

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 advanced 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 on an original topic in chemical engineering;
- demonstrate the ability to critically identify and solve research problems, summarize disciplinary information, and evaluate research findings;
- demonstrate knowledge of and commitment to safe and ethical behavior through adherence to best safety practices and academic integrity principles; and
- demonstrate the ability to serve as a STEM ambassador through outreach and service activities.

Requirements

The Doctor of Philosophy program in chemical and biochemical engineering requires a minimum of 72 s.h. of graduate credit. However, the degree is granted primarily on the basis of research achievement rather than on the accumulation of semester hours. Students must maintain a UI cumulative grade-point average (GPA) of at least 3.25.

All students must complete a core curriculum, which consists of one course each in transport phenomena, chemical thermodynamics, chemical reaction kinetics, technical communication, and data science plus five additional courses (total of 30 s.h.).

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.

Core Courses

Students must complete the five core courses with a minimum GPA of 3.50.

Course #	Title	Hours
All of these:		
CBE:5105	Introduction to Literature Review and Proposal Writing	3
CBE:5110	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	Atmospheric Chemistry and Physics	3

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. Students submit documentation, including a description of the event and a photograph showing them carrying out the service.

Electives

Students supplement the core curriculum with electives tailored to their research area.

Additional Requirements

All students are required to take ENGR:7270 Engineering Ethics during their first semester and CBE:5000 Seminar in Chemical and Biochemical Engineering every semester in residence. Students are required to present at one CBE:5000 graduate seminar.

In addition to a minimum GPA in the five core courses, 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. All students are also required to serve as a teaching assistant at least once during the duration of their graduate studies. A final examination, which is a defense of the thesis, completes the doctoral program.

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.

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.

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.

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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		
		Hours
		0
First Year		
Fall		
CBE:5000	Seminar in Chemical and Biochemical Engineering ^b	1
CBE:5105	Introduction to Literature Review and Proposal Writing	3
CBE:5120	Data Science in Chemical and Engineering Systems	3
ENGR:7270	Engineering Ethics ^c	1
Elective course ^d		3
		Hours
		11
Spring		
CBE:5315 or CBE:3205 or CBE:5425	Polymer Chemistry ^e or Introduction to Biochemical Engineering or Atmospheric Chemistry and Physics	3
CBE:5000	Seminar in Chemical and Biochemical Engineering ^b	1
CBE:5110	Intermediate Thermodynamics	3
Elective course ^d		3

Elective course ^d		3
Hours		13
Second Year		
Fall		
CBE:5000	Seminar in Chemical and Biochemical Engineering ^b	1
CBE:7999	Research: Chemical and Biochemical Engineering PhD Dissertation	3
Elective course ^d		3
Elective course ^d		3
Hours		10
Spring		
CBE:5000	Seminar in Chemical and Biochemical Engineering ^b	1
CBE:5115	Transport Phenomena I	3
CBE:7999	Research: Chemical and Biochemical Engineering PhD Dissertation	6
Hours		10
Third Year		
Any Semester		
Exam: Doctoral Comprehensive Exam ^f		
Hours		0
Fall		
CBE:5000	Seminar in Chemical and Biochemical Engineering ^b	1
CBE:7999	Research: Chemical and Biochemical Engineering PhD Dissertation	8
Hours		9
Spring		
CBE:5000	Seminar in Chemical and Biochemical Engineering ^b	1
CBE:7999	Research: Chemical and Biochemical Engineering PhD Dissertation	8
Hours		9
Fourth Year		
Fall		
CBE:5000	Seminar in Chemical and Biochemical Engineering ^b	1
CBE:7999	Research: Chemical and Biochemical Engineering PhD Dissertation	6
Hours		7
Spring		
CBE:5000	Seminar in Chemical and Biochemical Engineering ^b	1
Hours		1
Fifth Year		
Fall		
CBE:5000	Seminar in Chemical and Biochemical Engineering ^b	1
Hours		1
Spring		
CBE:5000	Seminar in Chemical and Biochemical Engineering ^b	1

Exam: Doctoral Final Exam ^g		1
Hours		1
Total Hours		72

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 this course each semester in residence.

c Must be completed during first semester.

d Work with faculty advisor to determine appropriate graduate coursework and sequence.

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

f Complete within three years of entering program.

g Dissertation defense.