BIOMEDICAL ENGINEERING (BIM)

College of Engineering

BIM 001 — Introduction to Biomedical Engineering (2 units)

Course Description: 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.
Learning Activities: Lecture 1 hour(s), Laboratory 3 hour(s).
Enrollment Restriction(s): Pass One open to freshmen.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 020 — Fundamentals of Bioengineering (4 units)

This version has ended; see updated course, below.
Course Description: Basic principles of mass, energy and momentum conservation equations applied to solve problems in the biological and medical sciences.
Prerequisite(s): (CHE 002B C- or better or CHE 002BH C- or better); MAT 021D C- or better; PHY 009B; ENG 006; BIM 020L (can be concurrent).
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Enrollment Restriction(s): Pass One restricted to BME majors only.
Credit Limitation(s): Only 2 units of credit to students who have previously taken ECH 051, ENG 105.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Visual Literacy (VL).

BIM 020 — Fundamentals of Bioengineering (4 units)
Course Description: Basic principles of mass, energy and momentum conservation equations applied to solve problems in the biological and medical sciences.
Prerequisite(s): CHE 002B C- or better; MAT 021D C- or better; PHY 009B; ENG 006; BIM 020L (can be concurrent).
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Enrollment Restriction(s): Pass One restricted to BME majors only.
Credit Limitation(s): Only 2 units of credit to students who have previously taken ECH 051, ENG 105.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Visual Literacy (VL).
This course version is effective from, and including: Summer Session 1 2024.

BIM 020L — Graphics Design for BME (2 units)

This version has ended; see updated course, below.
Course Description: Computer-aided design and its application to problems in Biomedical Engineering.
Prerequisite(s): (CHE 002B or CHE 002BH C- or better); MAT 021D C- or better; PHY 009B; ENG 006; BIM 020 (can be concurrent).
Learning Activities: Lecture 1 hour(s), Laboratory 2 hour(s).
Enrollment Restriction(s): Open to BME majors only.
Credit Limitation(s): No credit for students who have previously taken ENG 004.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 020L — Graphics Design for BME (2 units)
Course Description: Computer-aided design and its application to problems in Biomedical Engineering.
Prerequisite(s): CHE 002B C- or better; MAT 021D C- or better; PHY 009B; ENG 006; BIM 020 (can be concurrent).
Learning Activities: Lecture 1 hour(s), Laboratory 2 hour(s).
Enrollment Restriction(s): Open to BME majors only.
Credit Limitation(s): No credit for students who have previously taken ENG 004.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Summer Session 1 2024.

BIM 088V — Introduction to Research (2 units)

Course Description: Introduction to types of 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.
Learning Activities: Web Virtual Lecture 2 hour(s).
Grade Mode: Letter.
General Education: Social Sciences (SS).

BIM 089A — Topics in Biomedical Engineering (1-5 units)

Course Description: Topics in Biomedical Engineering. (A) Cellular and Molecular Engineering.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable 3-15 hour(s).
Enrollment Restriction(s): Restricted to lower division students.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 089B — Topics in Biomedical Engineering (1-5 units)

Course Description: Topics in Biomedical Engineering. (B) Biomedical Imaging.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable 3-15 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 089C — Topics in Biomedical Engineering (1-5 units)

Course Description: Topics in Biomedical Engineering. (C) Biomedical Engineering.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable 3-15 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 099 — Special Study for Undergraduates (1-5 units)

Course Description: Special study for undergraduates.
Learning Activities: Variable.
Repeat Credit: May be repeated.
Grade Mode: Pass/No Pass only.
General Education: Science & Engineering (SE).

BIM 102 — Cellular Dynamics (4 units)

Course Description: 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.
Prerequisite(s): BIS 002A; CHE 008B or CHE 118B.
Learning Activities: Lecture/Discussion 4 hour(s).
Enrollment Restriction(s): Open to College of Engineering students only.
Credit Limitation(s): Only 2 units of credit for students who have completed BIS 104.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 105 — Probability & Data Science for Biomedical Engineers (4 units)

This version has ended; see updated course, below.
Course Description: Concepts of probability, random variables, stochastic processes, mathematical modeling, and data analysis, with applications to biomedical engineering. Includes combinatorics, discrete, continuous, and jointly distributed random variables, probability distributions and models, Markov Chains, and Poisson Processes. Computer labs using MATLAB cover mathematical and computational modeling techniques, hands-on data analysis, and computer simulations.
Prerequisite(s): (MAT 022A C- or better or MAT 027A C- or better or BIS 027A C- or better); ENG 006 { can be concurrent }; or consent of instructor.
Learning Activities: Lecture 3 hour(s), Laboratory 2 hour(s).
Credit Limitation(s): No credit for students who have taken MAT 107 or BIS 107; only 2 units of credit for students who have completed MAT 135A or STA 131A.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 105 — Probability & Data Science for Biomedical Engineers (4 units)
Course Description: Concepts of probability, random variables, stochastic processes, mathematical modeling, and data analysis, with applications to biomedical engineering. Includes combinatorics, discrete, continuous, and jointly distributed random variables, probability distributions and models, Markov Chains, and Poisson Processes. Computer labs using MATLAB cover mathematical and computational modeling techniques, hands-on data analysis, and computer simulations.
Prerequisite(s): (MAT 022A C- or better or MAT 027A C- or better or BIS 027A C- or better); ENG 006 (can be concurrent); or consent of instructor.
Learning Activities: Lecture 3 hour(s), Laboratory 2 hour(s).
Credit Limitation(s): No credit for students who have taken MAT 107 or BIS 107; only 2 units of credit for students who have completed MAT 135A or STA 131A.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Spring Quarter 2024.

BIM 105 — Probability & Data Science for Biomedical Engineers (4 units)
Course Description: Concepts of probability, random variables, stochastic processes, mathematical modeling, and data analysis, with applications to biomedical engineering. Includes combinatorics, discrete, continuous, and jointly distributed random variables, probability distributions and models, Markov Chains, and Poisson Processes. Computer labs using MATLAB cover mathematical and computational modeling techniques, hands-on data analysis, and computer simulations.
Prerequisite(s): MAT 022A C- or better or MAT 027A C- or better or BIS 027A C- or better or ENG 006 (can be concurrent); or consent of instructor.
Learning Activities: Lecture 3 hour(s), Laboratory 2 hour(s).
Credit Limitation(s): No credit for students who have taken MAT 107 or BIS 107; only 2 units of credit for students who have completed MAT 135A or STA 131A.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Summer Session 1 2024.

BIM 106 — Biotransport Phenomena (4 units)

This version has ended; see updated course, below.
Course Description: 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.
Prerequisite(s): BIM 020 C- or better; BIM 020L; (BIM 116 or NPB 101); PHY 009B; (MAT 022B or MAT 027B).
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Enrollment Restriction(s): Open to Biomedical Engineering majors only.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Scientific Literacy (SL); Visual Literacy (VL).

BIM 106 — Biotransport Phenomena (4 units)

Course Description: 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.
Prerequisite(s): BIM 020 C- or better; BIM 020L; (BIM 116 or BIM 181 or NPB 101); PHY 009B; (MAT 022B or MAT 027B).
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Enrollment Restriction(s): Open to Biomedical Engineering majors only.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Scientific Literacy (SL); Visual Literacy (VL).
This course version is effective from, and including: Spring Quarter 2024.

