

## BIOMEDICAL ENGINEERING PH.D.

All students must meet the Requirements for the Doctor of Philosophy Degree.

### OVERVIEW

The program in Biomedical Engineering offers an interdisciplinary research focused path towards the Doctor of Philosophy degree.

Graduate students obtain the Ph.D. degree through a program administered by the Department of Electrical and Biomedical Engineering.

Participating faculty with strong commitments to biomedical engineering research and education are from the College of Engineering and Mathematical Sciences, the College of Medicine, and other departments and colleges across campus. The extensive research facilities of the participating faculty and departments are available to all graduate students enrolled in the program and the program provides the flexibility necessary for students to gain competence in the area of their choice. Research areas include: digital health, biomechanics, biomaterials, neuroengineering, and computational modeling.

Students in the program are generally supported by sponsored research projects, participating departments and training grants.

### SPECIFIC REQUIREMENTS

#### Requirements for Admission to Graduate Studies for the Degree of Doctor of Philosophy

Students applying for admission to the graduate program must meet the general requirements of admission of the University of Vermont Graduate College. Admission is competitive and students are selected on the basis of their scholastic preparation and intellectual capacity.

The following minimum preparation is recommended:

- Biology, Chemistry: 2 semesters each, or 4 introductory courses in the following subjects - anatomy, biology, biophysics, chemistry, physiology
- Engineering: 2 introductory courses in 1 or more of the following subjects - biomechanics, materials, mechanics, thermodynamics, electrical engineering, control theory, or fluid mechanics
- Mathematics: Calculus through differential equations, and 1 additional math/stats course
- Physics: 2 semesters of physics
- Undergraduate grade point average above 3.0 (based on a 4.0 scale), strong BME course grades (B average or better), and positive letters of recommendation
- Satisfactory scores on the general Graduate Record Examination (GRE) may be presented, but are not required

Special arrangements may be made, on an individual basis, for students who are highly prepared in one area, but less well prepared in another.

### Minimum Degree Requirements

Candidates for the degree of Doctor of Philosophy must complete 14 graduate credits of core courses including 6 credits of "domain-specific courses" (chosen from the following: (e.g. Advanced Biomedical Systems, Modeling Complex Systems, or Nanobiomaterials), 4 credits of human physiology and pharmacology (MPBP 6010), an advanced mathematics or statistics course (any MATH or STAT course at the 5000-level or above), and 1 credit of a research ethics course (CEMS 6010, NSCI 6270, or NFS 6362). Additionally, candidates must complete at least 16 credits of technical electives (any BHSC, BIOC, BIOL, BME, CEE, CEMS, CHEM, CLBI, CMPE, CS, CSYS, DPT, EE, EMGT, ENGR, ENSC, EXSC, HLTH, MATH, ME, MLS, MMG, MPBP, NSCI, OT, PATH, PH, PHRM, PHYS, RAD, or STAT course at the 5000-level or above), a teaching requirement, a comprehensive examination, at least 20 credits of dissertation research, and a final oral examination. A minimum of 9 credits of coursework must be at the 6000-level or above.

### Comprehensive Examination

The comprehensive exam for the Biomedical Engineering Ph.D. will normally be taken at the end of a candidate's fourth semester of study (typically around May of Year 2) and will consist of a written part and an oral part.

**The Written Part:** The written part of the comprehensive examination will be a report written in the form of a research grant proposal based around a research idea in the area of the candidate's dissertation work, and will comprise three Specific Aims. The first 2 aims will be focused in the area of the candidate's Ph.D. research, and will be expected to include some preliminary data and a research plan that is grounded in techniques that are well understood by the candidate. The third aim will be a "stretch aim" that extends beyond the scope of the candidate's research. In this third aim, the candidate will be expected to exhibit evidence of an ability to generate imaginative and thoughtful hypotheses, and to think laterally about how their Ph.D. research area could be developed in a new direction.

**The Oral Part:** The oral part of the comprehensive examination will be a formal seminar by the student in front of their graduate studies committee. The student will be asked to defend the proposal and to answer any additional questions the committee members feel appropriate after the seminar. It is expected that there will be specific questions directly associated with broad engineering and biological sciences.

### Requirements for Advancement to Candidacy for the Degree of Doctor of Philosophy

Successful completion of the Comprehensive Examination and fulfillment of the graduate course requirements.