		
Subjects in Other Colleges		

Biochemistry and molecular biology (prefix BMB), excluding BMB:3800, BMB:3993, BMB:4999, BMB:5215, BMB:5261, and BMB:7292
Chemistry (prefix CHEM), excluding CHEM:3994, CHEM:6990, and CHEM:7999
Computer science (prefix CS), excluding CS:3990, CS:5990, CS:6990, and CS:7990
Earth, environment, and sustainability (prefix SEES), excluding SEES:3150, SEES:3190, SEES:3992, SEES:4990, SEES:4995, SEES:6190, SEES:7990, and SEES:7999
Informatics (prefix IGPI), excluding IGPI:5015, IGPI:6510, IGPI:6515, and IGPI:6520
Mathematics (prefix MATH), excluding MATH:3996, MATH:3997, and MATH:7990
Microbiology (prefix MICR), excluding MICR:4161, MICR:5264, and MICR:7261
Occupational and environmental health (prefix OEH), excluding OEH:7000, OEH:7020, or OEH:7040
Pharmacy (prefix PHAR), excluding PHAR:3994, PHAR:3995, PHAR:5520, PHAR:6120, PHAR:6305, PHAR:6320, PHAR:6515, PHAR:6720, and PHAR:6820
Physics (prefix PHYS), excluding PHYS:4990, PHYS:4999, PHYS:7990, and PHYS:7992

Additional Requirements

All students must take ENGR:7270 Engineering Ethics (1 s.h.) during their first semester. Students completing a thesis are required to take CBE:5000 Seminar in Chemical and Biochemical Engineering (1 s.h.) each semester in residence. MS thesis students are required to present in the CBE:5000 seminar once before they graduate. Thesis students are also required to serve as a teaching assistant at least once during the duration of their graduate studies. Students not completing a thesis must take CBE:5100 Graduate Professional Development Seminar (1 s.h.) each semester in residence. Credit from these courses does not apply to the degree.

Students in the nonthesis program may petition for entry into the thesis program or the PhD program by requesting a change of status through the Graduate College. The request is reviewed by the Graduate Admissions Committee. If approved by the committee, the request is forwarded to the chemical and biochemical engineering faculty for final approval. Students then are assigned to research advisors as though they are newly admitted graduate students. For a detailed description of program requirements, see Graduate Program on the Department of Chemical and Biochemical Engineering website.

All students must pass a final examination.

Professional Development Experience

Professional growth extends beyond the curriculum and the research laboratory. Graduate professionals must be able to identify and lead educational and research enterprises that advance the scope and impact of the discipline. Important skills include building professional networks, developing a comprehensive outlook for identifying emerging directions in the field, the ability to explain scientific and engineering principles to a variety of audiences, and more.

Some examples of professional development experiences include an industrial internship, a second teaching assistant experience, teacher training, organizing a session at a national conference, and organizing a local conference. A student's professional development experience must be developed in consultation with their research mentor and approved by the director of graduate studies. The professional development experience is required for MS thesis students.

Graduate Education

Graduate education prepares students with advanced knowledge and skills in specialized fields. At the University of Iowa, the Graduate College advocates for student-centered graduate education and supports equitable application of rules and policies across graduate programs.

Academics

University of Iowa graduate credentials are regulated by policies and requirements found in the Graduate College Manual of Rules and Regulations. This includes minimum grade-point average (GPA) requirements for academic standing and degree conferral. The Graduate College sets the minimum requirement. Individual graduate programs may establish higher GPA requirements.

Admissions

Graduate student applicants must meet admission requirements for both the Graduate College and the program to which they have applied. University of Iowa graduate admission requirements are published by the Graduate College and on the Graduate Admissions website.

Financial Support

Graduate students might be eligible for financial support. Several contingencies apply, including degree program and award type, satisfactory progress toward degree, satisfactory completion of all duties related to an appointment, and availability of funding. Graduate students should inquire directly with their program for more information about funding availability. The Graduate Student Employment Standards govern the employment relationship between the University of Iowa and all graduate teaching and research assistants in all matters except wages, which are covered by an existing collective bargaining agreement or the conditions of an applicable federal grant.

Admission

Applicants must meet the admission requirements of the Graduate College; see the Manual of Rules and Regulations on the Graduate College website.

Applicants must provide the following.