BIM 106 — Biotransport Phenomena (4 units)

Course Description: 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.
Prerequisite(s): BIM 020 C- or better; BIM 020L; (BIM 116 or BIM 181 or NPB 101); PHY 009B; (MAT 022B or MAT 027B or BIS 027B).
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Enrollment Restriction(s): Open to Biomedical Engineering majors only.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Scientific Literacy (SL); Visual Literacy (VL).
This course version is effective from, and including: Summer Session 1 2024.

BIM 107 — Manufacturing Processes for BME (2 units)

Course Description: Manufacturing processes and computer numerical control methods applied to the design and fabrication of biomedical devices.
Prerequisite(s): BIM 020 C- or better; BIM 020L C- or better.
Learning Activities: Lecture/Discussion 1 hour(s), Laboratory 3 hour(s).
Enrollment Restriction(s): Open to BME majors only.
Credit Limitation(s): No credit for students who have previously taken EME 050.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 108 — Biomedical Signals & Control (4 units)

This version has ended; see updated course, below.
Course Description: 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.
Prerequisite(s): ENG 006; (ENG 017 or ENG 017V); (MAT 022B C- or better or MAT 027B C- or better).
Learning Activities: Lecture 4 hour(s).
Enrollment Restriction(s): Restricted to Biomedical Engineering majors only.
Credit Limitation(s): No credit for students who have taken EEC 150A; 2 units of credit for students who have taken EME 171.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL).

BIM 108 — Biomedical Signals & Control (4 units)

Course Description: 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.
Prerequisite(s): ENG 006; ENG 017; (MAT 022B C- or better or MAT 027B C- or better).
Learning Activities: Lecture 4 hour(s).
Enrollment Restriction(s): Open to Biomedical Engineering majors only.
Credit Limitation(s): No credit for students who have taken EEC 150; 2 units of credit for students who have taken EME 171.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Winter Quarter 2024.

BIM 108 — Biomedical Signals & Control (4 units)

Course Description: 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.
Prerequisite(s): ENG 006; (ENG 017 or ENG 017V); (MAT 022B C- or better or MAT 027B C- or better or BIS 027B C- or better).
Learning Activities: Lecture 4 hour(s).
Enrollment Restriction(s): Open to Biomedical Engineering majors only.
Credit Limitation(s): No credit for students who have taken EEC 150; 2 units of credit for students who have taken EME 171.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Summer Session 1 2024.

BIM 109 — Biomaterials (4 units)

This version has ended; see updated course, below.
Course Description: 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.
Prerequisite(s): BIS 002A; CHE 002C or CHE 002CH; BIM 106.
Learning Activities: Lecture 4 hour(s).
Enrollment Restriction(s): Open to Biomedical Engineering majors only.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Scientific Literacy (SL); Visual Literacy (VL).

BIM 109 — Biomaterials (4 units)
Course Description: 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.
Prerequisite(s): BIS 002A; CHE 002C; BIM 106.
Learning Activities: Lecture 4 hour(s).
Enrollment Restriction(s): Open to Biomedical Engineering majors only.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Scientific Literacy (SL); Visual Literacy (VL).
This course version is effective from, and including: Summer Session 1 2024.

BIM 110A — Biomedical Engineering Senior Design Experience (3 units)

This version has ended; see updated course, below.
Course Description: Application of bioengineering theory and experimental analysis to a design project culminating in the design of a unique solution to a biomedical problem. Continues in BIM 110B.
Prerequisite(s): BIM 105; BIM 106; BIM 107; BIM 108; BIM 109; BIM 020L; (BIM 116 or NPB 101).
Learning Activities: Lecture/Discussion 2 hour(s), Project 6 hour(s).
Enrollment Restriction(s): Restricted to senior Biomedical Engineering majors.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Oral Skills (OL); Visual Literacy (VL).

BIM 110A — Biomedical Engineering Senior Design Experience (3 units)
Course Description: Application of bioengineering theory and experimental analysis to a design project culminating in the design of a unique solution to a biomedical problem. Continues in BIM 110B.
Prerequisite(s): BIM 105; BIM 106; BIM 107; BIM 108; BIM 109; BIM 020L; (BIM 116 or BIM 181 or NPB 101).
Learning Activities: Lecture/Discussion 2 hour(s), Project 6 hour(s).
Enrollment Restrictions: Restricted to senior Biomedical Engineering majors.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Oral Skills (OL); Visual Literacy (VL).
This course version is effective from, and including: Spring Quarter 2024.

BIM 110B — Biomedical Engineering Senior Design Experience (3 units)

Course Description: Application of bioengineering theory and experimental analysis to a design project culminating in the design of a unique solution to a biomedical problem. Continues in BIM 110C.
Prerequisite(s): BIM 110A.
Learning Activities: Lecture/Discussion 2 hour(s), Project 6 hour(s).
Enrollment Restriction(s): Restricted to senior Biomedical Engineering majors.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Oral Skills (OL); Visual Literacy (VL).

BIM 110C — Biomedical Engineering Senior Design Experience (3 units)

Course Description: Application of bioengineering theory and experimental analysis to a design project culminating in the design of a unique solution to a biomedical problem.
Prerequisite(s): BIM 110B.
Learning Activities: Lecture/Discussion 2 hour(s), Project 6 hour(s).
Enrollment Restriction(s): Restricted to senior Biomedical Engineering majors.
Grade Mode: Letter.
General Education: Oral Skills (OL); Visual Literacy (VL).

BIM 111 — Biomedical Instrumentation Laboratory (6 units)

This version has ended; see updated course, below.
Course Description: 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.
Prerequisite(s): BIM 105; BIM 106; BIM 107; BIM 108; BIM 109; (ENG 100 or EEC 100); (BIM 116 or NPB 101).
Learning Activities: Lecture 4 hour(s), Discussion/Laboratory 4 hour(s).
Enrollment Restriction(s): Open to Biomedical Engineering majors only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 111 — Biomedical Instrumentation Laboratory (6 units)
Course Description: 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.
Prerequisite(s): BIM 105; BIM 106; BIM 107; BIM 108; BIM 109; (ENG 100 or EEC 100); (BIM 116 or BIM 181 or NPB 101).
Learning Activities: Lecture 4 hour(s), Discussion/Laboratory 4 hour(s).
Enrollment Restriction(s): Open to Biomedical Engineering majors only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Spring Quarter 2024.

BIM 116 — Physiology for Biomedical Engineers (5 units)

This version has ended; see updated course, below.
Course Description: 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.
Prerequisite(s): BIS 002A C- or better; PHY 009C; MAT 022B recommended.
Learning Activities: Lecture 2 hour(s), Discussion 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 116 — Quantitative Physiology (5 units)

Course Description: Human physiology from a quantitative and engineering perspective; quantitative models to understand human physiology of the pulmonary and cardiovascular systems with an emphasis on organ transport (convection and diffusion) and biomechanics.
Prerequisite(s): BIS 002A C- or better; BIM 020 C- or better; MAT 022B; PHY 009C recommended.
Learning Activities: Lecture 3 hour(s), Discussion 2 hour(s).
Enrollment Restriction(s): Open to students in the Biomedical Engineering (EBIM) major only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Winter Quarter 2024.

