

BIOENGINEERING

Graduate Program Head	Daniel J Hayes
Program Code	BIOE
Campus(es)	University Park (Ph.D., M.S.)
Degrees Conferred	Doctor of Philosophy (Ph.D.) Master of Science (M.S.)
The Graduate Faculty	View (https://secure.gradsch.psu.edu/gpms/index.cfm?searchType=fac&prog=BIOE)

This intercollege program provides graduate-level training in engineering and the life sciences, and their integration. Students graduating from this program will have acquired expertise in the application of engineering principles to fundamental problems in biology, clinical problems in medicine, or in the development of new biomedical instrumentation. They are also expected to produce scholarly work to be published in peer-reviewed journals and presented at national conferences. Graduate curricula and student assessment in bioengineering is under the direction of the program chair and a graduate curriculum committee that is composed of Graduate Faculty representing several departments in the Colleges of Engineering, Health and Human Development, Science, and Medicine.

Opportunities for specialized research are offered by Graduate Faculty working on electrical, mechanical, and biophysical properties of biological materials and the application of this knowledge to understanding molecular, cellular, tissue, and organ level processes involved in health and disease. Specific applications include:

- artificial organs
- biomaterials
- bioMEMs
- nanotechnology
- biophotonics
- cellular and medical imaging
- cardiovascular engineering
- cell signaling and protein dynamics
- mechanobiology
- neural interfaces
- tissue engineering
- regenerative medicine

Extensive computer facilities and specialized equipment are available to support a combination of studies that employ experimental observations and their analysis through mathematical modeling and computer simulations.

Admission Requirements

Applicants apply for admission to the program via the Graduate School application for admission (<http://gradschool.psu.edu/prospective-students/how-to-apply>). Requirements listed here are in addition to Graduate Council policies listed under GCAC-300 Admissions (<http://gradschool.psu.edu/graduate-education-policies>).

Students with a degree in engineering, physics, or the life sciences are eligible for admission. All students must have a strong background in physics and mathematics. This background should include chemistry,

calculus-based physics, and mathematics through calculus and differential equations. Students who lack this background may still be considered for provisional admission (<http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-300/provisional-admission>) but will have to make up any deficiency early in their graduate program. These remedial courses will be required in addition to the stated graduate program course requirements. Students with a 3.0 junior/senior grade-point average and with appropriate course backgrounds will be considered for admission. The best-qualified applicants will be accepted up to the number of spaces available. Exceptions to the minimum average may be made for students with special backgrounds, abilities, and interests, at the discretion of the program.

Scores from the Graduate Record Examinations (GRE) are required for admission. However, at the discretion of the program a student may be admitted for graduate study in the Bioengineering program without these scores.

Degree Requirements

Master of Science (M.S.)

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Requirements. (<http://gradschool.psu.edu/graduate-education-policies>)

A minimum of 30 credits are required for a master's degree in Bioengineering, with at least 24 credits at the 500-, 600-, or 800-level. Students must take the following:

Code	Title	Credits
Required Courses		
12 credits of lecture- or laboratory-based coursework at the 500-level ¹		12
6 credits of lecture- or laboratory-based coursework at the 400- or 500-level ¹		6
BIOE 591	Bioengineering Ethics and Professional Development	1
1-credit graduate seminar for every semester in attendance		4
Electives ²		1
Culminating Experience		
BIOE 600	Thesis Research	6
Total Credits		30

¹ Coursework must include at least 6 credits each in bioengineering, life sciences, and technical/quantitative electives.

² Students will select additional course work and research credits from a list of approved electives maintained by the program office, as appropriate, to obtain the total minimum of 30 credits.

Credits earned at other institutions but not used to earn a degree may be applied toward the requirements for a graduate degree, subject to restrictions outlined in GCAC-309 Transfer Credit (<http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-300/transfer-credit>).

A thesis is required for the M.S. degree. This thesis will be defended in front of the student's academic advisory committee. The thesis must be accepted by the academic advisory committee members, the head of the graduate program, and the Graduate School, and the student must pass a thesis defense.

