

Biomedical Engineering Courses

BME 100 Introduction to Biomedical Engineering (required)

A rigorous introduction to biomedical engineering that provides the historical and social context of BME though contemporary emerging areas within BME. Specific areas covered in depth include: bioelectricity and biosensors (action potentials to signal processing), biomaging (invasive and non-invasive), genetic engineering (with ethical discussions), and biostatistics. Hands-on computational modeling introduces the physiological concept of positive and negative feedback loops in the body. Emphasis is placed on ways engineers view the living system by using design based approaches and computation.

Prerequisites: BME Major, BNG Minor or Departmental Consent
3 credits, Fall only

BME 212 Biomedical Engineering Research Fundamentals (required)

Introduction to data collection and analysis in the context of biophysical measurements commonly used by bioengineers. Statistical measures, hypothesis testing, linear regression, and analysis of variance are introduced in an application-oriented manner. Data collection methods using various instruments, A/D boards, and PCs as well as LabView, a powerful data collection computer package.

Prerequisites: BME major, BME 100. *Pre- or Corequisite:* MEC 260; BIO 202 or 203.
3 credits, Fall or Spring

BME 213 Studies in Nanotechnology

This course is the first course for the Minor in Nanotechnology Studies (NTS) and is not a BME technical elective course. The emerging field of nanotechnology develops solutions to engineering problems by taking advantage of the unique physical and chemical properties of nanoscale materials. This interdisciplinary, co-taught course introduces materials and nano-fabrication methods with applications to electronics, biomedical, mechanical and environmental engineering. Guest speakers and a semester project involve ethics, toxicology, economic and business implications of nanotechnology. Basic concepts in research and design methodology and characterization techniques will be demonstrated. Course is cross-listed as BME 213, MEC 213, and EST 213 and is required for the Minor in Nanotechnology Studies (NTS).

Prerequisites: PHY 131 or PHY 125; CHE 131 or ESG 198
3 credits, Fall only

BME 300 Writing in Biomedical Engineering (required)

See Requirements for the Major in Biomedical Engineering, Upper-Division Writing Requirement.

Prerequisites: WRT 102; U3 or U4 standing; BME major

Corequisite: Any upper division BME course and permission of the course instructor or Undergraduate Program Director
Zero credits, S/U grading

BME 301 Bioelectricity (required)

Theoretical concepts and experimental approaches used to characterize electric phenomena that arise in live cells and tissues. Topics include excitable membranes and action potential generation, cable theory, equivalent dipoles and volume conductor fields, bioelectric measurements, electrodes and electric stimulation of cells and tissues.

Prerequisites: BME 212; ESE 271; ESG 111 (or ESE 124); BIO 202 or 203
3 credits, Spring only

BME 303 Biomechanics (technical elective)

Illuminates the principles of mechanics and dynamics that apply to living organisms, from cells to humans to Sequoia trees. The behavior of organisms is examined to observe how they are constrained by the physical properties of biological materials. Locomotion strategies (or the lack thereof) are investigated for the forces and range of motions required and energy expenditures. Includes the relationship between form and function to illustrate how form dominates behavior. Presents the physiological effects of mechanical stresses on organs, pathologies that develop from abnormal stress, and how biological growth and adaptation arise as a natural response to the mechanics of living.

Prerequisite: MEC 260; BME 212
Pre- or Corequisite: BIO 202 or 203
3 credits

BME 304-H Genetic Engineering (required)

An introduction to the realm of molecular bioengineering with a focus on genetic engineering. Includes the structure and function of DNA, the flow of genetic information in a cell, genetic mechanisms, the methodology involved in recombinant DNA technology and its application in society in terms of cloning and genetic modification of plants and animals (transgenics), biotechnology (pharmaceutics, genomics), bioprocessing (production and process engineering focusing on the production of genetically engineered products.), and gene therapy. Production factors such as time, rate, cost, efficiency, safety, and desired product quality are also covered. Considers societal issues involving ethical and moral considerations, consequences of regulation, as well as risks and benefits of genetic engineering.

