Drexel University

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The School of Biomedical Engineering, Science and Health Systems: Graduate Programs

The School of Biomedical Engineering, Science, and Health Systems

The School of Biomedical Engineering, Science, and Health Systems (formerly the Biomedical Engineering and Science Institute, founded in 1961) is the beneficiary of a major endowment that sponsors chair professorships and fellowships. Research and educational strengths include biosensors, biomedical ultrasound, biomedical imaging, biomedical systems and signal processing, biomechanics, biomaterials, tissue and cellular engineering, neuroengineering, cardiovascular systems, and bioinformatics and computational biomedicine.

Our faculty includes individuals with specialties in engineering, physics, mathematics, biostatistics, life sciences, medicine, and other clinical disciplines. Of the more than 100 Drexel faculty members associated with the School, 23 hold primary appointments in the School. Some 52 adjunct faculty members from regional institutions and industry also participate in the research and academic programs of the School.

In addition to the curriculum offered by the School, various departments at Drexel University offer courses that are suited for students in biomedical engineering and biomedical science. These courses offer advanced knowledge needed for industrial careers, health professions, graduate research, or careers in highly specialized fields.

Metropolitan Philadelphia has one of the nation's highest concentrations of medical institutions and pharmaceutical, biotechnology, and medical devices and systems industry. The School has close working relationships with select schools, institutes, health care institutions and industries in the region. We have formed partnerships with prominent local medical universities including Drexel University College of Medicine and Thomas Jefferson University to develop joint research and educational programs. The School has also entered into a joint initiative in Bioinformatics with the Coriell Institute for Medical Research and the Windber Research Institute. These initiatives provide students with ample opportunities in basic and clinical research as well as innovative academic programs.

Applicants to the graduate program must meet the requirements for admission to graduate studies at Drexel University. Candidates for degrees in the School of Biomedical Engineering, Science, and Health Systems are required to maintain academic standards applicable to all graduate students at Drexel University.

The School of Biomedical Engineering, Science, and Health Systems

Program Objectives

The overall objective of the graduate programs offered by the School of Biomedical Engineering, Science, and Health Systems is to provide multidisciplinary curricula with an instructional core and research opportunities for students. Graduate biomedical engineering students are typically individuals with undergraduate degrees in engineering, physical sciences, or mathematics. The core curriculum provides the necessary training in life and medical sciences, modeling and simulation, and biomedical engineering applications to allow students to apply their engineering skills and perspective to solve current problems in biology and medicine. Areas in which students may focus their advanced studies and research attention include biomechanics and biomaterials, cellular and tissue engineering, biomedical sensing and imaging, human factors and performance engineering, neuroengineering, and bioinformatics. Students without an academic background in engineering or physical science who wish to enter the biomedical engineering program may enroll in the Crossover Program.

The core courses in the Biomedical science program are designed to educate life science students in quantitative analysis, mathematical modeling, systems analysis, and fundamental computational and informatics skills. Students are then encouraged to combine their knowledge of the life sciences with their newly acquired analytical skills to focus in such areas as biostatistics, genome science, and systems biology.

Biomedical Engineering

General Information

Biomedical engineering is concerned with the application of engineering and science methodologies to the analysis of biological and physiological problems and to the delivery of health care. The biomedical engineer requires the analytical tools and broad physical knowledge of modern engineering and science, fundamental understanding of the biological or physiological system, and familiarity with recent technological breakthroughs.

The biomedical engineer serves as an interface between traditional engineering disciplines and living systems and may work in either direction, applying the patterns of living organisms to engineering design or engineering new approaches to human health. The biomedical engineer may use his/her knowledge of physiological systems to reverse engineer nature, creating, for example, artificial tissues and neural networks. On the other hand, a biomedical engineer may use his/her knowledge of engineering to create new equipment or environments for such purposes as maximizing human performance, accelerating wound healing, or providing non-invasive diagnostic tools.

For more information, visit the The School of Biomedical Engineering, Science, and Health Systems' web site.

Master of Science Program in Biomedical Engineering

The core requirements for the master's in biomedical engineering encompass approximately 45 course credits. (Most courses carry three credits each.) A thesis is highly recommended. A non-thesis option is also offered. Students who choose the non-thesis option must pass a comprehensive examination.

Curriculum

Courses		Credits
BIO 501	**Biochemistry Laboratory**	2.0
BMES 501	**Medical Sciences I: Cellular and Tissue Biology**	4.0
BMES 502	**Medical Sciences II: Organ-Level Physiology**	4.0
BMES 503	**Medical Sciences III: Neural and Endocrine Control Systems**	4.0
BMES 672	**Biosimulation I**	2.0
BMES 673	**Biosimulation II**	2.0
BMES 864	**Seminar**	0.0
Students select three BMES electives from a list that may include the following:		**9.0-10.0**
BMES 508	**Cardiovascular Engineering**	3.0
BMES 551	**Biomedical Signal Processing**	3.0
BMES 561	**Introduction to Systems Analysis in Biology**	3.0
BMES 621	**Medical Imaging Systems I**	3.0
BMES 641	**Biomedical Mechanics I**	3.0
BMES 661	**Biomedical Materials I**	3.0
BMES 711	**Principles of Neuroentineering**	4.0
Electives (selection varies by area of specialization)		**18.0**
BMES 897	**Research**	
BMES 898	**Master's Thesis***	

***The research for the thesis may include work carried out during an internship.**

Biomedical Engineering: Areas of Specialization

Concentration areas in biomedical engineering include:

Biomechanics and Biomaterials
Biomechanics and biomaterials is designed to meet two objectives: to acquaint students with the responses of biological tissues to mechanical loads as well as with the mechanical properties of living systems; and to familiarize the student with natural tissues and the implants designed to replace them.

