DEPARTMENT OF BIOLOGICAL ENGINEERING

Graduate Study

Graduate students in the Department of Biological Engineering can carry out their research as part of a number of multi-investigator, multidisciplinary research centers at MIT, including the Center for Biomedical Engineering, the Center for Environmental Health Sciences (*https://catalog.mit.edu/mit/research/center-environmental-health-sciences*), the Division of Comparative Medicine (*https://catalog.mit.edu/mit/research/division-comparative-medicine*), and the Synthetic Biology Engineering Research Center (*http://www.synberc.org*). These opportunities include collaboration with faculty in the Schools of Engineering (*https://catalog.mit.edu/schools/engineering*) and Science (*https://catalog.mit.edu/schools/science*), the Koch Institute for Integrative Cancer Research (*https://catalog.mit.edu/mit/research/koch-institute-integrative-cancer-research*), the Whitehead Institute for Biomedical Research (*https://catalog.mit.edu/mit/research/whitehead-institute-biomedical-research*), and the Broad Institute (*https://catalog.mit.edu/mit/research/broad-institute*), along with the Harvard University School of Medicine, Harvard University School of Dental Medicine, Harvard School of Public Health, and Boston University School of Medicine.

Master of Engineering in Biomedical Engineering

The Master of Engineering in Biomedical Engineering (MEBE) program is a five-year program leading to a bachelor's degree in a science or engineering discipline along with a Master of Engineering in Biomedical Engineering. The program emphasizes the fusion of engineering with modern molecular-to-genomic biology, as in our SB and PhD degree programs. Admission to the MEBE program is open only to MIT undergraduate students, and requires candidates to demonstrate adequate quantitative and engineering credentials through their undergraduate coursework.

In addition to satisfying the requirements of their departmental program, candidates also are expected to complete the following:

18.03	Differential Equations	12
5.12	Organic Chemistry I	12
5.07[J]	Introduction to Biological Chemistry	12
or 7.05	General Biochemistry	
Select one of the following:		12
2.005	Thermal-Fluids Engineering I	
6.2000	Electrical Circuits: Modeling and Design of Physical Systems	
Select two of the following:		24
1.010	Probability and Causal Inference	
2.086	Numerical Computation for Mechanical Engineers	
6.3700	Introduction to Probability	
18.05	Introduction to Probability and Statistics	

Applications to the MEBE program are accepted from students in any of the departments in the School of Engineering or School of Science. Students interested in applying to the MEBE program should submit a standard MIT graduate application by the end of their junior year; they are informed of the decision by the end of that summer.

Additional information on application procedures, objectives, and program requirements can be obtained by contacting the BE Academic Office (*be-acad@mit.edu*), Room 16-127.

Program Requirements

In addition to thesis credits, at least 66 units of coursework are required. At least 42 of these subject units must be from graduate subjects. The remaining units may be satisfied, in some cases, with advanced undergraduate subjects that are not requirements in MIT's undergraduate curriculum. Of the 66 units, a minimum distribution in each of three categories is specified below.

Bioengineering Core		
Select two of the following:		24
20.410[J]	Molecular, Cellular, and Tissue Biomechanics	
20.420[J]	Principles of Molecular Bioengineering	
20.430[J]	Fields, Forces, and Flows in Biological Systems	
Biomedical Engineering Electives		
Select 24 units from a selection of graduate subjects from various departments in the School of Engineering, including HST. [1]		24
Bioscience Elective		
Select one biological science subject in addition to organic chemistry and biochemistry. This must be a laboratory subject if one was not taken as part of the student's undergraduate curriculum		18
Total Units		**66**

[1] *A list of suggested subjects is available from the BE Academic Office (be-acad@mit.edu), Room 16-267.*

Thesis

The student is required to complete a thesis that must be approved by the program director. The thesis is an original work of research, design, or development. If the supervisor is not a member of the Department of Biological Engineering, a reader who belongs to the BE faculty must also approve and sign the thesis. The student submits a thesis proposal by the end of the fourth year.