Prerequisites: BME 100; BIO 202 or 203
3 credits, Spring only

BME 305 Biofluids (required)

The fundamentals of heat transfer, mass transfer, and fluid mechanics in the context of physiological systems. Techniques for formulating and solving biofluid and mass transfer problems with emphasis on the special features and the different scales encountered in physiological systems, from the organ and the tissue level down to the molecular transport level.

Prerequisites: AMS 261 (or MAT 203 or MAT 205); AMS 361 (or MAT 303 or MAT 305); BME 212; MEC 260 and MEC 262

Pre- or Corequisite: BIO 202 or 203
3 credits, Spring only

BME 311 Fundamentals of Macro to Molecular Bioimaging (technical elective)

This course will cover the fundamentals of modern imaging technologies, including techniques and applications within medicine and biomedical research. The course will also introduce concepts in molecular imaging with the emphasis on the relations between imaging technologies and the design of target specific probes as well as unique challenges in the design of probes of each modality: specificity, delivery, and amplification strategies. The course includes visits to clinical sites.

Prerequisites: BME 212
3 credits, Fall only

BME 313 Bioinstrumentation (technical elective)

Basic concepts of biomedical instrumentation and medical devices with a focus on the virtual instrumentation in biomedical engineering using the latest computer technology. Topics include basic sensors in biomedical engineering, biological signal measurement, conditioning, digitizing, and analysis. Advanced applications of LabVIEW, a graphics programming tool for virtual instrumentation. Helps students develop skills to build virtual instrumentation for laboratory research and prototyping medical devices.

Prerequisite: BME 212
3 credits, Fall only

BME 353 Biomaterials: Manufacture, Properties, and Applications (technical elective)

The engineering characteristics of materials, including metals, ceramics, polymers, composites, coatings, and adhesives, that are used in the human body. Emphasizes the need of materials that are considered for implants to meet the material requirements specified for the device application (e.g., strength, modulus, fatigue and corrosion resistance, conductivity) and to be compatible with the biological environment (e.g., nontoxic, noncarcinogenic, resistant to blood clotting if in the cardiovascular system). This course is offered as both ESM 353 and BME 353.

Prerequisite: ESG 332
3 credits

BME 381 Nanofabrication in Biomedical Applications (technical elective)

Theory and applications of nanofabrication. Reviews aspects of nanomachines in nature with special attention to the role of self-lubrication, intracellular or interstitial viscosity, and protein-guided adhesion. Discusses current nanofabricated machines to perform the same tasks and considers the problems of lubrication, compliance, and adhesion. Self-assembly mechanisms of nanofabrication with emphasis on cutting edge discovery to overcome current challenges associated with nanofabricated machines. This course is also a technical elective for the NTS minor.

Prerequisites: CHE 132
3 credits, Spring only

BME 400 Research and Nanotechnology

This is the capstone course for the minor in Nanotechnology Studies (NTS); it is not a technical elective for BME. Students learn primary aspects of the professional research enterprise through writing a journal-quality manuscript and making professional presentations on their independent research (499) projects in a formal symposium setting. Students will also learn how to construct a grant proposal (a typical NSF graduate fellowship proposal), methods to search for research/fellowship funding, and key factors in being a research mentor. Course is cross-listed as BME 213, MEC 213, and EST 213 and is required for the Minor in Nanotechnology Studies (NTS).

Prerequisites: BME 213; at least one semester of independent research (499 course)
3 credits, Spring only

BME 404 Essentials of Tissue Engineering (technical elective)

Topics covered are: developmental biology (nature's tissue engineering), mechanisms of cell-cell and cell matrix interactions, biomaterial formulation, characterization of biomaterial properties, evaluation of cell interactions with biomaterials, principles of designing an engineered tissue. Considers manufacturing parameters such as time, rate, cost, efficiency, safety and desired product quality as well as regulatory issues.