BIM 116 — Quantitative Physiology (5 units)

Course Description: Human physiology from a quantitative and engineering perspective; quantitative models to understand human physiology of the pulmonary and cardiovascular systems with an emphasis on organ transport (convection and diffusion) and biomechanics.
Prerequisite(s): BIS 002A C- or better; BIM 020 C- or better; (MAT 022B or MAT 027B); PHY 009C recommended.
Learning Activities: Lecture 3 hour(s), Discussion 2 hour(s).
Enrollment Restriction(s): Open to students in the Biomedical Engineering (EBIM) major only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Spring Quarter 2024.

BIM 116 — Quantitative Physiology (5 units)

Course Description: Human physiology from a quantitative and engineering perspective; quantitative models to understand human physiology of the pulmonary and cardiovascular systems with an emphasis on organ transport (convection and diffusion) and biomechanics.
Prerequisite(s): BIS 002A C- or better; BIM 020 C- or better; (MAT 022B or MAT 027B or BIS 027B); PHY 009C recommended.
Learning Activities: Lecture 3 hour(s), Discussion 2 hour(s).
Enrollment Restriction(s): Open to students in the Biomedical Engineering (EBIM) major only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Summer Session 1 2024.

BIM 117 — Modeling Strategies for Biomedical Engineering (4 units)

Course Description: Non-simulation strategies for modeling biomedical engineering systems, including natural and synthetic systems at the cell and molecular level. Formulating and testing hypotheses by translating real-world problems into appropriate mathematical models, translating mathematical results into real-world understanding, and gaining appreciation for how models contribute to the development cycle of biomedical engineering applications.
Prerequisite(s): BIS 002A C- or better; MAT 022A C- or better.
Learning Activities: Lecture 2 hour(s), Lecture/Discussion 2 hour(s).
Enrollment Restriction(s): Restricted to upper division standing.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 118 — Microelectromechanical Systems (4 units)

Course Description: Introduction to the theory and practice of micro-electromechanical systems (MEMS), including fundamentals of micro-nanofabrication, microscale sensing and actuation, self assembly, microfluidics and lab-on-a-chip. Weekly hands-on laboratory sections are emphasized on implementation and utilization of MEMS technologies.
Prerequisite(s): CHE 002A; (ENG 017 or ENG 017V).
Learning Activities: Lecture 2 hour(s), Laboratory 3 hour(s), Discussion 1 hour(s).
Enrollment Restriction(s): Pass One restricted to upper division standing in Biomedical Engineering.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 120 — Introduction to Materials Science for Biomedical Engineers (4 units)

This version has ended; see updated course, below.
Course Description: 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.
Prerequisite(s): (BIM 020 C- or better or ENG 105 C- or better); PHY 009C; MAT 022B or MAT 27B recommended.
Learning Activities: Lecture 4 hour(s).
Enrollment Restriction(s): Open to upper division Biomedical Engineering students only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 120 — Introduction to Materials Science for Biomedical Engineers (4 units)

Course Description: 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.
Prerequisite(s): (BIM 020 C- or better or ENG 105 C- or better); PHY 009C; MAT 022B or MAT 27B or BIS 027B recommended.
Learning Activities: Lecture 4 hour(s).
Enrollment Restrictions: Open to upper division Biomedical Engineering students only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Summer Session 1 2024.

BIM 125 — Introduction to Design & Analysis of Experiments for BME (4 units)

Course Description: 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.
Prerequisite(s): BIM 105 or STA 100.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 126 — Tissue Mechanics (3 units)

Course Description: Structural and mechanical properties of biological tissues, including bone, cartilage, ligaments, tendons, nerves, and skeletal muscle.
Prerequisite(s): EXB 103 or ENG 045 or ENG 045Y.
Learning Activities: Lecture 2 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 140 — Protein Engineering (4 units)

Course Description: Introduction to protein structure and function. Modern methods for designing, producing, and characterizing novel proteins and peptides. Design strategies, computer modeling, heterologous expression, in vitro mutagenesis. Protein crystallography, spectroscopic and calorimetric methods for characterization, and other techniques.
Prerequisite(s): BIS 002A.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Scientific Literacy (SL); Visual Literacy (VL).

BIM 140L — Protein Engineering Laboratory (2 units)

Course Description: Optional hands-on laboratory for BIM 140. Students use the engineering design process to design, build, and test a solution to a practical problem in the field of protein engineering. Problems change each offering.
Prerequisite(s): BIM 140 (can be concurrent); concurrent enrollment in BIM 140 required.
Learning Activities: Discussion 1 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 141 — Cell & Tissue Mechanics (4 units)

Course Description: 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.
Prerequisite(s): PHY 009B; ENG 006; ENG 035.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Visual Literacy (VL).

BIM 142 — Principles & Practices of Biomedical Imaging (4 units)

This version has ended; see updated course, below.
Course Description: Basic physics, engineering principles, and applications of biomedical imaging techniques including x-ray imaging, computed tomography, magnetic resonance imaging, ultrasound and nuclear imaging.
Prerequisite(s): BIM 108 (can be concurrent); (MAT 022B or MAT 027B).
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 142 — Principles & Practices of Biomedical Imaging (4 units)
Course Description: Basic physics, engineering principles, and applications of biomedical imaging techniques including x-ray imaging, computed tomography, magnetic resonance imaging, ultrasound and nuclear imaging.
Prerequisite(s): (MAT 022B or MAT 027B or BIS 027B); PHY 009B.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Summer Session 1 2024.

BIM 143 — Biomolecular Systems Engineering: Synthetic Biology (4 units)

Course Description: 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.
Prerequisite(s): BIS 002A; (MAT 016C or MAT 017C or MAT 021C).
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 143L — Synthetic Biology Laboratory (2 units)

Course Description: 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.
Prerequisite(s): BIM 143 (can be concurrent); concurrent enrollment in BIM 143 required.
Learning Activities: Discussion 1 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 144 — Fundamentals of Biophotonics & Bioimaging (4 units)

This version has ended; see updated course, below.
Course Description: Biophotonics and bioimaging, emphasizing quantitative description of light propagation & light tissue interactions. Key technologies and illustrative applications in basic research, clinical diagnostics and therapy.
Prerequisite(s): PHY 009B; (MAT 022B or MAT 027B); or consent of instructor. BIM 108 or equivalent helpful; Biology or Physiology course recommended.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 144 — Principles of Biophotonics (4 units)

Course Description: Principles of biophotonics, emphasizing quantitative description of light propagation, light tissue interactions, and working operation and design of biosensors and devices for optical imaging for detection of biomolecules. Key technologies and illustrative applications in basic research, clinical diagnostics, and therapy.
Prerequisite(s): PHY 009B; (MAT 022B or MAT 027B); or consent of instructor; BIM 108 or equivalent helpful.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Enrollment Restriction(s): Open to upper division Biomedical Engineering majors only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Spring Quarter 2024.

BIM 144 — Principles of Biophotonics (4 units)

Course Description: Principles of biophotonics, emphasizing quantitative description of light propagation, light tissue interactions, and working operation and design of biosensors and devices for optical imaging for detection of biomolecules. Key technologies and illustrative applications in basic research, clinical diagnostics, and therapy.
Prerequisite(s): PHY 009B; (MAT 022B or MAT 027B or BIS 027B); or consent of instructor; BIM 108 or equivalent helpful.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Enrollment Restriction(s): Open to upper division Biomedical Engineering majors only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Summer Session 1 2024.