- Completed application form.
- Unofficial transcript(s). If admitted, official transcripts are required before enrollment. For international students, all academic records should bear the original stamp or seal of the institution and the signature of a school official. Documents not in English must be accompanied by a complete, literal English translation, certified by the issuing institution.
- Optional: Official Graduate Record Examination (GRE) General Test scores (verbal and quantitative) from

Educational Testing Services (the university's institutional code is 6681).
- Statement of purpose.
- Three letters of recommendation.
- International students may also be required to submit TOEFL, IELTS, or DuoLingo scores to comply with the university's English Language Proficiency Requirements.

Admission to the department is competitive and is based on an applicant's previous coursework, research, and/or industrial experience. The admissions committee looks for evidence that an applicant has demonstrated qualities such as creativity, self-initiative, dedication, and perseverance exhibited by successful master's degree students.

Applicants must have earned a four-year baccalaureate degree (Bachelor of Science or Bachelor of Science in Engineering) in chemical engineering or a related science or engineering discipline, such as chemistry, biochemistry, biological engineering, environmental science, atmospheric science, materials science, mathematics, or physics.

Applicants are expected to have a cumulative grade-point average (GPA) of at least 3.00 on a 4.00 scale in work for their undergraduate degree. Applicants through the Undergraduate to Graduate (U2G) BS/MS program must have a cumulative GPA of at least 3.25 on a 4.00 scale.

Career Advancement

Chemical and biochemical engineers work in a wide range of industries, including petroleum and specialty chemical production, polymer and plastic production, food processing, energy, microelectronics production, pharmaceutical production, biochemical processing, environmental monitoring and compliance, applied climate research, and big data analytics. Potential jobs include production, process development, plant design and construction, fundamental research, strategic planning, and policy-making. The engineering profession is also a foundation for a variety of careers in medicine, law, government, consulting, and business management. Many experienced chemical and biochemical engineers move through management ranks to high-level administrative positions. Faculty mentors assigned to graduate students aid in their professional development. Students are exposed to opportunities through seminar speakers who have relevant expertise and are invited to campus.

The Graduate College offers numerous career advancement opportunities and professional development programs for graduate students. For ongoing program offerings, news, and announcements, see Grad Success Center on the Graduate College website.

Academic Plans

Sample Plan of Study

Sample plans represent one way to complete a program of study. Actual course selection and sequence will vary and should be discussed with an academic advisor. For additional sample plans, see MyUI.

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Course	Title	Hours
Academic Career		
Any Semester		
30 s.h. must be graduate level coursework; graduate transfer credits allowed upon approval. More information is included in the General Catalog and on department website. [a]		
	Hours	**0**
First Year		
Fall		
CBE:5100	Graduate Professional Development Seminar [b]	1
CBE:5104 or CBE:5105	Introduction to Literature Review and Technical Writing [c] or Introduction to Literature Review and Proposal Writing	3
CBE:5120	Data Science in Chemical and Engineering Systems [c]	3
ENGR:7270	Engineering Ethics [d]	1
Elective course [e]		3
	Hours	**11**
Spring		
CBE:5425 or CBE:5315 or CBE:3205	Atmospheric Chemistry and Physics [f] or Polymer Chemistry or Introduction to Biochemical Engineering	3
CBE:5100	Graduate Professional Development Seminar [b]	1
CBE:5110	Intermediate Thermodynamics [c]	3
Elective course [e]		3
	Hours	**10**
Second Year		
Fall		
CBE:5100	Graduate Professional Development Seminar [b]	1
Elective course [e]		3
Elective course [e]		3
	Hours	**7**
Spring		
CBE:5100	Graduate Professional Development Seminar [b]	1
CBE:5115	Transport Phenomena I [c]	3
Elective course [e]		3
	Hours	**7**
	Total Hours	**35**

a Students must complete specific requirements in the University of Iowa Graduate College after program admission. Refer to the Graduate College website and the Manual of Rules and Regulations for more information.
b Students must take CBE:5100 each semester in residence; credit from this course does not apply toward the hours required for the degree.
c Must be taken on an A-F graded basis.
d Students must complete ENGR:7270 during their first semester; credit from this course does not apply toward the hours required for the degree.

e Complete 15 s.h. of elective courses numbered 3000 or above; must be taken on an A-F graded basis. Students supplement the core curriculum with electives tailored to their interests and chosen in consultation with their advisor.
f Must be taken on an A-F graded basis. Note: CBE:5315 is typically offered only during fall semesters.