Doctor of Philosophy (Ph.D.)

Requirements listed here are in addition to Graduate Council policies listed under GCAC-600 Research Degree Requirements. (<http://gradschool.psu.edu/graduate-education-policies>)

Upon entering the program, a student, along with his/her research adviser, will select an academic advisory committee consisting of three members of the IDGP in Bioengineering Graduate Faculty (including the adviser). Working with this committee, students will select courses appropriate to their research and their professional goals.

Code	Title	Credits
Required Courses		
6 credits each in bioengineering, life sciences, and technical/quantitative electives		6
12 credits that are lecture- or laboratory-based (not independent study) and at the 500-level		12
6 credits at the 500-level in courses relevant to their research		6
4 credits in graduate program seminar series (1 credit every semester until passing the comprehensive exam)		4
BIOE 591	Bioengineering Ethics and Professional Development	1
Total Credits		29

600-level research credits are assigned every semester in attendance. Graduate credits earned at other institutions, including those used toward a degree, may be used to satisfy some of the Ph.D. degree requirements at Penn State, but in these cases credits are not transferred. Regardless of previous courses taken, every doctoral student must take a minimum of 6 course credits at the 500-level at the University Park campus.

Supporting courses are available at University Park in: anatomy, biochemistry, biology, biophysics, chemistry, laboratory animal medicine, materials science, mathematics, physics, physiology, and the engineering departments.

Exams

After completion of the first year, completion of at least 18 graduate credits and within three semesters (not including summer) of entry into the doctoral program, all students must complete and pass the qualifying exam, which consists of a written research proposal and oral defense of that proposal on a topic other than the subject of the student's dissertation. This exam also tests for English competency, which is a Graduate Council requirement. A comprehensive examination consisting of a written research proposal and oral defense of that proposal on the student's Ph.D. dissertation topic is administered by the student's Ph.D. committee, typically at the end of second year of residency. A final oral examination based on a defense of the doctoral dissertation is required of all candidates. This exam occurs typically after the fourth or fifth year of residency and consists of a formal public seminar followed by a closed meeting of the Ph.D. committee and the candidate.

In preparation for the comprehensive exam, students, along with their adviser, will choose a Ph.D. committee in accordance with Graduate Council policy (<http://gradschool.psu.edu/graduate-education-policies/gcac/gcac-600/phd-dissertation-committee-formation>). The Ph.D. committee consists of a minimum of four members of the Graduate Faculty including the adviser who serves as the chair. The adviser must be a member of the Intercollege Graduate Degree Program (IGDP) in Bioengineering. At least three committee members must be members of the IGDP in Bioengineering. The committee must also include an "Outside

Field Member" who is not a member of the IGDP in Bioengineering. Finally, at least one member of the Ph.D. committee must have his/her primary appointment outside the administrative unit in which the adviser's primary appointment is held. The Graduate School will appoint the committee and notify all persons.

To earn the Ph.D. degree, doctoral candidates must write a dissertation that is accepted by the Ph.D. committee, the head of the graduate program, and the Graduate School, and the student must pass a final oral examination (the dissertation defense).

Student Aid

Graduate assistantships available to students in this program and other forms of student aid are described in the Tuition & Funding (<http://gradschool.psu.edu/graduate-funding>) section of The Graduate School's website. Students on graduate assistantships must adhere to the course load limits (<http://gradschool.psu.edu/graduate-education-policies/gsad/gsad-900/gsad-901-graduate-assistants>) set by The Graduate School.

Courses

Graduate courses carry numbers from 500 to 699 and 800 to 899. Advanced undergraduate courses numbered between 400 and 499 may be used to meet some graduate degree requirements when taken by graduate students. Courses below the 400 level may not. A graduate student may register for or audit these courses in order to make up deficiencies or to fill in gaps in previous education but not to meet requirements for an advanced degree.

Bioengineering (BIOE) Course List (<https://bulletins.psu.edu/university-course-descriptions/graduate/bioe>)

Contact

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