

Biomedical Engineering (BMEG)

Courses

BMEG 51003. Design and Analysis of Experiments in Biomedical Research. 3 Hours.

An advanced course covering sample size estimation with power calculations, protection of vertebrate animals and human subjects, factorial design, multivariate analysis of variance, parametric and non-parametric data analysis, Kaplan-meier analysis, and post-test correction of multiple comparisons as related to biomedical data. Prerequisite: MATH 25804 and BMEG 36503 or equivalents. (Typically offered: Irregular)

BMEG 52103. Tissue Mechanics. 3 Hours.

The purpose of this course is to introduce students to non-linear biomechanics of soft tissues such as skin, bladder, blood vessels, and the brain. Topics covered: Tissue mechanics: continuum biomechanics, tensor analysis, kinematics of continua, balance laws. Governing physics of mechanics as applied to soft tissues. Various constitutive relations will be discussed: linear elastic, hyperelastic, viscoelastic, poroelastic, and inelastic materials with internal variables. Cannot receive credit for both BMEG 42103 and BMEG 52103. Prerequisite: BMEG 28103 and BMEG 46203 or equivalents. (Typically offered: Irregular)

BMEG 52203. Genome Engineering and Synthetic Biology. 3 Hours.

Genome Engineering and Synthetic Biology provides an overview of contemporary topics in genome engineering and synthetic biology. This course will introduce a range of topics in synthetic biology and genome engineering using recently published literature and publicly available data sets and software. In this rapidly evolving field, an ethics discussion will be held at the end of the course on potential topics including human embryo editing, genomic data privacy, patent claims, and GMOs. Students may not receive credit for both BMEG 49803 and BMEG 52203. Prerequisite: Graduate student standing. (Typically offered: Spring)

BMEG 52503. Biologics: Next Generation Therapeutics and Their Purification. 3 Hours.

The course focuses on the production and purification of biologics including monoclonal antibodies, viral vectors, nucleic acids and other biotherapeutics. In particular, the course will focus on the fundamental thermodynamics principles as well as kinetic limitations involved in upstream harvesting and downstream purification. Applications of PCR, mass spectroscopy, electrophoresis, imaging and modeling tools during the production and purification of biologics will be discussed. Students may not receive credit for both BMEG 42503 and BMEG 52503. (Typically offered: Irregular)

BMEG 53103. Advanced Biomaterials and Biocompatibility. 3 Hours.

From Absorbable sutures to Zirconium alloy hip implants, biomaterials science influences nearly every aspect of medicine. This course focuses on the study of different classes of biomaterials and their interactions with human tissues. Prerequisite: BMEG 36304 and BMEG 46203 or equivalents. (Typically offered: Irregular)

BMEG 54103. Tissue Engineering. 3 Hours.

This course introduces Tissue Engineering approaches at genetic and molecular, cellular, tissue, and organ levels. Topics include cell and tissue in-vitro expansion, tissue organization, signaling molecules, stem cell and stem cell differentiation, organ regeneration, biomaterial and matrix for tissue engineering, bioreactor design for cell and tissue culture, dynamic and transportation in cell and tissue cultures, clinical implementation of tissue engineered products, and tissue-engineered devices. Students may not earn credit for both BMEG 54103 and BMEG 44103. Prerequisite: Graduate Standing. (Typically offered: Irregular)

BMEG 54203. Regenerative Medicine. 3 Hours.

The course covers five broad areas: Biological and molecular basis for regenerative medicine, tissue development, regenerative medicine and innovative technologies, clinical applications of regenerative medicine, and regulation and ethics. Prerequisite: BIOL 25473 and BMEG 38204 or equivalents. (Typically offered: Irregular)

BMEG 55103. Biomedical Optics and Imaging. 3 Hours.

This course will provide students with a fundamental understanding of various biomedical imaging modalities. Topics will include: Basics of light-tissue interaction - absorption, fluorescence, elastic and inelastic scattering; Computational and analytical models of light propagation to quantify tissue optical properties; Optical imaging techniques - spectroscopy, tomography, and laser speckle with potential clinical applications; and Clinical imaging modalities and recent advances - X-ray, Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET), Computed Tomography (CT), Ultrasound imaging, and Photoacoustic imaging. At the end of this course, students should have a good understanding of optical imaging, spectroscopy, and non-optical imaging modalities, specific anatomical sites that they are best suited for, and the trade-offs between imaging depth and resolution. Students may not receive credit for both BMEG 45103 and BMEG 55103. (Typically offered: Irregular)

BMEG 55203. Biomedical Data and Image Analysis. 3 Hours.