Prerequisites: BIO 202 or 203; CHE 132
3 credits

BME 420 Computational Biomechanics (technical elective)

Introduces the concepts of skeletal biology; mechanics of bone, ligament, and tendon; and linear and nonlinear properties of biological tissues. Principles of finite differences method (FDM) and finite elements method (FEM) to solve biological problems. Both FDM and FEM are applied to solve equations and problems in solid and porous media. Requires knowledge of Fortran or C programming.

Prerequisites: BME 303; BME 305; MEC 363
3 credits

BME 430 Engineering Approaches to Drug Delivery (technical elective)

Introduction to the application of engineering principles and biological considerations in designing drug delivery systems for medical uses. The concept of biocompatibility and its implications in formulating controlled release devices are illustrated. Emphasis on the use of biodegradable materials to design drug delivery systems for site-specific applications.

Prerequisites: AMS 161 or MAT 132 or 142 or 171; BIO 202 or 203; BME 304
3 credits

BME 440 Biomedical Engineering Design (required)

Introduction to product development from the perspective of solving biomedical, biotechnological, environmental, and ergonomic problems. Teamwork in design, establishing customer needs, writing specifications, and legal and financial issues are covered in the context of design as a decision-based process. A semester-long team design project follows and provides the opportunity to apply concepts covered in class.

Prerequisites: BME major; U4 standing; BME 301 and 305

3 credits, Fall only

BME 441 Senior Design Project in Biomedical Engineering (required)

Formulation of optimal design problems in biomedical and physiological settings. Introduces optimization techniques for engineering design and modeling for compact and rapid optimization of realistic biomedical engineering problems.

Necessary conditions for constrained local optimum with special consideration for the constraints in which the product designed should function in terms of the settings (corporal, ex-corporal, biological, etc.) and the safety considerations involved which are unique to biomedical engineering. Students carry out the detailed design of projects chosen early in the semester. A final design report is required.

Prerequisite: BME 440

3 credits, Spring only

BME 461 Biosystems Analysis (technical elective)

Fundamentals of the linear time series analyses framework for modeling and mining biological data. Applications range from cardiorespiratory; renal blood pressure, flow, and sequence; to gene expression data. Tools of data analysis include Laplace and Z transforms, convolution, correlation, Fourier transform, transfer function, coherence function, various filtering techniques, and time-invariant and time-varying spectral techniques.

Prerequisites: BME 212 and 301

3 credits

BME 475 Undergraduate Teaching Practicum

Students assist the faculty in teaching by conducting recitation or laboratory sections that supplement a lecture course.

The student receives regularly scheduled supervision by the faculty instructor. May be used as an open elective and repeated once. *Prerequisites:* BME major; U4 standing; a minimum g.p.a. of 3.00 in all Stony Brook courses and a grade of B or better in the course in which the student is to assist; or permission of the department

3 credits

BME 481 Biosensors (technical elective)

A comprehensive introduction to the basic features of biosensors. Discusses types of most common biological agents (e.g. chromophores, fluorescence dyes) and the ways in which they can be connected to a variety of transducers to create complete biosensors for biomedical applications. Focus on optical biosensors and systems (e.g. fluorescence spectroscopy, microscopy), and fiberoptically-based biosensing techniques. New technologies such as molecular beacons, Q-dots, bioMEMs, confocal microscopy and multiphoton microscopy, and OCT will be referenced.

Prerequisites: BIO 202 or 203; ESE 271

3 credits

BME 488 Biomedical Engineering Internship

Participation in off-campus biomedical engineering practice. Students are required to submit a proposal to the undergraduate program director at the time of registration that includes the location, immediate supervisor, nature of the project, and hours per week for the project. One mid-semester report and one end of semester report are required. May be repeated up to a limit of 12 credits.

Prerequisites: BME 212 and permission of undergraduate program director

3-6 credits, S/U grading

BME 499 Research in Biomedical Engineering (up to 6 credits as a technical elective)

An independent research project with faculty supervision.

Prerequisites: Permission of instructor

0-3 credits per semester

Prerequisites for BME courses can be found here. (Course Prereqs 2008)