Pre-Approved BioE Electives

Academic Year 2026–2027

All courses listed are subject to change — please confirm current offerings and quarter in Gold.

BioE approved Elective Courses

Course	Title	Instructor	Quarter Offered	Description
BIOE 242	**Tissue Engineering and Regenerative Medicine**	Dewey	Fall 2026	An introduction to the principles of tissue engineering: interplay and design of cells, biomaterials, and bioactive molecules to assist the body in the repair of damaged tissues. Covers material fabrication approaches, engineering cells and their behavior, tissue microenvironments, the role of extracellular matrix in repair, in vitro approaches, and delivery of bioactive molecules (growth factors, extracellular vesicles, etc.). By the end of the course, students will be able to design and evaluate tissue engineered constructs to repair a specific organ system.
BIOE 241	**Engineering Biomaterials**	Stowers	Fall 2026	Lecture-based overview of material structure-property relationships, processing, and characterization techniques for metals, polymers and ceramics. Discusses design constraints imposed by the human body and strategies to enhance biocompatibility, with emphasis on applications of biomaterials engineering in medical devices.
BIOE 258	**Mechanobiology Methods**	Stowers	Winter 2027	Cell mechanobiology topics including cell structure, mechanical models, and chemo-mechanical signaling. Review and apply methods for controlling and analyzing the biomechanics of cells using traction force microscopy, AFM, micropatterning and cell stimulation. Design and application of methods for quantitative cell mechanobiology.
BIOE 244	**Introduction to Machine Learning Techniques for Interpretation of Biological Data**	Volkman	Spring 2027	General introduction to modern Machine Learning techniques with a focus on neural networks relevant to biological image processing and structural biology applications across scales from the atomic level to organisms.
BIOE 243	**Protein Engineering**	Mills	Spring 2027	Introduces current methods and general principles of engineering proteins, focusing on overall strategies for library generation, screening, and selection so students can extend approaches to engineering other biomolecules of interest (e.g., nucleic acids).
BIOE 250AG	**3D Printing for Bioengineering**	Dewey	Spring 2027	3D printing and bioprinting are critical tools used in bioengineering, from studying cell interactions to creating organs. Students will learn the basics of mammalian cell culture and how it integrates with bioprinting, how to use CAD software to develop 3D prints through in-class workshops, and ultimately design and print their own biological model for use in an interactive demo at a local public outreach event. Students will also learn materials selection, multi-material printing, various types of printers, and the parameters that matter in 3D printing for biological applications. While the course covers 3D printing broadly, the focus is largely on biomedical and bioengineering applications of 3D printing and bioprinting.

Course	Title	Instructor	Quarter Offered	Description
BIOE 254	**Systems Biology**	Dey	AY 27/28	Applications of engineering tools and methods to solve problems in systems biology, emphasizing integrative approaches that address multi-scale and multi-rate phenomena in biological regulation. Introduces modeling, optimization, and sensitivity analysis tools.
CHEM 259MM	**Gene Therapy**	Mukherjee	TBD	Developing therapies using nucleic acids for human diseases is a high-risk, high-reward endeavor in bioengineering and medicine. This course explores gene delivery, noninvasive reporter gene imaging, genetic editing, clinical trials, and the social and ethical considerations of gene therapy.
BIOE 274	**Model-guided Engineering of Biological Systems**	Mukherjee	TBD	Introduces foundational principles of biological engineering, integrating mechanistic modeling and quantitative analysis with basic molecular and cell biology, including biomolecular interactions, gene expression, network dynamics, and coupled mass transport & reaction. Includes a term project applying Poisson statistics & the Gillespie algorithm to model a biological process; Ph.D. students additionally implement classic modeling papers.
BIOE 240	**Haptics – Touch Perception, Interaction, and Engineering**	Visell	TBD	Haptics lies at the intersection of robotics, human-computer interaction, and computational and human perception. Introduces human haptics, sensory specializations, touch perception, and the engineering of electronic technologies for haptic feedback, including applications in sensory substitution, VR, and AR. Mix of readings, hands-on activities, lecture/discussion, and projects.
BIOE 272	**Omics-enabled Biotechnology**	O'Malley	TBD	Integrates genomic, transcriptomic, metabolomic, and proteomic approaches to quantify and understand intricate biological systems, alongside bioinformatics approaches to curate large associated datasets. By course end, students should be able to design an integrated experiment capitalizing on these "omics"-based approaches.
BIOE 250AD / ME 225EY	**Biological Control**	Yeung	TBD	Equips students with an understanding of how to use modern control methods to control biological networks and genetic circuits, including H2 and H∞ control methods, modeling of insularity/crosstalk in synthetic gene networks, and genetic circuit design using data-driven methods (sensor fusion, dynamic mode decomposition, dictionary-based approaches).

