DOCTOR OF PHILOSOPHY IN BIOMEDICAL ENGINEERING

This degree is awarded in recognition of a high level of mastery in subject matter and a significant original research contribution in biomedical engineering. The Ph.D. recipient will be capable of a continuing effort toward the advancement of knowledge and achievement in research and other scholarly activities and may pursue a career in a medical, industrial, or academic environment.

A minimum of 72 credit hours is required for the Ph.D. in Biomedical Engineering. Students who have received an M.S. degree from another university may petition for transfer of up to 32 credit hours applicable toward the Ph.D. degree. Students must pass the Ph.D. qualifying examination within the first year of full-time Ph.D. studies. This is a written and oral examination intended to explore both the depth and breadth of the student's academic abilities. Within two and one-half years of matriculation, students will be required to defend their thesis research proposal (comprehensive examination). A written dissertation and oral defense are also required for receiving the doctoral degree. Dissertation format and deadlines are established by the Graduate College.

There are no specific courses that are required for the doctoral degree in biomedical engineering. However, a minimum of three courses in life science, three courses in mathematics, and six courses in biomedical engineering or other engineering-related courses are required. The specific courses selected to meet these requirements will depend on the entering qualifications of the student and the nature of the thesis research proposal. In general, the student's thesis committee will determine the specific course requirements necessary for graduation. Graduate students should consult with their advisers to plan their curriculum.

Curriculum

Requirement	Credits
Minimum Credits Required	72
Maximum 400-Level Credit	9
Maximum Transfer Credit	32

Code	Title	Credit Hours
Life Science Courses		**(9-10)**
Select a minimum of three courses from the following:		9-10
BIOL 403	Biochemistry	4
BIOL 414	Genetics for Engineering Scientists	3
BIOL 426	Concepts of Cancer Biology	3
BIOL 430	Human Physiology	3
BIOL 445	Cell Biology	3
BIOL 512	Advanced Biochemistry	3
BIOL 515	Molecular Biology	3
BIOL 527	Immunology and Immunochemistry	3
BIOL 550	Bioinformatics	3
Mathematics Courses		**(9)**
Select a minimum of three courses from the following:		9
CHE 535	Applications of Mathematics to Chemical Engineering	3
CHE 536	Computational Techniques in Engineering	3
MATH 461	Fourier Series and Boundary-Value Problems	3
MATH 476	Statistics	3
MATH 489	Partial Differential Equations	3
MATH 512	Partial Differential Equations	3
MATH 519	Complex Analysis	3
MATH 532	Linear Algebra	3
MATH 542	Stochastic Processes	3
MATH 546	Introduction to Time Series	3
MATH 555	Tensor Analysis	3
MATH 564	Applied Statistics	3
MATH 577	Computational Mathematics I	3
MATH 578	Computational Mathematics II	3
MATH 581	Finite Element Method	3

MMAE 501	Engineering Analysis I	3
MMAE 502	Engineering Analysis II	3
MMAE 503	Advanced Engineering Analysis	3
MMAE 517	Computational Fluid Dynamics	3
PHYS 501	Methods of Theoretical Physics I	3
PHYS 502	Methods of Theoretical Physics II	3

Biomedical Engineering or Other Engineering-Related Courses		**(11-20)**
Select a minimum of six courses from the following:		11-20
BME 500	Introduction to Biomedical Engineering	3
BME 501	Communication Skills in BME	3
BME 503	Mathematical and Statistical Methods for Neuroscience I	2
BME 504	Neurobiology	2
BME 505	Mathematical and Statistical Methods for Neuroscience II	2
BME 506	Computational Neuroscience II: Vision	3
BME 507	Cognitive Neuroscience	2
BME 508	Mathematics and Statistics for Neuroscience III	2
BME 509	Vertebrate Neural Systems	3
BME 518	Reaction Kinetics for Biomedical Engineering	3
BME 521	Medical Imaging	3
BME 522	Mathematical Methods in Biomedical Engineering	3
BME 523	Cell Biomechanics: Principles and Biological Processes	3
BME 524	Quantitative Aspects of Cell andTissue Engineering	3
BME 530	Inverse Problems in Biomedical Imaging	3
BME 532	Medical Imaging Science	3
BME 533	Biostatistics	3
BME 535	Magnetic Resonance Imaging	3
BME 537	Introduction to Molecular Imaging	3
BME 538	Neuroimaging	3
BME 540	Wave Physics and Applied Optics for Imaging Scientists	3
BME 542	Advanced Concepts in Image Science	3
BME 543	Bioinstrumentation and Electronics	3
BME 551	Physiological Signal Processing and Control Theory	2
BME 552	Control Systems for Biomedical Engineers	3
BME 553	Advanced Quantitative Physiology	3
BME 575	Neuromechanics of Human Movement	3
BME 581	Fluid Mechanics for Biomedical Engineers	3
BME 582	Advanced Mass Transport for Biomedical Engineers	3
BME 585	Computational Models of the Human Cardiovascular System	3
BME 595	Seminar in Biomedical Engineering	3
BME 597	Special Problems	1-6
CHE 555	Polymer Processing	3
CHE 575	Polymer Rheology	3
CHE 577	Bioprocess Engineering	3
CHE 582	Interfacial and Colloidal Phenomena with Applications	3
CHE 583	Pharmaceutical Engineering	3
CHE 585	Drug Delivery	3
CS 480	Introduction to Artificial Intelligence	3
CS 525	Advanced Database Organization	3
CS 580	Topics in Machine Learning	3
CS 583	Probabilistic Graphical Models	3
ECE 511	Analysis of Random Signals	3
ECE 565	Computer Vision and Image Processing	3

ECE 566	Machine and Deep Learning	3
ECE 567	Statistical Signal Processing	3
MMAE 510	Fundamentals of Fluid Mechanics	4
MMAE 512	Dynamics of Viscous Fluids	4
MMAE 517	Computational Fluid Dynamics	3
MMAE 579	Advanced Materials Processing	3
General Electives		**(0-18)**
Select 0-18 credit hours of electives from BME 400-799 to fulfill minimum total credits		0-18
Ph.D. Research		**(24-36)**
BME 691	Research and Thesis PHD	24-36

Minimum degree credits required: 72