BIOMEDICAL ENGINEERING

Office: 818 W. Hancock; 313-577-1344
Chairperson: Cynthia Bir
http://engineering.wayne.edu/bme/

Biomedical engineering (BME) is one of the fastest growing disciplines in engineering. This field has developed from the knowledge that engineering principles can be applied to better understand how the human body functions as well as the effect that outside forces have on it, whether they be diagnostic or traumatic. A biomedical engineer brings together traditional engineering principles with the life sciences in a completely integrated fashion. The result is an engineer who views the human body as a complex system, its diseases and injuries as breakdowns in that system, and medical interventions as design alternatives for the repair of the system. As the population ages and medical costs increase, biomedical engineers are required both to understand the mechanistic causes of injury and disease and to design and implement interventions to prevent and mitigate the suffering of individuals and to reduce the cost of medical care to society.

Wayne State has a long history with respect to biomedical engineering research. In 1939, faculty from the College of Engineering and School of Medicine began collaborating to investigate the mechanisms of injuries to the human body, and educational programs in the area of biomedical engineering have existed at Wayne State since the 1950s. They have developed from a few courses taken within traditional engineering departments to the graduate degree program in biomedical engineering, introduced in 1998. The Department of Biomedical Engineering, interdisciplinary between the College of Engineering and the School of Medicine, was established in 2002. Drawing upon the strengths of the biomedical engineering graduate program, the Department has established a new undergraduate program that accepted its first students for the Fall 2010 semester.

BASS, CAMERON: Ph.D., University of Virginia; B.S., University of Virginia; Professor

BIR, CYNTHIA: Ph.D., M.S., Wayne State University; M.S., University of Michigan; B.S.N., Nazareth College; Professor and Chair

KAVDIA, MAHENDRA: Ph.D., Oklahoma State University; MTech, Indian Institute of Technology; BTech, Indian Institute of Technology; Associate Professor

KLUEH, ULRIKE: Ph.D., M.S., Unviersity of Connecticut; B.A.Sc., University of Applied Sciences Mittelhessen; Associate Professor

LAM, MAI T.: Ph.D., M.S.E., B.S.E., University of Michigan; Associate Professor

MUNDO, BRIAN: M.S., Wayne State University; B.E., University of Michigan; Lecturer

OYEN, MICHELLE: Ph.D., University of Minnesota; M.S., B.S., Michigan State University; Associate Professor

SUNDARARAGHAVAN, HARINI: Ph.D., Rutgers, State University of New Jersey; B.S.E., University of Michigan; Associate Professor

WASHABAUGH, EDWARD PETER: Ph.D., B.S.E., University of Michigan; Assistant Professor

ZHANG, LIYING: Ph.D. Wayne State University;M.S. and B.S. Shanghai Jiao Tong University; Associate Professor

- Biomedical Engineering (B.S.) (http://bulletins.wayne.edu/undergraduate/college-engineering/biomedical-engineering/biomedical-engineering-bs/)

BME 1900 Biomedical Engineering Freshmen Seminar Cr. 1
This course is designed to expose students to the Wayne State University undergraduate experience. Lectures will focus on presenting an overview of the world of biomedical engineering. Students will gain an understanding of campus resources, how to be successful undergrads, how to make connections with their cohort and faculty members, all while learning about possible career paths in the engineering field and Wayne State's role in achieving their career goals. Offered Winter.

BME 2050 Introduction to Anatomy and Physiology for Biomedical Engineers Cr. 4
Detailed study of the anatomical structure and physiological function of the major systems of the body: skeletal, nervous, muscular, endocrine, circulatory, respiratory, digestive, excretory, and reproductive. Relevant biomedical engineering applications related to these major systems of the body. Offered Yearly.
Prerequisite: BIO 1510 with a minimum grade of C-
Corequisite: BME 2920

BME 2910 Biomedical Engineering Design Lab I Cr. 1
Application of engineering principles to biomedical engineering problems through laboratory and design exercises. First of a four-semester sequence; analysis of musculoskeletal forces biomechanics. Offered Fall.
Prerequisites: BE 1200 with a minimum grade of C-, BE 1300 with a minimum grade of C-, BE 1310 with a minimum grade of C-, BE 1500 with a minimum grade of C-, MAT 2010 with a minimum grade of C-, MAT 2020 with a minimum grade of C-, (CHM 1125 with a minimum grade of C- or CHM 1130 with a minimum grade of C-), and (PHY 2170 with a minimum grade of C- or PHY 2175 with a minimum grade of C-)
Restriction(s): Enrollment is limited to students with a major in Biomedical Engineering or Biomedical Engg Honors; enrollment is limited to Undergraduate level students.
Fees: $25