BIM 145 — Immuno-Engineering (4 units)

Course Description: Basic immunology and immunological tools. Survey of current immuno-therapeutic strategies. Ongoing research efforts to engineer the immune system for positive diagnostic and therapeutic outcomes.
Prerequisite(s): BIM 161A or BIS 102.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 146 — Biomedical Image Processing (4 units)

Course Description: Concepts and tools of digital image processing with focus on biomedical images. Mathematical basics of various transforms used in image processing. Image denoising, image segmentation, feature extraction, image registration, and image classification. Image processing algorithms in MATLAB. Coding to process biomedical images. Essential scientist skills, including scientific writing, reading, and presentations.
Prerequisite(s): (BIM 105 C- or better or STA 131A C- or better); (BIM 108 C- or better or EEC 150 C- or better); or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Enrollment Restriction(s): Open to College of Engineering students only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 151 — Mechanics of DNA (3 units)

This version has ended; see updated course, below.
Course Description: Structural, mechanical and dynamic properties of DNA. Topics include DNA structures and their mechanical properties, in vivo topological constraints on DNA, mechanical and thermodynamic equilibria, DNA dynamics, and their roles in normal and pathological biological processes.
Prerequisite(s): BIS 002A; MAT 022B.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Oral Skills (OL); Quantitative Literacy (QL).

BIM 151 — Computational Tools & Applications in Bioengineering & Biomedicine (4 units)

Course Description: State-of-the-art computational tools and methods for biomolecular systems in bioengineering and biomedicine applications. Foundations, methods, and tools for the design of aptamers in 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.
Prerequisite(s): BIS 002A; PHY 009B; (MAT 022B or MAT 027B).
Learning Activities: Lecture 3 hour(s), Lecture/Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Winter Quarter 2024.

BIM 151 — Computational Tools & Applications in Bioengineering & Biomedicine (4 units)

Course Description: State-of-the-art computational tools and methods for biomolecular systems in bioengineering and biomedicine applications. Foundations, methods, and tools for the design of aptamers in 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.
Prerequisite(s): BIS 002A; PHY 009B; (MAT 022B or MAT 027B or BIS 027B).
Learning Activities: Lecture 3 hour(s), Lecture/Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Summer Session 1 2024.

BIM 152 — Molecular Control of Biosystems (4 units)

This version has ended; see updated course, below.
Course Description: 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.
Prerequisite(s): BIS 002A; PHY 009B; (MAT 022B or MAT 027B).
Learning Activities: Lecture 3 hour(s), Lecture/Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Oral Skills (OL).

BIM 152 — Molecular Control of Biosystems (4 units)

Course Description: 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.
Prerequisite(s): BIS 002A; PHY 009B; (MAT 022B or MAT 027B or BIS 027B).
Learning Activities: Lecture 3 hour(s), Lecture/Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Oral Skills (OL).
This course version is effective from, and including: Summer Session 1 2024.

BIM 154 — Computational Genomics (4 units)

Course Description: 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.
Prerequisite(s): ENG 006 C- or better; MAT 021D C- or better; (MAT 022A C- or better or MAT 027A C- or better); BIM 105 C- or better.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 155 — Machine Learning for Biomedical Engineering (4 units)

Course Description: Selected machine learning methods with biomedical engineering applications. Machine learning algorithms including linear regression, logistic regression, support vector machines, decision trees, fully connected neural networks, and clustering methods. Computer labs provide applications of machine learning algorithms to biomedical data.
Prerequisite(s): ENG 006 C- or better; (MAT 022A or MAT 027A); BIM 105; BIM 108 (can be concurrent); ECS 032B recommended.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Enrollment Restriction(s): Open to upper division Biomedical Engineering majors only.
Credit Limitation(s): No credit if student has taken ECS 111, ECS 171, or EEC 179; 3 units of credit if student has taken EEC 174AY or NPB 136.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 161A — Biomolecular Engineering (4 units)

Course Description: Introduction to the basic concepts and techniques of biomolecular engineering such as recombinant DNA technology, protein engineering, and molecular diagnostics.
Prerequisite(s): BIS 002A; CHE 008B or CHE 118B.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Enrollment Restriction(s): Restricted to upper division standing.
Credit Limitation(s): Only 3 units of credit for students who have taken BIM 161S.
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL).

BIM 161L — Biomolecular Engineering Laboratory (3 units)

Course Description: Introduction to the basic techniques in biomolecular engineering. Lectures, laboratory, and discussion sessions will cover basic techniques in DNA cloning, bacterial cell culture, gene regulation, protein expression, and data analysis.
Prerequisite(s): BIM 161A or BIS 101.
Learning Activities: Laboratory 4.50 hour(s), Lecture/Discussion 1.50 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Scientific Literacy (SL).

BIM 162 — Introduction to the Biophysics of Molecules & Cells (4 units)

This version has ended; see updated course, below.
Course Description: 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.
Prerequisite(s): PHY 009C C- or better; (MAT 022B C- or better or MAT 027B C- or better).
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Scientific Literacy (SL).

BIM 162 — Introduction to the Biophysics of Molecules & Cells (4 units)

Course Description: 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.
Prerequisite(s): PHY 009C C- or better; (MAT 022B C- or better or MAT 027B C- or better or BIS 027B C- or better).
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL); Scientific Literacy (SL).
This course version is effective from, and including: Summer Session 1 2024.

BIM 163 — Bioelectricity, Biomechanics, & Signaling Systems (4 units)

This version has ended; see updated course, below.
Course Description: 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.
Prerequisite(s): (BIM 116 or NPB 101); (MAT 022B C- or better or MAT 027B C- or better).
Learning Activities: Lecture 3 hour(s), Lecture/Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL).

BIM 163 — Bioelectricity, Biomechanics, & Signaling Systems (4 units)
Course Description: 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.
Prerequisite(s): (BIM 116 or BIM 181 or NPB 101); (MAT 022B C- or better or MAT 027B C- or better).
Learning Activities: Lecture 3 hour(s), Lecture/Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL).
This course version is effective from, and including: Spring Quarter 2024.

BIM 163 — Bioelectricity, Biomechanics, & Signaling Systems (4 units)
Course Description: 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.
Prerequisite(s): (BIM 116 or BIM 181 or NPB 101); (MAT 022B C- or better or MAT 027B C- or better or BIS 027B C- or better).
Learning Activities: Lecture 3 hour(s), Lecture/Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Quantitative Literacy (QL).
This course version is effective from, and including: Summer Session 1 2024.

BIM 167 — Biomedical Fluid Mechanics (4 units)

This version has ended; see updated course, below.
Course Description: 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.
Prerequisite(s): BIM 106 C- or better; NPB 101 or BIM 116.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 167 — Biomedical Fluid Mechanics (4 units)
Course Description: 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.
Prerequisite(s): BIM 106 C- or better; (NPB 101 or BIM 116 or BIM 181).
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Spring Quarter 2024.

