DOCTOR OF PHILOSOPHY WITH A MAJOR IN BIOENGINEERING

The BioE Program is interdisciplinary in that it is not a standalone academic unit like most departments or schools at Georgia Tech. This interdisciplinary graduate program offers advanced courses in bioengineering, engineering specialties, and life sciences combined with training in cutting-edge bioengineering research. The Bioengineering PhD degree requires a thesis based on independent study of a bioengineering research topic under the guidance of a bioengineering program faculty member. Bioengineering research focuses on the development of new or improved physical and mathematical concepts and techniques that may be applied to problems in medicine and biology, including the fundamental study of biological phenomena and development of new medical devices.

Eight different academic units from the Colleges of Engineering, Computing, and Design make up the program. The BioE Program provides research opportunities for students with any participating program faculty, allowing tremendous diversity and flexibility for research topics and advisors.

All PhD programs must incorporate a standard set of Requirements for the Doctoral Degree.

Requirements for the Doctor of Philosophy with a major in Bioengineering

Code	Title	Credit Hours
Qualifying Examinatin		
Teaching Practicum		
Thesis Proposal		
PhD Dissertation		
Coursework requirements		

PhD students in BioEngineering must complete course requirements with an average cumulative GPA of 3.2 or higher. PassFail hours not allowed.

Code	Title	Credit Hours
Coursework Requirements		
Engineering Fundamentals		9
Biological Sciences		9
Engineering Mathematics		3
Technical Electives		12
Doctoral Minor		9
Total Credit Hours		**42**

Qualifying Exam

The qualifying exam is a 1.5 to 2 hour oral exam consisting of questioning from a committee of three BioEnginereing faculty. PhD students must take the qualifying exam after 3 academic semesters of residency (excluding summers), except those students entering with a master's degree must take the qualifying exam within 2 academic semesters. Students must have a GPA of 3.2 to take their qualifying exam. Students who do not pass the exam the first time have a second opportunity to take and pass the exam within the following 3 months.

Teaching practicum

The purpose of the practicum is to provide the student with training and experience in teaching a course. The student will work with a BioE faculty member on all aspects of teaching a course, including:
– delivering lectures or managing discussion sessions
– holding office hours
– helping to prepare and grade assignments
The instructing faculty member must attend the student's lectures and provide feedback.
PhD students must also satisfy any related home school requirements.

Thesis proposal

A student must provide a cohesive research plan addressing a significant problem and obtain input and approval from their thesis committee on the proposed research plan via an oral defense of their thesis proposal. The proposal should include a critical review of the relevant literature, a cohesive set of specific aims, hypothesis, and expected outcomes addressing thesis topic, and an appropriate research design and plan.

PhD Dissertation

A student must complete a searching and authoritative investigation of their chosen field, culminating in a written Thesis covering that investigation. An oral defense will be scheduled on the subject matter for the Thesis and the field in which it lies. The thesis defense examination will be conducted by the Doctoral Examination Committee chosen by the student and the thesis advisor and approved by the Graduate Studies Committee and the Dean of Graduate Studies.

Code	Title	Credit Hours
Engineering Fundamentals		
AE 6760	Acoustics I	3
AE 6762	Applied Acoustics	3
AE 6766	Combustion	3
AE 6770	Energy and Variational Methods in Elasticity and Plasticity	3
AE 7772	Fundamentals of Fracture Mechanics	3
CEE 6251	Intermediate Fluid Mechanics	3
CEE 6504	Finite Element Method of Structural Analysis	3
CEE 7772	Fundamentals of Fracture Mechanics	3
CHBE 6100	Advanced Chemical Engineering Thermodynamics	3
CHBE 6200	Advanced Transport Phenomena, Fluid Mechanics, and Heat	3
CHBE 6220	Computational Fluid Dynamics: Applications in Environmental	3
CHBE 6250	Mass Transport through Solids	3
CHBE 6260	Transport Phenomena-Mass Transfer	3
CHBE 6300	Kinetics and Reactor Design	3
CHBE 6400	Advanced Process Control	3
CHBE 6768	Polymer Structure, Physical Properties and Characterization	3
CHBE 7772	Fundamentals of Fracture Mechanics	3
CHEM 6751	Physical Chemistry of Polymer Solutions	3

