BME Course Descriptions 2018-19

BIM 1 | Introduction to Biomedical Engineering | Units: 2 | Fall

Lecture: 1 hour; Laboratory: 3 hours. No prerequisite. Introduction to the field of biomedical engineering with emphasis on design, careers, and specializations, including (1) medical devices, (2) cellular & tissue engineering, (3) biomechanics, (4) systems & synthetic biology, and (5) biomedical imaging. **Required**

BIM 20 | Fundamentals of Bioengineering | Units: 4 | Spring

Lecture: 3 hours; Discussion: 1 hour. Prerequisites: CHE 2B or 2BH (C-), MAT 21D (C-). PHY 9B. *Credit restriction: Only 2 units for students who have taken ECH 51 or ENG 105.* Basic principles of mass, energy and momentum conservation equations applied to solve problems in the biological and medical sciences. **Required**

BIM 88V | Introduction to Research | Units: 2 | Winter

Web/Virtual Lecture: 2 hours. No prerequisite. Introduction to types or research, including the basics of joint research with a faculty mentor. Self-assessments to identify areas of interest, priorities, and fit. Literature search and library skills used in early stages of research. Research safety, integrity, and intellectual property. **This is a general interest course and not part of the BME Degree requirements.*

BIM 102 | Cellular Dynamics | Units: 4 | Fall

Lecture/discussion: 4 hours. Prerequisites: BIS 2A and CHE 8B or 118B. *Credit restriction: Only 2 units for students who have taken BIS 104.* Fundamental cell biology for bioengineers. Emphasis on physical concepts underlying cellular processes including protein trafficking, cell motility, cell division and cell adhesion. Current topics including cell biology of cancer and stem cells will be discussed. **SE**

BIM 105 | Probability and Statistics for BME | Units: 4 | Fall

Lecture: 3 hours; Discussion: 1 hour. Prerequisite: MAT 21D (C-), and ENG 6 (can be concurrent). Concepts of probability, random variables and processes, and statistical analysis with applications to engineering problems in biomedical sciences. Includes discrete and continuous random variables, probability distributions and models, hypothesis testing, statistical inference and Matlab applications. Emphasis on BME applications. **Required**

BIM 106 | Biotransport Phenomena | Units: 4 | Winter

Lecture: 3 hours; Discussion: 1 hour. Prerequisites: NPB 101 or BIM 116, PHY 9B, MAT 22B, and BIM 20 (C-). Principles of momentum and mass transfer with applications to biomedical systems; emphasis on basic fluid transport related to blood flow, mass transfer across cell membranes, and the design and analysis of artificial human organs. **Required**

BIM 108 | Biomedical Signals and Control | Units: 4 | Spring

Lecture: 4 hours. Prerequisites: ENG 6, ENG 17, and MAT 22B (C-). *Credit restriction: No credit for students who have taken EEC 150A and only 2 units for students who have taken EME 171.* Systems and control theory applied to biomedical engineering problems. Time-domain and frequency-domain analyses of signals and systems, convolution, Laplace and Fourier transforms, transfer function, dynamic behavior of first and second order processes, and design of control systems for biomedical applications. **Required**

BIM 109	Biomaterials	Units: 4 Spring

Lecture: 4 hours. Prerequisites: BIS 2A; CHE 2C or CHE 2CH; BIM 106. Introduce important concepts for design, selection and application of biomaterials. Given the interdisciplinary nature of the subject, principles of polymer science, surface science, materials science and biology will be integrated into the course. **Required**

BIM 110 LAB	BME Senior Design Experience	Units: 2-3-3 F W S

BIM 110L: CAD Lab: 2 hours; Machine Lab: 3 hours. Prerequisites: BIM 105, BIM 106, BIM 108, BIM 109; BIM 116 or NPB 101.
BIM 110A: Lecture/discussion: 1 hour. Prerequisite: BIM 110L, BIM 111 (may be concurrent).
BIM 110B: Lecture/discussion: 1 hour. Prerequisite: BIM 110A.
Manufacturing processes, safety, computer-aided design techniques applied to fabrication of biomedical devices. Application of engineering principles & design theory to build a functional prototype to solve a biomedical problem. Application of bioengineering theory and experimental analysis to a design project culminating in the design of a unique solution to a problem. Design may be geared towards current applications in biotechnology or medical technology. Deferred grading only pending completion of sequence. **Required**