APPROVED SCIENCE AND ENGINEERING ELECTIVES

Course	Title	Instructor	Quarter Offered	Description
CS 291A	**Bionic Vision**	Beyeler	—	A multidisciplinary graduate course on bionic vision, covering current bionic eye technology, the neuroscience of the human visual system, brain-computer interface design, and computational principles for encoding a visual scene into an artificial stimulus. Concludes with a team project on open problems in the field.
PSY 221F	**Computational Neuroscience**	Beyeler	—	Survey of methods in computational neuroscience, including single-cell methods (Hodgkin-Huxley models, integrate-and-fire models), neural network modeling (linear system theory, nonlinear

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				dynamics, connectionism), models of synaptic plasticity, and methods for generating predicted BOLD signals.
ME 225ED	**Bio-inspired Design**	Dressaire	—	Explores how nature can support the creative design process through evolutionary adaptation, extracting design principles from biological systems, with a focus on biologically inspired design in fluids. Includes lectures, case studies, and a team-based final project centered on a biological system from the local zoo.
MCDB 208C	**Computational and Systems Biology**	Louis	—	Introductory systems-biology approach to modeling the design and function of biological systems, covering probabilities and basic dynamical systems theory. Students build models of increasing complexity, from viral dynamics and bacterial drug resistance to homeostatic equilibrium, biological oscillators, and genetic switches.
PHYS 239	**Physical Biology of the Cell**	Marchetti, Dogic, Streichan	—	Explores the role of physics in biology through quantitative measurement and modeling, cell organization, and the physics of biologically relevant macromolecules (DNA, RNA, transcription/translation, protein folding). Covers the physics of the cytoskeleton, molecular motors, and active stresses, with a possible introduction to cell motility and epithelial tissue structure.
ECE 594N	**Biological Shape Analysis**	Miolane	—	Geometric transformations, mathematical models of shapes, articulated shapes, shapes of landmarks, curves and surfaces, shape deformations, and shape statistics and machine learning, with applications to the analysis of protein, cell, and organ shapes in computational biology and medicine.
MATRL 270	**Biomaterials and Biosurfaces**	Pitenis	—	Explores the fundamentals of natural and artificial biomaterials and biosurfaces, with emphasis on surface and contact mechanics, molecular-level structure and function, and the dynamic interactions between biomaterials and the body for biocompatible design.
MATRL 272	**Mechanical Force and Biomolecules**	Saleh	—	Explores single-molecule biophysics and the role of mechanical force in biomolecular behavior, including experimental techniques (optical/magnetic traps, AFM) and quantitative calibration. Covers linear elasticity of biomolecules, DNA torsional mechanics and topology, force-induced unfolding/unzipping, motor protein force generation, and stochastic physical models, drawing on recent literature and student presentations.
ECE 594	**Measuring and Manipulating Neuronal Activity**	Smith	—	Covers neuroengineering technology, including optical and electrical methods, for measuring and manipulating neural activity with resolution down to individual neurons and synapses, with applications to neuroscience research, ML/AI, and brain-machine interfaces.
MCDB 272	**Biological Dynamics**	Wilson	—	Introduction to mathematical models and computer simulations used to describe and understand time-varying biological systems. Surveys mathematical methods for describing time-dependence in biological phenomena and develops a working knowledge of a Python code base for evaluating common classes of models.

Writing Electives

Only one of the two writing courses below may be taken as an elective.

Course	Title	Instructor	Quarter Offered	Description
MCDB 221	**Preparation and Evaluation of Research Proposals and Scientific Presentations**	De Tomaso/Kim	—	Instruction in the preparation, writing, and evaluation of research grant proposals. Covers federal funding mechanisms, research ethics, peer review and proposal evaluation processes, and strategies for communicating scientific ideas, including poster and oral presentations. Writing-based, with guidance on applying to NSF and NIH Pre-Doctoral Fellowships.
EEMB 511	**Writing Science**	Schimmel	—	A hands-on workshop to polish writing skills, with modules on storytelling to make ideas compelling, streamlining writing for compactness and effectiveness, and developing flow of ideas and paragraphs. Students work on a chapter, paper, or proposal.