CS 6230	High-Performance Parallel Computing: Tools and Applications	3
CS 7641	Machine Learning	3
CS 7643	Deep Learning	3
ECE 4270	Fundamentals of Digital Signal Processing	3
ECE 4580	Computational Computer Vision	3
ECE 6130	Advanced VLSI Systems	3
ECE 6250	Advanced Digital Signal Processing	3
ECE 6254	Statistical Machine Learning	3
ECE 6255	Digital Processing of Speech Signals	3
ECE 6258	Digital Image Processing	3
ECE 6273	Methods of Pattern Recognition with Application to Voice	3
ECE 6350	Applied Electromagnetics	3
ECE 6360	Microwave Design	3
ECE 6370	Electromagnetic Radiation and Antennas	3
ECE 6380	Introduction to Computational Electromagnetics	3
ECE 6412	Analog Integrated Circuit Design	3
ECE 6414	Analog Integrated System Design	3
ECE 6435	Neuromorphic Analog VLSI Circuits	3
ECE 6442	Electronic Oscillators	3
ECE 6450	Introduction to Microelectronics Technology	3
ECE 6451	Introduction to the Theory of Microelectronics	3
ECE 6453	Theory of Electronic Devices	3
ECE 6460	Microelectromechanical Devices	3
ECE 6500	Fourier Techniques and Signal Analysis	3
ECE 6501	Fourier Optics and Holography	3
ECE 6520	Integrated Optics	3
ECE 6522	Nonlinear Optics	3
ECE 6542	Optoelectronics: Devices, Integration, Packaging, Systems	3
ECE 6550	Linear Systems and Controls	3
ECE 6552	Nonlinear Systems and Control	3
ECE 6553	Optimal Control and Optimization	3
ECE 6554	Adaptive Control	3
ECE 6556	Intelligent Control	3
ECE 6560	Partial Differential Equations in Image Processing and Computer Vision	3
ECE 6605	Information Theory	3
ECE 6606	Coding Theory and Applications	3
ECE 6771	Optoelectronics: Materials, Processes, Devices	3
ECE 6779	Thermal Engineering for Packaging of Micro and Nano Systems	3
ECE 7252	Advanced Signal Processing Theory	3
ISYE 6215	Models in Human-Machine Systems	3
ISYE 6223	Understanding and Supporting Human Decision Making	3
ISYE 6234	Measurement and Evaluation of Human-integrated Systems	3
ISYE 6650	Probabilistic Models and Their Applications	3
ISYE 6669	Deterministic Optimization	3
ME 6124	Finite-Element Method: Theory and Practice	3
ME 6201	Principles of Continuum Mechanics	3
ME 6203	Inelastic Deformation of Solids	3
ME 6204	Micromechanics of Materials	3
ME 6229	Introduction to Micro-Electro-Mechanical Systems	3
ME 6242	Mechanics of Contact	3
ME 6301	Conduction Heat Transfer	3
ME 6302	Convection Heat Transfer	3
ME 6303	Thermal Radiation Heat Transfer	3
ME 6304	Principles of Thermodynamics	3
ME 6305	Applications of Thermodynamics	3
ME 6401	Linear Control Systems	3
ME 6402	Nonlinear Control Systems	3
ME 6403	Digital Control Systems	3
ME 6405	Introduction to Mechatronics	3
ME 6407	Robotics	3
ME 6441	Dynamics of Mechanical Systems	3
ME 6442	Vibration of Mechanical Systems	3
ME 6443	Variational Methods in Engineering	3
ME 6449	Acoustic Transducers and Signal Analysis	3
ME 6452	Wave Propagation in Solids	3
ME 6601	Introduction to Fluid Mechanics	3
ME 6602	Viscous Flow	3
ME 6622	Experimental Methods	3
ME 6760	Acoustics I and II	3
ME 6762	Applied Acoustics	3
ME 6766	Combustion I	3
ME 6768	Polymer Structure, Physical Properties, and Characterization	3
ME 6769	Linear Elasticity	3
ME 6770	Energy and Variational Methods in Elasticity and Plasticity	3
ME 6779	Thermal Engineering for Packaging of Micro and Nano Systems	3
ME 6796	Structure-Property Relationships in Materials	3
ME 7751	Computational Fluid Mechanics	3
ME 7771	Mechanics of Polymer Solids and Fluids	3
ME 7772	Fundamentals of Fracture Mechanics	3
ME 7774	Fatigue of Materials and Structures	3
MSE 6130	Surface Analysis	3
MSE 6751	Physical Chemistry of Polymer Solutions	3
MSE 6752	Polymer Characterization	4
MSE 6768	Polymer Structure, Physical Properties, and Characterization	3
MSE 6796	Structure-Property Relationships in Materials	3
MSE 7772	Fundamentals of Fracture Mechanics	3
PTFE 6100	Mechanics of Fibrous Materials	3
PTFE 6751	Physical Chemistry of Polymer Solutions	3
PTFE 6768	Polymer Structure, Physical Properties, and Characterization	3
PTFE 6796	Structure-Property Relationships in Materials	3

