

Chemical and Biochemical Engineering, PhD

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 Doctor of Philosophy 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, and to impact their communities through service learning. The department emphasizes research; most opportunities for graduates are in research and development.

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 core chemical engineering concepts;
- effectively communicate scientific concepts and/or research results in both written and oral formats to scientific and general audiences;
- demonstrate the ability to perform independent research, critically identify and solve research problems, summarize disciplinary information, and evaluate research findings; and
- demonstrate knowledge of and commitment to safe and ethical behavior through adherence to best safety practices and academic integrity principles.

Requirements

The Doctor of Philosophy program in chemical and biochemical engineering requires a minimum of 72 s.h. of graduate credit. Students must maintain a Graduate College program grade-point average (GPA) of at least 3.25.

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 PhD in chemical and biochemical engineering requires the following coursework.

Required Courses

Engineering Ethics and Graduate Seminar

Students are required to take ENGR:7270 Engineering Ethics (1 s.h.) during their first semester.

Students are also required to take CBE:5000 Seminar in Chemical and Biochemical Engineering (1 s.h.) every semester in residence. Students are required to present in the CBE:5000 seminar once before they graduate.

Core Courses

Students must complete the five core courses with a minimum GPA of 3.45. All core courses must be taken on an A-F graded basis.

Students who have previously taken CBE:5104 Introduction to Literature Review and Technical Writing may substitute this course for CBE:5105 Introduction to Literature Review and Proposal Writing; otherwise, CBE:5105 is required for the PhD.

Course #	Title	Hours
All of these:		
CBE:5105	Introduction to Literature Review and Proposal Writing	3
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

Elective courses must bring the total credit for the degree to 72 s.h. At least 15 s.h. of these electives must be taken on an A-F graded basis; this 15 s.h. cannot include CBE:7999 Research: Chemical and Biochemical Engineering PhD Dissertation, although this course typically contributes to other elective credit.

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	
	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, and 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

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.

Service Expectations

The service expectation has two components: one that explicitly links the student's research to service and another that connects the student to the more general support activities of their academic and professional community.

For the first service component, students must discuss the impact of research and highlight how research provides outreach opportunities in a comprehensive proposal chapter. Like the rest of the proposal, the chapter is expected to be prospective and prompt the student to incorporate broader impacts into their professional activities.

For the second service component, students must identify approximately 10 hours of appropriate service in their individual development plan and then carry it out during the semester.

Examinations and Dissertation

Students are required to pass a comprehensive examination before they can become degree candidates. The comprehensive examination is the presentation and defense of the candidate's research proposal. These examinations are arranged by members of the examining committee and may be repeated at the committee's discretion. Comprehensive examination policies are published in the Manual of Rules and Regulations on the Graduate College website. A final examination, which is a defense of the thesis, completes the doctoral program.

All students are also required to serve as a teaching assistant at least once during the duration of their graduate studies.

For a detailed description of program requirements, see Graduate Program on the Department of Chemical and Biochemical Engineering website.

Combined Programs

PhD/MD

Students may work toward the Doctor of Medicine degree and a PhD in chemical and biochemical engineering in a combined degree program offered by the College of Engineering and the Carver College of Medicine. Applicants must be admitted to both programs before they may be admitted to the combined degree program. See the Medical Scientist Training Program (Carver College of Medicine) in the catalog.

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 will be 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 PhD or 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, and physics. An MS is not a prerequisite for admission to the PhD program. Applicants to the PhD program are expected to have a cumulative grade-point average of at least 3.00 on a 4.00 scale in work for their undergraduate degree.

Career Advancement

The PhD program is designed to equip students with the skills to pursue a career in industry, academia, or government. Faculty and alumni 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.

