Biomedical Engineering

Prospective students should use this checklist (http://www.uab.edu/graduate/images/acrobat/checklist/biomedicaleng.pdf) to obtain specific admissions requirements on how to apply to Graduate School.

Biomedical Engineering (PhD, MSBME, MSBME with Certificate in Technology Commercialization and Entrepreneurship)

Degrees Offered: PhD, MSBME, MSBME with Certificate in Life Sciences Entrepreneurship

Phone: (205) 996-6936
E-mail: uabbmegrad@uab.edu
Website: www.uab.edu/bme

Additional Information

Deadline for Entry Term(s): Fall
Deadline for All Application Materials to be in the Graduate School Office: December 15
Number of Evaluation Forms Required: Three
Entrance Tests: GRE (TOEFL is also required for international applicants whose native language is not English)
Comments: Students are rarely admitted for the Spring term

For detailed information, contact Dr. Ho-Wook Jun, Associate Professor, BME Graduate Program Director, UAB Department of Biomedical Engineering, 1825 University Blvd., Shelby Biomedical Research Building, 806 Birmingham, AL 35294-2182.

Telephone (205) 996-6936
E-mail uabbmegrad@uab.edu
Web www.uab.edu/bme

Master of Science in Biomedical Engineering

A minimum GPA of 3.20 is required.

Plan I - 30 with Thesis

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 517 Engineering Analysis</td>
<td>3</td>
</tr>
<tr>
<td>or ME 661 Math Methods in EGR I</td>
<td></td>
</tr>
<tr>
<td>BME 670 Quantitative Physiology</td>
<td>3</td>
</tr>
<tr>
<td>BST 621 Statistical Methods I</td>
<td>3</td>
</tr>
<tr>
<td>BME Elective 500-697</td>
<td>3</td>
</tr>
<tr>
<td>Life Science Elective at the 500+ level</td>
<td>3</td>
</tr>
<tr>
<td>BME/EGR/MA/Life Science Elective at the 500+ level</td>
<td>3</td>
</tr>
<tr>
<td>BME Seminar</td>
<td>3</td>
</tr>
<tr>
<td>BME 601 Seminar in Biomedical Engineering</td>
<td></td>
</tr>
<tr>
<td>BME 698 Non-Thesis Research</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Hours</strong></td>
<td><strong>30</strong></td>
</tr>
</tbody>
</table>

Plan II - 33 hours

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BME 517 Engineering Analysis</td>
<td>3</td>
</tr>
<tr>
<td>or ME 661 Math Methods in EGR I</td>
<td></td>
</tr>
<tr>
<td>BME 670 Quantitative Physiology</td>
<td>3</td>
</tr>
<tr>
<td>BST 621 Statistical Methods I</td>
<td>3</td>
</tr>
<tr>
<td>BME Elective 500-697</td>
<td>3</td>
</tr>
<tr>
<td>Life Science Elective at the 500+ level</td>
<td>3</td>
</tr>
<tr>
<td>BME/EGR/MA/Life Science Elective at the 500+ level</td>
<td>3</td>
</tr>
<tr>
<td>BME Seminar</td>
<td>3</td>
</tr>
<tr>
<td>BME 601 Seminar in Biomedical Engineering</td>
<td></td>
</tr>
<tr>
<td>BME 698 Non-Thesis Research</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Hours</strong></td>
<td><strong>33</strong></td>
</tr>
</tbody>
</table>

\[^1\] BME 698 may be taken for this elective

PhD Program

The PhD degree prepares students for careers in industry and academics. Students entering the doctoral program will possess a BS, MS, or be currently enrolled in the DMD/PhD or MD/PhD program at UAB.

Admission to the PhD program is competitive, and successful applicants will usually present scores of at least 156 on the verbal and at least 159 on the quantitative sections of the GRE General Test. Typical students have a graduate GPA of 3.5 or greater and have a significant research experience. Students admitted to the doctoral program typically receive a competitive stipend that usually includes payment of tuition.

Students can be admitted to the PhD program with a BS degree in a field of biomedical engineering or closely-related discipline. Students with undergraduate degrees in the physical sciences, life sciences, or mathematics can also be considered for admission. Students entering the PhD program with a BS are required to complete at least 72 semester hours of graduate work, including 48 semester hours of graduate coursework, and a minimum of 24 hours of dissertation research (BME 799) earned over at least two semesters in candidacy. All students are required to take BME 517 Engineering Analysis, BME 770 Quantitative Physiology, at least one Biostatistics course (BST 621 Statistical Methods I), GRD 717 Principles of Scientific Integrity and 6 semesters of BME seminars (BME 701 Seminar in Biomedical Engineering). The remaining coursework should be a combination of life sciences, biomedical engineering, or mathematics elective courses that provide sufficient breadth and depth to gain the necessary graduate level, interdisciplinary knowledge to complete dissertation research. Three peer-reviewed first-author publications are required for completion of the PhD in the Department of Biomedical Engineering.

