Biomedical Engineering, Ph.D.

Graduate study in biomedical engineering prepares students to use contemporary methods at an advanced level during a professional career in engineering design, development, and research.

Each student’s course of study is based on individual background, career objectives, and sound academic practice. An individual program for each student may be developed from courses offered by the Roy J. Carver Department of Biomedical Engineering and other departments, particularly mechanical engineering, electrical engineering, physiology, mathematics, and biological sciences. Faculty members in the department have teaching and research expertise in cardiovascular and fluid biomechanics, musculoskeletal biomechanics, biomaterials and tissue engineering, bioinstrumentation, biosystems, biomedical imaging, biological signal analysis, bioinformatics and computational biology, and other allied fields.

Ph.D. programs may center on any one of the previously described areas through the choice of appropriate coursework and research topic.

Learning Outcomes

By completing the graduate curriculum in biomedical engineering, students will be able to:

• demonstrate broad knowledge of the field of biomedical engineering and deep knowledge in their specific area of study;
• communicate complex technical ideas concisely and effectively to both general and specialized audiences through verbal, visual, and written formats;
• formulate research questions, pose testable hypotheses, employ methods that enhance reproducibility of research, and apply critical thinking skills to produce solutions to complex engineering problems that intersect with biology and human health; and
• operate with professionalism and under standards of ethical conduct.

Requirements

The Doctor of Philosophy program in biomedical engineering requires a minimum of 72 s.h. of graduate work, including acceptable transfer credit. At least 42 s.h. must be earned in formal coursework taken after the B.S.E. is awarded, and at least 12 s.h. must be earned for research and the thesis. Students who enter with an M.S. may count a maximum of 30 s.h. of approved transfer credit toward the Ph.D., but they must earn 39 s.h. of graduate credit at the University of Iowa, including at least 12 s.h. for research and the thesis. Based on a student’s research progress, examination results, or other measures, the graduate committee may require additional formal coursework to strengthen perceived areas of weakness.

All Ph.D. students must successfully complete the Graduate Core Courses as part of their graduate curriculum. Students are expected to complete them during their first year of study. Additionally, students must complete 18 s.h. of graduate-level coursework in the College of Engineering over the course of their studies. Medical scientist training program students are required to complete 12 s.h. of graduate-level coursework in the College of Engineering.

Graduate Core Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>ENGR:7270</td>
<td>Engineering Ethics</td>
<td>1</td>
</tr>
<tr>
<td>HHP:3500</td>
<td>Human Physiology</td>
<td>3</td>
</tr>
<tr>
<td>ME:5113</td>
<td>Mathematical Methods in Engineering (or equivalent graduate mathematics course; approval of academic advisor required before registering)</td>
<td>3</td>
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</tbody>
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Depending upon a student’s performance in Graduate Core Courses and the nature of their research project, the student’s examining committee may specify additional coursework to be completed to satisfy the Graduate Core Courses requirement.

Graduate Core Courses may be substituted by other equivalent courses at the discretion of the student’s examining committee. Equivalent coursework taken as part of a student’s undergraduate or graduate studies prior to starting the biomedical engineering graduate program at the University of Iowa may satisfy one or more of the Graduate Core Courses requirements. Students who wish to request a substitution or a waiver of HHP:3500 Human Physiology must submit a core course substitution or waiver form. Forms may be obtained from the graduate program coordinator.

Admission to the Ph.D. program is conditional until students successfully complete a qualifying examination. The biomedical engineering faculty administers the exam and decides whether a student’s performance on it is adequate for admission to the Ph.D. program.

Admission to Ph.D. candidacy requires a g.p.a. of at least 3.00 on all graduate work at the University of Iowa. Upon completion of the coursework specified in the plan of study and with the required grade-point average and the advisor’s recommendation, students are admitted to the comprehensive examination by their committee.

Having satisfactorily completed these examinations, students usually have only to complete and defend their dissertation at the final examination. Requirements for the Ph.D. generally can be completed in about three years beyond the master’s degree.

Combined Programs

Ph.D./M.D.

Students may work toward the Doctor of Medicine degree and a Ph.D. in biomedical engineering in a combined degree program offered by the Carver College of Medicine and the College of Engineering. 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.
Reference letters, research interests, previous graduate grade-point average, and other factors may be considered in admission decisions.

Admission to the Doctor of Philosophy in biomedical engineering is conditional until students successfully complete a qualifying examination.

**Financial Support**

Research assistant positions are available on a variety of research projects, and a limited number of teaching assistant positions may be available. Selection of recipients is usually based on scholastic achievement and research interest. These awards may be made on a semester, academic year, or calendar year basis. Awards and reappointments are competitive and are based on a student's potential contribution to the teaching and research goals of the department. Students who fulfill their research assistant responsibilities and continue to make satisfactory progress toward their degree objective receive preference in new awards.

**Career Advancement**

Biomedical engineers with Ph.D. degrees can pursue career opportunities in the health care industry in the fields of biomedical devices, diagnostic equipment, and software. Graduates have started careers in research, design, development, sales, and entrepreneurship, and advance to administrative and leadership positions in their organizations. Graduates also have careers with health care providers such as in hospitals, or used their biomedical engineering expertise to advance careers in medicine and law. Graduates also have careers in academia or at research institutions where they advance understanding of human health. Faculty mentors assigned to graduate students aid in their professional development. Students are exposed to opportunities through seminar speakers who have relevant expertise that are invited to campus.

The Graduate College offers numerous career advancement opportunities and professional development programs for graduate students. Ongoing program offerings, news, and announcements can be found under Grad Success Center on the Graduate College website.