Doctor of Philosophy and Doctor of Science in Biological Engineering

The Department of Biological Engineering offers a Doctor of Philosophy (PhD) and Doctor of Science (ScD) in Biological Engineering; the program is the same for both degrees. The Biological Engineering doctoral program (*https://catalog.mit.edu/degree-charts/phd-biological-engineering*) educates students to use engineering principles in the analysis and manipulation of biological systems, allowing them to solve problems across a spectrum of important applications. The curriculum is inherently interdisciplinary in that it brings together engineering and biology as fundamentally as possible and cuts across the boundaries of the traditional engineering disciplines.

The written part of the doctoral qualifying examinations—focused on the core curriculum—is taken after the second term. The student selects a research advisor, typically by the start of the spring term in the first year, and begins research before the end of that year. The oral part of the doctoral qualifying examinations, which focuses on the student's area of research, is taken prior to December 1 of the third year. A total of approximately five years in residence is needed to complete the doctoral thesis and other degree requirements. Upon successful completion of the program, students are awarded either the PhD or ScD in biological engineering.

Students admitted to the Biological Engineering doctoral program typically have a bachelor's or master's degree in science or engineering. Foundational coursework in biochemistry and molecular cell biology is required, either prior to admission or during the first year of graduate study. Students who have not taken biochemistry previously should take 7.05 General Biochemistry or 5.07[J] Introduction to Biological Chemistry, and those who have not taken cell biology previously should take 7.06 Cell Biology, prior to taking the core classes. During their first year, students pursue a unified core curriculum in which engineering approaches are used to analyze biological systems and technologies over a wide range of length and time scales. The subjects in the unified core bring central engineering principles to bear on the operation of biological systems from molecular to cell to tissue/organ/device systems levels. These are then supplemented by electives in the biological sciences and engineering to enhance breadth and depth.

Faculty members associated with the program possess a wide range of research interests. Areas in which students may specialize include systems and synthetic biology; biological and physiological transport phenomena; biological imaging and functional measurement; biomolecular engineering; cell and tissue engineering; computational modeling of biological and physiological systems; bioinformatics; design, discovery, and delivery of molecular therapeutics; molecular, cell, and tissue biomechanics; development of in vitro models of the immune system and lymphoid tissue; development of molecular methods for direct measurement of mutations in humans; metabolism of foreign compounds; genetic toxicology; the molecular aspects and dosimetry of interactions between mutagens and carcinogens with nucleic acids and proteins; molecular mechanisms of DNA damage and repair; design and mechanisms of action of chemotherapeutic agents; environmental carcinogenesis and epidemiology; molecular mechanisms of carcinogenesis; cell physiology; extracellular regulation and signal transduction; molecular and pathologic interactions between infectious microbial agents and carcinogens; and new tools for genomics, proteomics, and glycomics.

Interdisciplinary Programs

Leaders for Global Operations

The 24-month Leaders for Global Operations (LGO) (*https://catalog.mit.edu/interdisciplinary/graduate-programs/leaders-global-operations*) program combines graduate degrees in engineering and management for those with previous postgraduate work experience and strong undergraduate degrees in a technical field. During the two-year program, students complete a six-month internship at one of LGO's partner companies, where they conduct research that forms the basis of a dual-degree thesis. Students finish the program with two MIT degrees: an MBA (or SM in management) and an SM from one of eight engineering programs, some of which have optional or required LGO tracks. After graduation, alumni lead strategic initiatives in high-tech, operations, and manufacturing companies.

Polymers and Soft Matter

The Program in Polymers and Soft Matter (PPSM) (*http://polymerscience.mit.edu*) offers students from participating departments an interdisciplinary core curriculum in polymer science and engineering, exposure to the broader polymer community through seminars, contact with visitors from industry and academia, and interdepartmental collaboration while working towards a PhD or ScD degree.

Research opportunities include functional polymers, controlled drug delivery, nanostructured polymers, polymers at interfaces, biomaterials, molecular modeling, polymer synthesis, biomimetic materials, polymer mechanics and rheology, self-assembly, and polymers in energy. The program is described in more detail (*https://catalog.mit.edu/interdisciplinary/graduate-programs/polymers-soft-matter*) under Interdisciplinary Graduate Programs.

Inquiries

For further information on the graduate programs, see the Biological Engineering website (*http://be.mit.edu*) or contact the BE Academic Office (*be-acad@mit.edu*), Room 16-267, 617-253-1712.