BME 2920 Biomedical Engineering Design Lab II Cr. 1
Application of engineering principles to biomedical engineering problems through laboratory and design exercises involving tissue biomechanics. Introduction to finite element modeling. Second of a four-semester sequence. Offered Winter.
Prerequisites: BE 2100 with a minimum grade of C- (may be taken concurrently), BME 2910 with a minimum grade of C-, and ME 2420 with a minimum grade of C- (may be taken concurrently)
Corequisite: BME 2050
Restriction(s): Enrollment is limited to students with a major in Biomedical Engineering or Biomedical Engg Honors; enrollment is limited to Undergraduate level students.
Fees: $25

BME 3010 Biomedical Transport Cr. 3
This is an introductory course of transport phenomena in biological systems. It will cover conservation relations in fluid and mass transport mass at the tissue and cellular levels. Topics including mass transport by diffusion with effects of convection and chemical reactions will be covered. Applications of fundamental principles using quantitative, computational approaches will be emphasized. Offered Fall.
Prerequisites: BE 1500 with a minimum grade of C- and MAT 2150 with a minimum grade of C-
Corequisite: BME 3910

BME 3470 Biomedical Signals and Systems Cr. 3
Mathematical, engineering and computer techniques for describing and analyzing biomedical signals, including ECG, EEG, EMG, blood pressure, and tomographic images. Offered Fall.
Prerequisites: (ECE 3320 with a minimum grade of C- (may be taken concurrently) or ECE 3300 with a minimum grade of C- (may be taken concurrently)), (PHY 2185 with a minimum grade of C- or PHY 2180 with a minimum grade of C-), and MAT 2150 with a minimum grade of C-
Corequisite: BME 3910
Restriction(s): Enrollment is limited to Undergraduate level students; enrollment limited to students in the College of Engineering.
Fees: $50

BME 3910 Biomedical Engineering Design Lab III Cr. 1
Application of engineering principles to biomedical engineering problems through laboratory and design exercises. Focus on measurement, analysis, modeling, and interaction with biomedical signals from living systems. Third of a four-semester sequence. Offered Fall.
Prerequisites: BE 1500 with a minimum grade of C-, MAT 2150 with a minimum grade of C-, ENG 3050 with a minimum grade of C- (may be taken concurrently), BME 3010 with a minimum grade of C- (may be taken concurrently), ME 2420 with a minimum grade of C-, and BME 2920 with a minimum grade of C-
Corequisite: BME 3010
Restriction(s): Enrollment is limited to students with a major in Biomedical Engineering or Biomedical Engg Honors; enrollment is limited to Undergraduate level students.
Fees: $25

BME 3920 Biomedical Engineering Design Lab IV Cr. 2
Application of engineering principles to biomedical engineering problems through laboratory and design exercises. Introduction to the capstone design process. Integration of the design process with the complete government regulation system for medical device design. Use of advanced CAE tools for analysis. Fourth of a four-semester sequence. Offered Winter.
Prerequisites: BME 3910 with a minimum grade of C- and BME 3470 with a minimum grade of C-
Restriction(s): Enrollment is limited to students with a major in Biomedical Engineering or Biomedical Engg Honors; enrollment is limited to Undergraduate level students.
Fees: $100

BME 4010 Engineering Physiology Laboratory Cr. 2
Measurement and analysis of physiological signals on living systems, with a focus on neural, cardiovascular, respiratory, and muscular systems. Includes a student-designed experiment on a physiological system. Offered Winter.
Prerequisites: BME 2050 with a minimum grade of C-
Restriction(s): Enrollment is limited to students with a major in Biomedical Engineering or Biomedical Engg Honors; enrollment is limited to Undergraduate level students.
Fees: $30

BME 4210 Introduction to Biomechanics Cr. 3
Broad introduction to the application of mechanical engineering principles to biomedical engineering, including motion analysis, injury and forensic biomechanics, cardiovascular and pulmonary mechanics, and design of implants with mechanical functions. Offered Fall.
Prerequisite: ME 2420 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the following programs: BS in Biomedical Engineering, BS in Chemical Engineering, BS in Civil Engineering, BS in Electrical Engineering, BS in Electrical and Comp Engg, BS in Industrial Engineering, BS in Mechanical Engineering; enrollment is limited to Undergraduate level students; enrollment limited to students in the College of Engineering.