BIM 170 — Aspects of Medical Device Design & Manufacturing (2 units)

Course Description: 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.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture 2 hour(s).
Enrollment Restriction(s): Open to upper division Biomedical Engineering majors only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 171 — Clinical Applications for Biomedical Device Design (4 units)

This version has ended; see updated course, below.
Course Description: 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.
Prerequisite(s): BIM 116 C- or better or NPB 101 C- or better; NPB 101 recommended.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Enrollment Restriction(s): Restricted to Biomedical Engineering majors only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 171 — Clinical Applications for Biomedical Device Design (4 units)
Course Description: 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.
Prerequisite(s): BIM 116 C- or better or BIM 181 C- or better or NPB 101 C- or better; NPB 101 recommended.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Enrollment Restriction(s): Restricted to Biomedical Engineering majors only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Spring Quarter 2024.

BIM 172 — Introduction to Neuroengineering Lab (2 units)

Course Description: Basics of electroencephalography (EEG). Recording EEG signals from the brain. Machine learning tools for brain-computer interface (BCI) techniques. The power of neural signals to improve health outcomes.
Prerequisite(s): BIM 105; (ENG 100 or EEC 100).
Learning Activities: Discussion 1 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 173 — Cell & Tissue Engineering (4 units)

Course Description: 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.
Prerequisite(s): BIM 106 C- or better; BIM 109 C- or better.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.
General Education: Science & Engineering (SE); Oral Skills (OL); Scientific Literacy (SL); Writing Experience (WE).

BIM 174 — Microcontroller Applications Lab (2 units)

This version has ended; see updated course, below.
Course Description: 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.
Prerequisite(s): ENG 017 C- or better.
Learning Activities: Laboratory 3 hour(s), Lecture 1 hour(s).
Enrollment Restriction(s): Restricted to upper division BME students.
Credit Limitation(s): No credit for students who have previously taken EEC 010.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 174 — Microcontroller Applications Lab (2 units)
Course Description: 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.
Prerequisite(s): ENG 017 C- or better or ENG 017V C- or better..
Learning Activities: Laboratory 3 hour(s), Lecture 1 hour(s).
Enrollment Restriction(s): Restricted to upper division BME students.
Credit Limitation(s): No credit for students who have previously taken EEC 010.
Grade Mode: Letter.
General Education: Science & Engineering (SE).
This course version is effective from, and including: Winter Quarter 2024.

BIM 176 — Microfluidic Lab (2 units)

Course Description: 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.
Prerequisite(s): CHE 002A; (ENG 017 or ENG 017V).
Learning Activities: Lecture 1 hour(s), Laboratory 3 hour(s).
Enrollment Restriction(s): Upper division standing.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 177 — Introduction to Rapid Prototyping for BME (2 units)

Course Description: Introduction to additive manufacturing techniques (3D printing), laser cutting, and other rapid prototyping technologies, their strengths and limitations. Emphasis on workflows and design considerations including features that enhance function, manufacturability, and common pitfalls. Application to problems in biology and medicine, including medical model development.
Prerequisite(s): BIM 110A; BIM 020L.
Learning Activities: Laboratory 2 hour(s); Lecture/Discussion 1 hour(s).
Enrollment Restriction(s): Open to Biomedical Engineering seniors.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 178 — Biomedical Engineering Cell Culture Laboratory (2 units)

Course Description: Fundamentals of cell culture techniques in the context of biomedical engineering research and applications. Lab basics and safety, basic wet bench skills, pipetting, aseptic technique, and fundamental two-dimensional and three-dimensional cell culture processes.
Prerequisite(s): BIM 116 or BIM 181 or NPB 101.
Learning Activities: Lecture 1 hour(s), Laboratory 3 hour(s).
Enrollment Restriction(s): Open to upper division Biomedical Engineering majors only.
Credit Limitation(s): 1 unit of credit if student has taken ANS 133.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 180 — Clinical Needs in Healthcare Settings (5 units)

Course Description: Unique hands-on experience that brings students into clinical arenas where biomedical technologies are deployed, such as surgical suites and operating rooms. Direct interaction with surgeons, radiologists and other medical providers on how engineering concepts and techniques can be applied. Development of skills necessary to identify unmet clinical needs, including observations in workflow and communication skills.
Prerequisite(s): Consent of instructor; complete all BME lower division coursework; must apply and be selected to the BME Quarter at Aggie Square program.
Learning Activities: Lecture 2 hour(s), Discussion 2 hour(s), Laboratory 3 hour(s).
Enrollment Restriction(s): Open to Biomedical Engineering majors only.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 181 — Clinical Physiology for Engineers (5 units)

Course Description: Physiological systems and their integration and homeostatic control. Biology and physics of tissues and organ systems. Disease processes. Application to clinical problems and approaches via case studies.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture 2 hour(s), Discussion 2 hour(s), Clinical Activity 3 hour(s).
Enrollment Restriction(s): Open to Biomedical Engineering majors only; must be selected to Biomedical Engineering Quarter at Aggie Square program.
Credit Limitation(s): Only 2 units of credit if student has taken BIM 116, or NPB 110C, or NPB 101.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 189A — Topics in Biomedical Engineering: Cellular & Molecular Engineering (1-5 units)

Course Description: Topics in Biomedical Engineering: Cellular & Molecular Engineering.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable 3-15 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 189B — Topics in Biomedical Engineering: Biomedical Imaging (1-5 units)

Course Description: Topics in Biomedical Engineering: Biomedical Imaging.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable 3-15 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 189C — Topics in Biomedical Engineering: Biomedical Engineering (1-5 units)

Course Description: Topics in Biomedical Engineering: Biomedical Engineering.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable 3-15 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.
General Education: Science & Engineering (SE).

BIM 190A — Upper Division Seminar in Biomedical Engineering (1 unit)

Course Description: In depth examination of research topics in a small group setting. Question and answer session with faculty members.
Learning Activities: Seminar 1 hour(s).
Enrollment Restriction(s): Restricted to upper division standing.
Repeat Credit: May be repeated.
Grade Mode: Pass/No Pass only.
General Education: Science & Engineering (SE).

BIM 192 — Internship in Biomedical Engineering (1-12 units)

Course Description: Supervised work experience in the Biomedical Engineering field.
Prerequisite(s): Consent of instructor.
Learning Activities: Internship 3-36 hour(s).
Enrollment Restriction(s): Restricted to upper division majors.
Repeat Credit: May be repeated.
Grade Mode: Pass/No Pass only.
General Education: Science & Engineering (SE).

BIM 198 — Directed Group Study (1-5 units)

Course Description: Directed group study.
Learning Activities: Variable 3-15 hour(s).
Repeat Credit: May be repeated 3 time(s) when content differs.
Grade Mode: Pass/No Pass only.
General Education: Science & Engineering (SE).

BIM 199 — Special Study for Advanced Undergraduates (1-5 units)

Course Description: Special study for advanced undergraduates.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable 3-15 hour(s).
Grade Mode: Pass/No Pass only.
General Education: Science & Engineering (SE).

BIM 201 — Scientific Communication for Biomedical Engineers (1 unit)

Course Description: Designed to improve the written and oral communication skills of first-year graduate students through writing fellowship proposals, analyzing data, and critically reviewing research papers.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Discussion 1 hour(s).
Grade Mode: Satisfactory/Unsatisfactory only.

