

BIOMEDICAL ENGINEERING, PH.D.

Learning Outcomes

- Graduates will be able to identify and explain fundamental concepts in the following core courses:
 - BMEN 710—Modeling and Simulation of Biomedical Systems
 - BMEN 713—Human Cell and Molecular Biology for Biomedical Engineering
 - BMEN 720—Transport Phenomena in Biomedical Systems
 - BMEN 723—Anatomy and Physiology for Biomedical Engineering
- In addition to acquiring foundation knowledge (represented by the core courses), students will be able to integrate driving concepts in each course and most importantly articulate/practice the multidisciplinary approach inherent to Biomedical Engineering.
- Graduates should be able to explain the tools and techniques associated with mathematical modeling and simulation of biomedical systems, concepts in molecular, cell, and systems level biology, and transport phenomena.
- Students will prepare and deliver scientific presentations.

Other Program Requirements

Each Ph.D. student must select a research advisor during the first semester after admission to the doctoral program. After a Ph.D. student passes the admission to candidacy examination, an advisory committee of no less than four members will be selected. The committee must include the department chair and one outside member. A student Advisory Committee also serves as the students' Comprehensive Exam Committee, Dissertation Committee and Dissertation Examination Committee.

Qualifying Exam

The purpose of the Ph.D. qualifying exam is for a Ph.D. student to demonstrate his/her qualification to pursue the Ph.D. degree program. Prior to admission to candidacy, the student is required to pass a written qualifying examination. This examination is designed to test fundamental knowledge and conceptual understanding of the mainstream areas of biomedical engineering as presented through the core BMEN courses.

If the exam committee determines that a student is not qualified to pursue the Ph.D. degree program, then the student cannot continue in the Ph.D. degree program but may apply for entrance into the M.S. degree program in the Biomedical Engineering Program. A student may re-apply for the Ph.D. degree program:

1. after completing an M.S degree or
2. after not being enrolled as a USC biomedical engineering student for two years.

Admission to Candidacy

The dean of The Graduate School admits a student to doctoral candidacy after the student has:

1. passed the Ph.D. qualifying exam;
2. been fully admitted to the doctoral degree program; and

3. filed an approved doctoral program of study with The Graduate School.

The Graduate School will notify the student and the graduate director of the admission to candidacy. Completion of all three components of the admission to candidacy procedure should be at least one full academic year before granting of the degree.

Comprehensive Exam

The Ph.D. Comprehensive Exam for the Biomedical Engineering Program is to consist of both a written and oral parts. The examination is to be conducted by the student's Comprehensive Exam Committee. The examination is to focus on the student's proposed dissertation work. The student is to prepare a written dissertation proposal that will include background information, literature review, and proposed work. This written dissertation proposal will be considered the students written examination and will be delivered to the examination committee no less than 7 days prior to the oral portion of the exam. The oral portion of the examination will consist of a 30 to 45 minute presentation of the proposed work followed by questions from the attendees. The presentation is to be open to all members of the University community and guests. After questions are complete from the general audience all non-faculty guests will be asked to leave the room. The remaining faculty may ask question of the candidate on any subject related to the proposed work. The presentation is to be conducted during normal business hours and on a day on which faculty members are expected to be on campus.

At least 14 days prior to the oral portion of the examination, a notice consisting of a presentation title, abstract, time, place, name of student's advisor, and names of the student's Comprehensive Examination Committee members is to be delivered to the BME Graduate Director. The notice is to be approved by the Graduate Director and a copy of the notice placed in the student's file. Using the information supplied, the Graduate Studies Committee will publicize the oral portion of the examination.

The Graduate Studies Committee will appoint a BMEN faculty member who is not part of the student's comprehensive exam committee to serve as the Graduate Studies Committee Representative. This representative will observe at the student's comprehensive exam and report the results of the exam to the Graduate Studies Committee.

Within 7 days after completion of the student's exam, the examination committee and the committee representative will inform the Graduate Studies Committee of the examination committee's assessment of the student's performance on the exam. The examination committee shall recommend one of the following options:

1. the student's proposal is satisfactory,
2. the student's proposal is unsatisfactory but only minor revisions are needed or
3. the student's proposal is unsatisfactory and major revisions are needed.

In the case of option 2), the student must revise the proposal to the satisfaction of the examination committee. Once the revisions are completed to the satisfaction of the examination committee the student will have passed the exam. In the case of option 3), the student will have one year to retake the exam. The student must complete both the written and oral portions. If a student's performance is unsatisfactory and major revisions are needed again, then the student will be removed from the Ph.D. program.

Passage of the exam is required at least 12 calendar months prior to graduation. A student must attempt the examination within 24 months (36 months for APOGEE students) after enrolling in the Ph.D. degree program. The student must successfully pass the exam within 36 months (48 months for APOGEE). Any student who does not pass the examination within the specified time limit cannot continue in the Ph.D. program.

A student may appeal to the Graduate Studies Committee for a 12-month extension. This appeal must include reasons for the student not completing the exam on time, the plan for the student to complete the exam within 12 months, and endorsement from the student's dissertation committee.

Publication Requirement

An educational objective for Ph.D. students is that they have the ability to communicate their research results through oral presentations and written publications. Consistent with this objective, a Ph.D. student is required to submit, based on research performed while at USC, at least one accepted journal publication prior to graduation.

Doctoral Dissertation

No later than five years after the Comprehensive Exam, the student must present a dissertation based on research that has been approved by the student's Dissertation Committee and the Dean of the Graduate School.

