Bioengineering (M.S.BIOE)

About The Program:

The M.S.Bioe. program offers students graduate-level interdisciplinary education and research opportunities in bioengineering and engineering applications in related healthcare fields. The program offers concentrations in Bioelectronics, Biomaterials, and Biomechanics. Graduates of the program are prepared for careers in industry or may choose to pursue a program of study leading to the Ph.D. degree. The program offers research opportunities in collaboration with faculty in the College of Science and Technology and the School of Medicine.

Career Options: Graduates with the M.S.Bioe. degree are employed in a variety of biomedical industries ranging from device manufacturers to design engineering. Other possibilities include careers in government, either in regulatory agencies or with the U.S. Patent and Trademark Office. Students who complete the M.S.Bioe. degree with a thesis are prepared to enter a doctoral program.

Prerequisites for Admission: Bachelor's degree in Bioengineering or a related discipline

Areas of Specialization:

- Bioelectronics - sensor development and image analysis.
- Biomaterials - wear of ultra-high molecular weight polyethylene, polymer chemistry, and interfacial chemistry.
- Biomechanics - computer-aided design of composite biomaterials, mechanical properties of orthopedic implant materials, design of orthopedic implants, and modeling of biomaterial behavior.

For the M.S.Bioe. program, students also choose between three tracks:

1. The Thesis Track is intended for students pursuing advanced research and includes 24 credits of didactic coursework, 3 credits of Project (BIOE 9995), and 3 credits of Thesis (BIOE 9996).
2. The Project Track introduces students to applied research and includes 27 credits of didactic coursework and 3 credits of Project (BIOE 9995).
3. The Coursework Track provides students with an advanced engineering background for their future in the engineering profession through 30 credits of didactic coursework.

Requirements of Programs:

- **Total Credit Hours**: 30
- **Culminating Events**:
  Thesis Track:
  The culminating events in the Thesis Track are typically undertaken during the last two successive terms of study. Successful completion requires the following:
  1. Thesis Proposal — BIOE 9995 Bioengineering Project Research (3 credits)
  2. Thesis Defense — BIOE 9996 Bioengineering Thesis Research (3 credits)

Project Track:
The culminating event for the Project Track is BIOE 9995 Bioengineering Project Research. This entails a one-term research activity done under the supervision of a full-time faculty advisor on an applied engineering topic of interest.

Coursework Track:
No culminating event is warranted for the Coursework Track.

Required Courses (Thesis Track)

Bioengineering Graduate Seminar – Required seminar for bioengineering graduate students. These seminars include speakers from academic and professional backgrounds for both scientific development and professional development. Students will be graded on participation of at least 70% of the bi-weekly seminars throughout the duration of the semester.

Engineer Mathematics I – This is a survey course in essential mathematics for first-year graduate students in engineering and physical sciences. Topics include analytic methods in ordinary differential equations, complex-variable theory, the laplace transform and its inversion, and initial-value problems and boundary-value problems. Matlab, numerical methods, and introductory numerical algorithm design are introduced.

Bioengineering Project Research

Bioengineering Thesis Research

Electives (12 Credits worth)

Specialty Courses (Select Three From Below)

Introduction to Bioengineering – This course offers an introduction to biomedical engineering, a diverse and evolving field that integrates engineering principles, life sciences, clinical medicine, research and engineering design, with the overall goal of improving health care and quality of life. Professors with expertise in specific fields of biomedical engineering will present lectures and discussions on a broad range of topics, including tissue engineering and regenerative medicine, biomaterials, biomechanics, bioinstrumentation, biomedical imaging and optics, and signal processing.

Cell Biology for Engineers – This course introduces biological concepts in modern cellular and molecular biology to engineering students. Topics will include the chemical composition of cells, bioenergetics and metabolism, structure and function of the plasma membrane, transport across membranes, the cytoplasmic membrane system, the extracellular matrix, interactions between cells and their environment, the cytoskeleton and cell motility, sensory systems, and cell signaling. In addition, an introduction to basic anatomy and physiology of vertebrates will include the skeletal system, muscle system, cardiovascular system, and nervous system.

Systems Physiology for Engineers – Systems Physiology is designed for graduate students majoring in engineering and for others interested in studying physiological processes from the molecular level to the organ/systems level. Among the topics covered are: scaling, respiration, circulation, cardiac process,

renal function, muscle function, neuromuscular junction, neural processes, and temperature regulation. The course stresses the application of energetic and informational principles to the study of the body.

Biostatistics – Biostatistics is an important part of the research activities related to biological and medical issues. Statistics is used to analyze phenomena with random properties and is often essential to draw the right conclusions based on a data set. The course will be designed to cover different statistical methods for data analysis mainly applied to medical and biological problems. Advanced undergraduate and graduate students with interests in medicine and biomedical research will benefit most from the course. However statistical methods that can be applied to behavioral science and ecology will also be covered.

Required Courses (Project Track)

Bioengineering Graduate Seminar – Required seminar for bioengineering graduate students. These seminars include speakers from academic and professional backgrounds for both scientific development and professional development. Students will be graded on participation of at least 70% of the bi-weekly seminars throughout the duration of the semester.

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Bioengineering Project Research

Electives (Worth 15 Credits)

Specialty Courses (Select Three From Below)

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Required Courses (Coursework Track)

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Electives (Worth 18 Credits)

Specialty Courses (Select Three From Below)

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Courses:

Click HERE for more information on the courses below.

- Biosignals
- The Entrepreneurial Bioengineer
- Biosensors
- Applied Biospectroscopy
- Capstone Elective: Bionanotechnology
- Neuroengineering
- Biomechanics
- Biomedical Imaging
- Principles of Tissue Engineering
- Special Topics in Bioengineering
- Regenerative Engineering
- Biophotonics: Seeing is Believing
- Bioengineering Graduate Seminar
- Introduction to Bioengineering
- Cell Biology for Engineers
- Systems Physiology for Engineers
- Biomaterials for Engineers
- Research Experience in Bioengineering
- Independent Study
- Independent Study II
- Directed Research
- BioEngineering Preliminary Examination Preparation
- BioEngineering Project Research
- BioEngineering Thesis Research
- Bioengineering Pre-Dissertation Research
- BioEngineering Dissertation Research
- Engineering Mathematics I
- Engineering Mathematics II
- Engineering Analysis and Applications
- Engr Prob Stats Stoc Met
- Probability, Statistics, and Stochastic Methods
- Probability and Random Processes
- Special Topics
- Spacecraft Systems Engineering
- Experimental Methods
- Continuum Mechanics
- Dynamical Systems
- Fluid Dynamics
- Computational Fluid Dynamics
- Exper Engineer Prof I
- Exper Engineer Prof II
- Engineering Seminar