BME Biomedical Engineering

BME 100 Introduction to Biomedical Engineering
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), biofluids, tissue engineering and life support systems (with ethical discussions), and biostatistics. Hands-on computational modeling introduces the physiological concepts 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

BME 201-H Biomedical Engineering and Society
How engineers interact with others in the development of solutions to societal problems, with emphasis on engineering problems arising in the biological realm. In-depth evaluations of both successful and unsuccessful technologies illuminate the role of biomedical engineers in supporting the wellbeing of urban and rural populations throughout the world, through developments in medical engineering, biotechnology, environmental engineering, and ergonomic design. Not for credit in addition to BME 100.
Prerequisite: One D.E.C. category E course
3 credits

BME 212 Biomedical Engineering Research Fundamentals
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. Not for credit in addition to the discontinued BME 309.
Prerequisites: BME major, BME 100 and MEC 260
Pre or Corequisite: BIO 202 or 203
3 credits

BME 213 Studies in Nanotechnology
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, technology, 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

BME 300 Writing in Biomedical Engineering
See Requirements for the Major in Biomedical Engineering, Upper-Division Writing Requirement.
Prerequisites: WRT 102; U3 or U4 standing; BME major
Corequisite: Any 300-level BME course
S/U grading

BME 301 Biodelectricity
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

BME 303 Biomechanics
Illustrates 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. Emphasizes 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
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), biotechnolgy (pharmaceutics, genomics), bioprocessing (production and process engineering focusing on the production of genetically engineered products.), and gene therapy. Production and process 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

BME 305 Biofluids
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 difficulties 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 361 or MAT 303); BME 215; MEC 260 and MEC 262
Pre or Corequisite: BIO 202 or 203
3 credits

BME 308 Biomedical Engineering Design
Prerequisites: BME 201-H
Pre or Corequisite: BIO 301
3 credits

BME 313 Bioinstrumentation
Basic concepts of biomedical instrumentation and medical devices with a focus on the virtual instrumenta- tion in biomedical engineering using the latest com- puter technology. Topics include basic sensors in bio- medical engineering, biomedical signal measurement, conditioning, digitizing, and analysis. Advanced applica- tions 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

BME 353 Biomaterials: Manufacture, Properties, and Applications
The engineering characteristics of materials, includ- ing 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 speci- fied for the device application (e.g., strength, modulu- s, fatigue and corrosion resistance, conductivity) and to be compatible with the biological environment (e.g., nontoxic, noncarcinogenic, resistant to blood clotting 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
Topics and applications of nanofabrication. Reviews aspects of nanomachines in nature with special atten- tion to the role of self-assembly, intracellular or inter- stitial viscosity, and protein-guided adhesion. Discusses current nanofabricated machines to perform the same tasks and considers the problems of lubri- cation, compliance, and adhesion. Self-assembly mecha- nisms of nanofabrication with emphasis on cutting- edge delivery to overcome current challenges associ- ated with nanofabricated machines.
Prerequisites: CHE 132; BME 100
Pre or Corequisite: BIO 202 or 203
3 credits

BME 404 Essentials of Tissue Engineering
Topics covered are: developmental biology (nature’s tissue engineering), mechanisms of cell-cell and cell-material interactions, biomaterial formulation, charac- terization of biomaterial properties, evaluation of cell interactions with biomaterials, principles of designing an engineered tissue. Considers manufacturing para- meters 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
Introduces the concepts of skeletal biology; mechan- ics of bone, ligament, and tendon; and linear and non- linear 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 knowl- edge of Fortran or C programming.
Prerequisites: BME 303; BME 305; MEC 363
3 credits

BME 430 Engineering Approaches to Drug and Gene Delivery
Introduction to the application of engineering princi- ples and biological considerations in designing drug delivery systems for medical uses. The concept of bio- compatibility and its implications in formulating con- trolled 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
Introduction to product development from the perspec- tive of solving biomedical, biotechnological, environmental, and ergonomic problems. Teamwork in design, establishing customer needs, writing specifications, and legal and financial issues are cov- ered in the context of design as a decision-based process. A semester-long team design project fol- lows and provides the opportunity to apply concepts covered in class.
Prerequisites: BME major; U4 standing; BME 301 and 305
3 credits

BME 441 Senior Design Project in Biomedical Engineering
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 con-
strained local optimum with special consideration for the constraints in which the product designed should function in terms of the settings (corporal, ex-corpo-
rul, 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

BME 461 Biosystems Analysis
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 lec-
ture 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
A comprehensive introduction to the basic features of biosensors. Discusses types of most common biologi-
cal agents (e.g. chromophores, fluorescence dyes) and the ways in which they can be connected to a vari-
ety of transducers to create complete biosensors for biomedical applications. Focus on optical biosensors
and systems (e.g. fluorescence spectroscopy, micro-
scopy), and fiberoptically-based biosensing tech-
niques. New technologies such as molecular beacons, Q-dots, bioMEMs, confocal microscopy and multipho-
ton 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 undergrad-
uate program director
3-6 credits, S/U grading

BME 499 Research in Biomedical Engineering
An independent research project with faculty super-
vision.
Prerequisites: Permission of instructor
0-3 credits