Students can be admitted to the PhD program following completion of a Master's Degree in BME or closely-related discipline. Students entering the PhD program with a MS are required to complete at least 51 semester hours of graduate work beyond the Master's degree including 27 semester hours of coursework and 24 hours of dissertation research (BME 799) earned over at least two semesters in candidacy. All students are required to take BME 517 Engineering Analysis, BME 770 Quantitative Physiology, BST 621 Statistical Methods I, GRD 717 Principles of Scientific Integrity, if not taken as part of their Master's
program, and three semesters of BME 701 BME Seminar. The remaining coursework should be a combination of life sciences, biomedical engineering, or mathematics elective courses that provide sufficient breadth and depth to gain the necessary graduate level, interdisciplinary knowledge to complete dissertation research. A total of three first-author original research articles in peer-reviewed journals based on the student's dissertation research are required for completion of the PhD in the BME Department. If one article was published as part of the MSBME degree, then two articles are required for the PhD degree.

Courses

BME 508. Biofluids. 3 Hours.
Application of fluid mechanics in blood flow in the circulatory system; cardiovascular fluid mechanics, wall shear stress and the development of atherosclerosis, viscoelastic behavior of the arteries, Non-Newtonian character of blood.

BME 517. Engineering Analysis. 3 Hours.
Solutions to engineering problems involving ordinary and partial differential equations; Laplace transform, power series, Bessel functions, Legendre polynomials, Fourier series, Fourier integral and transform, Sturm-Liouville and separation of variables.

BME 520. Implant-Tissue Interactions. 3 Hours.
An overview of implant biocompatibility including tissue histology, histopathology of implant response and the regulatory process for medical devices.

BME 535. Tissue Engineering. 3 Hours.
Principles underlying strategies for regenerative medicine such as stem cell based therapy, scaffold design, proteins or genes delivery, roles of extracellular matrix, cell-materials interactions, angiogenesis, tissue transplantation, mechanical stimulus and nanotechnology.

BME 542. Principles of Medical Imaging. 3 Hours.
Types of radiation used in medical imaging, physics of interaction of ionizing radiation with matter, bremsstrahlung, attenuation coefficients, Compton scatter, nuclear disintegration of radionuclides, generation of medical radionuclides.

BME 543. Medical Image Processing. 3 Hours.
Fundamental topics of medical image processing to practical applications using conventional computer software.

BME 550. Computational Neuroscience. 3 Hours.
This course examines the computational principles used by the nervous system. Topics include: biophysics of axon and synapse, sensory coding (with an emphasis on vision and audition), planning and decision-making, and synthesis of motor responses. There will be an emphasis on a systems approach throughout. Homework includes simulations.

BME 554. Introduction to Pharmaceutical Engineering. 3 Hours.
This course is designed to introduce the science and biopharmaceutical principles of drug delivery to undergraduate students of Biomedical Engineering. Graduate students of BME, Pharmacology & Toxicology, and Chemistry are also eligible to take it as an elective course.

BME 561. Bioelectric Phenomena. 3 Hours.
Quantitative methods in the electrophysiology of neural, cardiac and skeletal muscle systems.

BME 562. Cardiac Electrophysiology. 3 Hours.
Experimental and computational methods in cardiac electrophysiology, ionic currents, action potentials, electrical propagation, the electrocardiogram, electromechanical coupling, cardiac arrhythmias, effects of electric fields in cardiac tissue, defibrillation, and ablation.

BME 571. Continuum Mechanics of Solids. 3 Hours.
Matrix and tensor mathematics, fundamentals of stress, momentum principles, Cauchy and Piola-Kirchhoff stress tensors, static equilibrium, invariance, measures of strain, Lagrangian and Eulerian formulations, Green and Almansistain, deformation gradient tensor, infinitesimal strain, constitutive equations, finite strain elasticity, strain energy methods, 2-D Elasticity, Airy Method, viscoelasticity, mechanical behavior of polymers.

BME 575. Quantitative Biomechanics of Injury and Rehabilitation. 3 Hours.
Students will learn the material, mechanical, electrophysiological and energetic principles of human movement. Students will learn about the healthy nonimpaired system and compare to systems impaired by injury or disability for applications in rehabilitation.

BME 590. Special Topic in BME. 3 Hours.
Special topics in biomedical areas.