BIM 202 — Cell & Molecular Biology for Engineers (4 units)

Course Description: Preparation for research and critical review in the field of cell and molecular biology for biomedical or applied science engineers Emphasis on biophysical and engineering concepts intrinsic to specific topics including receptor-ligand dynamics in cell signaling and function, cell motility, DNA replication and RNA processing, cellular energetics and protein sorting. Modern topics in bioinformatics and proteomics.
Prerequisite(s): BIS 104 or MCB 121.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.

BIM 204 — Physiology for Bioengineers (5 units)

Course Description: Basic human physiology of the nervous, muscular, cardiovascular, respiratory, and renal systems and their interactions; Emphasis on the physical and engineering principles governing these systems, including control and transport processes, fluid dynamics, and electrochemistry.
Prerequisite(s): BIS 001A; or equivalent; graduate standing or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

BIM 208Y — Towards Well-Being (2 units)

Course Description: Mental health issues, key elements in collaboration and team science, and select coping skills to deal with common graduate school stressors. Self-efficacy, resilience, problem-solving, conflict resolution, self-compassion, and role of psychosocial factors in well-being. Wellness topics in art therapy, interaction with nature, soothing sound/music, cooking, and walking. Mind-body activities. Extensive small group discussion.
Learning Activities: Web Electronic Discussion 1 hour(s); Lecture/Discussion 1 hour(s).
Grade Mode: S/U only.

BIM 209 — Scientific Integrity for Biomedical Engineers (2 units)

Course Description: Scientific integrity and ethics for biomedical engineers, with emphasis and discussion on mentoring, authorship and peer review, use of humans and animals in biomedical research, conflict of interest, intellectual property, genetic technology and scientific record keeping.
Learning Activities: Lecture 1 hour(s), Discussion 1 hour(s).
Enrollment Restriction(s): Open to Biomedical Engineering majors only.
Grade Mode: Satisfactory/Unsatisfactory only.

BIM 210 — Introduction to Biomaterials (4 units)

Course Description: Mechanical and atomic properties of metallic,ceramic, and polymeric implant materials of metallic, ceramic, and polymeric implant materials; corrosion, degradation, and failure of implants; inflammation, wound and fracture healing, blood coagulation; properties of bones, joints, and blood vessels; biocompatibility of orthopaedic and cardiovascular materials.
Prerequisite(s): ENG 045 or ENG 045Y; or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

BIM 211 — Design of Polymeric Biomaterials & Biological Interfaces (4 units)

Course Description: Design, selection and application of polymeric biomaterials. Integration of the principles of polymer science, surface science, materials science and biology.
Prerequisite(s): ENG 045 or ENG 045Y; or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Enrollment Restriction(s): Open to upper division undergraduates or graduate students.
Grade Mode: Letter.

BIM 212 — Biomedical Heat & Mass Transport Processes (4 units)

Course Description: Application of principles of heat and mass transfer to biomedical systems related to heat exchange between the biomedical system and its environment, mass transfer across cell membranes and the design and analysis of artificial human organs.
Prerequisite(s): EME 165; EBS 125; ECH 153; or equivalent.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).
Cross Listing: MAE 212.
Grade Mode: Letter.

BIM 213 — Principles & Applications of Biological Sensors (4 units)

Course Description: Biological sensors based on principles of electrochemical, optical and affinity detection. Methods for integration of sensing elements (e.g. enzymes) into biosensors and miniaturization of biosensors.
Prerequisite(s): CHE 002C.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

BIM 214 — Continuum Biomechanics (4 units)

Course Description: Continuum mechanics relevant to bioengineering. Concepts in tensor calculus, kinematics, stress and strain, and constitutive theories of continua. Selected topics in bone, articular cartilage, blood/circulation, and cell biomechanics will illustrate the derivation of appropriate continuum mechanics theories.
Prerequisite(s): BIM 141; ENG 102; or equivalent.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

BIM 216 — Advanced topics in Cellular Engineering (4 units)

Course Description: Advanced research strategies and technologies used in the study of immune function and inflammation. Static and dynamic measurements of stress, strain, and molecular scale forces in blood and vascular cells, as well as genetic approaches to the study of disease.
Prerequisite(s): BIM 214; or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

BIM 217 — Mechanobiology in Health & Disease (4 units)

Course Description: Principles by which biomechanical forces affect cell and tissue function to impact human health and disease. Emphasis on cardiovascular system: structure and function, biofluid mechanics and mechanotransduction, disease mechanisms and research methods. Cartilage, bone and other systems; current topics discussed.
Prerequisite(s): BIM 106; BIS 101; NPB 101; or equivalents.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.

BIM 221 — Drug Delivery Systems (4 units)

Course Description: Fundamental engineering and biotechnology principles critical for the formulation and delivery of therapeutic agents, including peptide/protein drugs and small molecules.
Prerequisite(s): BIM 204 recommended but not required.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.

BIM 222 — Cytoskeletal Mechanics (4 units)

Course Description: Current topics in cytoskeletal mechanics including physical properties of the cytoskeleton and motor proteins, molecular force sensor and generator, cytoskeletal regulation of cell motility and adhesion.
Prerequisite(s): BIM 202.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.

BIM 223 — Multibody Dynamics (4 units)

Course Description: Coupled rigid-body kinematics/dynamics; reference frames; vector differentiation; configuration and motion constraints; holonomicity; generalized speeds; partial velocities; mass; inertia tensor/theorems; angular momentum; generalized forces; comparing Newton/Euler, Lagrange's, Kane's methods; computer-aided equation derivation; orientation; Euler; Rodrigues parameters.
Prerequisite(s): ENG 102.
Learning Activities: Lecture 4 hour(s).
Cross Listing: MAE 223.
Grade Mode: Letter.

BIM 225 — Spatial Kinematics & Robotics (4 units)

Course Description: Spatial kinematics, screw theory, spatial mechanisms analysis and synthesis, robot kinematics and dynamics, robot workspace, path planning, robot programming, real-time architecture and software implementation.
Prerequisite(s): BIM 222; C Language.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Cross Listing: MAE 225.
Grade Mode: Letter.

BIM 228 — Skeletal Muscle Mechanics: Form, Function, Adaptability (4 units)

Course Description: Basic structure and function of skeletal muscle examined at the microscopic and macroscopic level. Muscle adaptation in response to aging, disease, injury, exercise, and disuse. Analytic models of muscle function are discussed.
Prerequisite(s): ENG 035; (ENG 045 or ENG 045Y); MAT 021D; basic background in biology, physiology, and engineering; NPB 101 recommended.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

BIM 232 — Skeletal Tissue Mechanics (3 units)

Course Description: Overview of the mechanical properties of the various tissues in the musculoskeletal system, the relationship of these properties to anatomic and histologic structure, and the changes in these properties caused by aging and disuse.
Prerequisite(s): Engineering 104B.
Learning Activities: Lecture 3 hour(s), Laboratory 1 hour(s).
Cross Listing: MAE 232.
Grade Mode: Letter.