Tissue Engineering
The program builds on the fundamental knowledge of natural and synthetic biomaterials and cellular biology and educates students in the emerging field of cellular and tissue engineering. Specialized courses developed for this program include Advanced Scaffold Design and Manufacturing, Factor-Mediated Tissue Engineering, Biosurfaces, Computer-Aided Tissue Engineering, Integrated CAD/CAM for Tissue Engineering Applications, and Cellular Biomechanics.

Biomedical Imaging
Biomedical imaging focuses on the theoretical and practical issues related to machine vision, image processing and analysis, and signal processing associated with such medical applications as ultrasound, optics, magnetic resonance, and autoradiographic imaging.

Human Factors and Performance Engineering
Human factors and performance engineering provides the student with the background and skills needed to create work and living environments which improve human health and enhance performance. Courses in this area of specialization cover such topics as evolutionary medicine, chronobiology, biomechanics, motor systems, human nutrition, toxicology, risk assessment, social factors in health and aging, and environmental design.

Neuroengineering
Neuroengineering is broadly defined to include the modeling of neural and endocrine systems, neural networks, complexity in physiological systems, evolutionary influences in biological control systems, neurocontrol, neurorobotics, and neuroprosthetics.

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Doctoral Program in Biomedical Engineering

To be awarded the Ph.D., students must complete 90 credits (credits earned toward a masterís degree may apply toward the 90), fulfill a one-year residency requirement, and successfully pass the qualifying examination, the candidacy examination, and a Ph.D. dissertation and oral defense.

The qualifying examination is intended to test students' general knowledge of biomedical engineering and science. It is a written examination that covers the basic knowledge expected of students wishing to proceed toward a Ph.D. Biomedical engineering students are also expected to demonstrate physical science aptitude and preparation.

Prospective Ph.D. students are welcome to contact the school to discuss their research interests For more information, visit the School's Academics web page.

Biomedical Science

General Information
Biomedical science is a broad field concerned with the application of fundamental biological research and quantitative analysis to human health.

The School, in close collaboration with the Department of Bioscience and Biotechnology, provides coursework needed to acquire proficiency in the life sciences. Students in Biomedical science achieve depth in the modeling of living systems and biomedical information processing.

Students may choose to specialize in biostatistics, genome science or systems biology.

For more information, visit the The School of Biomedical Engineering, Science, and Health Systems' web site.

Master of Science Program in Biomedical Science

The core requirements for the masterís in biomedical science encompass approximately 45 course credits. (Most courses carry three credits each.) A thesis is highly recommended. A non-thesis option is also offered (students who choose this option must pass a comprehensive examination).

One unique aspect of the School's program in Biomedical science is its ability to integrate aspects of physiology and molecular biology with quantitative analysis, mathematical modeling, and computer processing to create a systems approach to biomedical research and applications. Elective courses such as Biological Controls Systems I, II, and III; Evolutionary Medicine; Human Chronobiology and Sleep I and II; and Complexity in Living Systems reflect the school's emphasis on a multidisciplinary approaches to the most current research in biology and medicine.

Curriculum

Courses		Credits
BIO 643	**Modeling Methods in Biology II**	3.0
BMES 505	**Mathematics for Biomedical Science I**	3.0
BMES 506	**Mathematics for Biomedical Science II**	3.0
BMES 507	**Mathematics for Biomedical Science III**	3.0
BMES 510	**Biomedical Statistics**	3.0
BMES 511	**Principles of Systems Analysis Applied to Biomedicine I**	3.0
BMES 512	**Principles of Systems Analysis Applied to Biomedicine II**	3.0
BMES 515	**C Programming for Life Scientists**	3.0
BMES 681	**Physics of Living Systems I**	3.0
BMES 864	**Seminar I**	0.0

Electives		18.0
BMES 897	**Research**	(max. 6.0)
BMES 898	**Master's Thesis**	

Additional courses in biostatistics		Credits
MATH 510	**Applied Probability and Statistics I**	3.0
MATH 511	**Applied Probability and Statistics II**	3.0
MATH 512	**Applied Probability and Statistics III**	3.0
STAT 620	**Applied Multivariate Analysis**	3.0
STAT 628	**Regression and Correlation Analysis**	3.0
STAT 632	**Multivariate Discrete Analysis**	3.0
STAT 636	**Experimental Design**	3.0

Biomedical Science: Areas of Specialization

Biostatistics is currently offered as a specialization in biomedical science. The program responds to the demand for life scientists with advanced training in biostatistics and experimental design.

Genome science is designed to provide students with advanced training in biochemistry, recombinant DNA technology, and information science.

Systems biology trains students to deal with organisms as systems and includes coursework in biochemistry, biological control systems, cell biology, and neural networks.

Doctoral Program in Biomedical Science

To be awarded the Ph.D., students must complete 90 credits (credits earned toward a master's degree may apply toward the 90), fulfill a one-year residency requirement, and successfully pass the qualifying examination, the candidacy examination, and a Ph.D. dissertation and oral defense. Prospective Ph.D. students are welcome to contact the school to discuss their research interests.

The qualifying examination is intended to test students' general knowledge of biomedical engineering and science. It is a written examination that covers the basic knowledge expected of students wishing to proceed toward a Ph.D. Biomedical science students are expected to demonstrate aptitude and preparation in life sciences, as well as an understanding of mathematics and basic principles of physical science.

For more information, visit the School's Academics web page.