BME 4310 Introduction to Biomaterials Cr. 3
Broad introduction to the field of biomaterials and its application to tissue engineering, implant design, controlled drug delivery, and designer materials for therapeutic use. Offered Winter.
Prerequisite: ME 2420 with a minimum grade of C-
Restriction(s): Enrollment limited to students in the BS in Biomedical Engineering program.

BME 4410 Introduction to Biomedical Instrumentation Cr. 3
Broad introduction to the use and design of instrumentation for biomedical applications, in both clinical and research use; includes filtering techniques, safety issues, and special concerns for implanted and external systems. Offered Winter.
Prerequisites: BME 3470 with a minimum grade of C- and (ECE 3300 with a minimum grade of C- or ECE 3320 with a minimum grade of C-)
Restriction(s): Enrollment is limited to Undergraduate level students; enrollment limited to students in the College of Engineering.
Fees: $25

BME 4910 Biomedical Engineering Capstone Design I Cr. 3
Satisfies General Education Requirement: Writing Intensive Competency
First in a two-semester sequence during which student teams develop a design to address a biomedical engineering challenge; includes discussions with clinical faculty, analysis of current solutions, and finalization of conceptual design. Offered Fall.
Prerequisite: BME 3920 with a minimum grade of C-
Restriction(s): Enrollment limited to students with a class of Junior or Senior; enrollment is limited to students with a major in Biomedical Engineering or Biomedical Engg Honors.
Fees: $50

BME 4920 Biomedical Engineering Capstone Design II Cr. 3
Second of a two-semester sequence. Students develop and test a prototype of their biomedical engineering design; culminates in a public design expo to exhibit student designs. Offered Winter.
Prerequisite: BME 4910 with a minimum grade of C-
Restriction(s): Enrollment limited to students with a class of Senior; enrollment is limited to students with a major in Biomedical Engineering or Biomedical Engg Honors; enrollment is limited to Undergraduate level students.
Fees: $50

BME 5010 Quantitative Physiology Cr. 4
Basic principles of human physiology presented from the engineering perspective. Bodily functions, their regulation and control discussed in quantitative terms and illustrated by mathematical models where feasible. Offered Every Term.
Equivalent: CHE 5100, ECE 5100, ME 5100

BME 5020 Computer and Mathematical Applications in Biomedical Engineering Cr. 4
Application of numerical methods in biomedical engineering. Programming algorithms and development of data analysis interfaces using Matlab and Excel. Development and refinement of mathematical models, binary data storage and round-off error, algorithm truncation error, and application of Taylor series for function approximation, error estimation, and algorithm development. Numerical methods for solving: roots of equations, systems of linear equations, system optimization, regression and interpolation, integration, differentiation, and ordinary and partial differential equations. Attention is focused on application of techniques within biomedical engineering. Offered Every Term.

BME 5060 Engineering for Women's Health Cr. 3
Engineering approaches have many uses in improving reproductive and non-reproductive aspects of women's health, from basic science understanding through to clinical implementation. This course will start with an overview of reproductive anatomy and physiology and continue with case studies from different engineering sub-fields as applied to reproductive health. Students will complete one in-depth project on a women's health engineering technology development. Offered Yearly.

BME 5070 Anatomy for Engineers Cr. 4
A cadaver based anatomy course for undergraduate students and MS-level students in biomedical engineering. This hands-on course is intended to give the students directed experience of the study of human anatomy in relation to engineering principles. The histological study of tissues in relation to mechanical function of the organism is included in this study. Offered Fall.
Prerequisites: BME 2050 with a minimum grade of C-
Restriction(s): Enrollment is limited to Graduate or Undergraduate level students.
Fees: $225

BME 5130 Vehicle Safety Engineering Cr. 4
Role of vehicle in road safety, occupation and pedestrian injury mechanisms, measures of vehicle safety performance, driver behavior and vehicle interface. Use of new technology to improve vehicle safety. Offered Winter.

BME 5140 Biomedical Aspects of Neurotrauma Cr. 3
Introduction to the biomechanical basis and medical consequences of neurotrauma, including injury to the human brain from mild to severe, from acute to chronic. Exploration of the history and social interactions both engineering (biomechanics) and medicine covering the etiology of human injury and state-of-the-art analytic and observational understanding on neurotrauma including biomechanics of initiating events, acute consequences including shock, systemic pathophysiology and long term prognosis, care and rehabilitation. This includes discussion of the evolution of medical opinion compared to contemporary knowledge of neurotrauma, especially in the evolving understanding of both severe neurotrauma and milder forms of injury. The course will additionally consider complex predisposing interactions that may lead to neurotrauma, social consequences, comorbidities, and their effects on short and long term outcomes. Offered Winter.