Code	Title	Credit Hours
Biological Sciences		
APPH 6211	Systems Physiology I: Cellular Mechanisms of Plasticity	3
APPH 6212	Systems Physiology II: Physiology of Neuromotor Tissues	3
APPH 6231	Biomechanical Aspects of Human Motor Control	3
APPH 6232	Locomotion Neuromechanics	3
APPH 6600	Muscle Structure and Plasticity	3
APPH 6213	Systems Physiology III: Integrated Systems and Adaptation	3
BIOL 6418	Microbial Physiology	3
BIOL 6570	Immunology	4
BIOL 6600	Evolution	3
BIOL 6626	Physiological Ecology	3
BIOL 6756	Discovery of Signaling Molecules	3
BIOL 7001	Foundations in Molecular and Cell Biology	4
BIOL 7668	Eukaryotic Molecular Genetics	3
BMED 4752	Introductory Neuroscience	3
BMED 6031	Principles of Basic Biomedical and Biological Sciences I	6
BMED 6032	Principles of Basis Biomedical and Biological Sciences II	6
BMED 6042	Systems Physiology	3
BMED 6793	Systems Pathophysiology	3
CHEM 6183	Organometallic Chemistry	3
CHEM 6373	Organic Synthesis	3
CHEM 6501	Biochemistry I	3
CHEM 6502	Biochemistry II	3
CHEM 6571	Enzymology and Metabolism	3
CHEM 6572	Macromolecular Structure	3
CHEM 6573	Molecular Biochemistry	3
CHEM 6582	Biophysical Chemistry	3
ME 6793	Systems Pathophysiology	3
Emory Courses:		
IBS 506	Basics of Neurological Diseases	
IBS 518	Human Embryology	
IBS 519	Foundations in Developmental Biology	
IBS 524	Cancer Biology	
IBS 526	Cellular and Developmental Neuroscience	
IBS 527	Cell Biology and Histology	
IBS 531	Principles of Pharmacology	
IBS 536	Drug Metabolism and Toxicology	
IBS 542	Concepts of Immunology	
IBS 548	Biology of the Eye	
IBS 600	Blood and Water	
IBS 761	Cancer Pharmacology	

Code	Title	Credit Hours
Engineering Mathematics		
CHBE 6500	Mathematical Modeling and Analysis of Chemical Processes	3
ECE 6601	Random Processes	3
MATH 6267	Multivariate Statistical Analysis	3
MATH 6646	Numerical Methods for Ordinary Differential Equations	3
MATH 6701	Math Methods of Applied Sciences I	3
PHYS 6268	Nonlinear Dynamics and Chaos	3

Code	Title	Credit Hours
Technical Electives		
AE 6230	Structural Dynamics	3
APPH 6202	Clinical Gait Analysis	3
APPH 6225	Biostatistics	3
BIOL 7015	Cancer Biology and Technology	3
BIOL 7023	Bioinformatics	3
BMED 4750	Diagnostic Imaging Physics	3
BMED 4783	Introduction to Medical Image Processing	3
BMED 4784	Engineering Electrophysiology	3
BMED 6517	Machine Learning in Biosciences	3
BMED 6700	Biostatistics	3
BMED 6710	Rational Design of Biomaterials	3
BMED 6720	Biotransport	3
BMED 6739	Medical Robotics	3
BMED 6743	Tissue Mechanics	3
BMED 6774	Biomaterials: Structure and Function	3
BMED 6780	Medical Image Processing	3
BMED 6782	Cellular Engineering	3
BMED 6784	Cardiovascular Biomechanics	3
BMED 6786	Medical Imaging Systems	3
BMED 6786	Medical Imaging Systems	3
BMED 6787	Quantitative Electrophysiology	3
BMED 6794	Tissue Engineering	3
BMED 7201	Advanced Seminar: Cardiovascular Biology & Biomechanics	3
BMED 7413	Biochemical Systems Analysis	3
BMED 7610	Quantitative Neuroscience	3
CEE 6345	Sustainable Engineering	3
CHBE 6710	Microfluidics & Appl	3
CHBE 6752	Polymer Characterization	4
CHBE 6765	Drug Design, Development and Delivery	3
CHBE 6777	Advanced Biomaterials	3
CHBE 6782	Cellular Engineering	3
CHBE 6794	Tissue Engineering	3
CHBE 8803	Special Topics (Biosurfaces)	3
CHEM 6750	Preparation and Reaction of Polymers	3
CS 7643	Deep Learning	3
ECE 4781	Biomedical Instrumentation	3
ECE 4782	Biosystems Analysis	3

ECE 4784	Engineering Electrophysiology	3
ECE 6200	Biomedical Applications of Microelectromechanical Systems	3
ECE 6780	Medical Image Processing	3
ECE 6786	Medical Imaging Systems	3
ECE 6787	Quantitative Electrophysiology	3
ISYE 6413	Design and Analysis of Experiments	3
ISYE 6414	Statistical Modeling and Regression Analysis	3
ISYE 7406	Data Mining and Statistical Learning	3
ME 6743	Tissue Mechanics	3
ME 6746	Rehabilitation Engineering	3
ME 6777	Advanced Biomaterials	3
ME 6782	Cellular Engineering	3
ME 6794	Tissue Engineering	3
MP/NRE 4750	Diagnostic Imaging Physics	3
MSE 6600	Advanced Polymer Processing	3
MSE 6752	Polymer Characterization	4
MSE 6777	Advanced Biomaterials	3
PHYS 6268	Nonlinear Dynamics and Chaos	3
PTFE 6750	Preparation and Reactions of Polymers	3
Emory course:		
IBS 534	Computational Neuroscience	