BIM 111	Biomedical Instrumentation Laboratory	Units: 6 Fall

Lecture: 4 hours; Discussion/Lab: 4 hours. Prerequisites: BIM 105, BIM 108; ENG 100 or EEC 100; NPB 101 or BIM 116. Basic biomedical signals and sensors. Topics include analog and digital records using electronic, hydrodynamic, and optical sensors, and measurements made at cellular, tissue and whole organism level. **Required**

BIM 116	Physiology for Biomedical Engineers	Units: 5 Fall

Lecture: 2 hours; Discussion: 3 hours. Prerequisites: BIS 2A (C-), PHY 9C, and MAT 22B (recommended). Basic human physiology for the nervous, musculoskeletal, cardiovascular, respiratory, gastrointestinal, renal, and endocrine systems. Emphasis on small group design projects and presentations in interdisciplinary topics relating biomedical engineering to medical diagnostic and therapeutic applications. **The choice of BIM 116 or NPB 101 is Required**.

BIM 120/189C	Introduction to Materials Science for BME	Units: 4 Winter

Lecture: 4 hours. Prerequisites: BIM 20 (C-) or ENG 105 (C-); PHY 9C, MAT 22B recommended. Historical perspective on materials usage in the body. Fundamental properties of materials and key considerations needed for material selection in the context of biomedical applications. Case studies of commonly used biomaterials spanning a range of material types. **EE**

BIM 125	Introduction to Design and Analysis of Experiments for BME	Units: 4 Fall

Lecture: 3 hours; Discussion: 1 hour. Prerequisites: BIM 105. Basic concepts and methods in design of experiments with biomedical engineering applications. Statistical concepts and methods to study strategies to design efficient industrial experiments that can improve data quality and simplify data analysis. **EE**

BIM 141	Cell and Tissue Mechanics	Units: 4 Winter

Lecture: 3 hours; Discussion: 1 hour. Prerequisites: PHY 9B, ENG 6 and ENG 35. Mechanical properties that govern blood flow in the microcirculation. Concepts in blood rheology and cell and tissue viscoelasticity, biophysical aspects of cell migration, adhesion, and motility. **EE**

BIM 142	Principles and Practices of Biomedical Imaging	Units: 4	Spring

Lecture: 4 hours. Prerequisites: MAT 22B and BIM 108 (can be concurrent). Basic physics, engineering principles, and applications of biomedical imaging techniques including x-ray imaging, computed tomography, magnetic resonance imaging, ultrasound and nuclear imaging**.** **EE**

BIM 143	Biomolecular Systems Engineering: Synthetic Biology	Units: 4	Spring *odd*

Lecture: 3 hours; Discussion: 1 hour. Prerequisites: BIS 2A, MAT 21C or equivalent. Includes analysis, design, construction and characterization of molecular systems. Process and biological parts standardization, computer aided design, gene synthesis, directed evolution, protein engineering, issues of human practice, biological safety, security, innovation, and ethics are covered. Offered odd years. **EE**

BIM 143L	Synthetic Biology Laboratory	Units: 2	Spring *odd*

Discussion: 1 hour; Laboratory: 3 hours. Prerequisites: BIM 143 (must be concurrent). Optional hands-on laboratory for BIM 143. Students solve a practical problem in the field of synthetic biology by designing, building, and testing an appropriate solution or product. Problems change each offering. Offered odd years. **EE**

BIM 144	Fundamentals of Biophotonics and Bioimaging	Units: 4	Winter

Lecture: 4 hours. Prerequisites: PHY 9B, MAT 22B, or instructor consent; BIM 108 or equivalent helpful; biology or physiology course recommended. Biophotonics and bioimaging, emphasizing quantitative description of light propagation & light tissue interactions. Key technologies and illustrative applications in basic research, clinical diagnostics and therapy. **EE**