BME 5210 Musculoskeletal Biomechanics Cr. 4
Structure and properties of the major tissue components of the musculoskeletal system and evaluation of how tissues combine to provide support and motion to the body. Offered Fall.
Prerequisite: BME 5010 with a minimum grade of B-
Equivalent: ME 5160

BME 5220 Cellular and Tissue Biomechanics Cr. 3
Introduces biomechanics on the cellular to the tissue level. We will be studying mediators of cell mechanics such as the cytoskeleton, extracellular matrix and receptor-ligand interactions. Topics include cell adhesion, cell motility, and hemodynamics. Understanding of these topics will lend to discussion of translation of these forces up to the tissue level and subsequent tissue function. Offered Fall.
Prerequisites: MAT 2010 with a minimum grade of C- and MAT 2020 with a minimum grade of C-

BME 5310 Device and Drug Approval and the FDA Cr. 3
Government regulations and industrial procedures that lead to device/drug approval. Offered Spring/Summer.

BME 5370 Introduction to Biomaterials Cr. 4
Introduction to study of both biological materials (bone, muscle, etc.) and materials for medical applications. Topics include tissue properties and effects of pathology, biocompatibility, and design considerations. Offered Intermittently.
Prerequisites: BME 5010 with a minimum grade of C- (may be taken concurrently)
Equivalent: ME 5180

BME 5380 Biocompatibility Cr. 4
Introduces concepts and applications of biocompatibility. Cellular response to implants (e.g. prosthetics, gene therapies, cells, etc.) will be covered in detail, including wound healing, immune response, and foreign body response. Topics include stem cell effects; in vitro and in vivo studies; and synthetic and natural material body response. The course material will be applicable to implant design, gene therapies, and stem cell treatments. Offered Winter.
Prerequisites: BIO 1050 with a minimum grade of C-, BIO 1500 with a minimum grade of C-, or BIO 1510 with a minimum grade of C-
Equivalent: MSE 5385

BME 5425 Robotic Systems I Cr. 4
Introduction to robot kinematics and control. Computational algorithms for robot movement, sensor fusion, and intelligent behavior, which are needed to build a system that performs actions and interacts with its environment. Offered Fall.
Prerequisites: BE 2550 with a minimum grade of C-, BE 1500 with a minimum grade of C-, BME 5020 with a minimum grade of C-, or ECE 3040 with a minimum grade of C-
Equivalent: ECE 5425

BME 5570 Design of Human Rehabilitation Systems Cr. 3
This course provides basic to advanced knowledge in the field of rehabilitation engineering. The course will cover engineering principles required to 1) develop technological solutions and devices to assist individuals with disabilities and 2) aid the recovery of physical functions lost due to disease or injury. Special emphasis will be placed on learning techniques for measuring, processing, and interpreting movement biomechanics during locomotion. Students will apply these skills to develop and test orthotics and neural prosthetics. Offered Winter.
Prerequisites: BME 4210 with a minimum grade of C-

BME 5990 Directed Study Cr. 1-4
Independent projects on subjects in the field of biomedical engineering. Offered Every Term.
Repeatable for 4 Credits

BME 5995 Special Topics in Biomedical Engineering I Cr. 1-4
Topics as announced in Schedule of Classes. Offered Intermittently.
Repeatable for 12 Credits

BME 6050 Engineering for Women's Health Cr. 3
Engineering approaches have many uses in improving reproductive and non-reproductive aspects of women's health, from basic science understanding through to clinical implementation. This course will start with an overview of reproductive anatomy and physiology and continue with case studies from different engineering sub-fields as applied to reproductive health. Students will complete one in-depth project on a women's health engineering technology development. Offered Yearly.

BME 6130 Accident Reconstruction Cr. 3
Passenger car and light truck behavior in collisions; recognition of roadway markings and vehicle damage used to analyze vehicle accidents and to use that evidence to reconstruct driver, vehicle and occupant dynamics at the time of the collision. Offered Spring/Summer.

BME 6470 Smart Sensor Technology I: Design Cr. 3
Introduction to various types of sensors and the design of basic analog VLSI circuit building blocks. Offered Winter.
Prerequisites: PHY 2185 with a minimum grade of C- or PHY 2180 with a minimum grade of C-
Equivalent: ECE 6570, PHY 6570

BME 6991 Internship in Industry Cr. 1-6
Industrial internship in biomedical engineering. Offered Every Term.
Repeatable for 6 Credits