BIM 233 — Soft Tissue Mechanics (4 units)

Course Description: Presentation of structure and function of musculoskeletal soft tissues: cartilage, tendon, ligament, meniscus, and intervertebral disc. Instruction in engineering principals governing the mechanical behavior of these tissues: viscoelasticity, quasilinear viscoelasticity, and biphasic theory.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

BIM 239 — Advanced Finite Elements & Optimization (4 units)

Course Description: Introduction to advanced finite elements and design optimization methods, with application to modeling of complex mechanical, aerospace and biomedical systems. Application of states of the art in finite elements in optimum design of components under realistic loading conditions and constraints.
Prerequisite(s): ENG 180 or MAT 128C or EAD 115.
Learning Activities: Lecture 4 hour(s).
Cross Listing: MAE 239.
Grade Mode: Letter.

BIM 240 — Computational Methods in Nonlinear Mechanics (4 units)

Course Description: Deformation of solids and the motion of fluids treated with state-of-the-art computational methods. Numerical treatment of nonlinear dynamics; classification of coupled problems; applications of finite element methods to mechanical, aeronautical, and biological systems.
Prerequisite(s): MAT 128B or ENG 180 or EAD 115.
Learning Activities: Lecture 4 hour(s).
Cross Listing: MAE 240.
Grade Mode: Letter.

BIM 241 — Introduction to Magnetic Resonance Imaging (4 units)

Course Description: Basic hardware, acquisition, and reconstruction of MRI. Basic and advanced pulse sequences, MRI sequence design and sampling requirements, and image reconstruction strategies. Clinical applications of MRI.
Prerequisite(s): BIM 108; PHY 009D.
Learning Activities: Lecture 3 hour(s), Project.
Grade Mode: Letter.

BIM 242 — Introduction to Biomedical Imaging (4 units)

Course Description: Basic physics and engineering principles of image science. Emphasis on ionizing and nonionizing radiation production and interactions with the body and detectors. Major imaging systems: radiography, computed tomography, magnetic resonance, ultrasound, and optical microscopy.
Prerequisite(s): PHY 009D; EEC 106 or consent of instructor.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

BIM 243 — Radiation Detectors for Biomedical Applications (4 units)

Course Description: Radiation detectors and sensors used for biomedical applications. Emphasis on radiation interactions, detection, measurement and use of radiation sensors for imaging. Operating principles of gas, semiconductor, and scintillation detectors.
Prerequisite(s): PHY 009D; MAT 021D; MAT 022B.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.

BIM 246 — Magnetic Resonance Technology (3 units)

Course Description: Covers MRI technology at an advanced level with emphasis on mathematical descriptions and problem solving. Topics include spin dynamics, signal generation, image reconstruction, pulse sequences, biophysical basis of T1, T2, RF, gradient coil design, signal to noise, image artifacts.
Prerequisite(s): PHY 009D; MAT 022B.
Learning Activities: Lecture 3 hour(s).
Grade Mode: Letter.

BIM 248 — Multi-modal Neuroimaging Techniques (4 units)

Course Description: Neuroimaging techniques including magnetic resonance imaging (MRI) and positron emission tomography (PET) and their multi-modal applications in neuroscience and neurological disorders. Imaging methods and brain biomarkers. Software and coding experience to analyze imaging datasets of brain structure, function, and pathology.
Prerequisite(s): BIM 108; BIM 142.
Learning Activities: Lecture 3 hour(s), Project.
Grade Mode: Letter.

BIM 251 — Medical Image Analysis (4 units)

Course Description: Techniques for assessing the performance of medical imaging systems. Principles of digital image formation and processing. Measurements that summarize diagnostic image quality and the performance of human observers viewing those images. Definition of ideal observer and other mathematical observers that may be used to predict performance from system design features. Obtain hands-on experience in computer vision by completing individual Matlab assignments that they select from topics in the course.
Prerequisite(s): EEC 106.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

BIM 252 — Computational Methods in Biomedical Imaging (4 units)

Course Description: Analytic tomographic reconstruction from projections in 2D and 3D; model-based image reconstruction methods; maximum likelihood and Bayesian methods; applications to CT, PET, and SPECT.
Prerequisite(s): (BIM 105 or STA 120); (BIM 108 or EEC 150A).
Learning Activities: Lecture 4 hour(s).
Cross Listing: EEC 205.
Grade Mode: Letter.

BIM 254 — Statistical Methods in Genomics (4 units)

Course Description: Statistical approaches to problems in computational molecular biology and genomics; formulation of questions via probabilistic modeling, statistical inference methods for parameter estimation, and interpretation of results to address biological questions; application to high-impact problems in functional genomics and molecular biology.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

BIM 255 — Nanoscale Imaging for Molecular Medicine (3 units)

Course Description: Current and emerging technologies to visualize biological structures and processes at size scales = 100 nanometers — and their application towards the advancement of molecular medicine. Technologies include superresolution optical microscopy, electron microscopy and tomography. Emphasis on quantitative imaging.
Prerequisite(s): BIM 202 highly recommended; graduate standing.
Learning Activities: Lecture/Discussion 3 hour(s).
Cross Listing: BPH 255.
Grade Mode: Letter.

BIM 257 — Fundamentals of Tissue Optics & Biomedical Applications (5 units)

Course Description: Fundamentals of optical properties of tissue. Range of optical technologies and their applications to tissue characterization and diagnostics.
Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s), Laboratory 3 hour(s).
Grade Mode: Letter.

BIM 258 — Advanced Biophotonics & Bioimaging (4 units)

Course Description: Quantitative basis for biophotonics and bioimaging, with an emphasis on the physical and mathematical description of optics, light propagation, and light-tissue interactions. Advantages and limitations of various optical imaging and sensing technologies. Illustrative applications in diagnostics, basic research, and therapy.
Prerequisite(s): BIM 108; PHY 108; or an equivalent undergraduate optics course to PHY 108.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

BIM 260 — Techniques in Molecular & Cellular Mechanics (4 units)

Course Description: Physical techniques used to visualize and manipulate mechanical processes in cells. Biophysical techniques used to characterize cellular and molecular mechanics, with a particular emphasis on single molecule technologies.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.

BIM 262 — Cell & Molecular Biophysics for Bioengineers (4 units)

Course Description: Introduction to fundamental mechanisms governing the structure, function, and assembly of bio-macromolecules. Emphasis is on a quantitative understanding of the nano-to-microscale interactions between and within individual molecules, as well as of their assemblies, in particular membranes.
Prerequisite(s): BIM 284; or equivalent; graduate standing; undergraduate students by consent of instructor.
Learning Activities: Lecture 4 hour(s).
Credit Limitation(s): Not open for credit to students who have completed BIM 162.
Cross Listing: ECH 269.
Grade Mode: Letter.

BIM 263 — Optical Microscopy Hands-On (4 units)

Course Description: Informed use of an optical research microscope. Analysis of digitized images. Optical image formation and its limitations. Laboratories on modern microscope usage and videomicroscopy techniques including optimization of recorded images and quantification of microscopic distances and displacements.
Prerequisite(s): Consent of instructor.
Learning Activities: Lecture/Discussion 2 hour(s), Laboratory 4 hour(s).
Grade Mode: Letter.

BIM 264 — Synthetic & Systems Engineering of Cells (4 units)

Course Description: Introduction to the design, engineering, and control of biological systems for biotechnological applications and biological studies.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

BIM 265 — NanoEngineering (4 units)

Course Description: Inorganic and organic nanomaterials and their technological applications in medicine, imaging, energy harvesting, and computing. Fundamentals and applications of methods to fabricate, image, and analyze materials and devices that are structured at the nanometer scale. Intermolecular forces between atoms and molecules and how these forces give rise to exploitable phenomena at the nanoscale.
Prerequisite(s): BIM 109 or BIM 120.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.