BIM 145/189A	Immuno-engineering	Units: 4	Winter

Lecture: 4 hours. Prerequisites: BIM 161A or BIS 102. Basic immunology and immunological tools. Survey of current immuno-therapeutic strategies. Ongoing research efforts to engineer the immune system for positive theranostic outcomes. **EE**

BIM 152	Molecular Control of Biosystems	Units: 4	Fall

Lecture: 3 hours, Discussion, 1 hour. Prerequisites: BIS 2A, PHY 9B, and MAT 22B. Fundamentals of molecular biomedicine covering state-of-the-art methods for quantitative understanding of gene regulation and signal transduction networks at different levels of organization in health and disease. Topics include classic genetic systems, synthetic circuits, networks disrupted in disease and cancer. **EE**

BIM 161A	Biomolecular Engineering	Units: 4	Fall *odd*

Lecture: 3 hours, Discussion: 1 hour. Prerequisites: BIS 2A, CHE 8B or 118B. Introduction to the basic concepts and techniques of biomolecular engineering such as recombinant DNA technology, protein engineering, and molecular diagnostics. Offered odd years. **SE**

BIM 162	Introduction to the Biophysics of Molecules and Cells	Units: 4	Fall

Lecture: 4 hours. Prerequisites: MAT 22B (C-), PHY 9C (C-). Introduction to fundamental physical mechanisms governing structure and function of bio-macromolecules. Emphasis on a quantitative understanding of the nano- to microscale biomechanics of interactions between and within individual molecules, as well as of their assemblies, in particular membranes. **EE**

BIM 163	Bioelectricity, Biomechanics, and Signaling Systems	Units: 4	Spring

Lecture: 3 hours, Discussion: 1 hour. Prerequisites: MAT 22B (C-); BIM 116 or NPB 101. Fundamentals of bioelectricity in cells, the calcium signaling system, and mechanical force generation in muscle. Combination of lecture and projects to promote learning of important concepts in hands-on projects using neurons and muscle as microcosms. **EE**

BIM 167	Biomedical Fluid Mechanics	Units: 4	Spring

Lecture: 3 hours, Discussion: 1 hour. Prerequisites: BIM 106 (C-); BIM 116 or NPB 101. Theories of fluid mechanics, including Navier Stokes Equation and Conservation Laws, will be presented to understand dynamics of human circulatory systems. Fluid dynamics will be analyzed using partial differential equations. **EE**

BIM 170	Aspects of Medical Device Design and Manufacturing	Units: 2	Winter

Lecture: 2 hours. Prerequisite: Upper Division Standing in BME. Survey of medical device design & impact on manufacturing operations. Introduction to medical device design process & product lifecycle. Principles of Design for Manufacturability, Design for Lean Manufacturing, and quality management systems. **EE**

BIM 171	Clinical Applications for Biomedical Device Design	Units: 4	Fall

Lecture: 3 hours; Discussion: 1 hour. Prerequisites: BIM 116 (C-) or NPB 101 (C-); NPB 101 recommended. Clinical applications for biomedical devices with emphasis in the pathophysiology of common diseases as it relates to the biodesign process, biosensors principles, in vitro diagnostics, needs assessment, and regulatory considerations. **EE**

BIM 173	Cell and Tissue Engineering	Units: 4	Fall

Lecture/Discussion: 4 hours. Prerequisites: BIM 106 (C-) and BIM 109 (C-). Engineering principles to direct cell and tissue behavior and formation. Cell sourcing, controlled delivery of macromolecules, transport within and around biomaterials, bioreactor design, tissue design criteria and outcomes assessment. **EE**

BIM 174/189C	Microcontroller Applications Lab	Units: 2	Fall

Laboratory: 3 hours; Lecture: 1 hour. Prerequisite: ENG 17 (C-). Restricted to Upper Division BME students. Hands-on design module to introduce microcontroller platforms, e.g. Arduino; programming microcontroller development board, use of external programs to support development of controlled systems, design of simple control systems. **EE**