Information on the fees associated with dissertation submission is available in the Doctoral Dissertation Guidelines or from the Graduate School. During the preparation of the dissertation, any student who wishes to use University facilities or to confer with the faculty on dissertation work must be officially enrolled for dissertation credit. Registration for a minimum of 12 credits in Dissertation Preparation is required of all doctoral candidates.

Residency

At least three years of the Ph.D. program must be spent on the Columbia campus of the University of South Carolina and all must be within eight years of the date at which the degree is to be granted.

Residency on the Columbia campus after admission to a doctoral program can be fulfilled by successful completion of two consecutive semesters of 9 or more graduate credits per semester, or three consecutive semesters of 6 or more graduate credits per semester. Enrollment in a summer term (both sessions) may be counted as equivalent to a semester, but enrollment in summer is not required to maintain continuity. Of the 18 hours, only 12 may be Dissertation Preparation (899).

The intent of the residency requirement is to ensure that doctoral students benefit from and contribute to the complete spectrum of educational and professional opportunities provided on the campus of a comprehensive university. When establishing residency, the student should interact with faculty and peers by regularly attending courses, conferences, and seminars, and utilize the library and laboratory facilities provided for graduate education.

Maximum Time Allowed

Ph.D. students are expected to complete the degree requirements within four years from the time of admission. Although there is no imposed maximum time for completion of the program, students are strongly encouraged to complete their programs in less than eight

years. Extension of the program beyond this limit may cause curriculum complications.

Transfer Credit

A student may transfer a master degree from another institution if approved by the Graduate Director and major professor. The student is also allowed to transfer 12 hours from an institution where no degree was obtained with the approval by both the Biomedical Engineering Program and the Graduate School. The course work must be relevant to the current degree and have course content and level of instruction equivalent to that offered by the University's own graduate degree programs.

Program of Study

Prior to taking the Ph.D. qualifying exam, the student, in cooperation with the student's Academic Advisor, must complete the Ph.D. Program of Study Form. This form lists courses to be taken, courses to be transferred to USC, and courses already taken at USC.

Dissertation Presentation and Defense/ Examination

The dissertation presentation is to be open to all members of the University community and guests. During the Fall and Spring semesters, the presentation and defense is to be conducted during normal business hours and on a day that faculty are expected to be on campus. The Graduate Director must approve the date and time of presentations given during the summer sessions.

At least 14 days prior to the presentation and defense, a notice consisting of presentation title, abstract, time, place, name of student's advisor, and names of the student's Dissertation Examination Committee members is to be delivered to the Graduate Director. The notice is to be approved by the Graduate Director and a copy of the notice placed in the student's file. Using the information supplied, the Graduate Studies Committee will publicize the dissertation and defense.

At least 7 days prior to the presentation and defense, the student must deliver a printed copy of the complete dissertation to members of the student's Dissertation Examination Committee and to the Graduate Director.

The Graduate Studies Committee will appoint a Biomedical Engineering Program faculty member who is not part of the student's dissertation committee to serve as the Graduate Studies Committee Representative. This representative will observe at the student's dissertation presentation and defense and will report to the Graduate Studies Committee the results of the presentation and defense.

Immediately following the dissertation presentation, the student must orally defend the dissertation before their Dissertation Examination Committee and other members of the Biomedical Engineering Program Graduate Faculty. This dissertation exam is primarily concerned with evaluation of the student's dissertation and understanding in the student's area of specialization. The exam will be interpreted as pass or fail. Students who fail the exam may be allowed to correct the dissertation and/or re-stand the oral examination, depending upon the decision of their Dissertation Examination Committee. A student who is not granted a re-examination or does not properly correct the dissertation may not receive a Ph.D. degree in the Biomedical Engineering Program.

Graduation

Within 15 days after the beginning of the semester of graduation, the student should submit an Application for Degree Form to the Graduate School. Dates for submission for each term are published by the Graduate School. If a student fails to meet the graduation requirements, a new application must be submitted for the subsequent term.

Degree Requirements (60 Post-Baccalaureate Hours)

Requirements for the Ph.D. degree in biomedical engineering fall into four categories: course requirements, the qualifying examination, the comprehensive examination, and the doctoral dissertation. Additionally, students must submit at least three papers for publication in peer-reviewed technical journals prior to graduation.

The Ph.D. degree in biomedical engineering requires 60 credit hours of graduate level work beyond the B.S. degree. Students who enter the program with a bachelor's degree must complete:

Core BMEN Courses (12 Hours)

Course	Title	Credits
BMEN 710	Modeling and Simulation of Biomedical System	3
BMEN 713	Human Cell and Molecular Biology for Biomedical Engineers	3
BMEN 720	Transport Phenomena in Biomedical Systems	3
BMEN 723	Anatomy and Physiology for Biomedical Engineers	3
Total Credit Hours		12

BMEN or Other Approved Electives (15 Hours)

Seminar (3 Hours)

Course	Title	Credits
BMEN 795	Biomedical Engineering Literature	1
BMEN 798	Graduate Seminar in Biomedical Engineering	1
BMEN 898	Doctoral Seminar in Biomedical Engineering	1
Total Credit Hours		3

Research (18 Hours)

Course	Title	Credits
BMEN 797	Biomedical Engineering Doctoral Research	18
Total Credit Hours		18

Dissertation Preparation (12 Hours)

Course	Title	Credits
BMEN 899	Biomedical Engineering Doctoral Dissertation Preparation	12
Total Credit Hours		12