Chemical and Biochemical Engineering, Ph.D.

The Department of Chemical and Biochemical Engineering provides a stimulating academic community where students engage in a highly personalized learning and research environment. 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, since 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 catalysis, air quality and climate, polymeric and advanced materials, quantum chemical simulation, and remote sensing; see Graduate Program on the Department of Chemical and Biochemical Engineering website.

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 achievement rather than on the accumulation of semester hours. Students typically are expected to have completed three academic years in residence, or two years if they already hold a recognized master's degree. Students must maintain a cumulative g.p.a. of at least 3.25.

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

The Ph.D. with a major in chemical and biochemical engineering requires the following coursework.

### Transport Phenomena

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBE:5115</td>
<td>Transport Phenomena I</td>
<td>3</td>
</tr>
</tbody>
</table>

Alternate courses approved on a case-by-case basis, and may include:

- BME:5430 Biotransport 3
- ME:5143 Computational Fluid and Thermal Engineering 3

Other courses with consent of advisor

### Chemical Thermodynamics

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBE:5110</td>
<td>Intermediate Thermodynamics</td>
<td>3</td>
</tr>
</tbody>
</table>

Alternate courses approved on a case-by-case basis, and may include:

A 5000-level thermal physics course

Other courses with consent of advisor

### Chemical Reaction Kinetics

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBE:3205</td>
<td>Introduction to Biochemical Engineering</td>
<td>3</td>
</tr>
<tr>
<td>CBE:5315</td>
<td>Polymer Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>CBE:5425</td>
<td>Atmospheric Chemistry and Physics</td>
<td>3</td>
</tr>
</tbody>
</table>

### Technical Communication

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBE:5105</td>
<td>Introduction to Literature Review and Proposal Writing</td>
<td>3</td>
</tr>
</tbody>
</table>

### Data Science

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CBE:5120</td>
<td>Data Science in Chemical and Engineering Systems</td>
<td>3</td>
</tr>
</tbody>
</table>

Additional Requirements

All students are required to take ENGR:7270 Engineering Ethics (1 s.h.) during their first semester and CBE:5000 Seminar in Chemical and Biochemical Engineering every semester in residence. Students earn the remainder of credit for the degree in elective courses and research.

Students are required to satisfy a qualifying requirement with a minimum g.p.a. of at least 3.50 in the four core courses and pass a comprehensive examination before they can become candidates for degree. 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.

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

Combined Programs

### Ph.D./M.D.

Students may work toward the Doctor of Medicine degree and a Ph.D. 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.
- Official Graduate Record Examination (GRE) General Test scores (verbal and quantitative) from Educational Testing Services (the University’s institutional code is 6681) or International English Language Testing System (IELTS).
- Statement of purpose.
- Three letters of recommendation.
- Test of English as a Foreign Language (TOEFL) scores for applicants whose first language is not English.

Applicants should have a B.S. degree in chemical engineering or a related discipline with satisfactory grades from a recognized college or university in the United States and a cumulative g.p.a. of at least 3.00 on a 4.00 scale. Graduates of non-U.S. universities may be accepted, depending on evaluation of their records. Applicants who do not meet these requirements may be granted conditional admission by the Graduate Admissions Committee.

Graduate courses in chemical and biochemical engineering are designed for students who have an undergraduate background in chemical engineering. Exceptional students from other areas also may apply for admission. If admitted, they may be required to take specific undergraduate courses to prepare them for graduate coursework.

Financial Support

Full financial support is available to admitted Ph.D. students in the form of teaching assistantships, research assistantships, and fellowships. The department provides up to five years of support for all full-time Ph.D. students that are making normal progress toward the degree, exhibit satisfactory performance in all duties, and maintain appropriate professional conduct.

Career Advancement

The Ph.D. program is designed to equip students with the skills to pursue a career in industry, academia, or government. 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.