BIM 176/189C	Microfluidic Lab	Units: 2	Winter

Lecture: 1 hour; Laboratory: 3 hours. Prerequisites: CHE 2A, ENG 17. Theory and practice of microfluidic and lab-on-a-chip (LOC) systems. Microfluidic theories, microfluidic functions and operations, microfluidic sensing, and organ-on-a-chip development. Laboratory sections emphasize implementation and utilization of modern microfluidic devices, interfacial phenomena, and digital and droplet microfluidics. **EE**

BIM 189	Topics in Biomedical Engineering	Units: 1 - 5

Topics in Biomedical Engineering. (A) Cellular and Molecular Engineering (B) Biomedical Imaging (C) Biomedical Engineering. These courses are temporarily numbered “189”, so check the instructor’s name and course title.

BIM 189C/154	Computational Genomics (Aviran)	Units: 4 Winter

Lecture: 4 hours. Prerequisites: ENG 6 (C-); MAT 21D (C-); MAT 22A (C-); BIM 105 (C-). Fundamental computational and probabilistic modeling techniques underlying analytical approaches to recent problems in functional genomics and molecular biology; DNA sequencing technologies; sequencing-based genomic assays; genomics and molecular biology lab techniques; gene expression quantification; nucleic acid structure; statistical inference and parameter estimation; resampling methods; simulations of genomic big data sets. **EE**

BIM 189C/175	Advanced Manufacturing: Welding & Metalworking (Choi)	Units: 1 Winter

Laboratory: 3 hours. Prerequisites: BIM 110L. Hands-on advanced manufacturing module that introduces basic concepts in welding & metalworking. The importance of safe and proper usage of tools, along with appropriate planning and setup are emphasized. Weekly laboratory sessions will cover machine shop safety, utilizing hand tools, materials preparation, preparation of fixtures, and welding. **EE**

BIM 189C	Computational tools in Bioengineering & Biomedicine (Saiz)	Units: 4 Winter

Lecture: 4 hours. Prerequisites: BIS 2A; PHY 9B; MAT 22B; or consent of instructor. This course is designed to introduce students to the state-of-the-art computational tools and methods for biomolecular systems in bioengineering and biomedicine applications. Students will learn the foundations and get acquainted with tools used, among others, for the design of aptamers for biosensor applications, design of cancer vaccines, identification of therapeutic targets in cancer pathways, control of signal transduction networks disrupted in disease, and design of transcriptional programs for genetic engineering. **EE**

BIM 189C	Introduction to Neuroengineering (Moxon)	Units: 2 Spring

Laboratory: 3 hours: Discussion 1 hour. Prerequisites; BIM 105; ENG 100 or EEC 100. Learn how to transduce signals from your brain. Understand the power of neural signals to improve health outcomes. **EE**

BIM 192	Internship in BME	Units: 1-12

Internship: 3-36 hours/week for 10 weeks. Prerequisite: Upper division majors. Petition to be filed with UG Advisor. Approval of UG Committee. Supervised work experience in the Biomedical Engineering field. May be repeated for credit. P/NP

BIM 192	Internship in BME: **Engineering or Science Elective Credit**	Units: 4

Internship: 12 hours/week for 10 weeks. Prerequisite: Upper division majors. Petition to be filed with UG Advisor. Part I: Research proposal. Part II: Presented results. Approvals by UG Committee. Supervised work experience in the Biomedical Engineering field. 4 units only. P/NP

BIM 199	Special Study for Advanced Undergraduates Lab Credit	Units: 1-5

Prerequisite: Upper division standing. 3 hours of lab work/week = 1 unit. Petition to be filed with UG Advisor at beginning of each quarter. May be repeated for credit. P/NP

BIM 199	Special Study for Advanced Undergraduates: **Engineering or Science Elective Credit**	Units: 4

Prerequisite: Upper division majors. 6 hours/week for 20 weeks. 2 units/quarter for 2 consecutive quarters for a total of 4 units. Petition to be filed with UG Advisor at beginning of quarter.
Part I: Research proposal. Part II: Presented results. Approvals by UG Committee. 4 units only. P/NP