Chemical and Biochemical Engineering, PhD

Course	Title	Hours
Academic Career		
Any Semester		
72 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, b}		
		Hours
		0
First Year		
Fall		
CBE:5000	Seminar in Chemical and Biochemical Engineering ^c	1
CBE:5120	Data Science in Chemical and Engineering Systems ^d	3
ENGR:7270	Engineering Ethics ^e	1
Elective course ^f		3
Elective course ^f		3
		Hours
		11
Spring		
CBE:5315 or CBE:3205 or CBE:5425	Polymer Chemistry ^{d, g} or Introduction to Biochemical Engineering or Atmospheric Chemistry and Physics	3
CBE:5000	Seminar in Chemical and Biochemical Engineering ^c	1
CBE:5110	Intermediate Thermodynamics ^d	3
Elective course ^f		3
Elective course ^f		3
		Hours
		13
Second Year		
Any Semester		
Professional Development Experience ^h		
		Hours
		0
Fall		
CBE:5000	Seminar in Chemical and Biochemical Engineering ^c	1
CBE:5105	Introduction to Literature Review and Proposal Writing ^d	3
CBE:7999	Research: Chemical and Biochemical Engineering PhD Dissertation	3
Elective course ^f		3
		Hours
		10
Spring		
CBE:5000	Seminar in Chemical and Biochemical Engineering ^c	1
CBE:5115	Transport Phenomena I ^d	3
CBE:7999	Research: Chemical and Biochemical Engineering PhD Dissertation	3
Elective course (or additional s.h. of CBE:7999 Research Chem/Biochem Engr PhD Diss) ^f		3
		Hours
		10

Third Year**Any Semester**Exam: Doctoral Comprehensive Exam ⁱ**Hours** **0****Fall**CBE:5000 Seminar in Chemical and Biochemical Engineering ^c 1

CBE:7999 Research: Chemical and Biochemical Engineering PhD Dissertation 5

Elective course (or additional s.h. of CBE:7999 Research Chem/Biochem Engr PhD Diss) ^f 3**Hours** **9****Spring**CBE:5000 Seminar in Chemical and Biochemical Engineering ^c 1

CBE:7999 Research: Chemical and Biochemical Engineering PhD Dissertation 5

Elective course (or additional s.h. of CBE:7999 Research Chem/Biochem Engr PhD Diss) ^f 3**Hours** **9****Fourth Year****Fall**CBE:5000 Seminar in Chemical and Biochemical Engineering ^c 1

CBE:7999 Research: Chemical and Biochemical Engineering PhD Dissertation 2

Hours **3****Spring**CBE:5000 Seminar in Chemical and Biochemical Engineering ^c 1

CBE:7999 Research: Chemical and Biochemical Engineering PhD Dissertation 2

Hours **3****Fifth Year****Fall**CBE:5000 Seminar in Chemical and Biochemical Engineering ^c 1

CBE:7999 Research: Chemical and Biochemical Engineering PhD Dissertation 1

Hours **2****Spring**CBE:5000 Seminar in Chemical and Biochemical Engineering ^c 1

CBE:7999 Research: Chemical and Biochemical Engineering PhD Dissertation 1

Exam: Doctoral Final Exam ^j**Hours** **2****Total Hours** **72**

c Students must take CBE:5000 each semester in residence.

d Students must complete the five course courses with a minimum GPA of 3.45. All core courses must be taken on an A-F graded basis.

e Students are required to take ENGR:7270 during their first semester.

f Elective courses must bring the total credit for the degree to 72 s.h. At least 15 s.h. of these electives must be taken on an A-F graded basis; this 15 s.h. cannot include CBE:7999. Work with faculty advisor to determine appropriate elective graduate coursework and sequence.

g CBE:5315 is typically offered only during fall semesters.

h 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.

i Students are required to pass a comprehensive examination before they can become degree candidates. The comprehensive examination is the presentation and defense of the candidate's research proposal. These examinations are arranged by members of the examining committee. An unsatisfactory examination may be repeated once at the committee's discretion.

j A final examination, which is a defense of the thesis, completes the doctoral program.

a All students are required to serve as a teaching assistant at least once during the duration of their graduate studies.

b 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.