BIM 272 — Tissue Engineering (3 units)

Course Description: Based on morphogenetic signals, responding stem cells and extracellular matrix scaffolding. Design and development of tissues for functional restoration of various organs damaged/lost due to cancer, disease and trauma. Fundamentals of morphogenetic signals, responding stem cells and extracellular matrix scaffolding.
Prerequisite(s): BIS 104 or MCB 121.
Learning Activities: Lecture/Discussion 3 hour(s).
Grade Mode: Letter.

BIM 273 — Integrative Tissue Engineering & Technologies (4 units)

Course Description: Engineering principles to direct cell and tissue behavior and formation. Contents include controlled delivery of macromolecules, transport within and around biomaterials, examination of mechanical forces of engineered constructs, and current experimental techniques used in the field.
Prerequisite(s): BIM 202; BIM 204; or equivalent; strongly encourage completion of BIM 272 although not a prerequisite.
Learning Activities: Lecture/Discussion 4 hour(s).
Enrollment Restriction(s): Restricted to graduate standing.
Grade Mode: Letter.

BIM 280 — Neural Signals & Machine Learning Tools for Neural Data (4 units)

Course Description: Select and use machine learning tools to analyze neural data. Knowledge of the definitions and fundamental principles of data analytics related to neural data including field potentials (EEG, iEEG, local field potentials, EMG) and single neuron or muscle action potentials. Neural decoding/encoding, how to apply classifiers, regression and dimension reduction techniques, factor analysis and dynamic modeling.
Learning Activities: Lecture 4 hour(s).
Grade Mode: Letter.

BIM 281 — Acquisition & Analysis of Biomedical Signals (4 units)

Course Description: Basic concepts of digital signal recording and analysis; sampling; empirical modeling; Fourier analysis, random processes, spectral analysis, and correlation applied to biomedical signals.
Prerequisite(s): ENG 100; STA 130A.
Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).
Enrollment Restriction(s): Restricted to upper division engineering.
Grade Mode: Letter.

BIM 283 — Advanced Design of Experiments for Biomedical Engineers (4 units)

Course Description: Provides biomedical engineering graduate students with the tools to properly design experiments, collect and analyze data, and extract, communicate and act on information generated.
Learning Activities: Lecture 4 hour(s).
Enrollment Restriction(s): Open to graduate students only.
Credit Limitation(s): Not open for credit to students who have taken EBS 265.
Grade Mode: Letter.

BIM 284 — Mathematical Methods for Biomedical Engineers (4 units)

Course Description: Theoretical applications of linear systems, ordinary and partial differential equations, and probability theory and random processes that describe biological systems and instruments that measure them. Students will be introduced to numerical solution techniques in MATLAB.
Prerequisite(s): MAT 022B; STA 130A; or consent of instructor; upper division biomedical engineering majors, and graduate students in sciences and engineering; priority given to Biomedical Engineering graduate students.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.

BIM 286 — Nuclear Imaging in Medicine & Biology (4 units)

Course Description: Radioactive decay, interaction of radiation with matter, radionuclide production, radiation detection, digital autoradiography, gamma camera imaging, single photon emission computed tomography, positron emission tomography and applications of these techniques in biology and medicine.
Prerequisite(s): BIM 243; or consent of instructor.
Learning Activities: Lecture/Discussion 4 hour(s).
Grade Mode: Letter.

BIM 287 — Concepts in Molecular Imaging (4 units)

Course Description: Current techniques and tools for molecular imaging. Emphasis on learning to apply principles from the physical sciences to imaging problems in medicine and biology.
Prerequisite(s): CHE 002C; MAT 021C; PHY 009D; and consent of instructor.
Learning Activities: Lecture 2 hour(s), Lecture/Discussion 2 hour(s), Term Paper.
Grade Mode: Letter.

BIM 288 — Living Matter: Physical Biology of the Cell (3 units)

Course Description: Introduction to the origin, maintenance, and regulation of the dynamic architecture of the cell, including cellular modes of organization, dynamics and energy dissipation, molecular transport, motility, regulation, and adaptability.
Learning Activities: Lecture 3 hour(s).
Enrollment Restriction(s): Open to any student possessing general background in any disciplines of physical or biological sciences and engineering.
Cross Listing: EMS 288, BPH 288.
Grade Mode: Letter.

BIM 289A — Selected Topics in Biomedical Engineering: Cellular & Molecular Systems Engineering (1-5 units)

Course Description: Selected topics in Cellular and Molecular Systems Engineering.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable 1-5 hour(s).
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

BIM 289B — Selected Topics in Biomedical Engineering: Biomedical Imaging (1-5 units)

Course Description: Selected topics in Biomedical Imaging.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

BIM 289C — Selected Topics in Biomedical Engineering: Computational Bioengineering (1-5 units)

Course Description: Selected topics in Computational Bioengineering.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

BIM 289D — Selected Topics in Biomedical Engineering: Cell & Tissue Biomechanics (1-5 units)

Course Description: Selected topics in Cell and Tissue Biomechanics.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

BIM 289E — Selected Topics in Biomedical Engineering: Analysis of Human Movement (1-5 units)

Course Description: Selected topics in Analysis of Human Movement.
Prerequisite(s): Consent of instructor.
Learning Activities: Variable.
Repeat Credit: May be repeated when topic differs.
Grade Mode: Letter.

BIM 290 — Seminar (1 unit)

Course Description: Seminar in biomedical engineering.
Learning Activities: Seminar 1 hour(s).
Grade Mode: Satisfactory/Unsatisfactory only.

BIM 290C — Graduate Research Conference (1 unit)

Course Description: Individual and/or group conference on problems, progress, and techniques in biomedical engineering research.
Prerequisite(s): Consent of instructor.
Learning Activities: Discussion 1 hour(s).
Repeat Credit: May be repeated.
Grade Mode: Satisfactory/Unsatisfactory only.

BIM 295 — Literature in Neuroengineering (2 units)

Course Description: Critical presentation and discussion of current literature in neuroengineering.
Learning Activities: Seminar 2 hour(s).
Enrollment Restriction(s): Open to graduate students only.
Repeat Credit: May be repeated.
Cross Listing: NSC 295.
Grade Mode: Satisfactory/Unsatisfactory only.

BIM 298 — Directed Group Study (1-5 units)

Course Description: Directed group study in Biomedical Engineering.
Learning Activities: Variable 1-5 hour(s).
Enrollment Restriction(s): Open to graduate students in the Biomedical Engineering Graduate Group, or consent of instructor.
Repeat Credit: May be repeated.
Grade Mode: Satisfactory/Unsatisfactory only.

BIM 299 — Research (1-12 units)

Course Description: Research.
Learning Activities: Variable.
Grade Mode: Satisfactory/Unsatisfactory only.

BIM 396 — Teaching Assistant Training Practicum (1-4 units)

Course Description: Teaching assistant training practicum.
Prerequisite(s): Graduate standing.
Learning Activities: Variable.
Repeat Credit: May be repeated.
Grade Mode: Pass/No Pass only.