This course focuses on an introduction to image processing and analysis for applications in biomedical research. After a review of basic MATLAB usage, students will learn fundamental tools for processing and analyzing data from a variety of subdisciplines within biomedical engineering. Topics include: filtering, thresholding, segmentation, morphological processing, and image registration. Through exercises involving 1D, 2D, and 3D data, students will develop problem-solving skills and a knowledge base in MATLAB required for customized quantitative data analysis. Students may not receive credit for both BMEG 45203 and BMEG 55203. Prerequisite: Graduate standing. (Typically offered: Irregular)

BMEG 5600V. Advanced Individual Study. 1-6 Hour.

Individual study and research of a topic mutually agreeable to the student and faculty member. Prerequisite: Graduate standing. (Typically offered: Irregular)

BMEG 5700V. Advanced Special Topics. 1-6 Hour.

Consideration of current biomedical engineering topics not covered in other courses. Prerequisite: Graduate standing. (Typically offered: Irregular) May be repeated for up to 15 hours of degree credit.

BMEG 57103. Cardiovascular Physiology and Devices. 3 Hours.

Understanding etymology of disease while creating solutions and dedicated devices is the primary focus of biomedical engineering. This course describes an interdisciplinary approach of the clinical and engineering worlds to develop devices for treating cardiovascular disease. The first part of the course will be a thorough review of the relevant anatomic and physiological considerations important for developing devices. Understanding these considerations from an engineering perspective to inform device development will be the second part of the course. Students may not receive credit for both BMEG 47103 and BMEG 57103. Prerequisite: Graduate standing. (Typically offered: Irregular)

BMEG 58000. Graduate Seminar I. 0 Hours.

A weekly seminar series comprised of presentations by invited speakers and graduate students as well as didactic instruction in relevant topics including research ethics, authorship, biosafety and the use of animals in biomedical research. Prerequisite: BMEG 58001. (Typically offered: Fall) May be repeated for up to 0 hours of degree credit.

BMEG 58001. Graduate Seminar I. 1 Hour.

A weekly seminar series comprised of presentations by invited speakers and graduate students as well as didactic instruction in relevant topics including research ethics, authorship, biosafety and the use of animals in biomedical research. (Typically offered: Fall) May be repeated for up to 2 hours of degree credit.

BMEG 58100. Graduate Seminar II. 0 Hours.

A weekly seminar series comprised of presentations by invited speakers and graduate students as well as didactic instruction in relevant topics including professional development, career options, effective communication, technology transfer, clinical translation and intellectual property. Prerequisite: BMEG 58101. (Typically offered: Spring) May be repeated for up to 0 hours of degree credit.

BMEG 58101. Graduate Seminar II. 1 Hour.

A weekly seminar series comprised of presentations by invited speakers and graduate students as well as didactic instruction in relevant topics including professional development, career options, effective communication, technology transfer, clinical translation and intellectual property. (Typically offered: Spring) May be repeated for up to 2 hours of degree credit.

BMEG 59003. Entrepreneurial Bioengineering. 3 Hours.

The course introduces entrepreneurship, business model canvas, and lean start-up principles to the students with a focus on medical device customer discovery and technology commercialization. Graduate degree credit will not be awarded for BMEG 49003. Degree credit will not be awarded for both BMEG 49003 and BMEG 59003. (Typically offered: Irregular)

BMEG 59503. Fundamentals of Fracture and Fatigue in Structures. 3 Hours.

The course will cover the concepts of linear-elastic, elastic-plastic and time-dependent Fracture Mechanics as applied to fracture in a variety of materials, structures, and operating conditions. The examples will include fracture in large components such as aircraft, bridges and pressure vessels and also in bones and in soft materials and human tissue. Prerequisite: Graduate standing in Civil, Mechanical or Biomedical Engineering or consent of the instructor. (Typically offered: Fall and Spring)

This course is cross-listed with MEEG 59503, CVEG 59503.

BMEG 6000V. Master's Thesis. 1-6 Hour.

Master's Thesis. Prerequisite: Graduate standing. (Typically offered: Irregular) May be repeated for degree credit.

BMEG 7000V. Doctoral Dissertation. 1-6 Hour.

Doctoral Dissertation. Prerequisite: Graduate standing. (Typically offered: Irregular) May be repeated for degree credit.