BME 598. Biomedical Product Development. 3 Hours.
Design and development issues of the medical product industry. Consideration of the impact of legal, regulatory and marketing issues, business ethics and economics will be addressed.

BME 601. Seminar in Biomedical Engineering. 1 Hour.
Current topics in biomedical engineering technology and applications.

BME 623. Wound Healing. 3 Hours.
Study of principles of healing, methods to enhance, and clinical applications.

BME 630. Engineering Design and Commercialization. 3 Hours.
The purpose of this course is to introduce students to the process of innovating medical technologies and better prepare them for a career in the medical technology industry. Students will learn aspects of biomedical product development from needs finding, invention, intellectual property, and regulatory processes.

BME 644. Neural Computation. 3 Hours.
This course examines the principal theoretical underpinnings of computation in neural networks. Emphasis will be placed on understanding the relationship between the different approaches: dynamical systems, statistical mechanics, logic, Kalman filters, and likelihood/Bayesian estimation.

BME 665. Computational Vision. 3 Hours.
This course approaches the study of biological and artificial vision from atheoretical perspective. We begin with a comparative survey of visual systems, and will examine vision algorithms and architectures.

BME 670. Quantitative Physiology. 3 Hours.
Study of physiological problems using advanced mathematical techniques. Topics covered include: mechanics, fluid dynamics, transport, electrophysiology of cell membranes, and control systems.
Prerequisites: BME 517 [Min Grade: C] or ME 661 [Min Grade: C] or ME 567 [Min Grade: C] or ME 761 [Min Grade: C]

BME 676. Fracture Mechanics. 3 Hours.
This course is geared for graduate students in a mechanics curriculum with an interest in advanced techniques and concepts in fracture mechanics. The course covers linear elastic fracture mechanics, including fatigue crack growth, and nonlinear elastic fracture mechanics. Experimental and computational methods are also introduced.
BME 680. Biomolecular Modeling. 3 Hours.
We will teach molecular modeling principles and applications in this course. Throughout the course, students are offered hands-on exercises in molecular modeling tools and software. The course will help students understand the critical relationship among structure, function, and thermodynamic driving forces in structural biology, and be able to utilize molecular modeling techniques to explore biological phenomena at the molecular level.

BME 690. Special Topics in (Area). 1-6 Hour.

BME 691. Individual Study in (Area). 1-6 Hour.

BME 693. Internship in Biomedical Engineering. 1-6 Hour.

BME 697. Journal Club in (Area). 1-3 Hour.
Journal Club in Medical Imaging.


BME 699. Master s Degree Thesis Research. 1-12 Hour.
Prerequisites: GAC M

BME 701. Seminar in Biomedical Engineering. 1 Hour.
Current topics in biomedical engineering technology and applications.

BME 723. Wound Healing. 3 Hours.
Study of principles of healing, methods to enhance, and clinical applications.

BME 744. Neural Computation. 3 Hours.
This course examines the principal theoretical underpinnings of computation in neural networks. Emphasis will be placed on understanding the relationship between the different approaches: dynamical systems, statistical mechanics, logic, Kalman filters, and likelihood/Bayesian estimation.

BME 754. Computational Vision. 3 Hours.
This course approaches the study of biological and artificial vision from a theoretical perspective. We begin with a comparative survey of visual systems, and will examine vision algorithms and architectures.

BME 770. Quantitative Physiology. 3 Hours.
Study of physiological problems using advanced mathematical techniques. Topics covered include: mechanics, fluid dynamics, transport, electrophysiology of cell membranes, and control systems.
Prerequisites: BME 517 [Min Grade: C] or ME 661 [Min Grade: C] or ME 567 [Min Grade: C] or ME 761 [Min Grade: C]

BME 776. Fracture Mechanics. 3 Hours.
This course is geared for graduate students in a mechanics curriculum with an interest in advanced techniques and concepts in fracture mechanics. The course covers linear elastic fracture mechanics, including fatigue crack growth, and nonlinear elastic fracture mechanics. Experimental and computational methods are also introduced.

BME 780. Biomolecular Modeling. 3 Hours.
We will teach molecular modeling principles and applications in this course. Throughout the course, the students are offered hands-on exercises in molecular modeling tools and software. The course will help students understand the critical relationship among structure, function, and thermodynamic driving forces in structural biology, and be able to utilize molecular modeling techniques to explore biological phenomena at the molecular level.

BME 790. Special Topics in (Area). 1-6 Hour.

BME 791. Individual Study in (Area). 1-6 Hour.

BME 793. Internship in Biomedical Engineering. 1-6 Hour.