Translational Medicine

The MTM program is a cross-campus collaboration between the Department of Bioengineering at UC Berkeley (http://bioeng.berkeley.edu/) and the Department of Bioengineering and Therapeutic Sciences at UCSF (http://bts.ucsf.edu/). Students are enrolled in both Universities and draw on the range of expertise and technological resources available at the two institutions. In addition to these two core departments, students join in aspects of the leadership training offered by the Fung Institute for Engineering Leadership (http://funginstitute.berkeley.edu/) at UC Berkeley.

This program is designed to train students in applying translational research and engineering approaches to solve fundamental problems in healthcare delivery. The program is focused on addressing real-world problems in a creative, interdisciplinary team setting.

This program should appeal to engineers, scientists, and clinicians who seek to bring innovative treatments and devices into clinical use. Individuals with backgrounds in medicine, nursing, dentistry, and pharmacy are encouraged to apply. We anticipate that upon receiving their master's degree or after further academic or clinical training, graduates will work in industries that deliver healthcare products or patient care.

The MTM program is an intense year of coursework designed around the main content themes of engineering, clinical needs & strategies, and business, entrepreneurship & technology. The centerpiece of the curriculum is the capstone project (http://uctranslationalmedicine.org/projects/) course. Complementing 10 months of work with external mentors, this class meets regularly to provide peer support, introduce concepts in translational medicine, and develop presentation skills.

The MTM program is focused specifically on training in translational medicine as opposed to basic research science. As such, this master's degree is intended as a terminal degree for students interested in industry and entrepreneurship and is not a gateway to the Bioengineering PhD program.

MTM Admissions

Please see the MTM Program website (http://uctranslationalmedicine.org/) for detailed application instructions.

Admissions decisions are governed by committee, and are based on several factors in the application, including (but not limited to) test scores, academics, essays, letters of recommendation, and prior research and work experience. Students from all educational fields are eligible to apply, but all applicants should be aware that the masters curriculum includes required coursework in bioengineering fundamentals; applicants with a non-technical background should make it clear in their application why they feel that they will be able to handle the more rigorous technical components of the coursework. Applicants who already hold a master's degree in bioengineering (or a similar field) will need to carefully specify their reasons for pursuing this additional masters; duplicate degrees are not allowed.

Please note: Applicants who intend to pursue additional degrees beyond the MTM program should be prepared to explain their intended educational trajectory.

Admission to the University

Applying for Graduate Admission

Thank you for considering UC Berkeley for graduate study! UC Berkeley offers more than 120 graduate programs representing the breadth and depth of interdisciplinary scholarship. The Graduate Division hosts a complete list (https://grad.berkeley.edu/admissions/choosing-your-program/list/) of graduate academic programs, departments, degrees offered, and application deadlines can be found on the Graduate Division website.

Prospective students must submit an online application to be considered for admission, in addition to any supplemental materials specific to the program for which they are applying. The online application and steps to take to apply can be found on the Graduate Division website (https://grad.berkeley.edu/admissions/steps-to-apply/).

Admission Requirements

The minimum graduate admission requirements are:

1. A bachelor's degree or recognized equivalent from an accredited institution;
2. A satisfactory scholastic average, usually a minimum grade-point average (GPA) of 3.0 (B) on a 4.0 scale; and
3. Enough undergraduate training to do graduate work in your chosen field.

For a list of requirements to complete your graduate application, please see the Graduate Division's Admissions Requirements page (https://grad.berkeley.edu/admissions/steps-to-apply/requirements/). It is also important to check with the program or department of interest, as they may have additional requirements specific to their program of study and degree. Department contact information can be found here (https://guide.berkeley.edu/archive/2024-25/graduate/degree-programs/).

Where to apply?

Visit the Berkeley Graduate Division application page (http://grad.berkeley.edu/admissions/apply/).

Admission to the Program

Applicants from countries in which the official language is not English must also demonstrate English language proficiency.

Curriculum

Satisfactory completion of the MTM program requires the completion of 24 semester (or equivalent) units of upper division and graduate courses, including 6 semester (or equivalent) units of a master's capstone project (http://uctranslationalmedicine.org/projects/) administered by the MTM faculty directors. Presentation of the capstone project at a final symposium is required.

Two additional required MTM courses can be split across categories to help you design a curriculum that fits your interests:

- The 6 semester units of the required MTM Capstone Course [BIOENG 296 at UCSF; 3 units per quarter, 9 quarter units] can be distributed between the *Engineering* and *Clinical Needs and Strategies* categories

- The 4 units of the required Project Management Course [BIO ENG 290 and BIO ENG 291 at Berkeley; 2 unitS per semester] can be distributed between the *Engineering* and *Business Entrepreneurship, and Technology* categories

Please see the MTM curriculum website (http://uctranslationalmedicine.org/curriculum/) for more detail.

Technical Courses (at least 10 semester units or equivalent)

Courses Required- 10 semester units		
BIO ENG 270: Translational Challenges: Diagnostics, Devices, and Therapeutics (UCSF course, 2 quarter units)		
BIO ENG 280	Ethical and Social Issues in Translational Medicine (Berkeley)	1
Bioengineering Electives per approved study list (https://uctranslationalmedicine.org/curriculum/electives/#engineering)		

Clinical Needs and Strategies Courses (at least 6 semester units or equivalent)

Courses Required- 6 semester units
BIO ENG 283: Designing Clinical Research (UCSF, 2 quarter units)
BIO ENG 260: Translational Challenges as Medicine--"Anti-Medical School" (UCSF course, 1 quarter unit)
BIO ENG 285: Health Care Finance and Economics (UCSF course, 2 quarter units)
Clinical needs and strategies electives per approved study list

Business, Entrepreneurship & Technology Courses (at least 8 semester units or equivalent)

Courses Required - 8 semester units		
ENGIN 270A	Organizational Behavior for Engineers	1
ENGIN 270B	R&D Technology Management & Ethics (ENGIN 270 D/E/F/G/H/I/J - choose two)	1
ENGIN 270 D-Q - choose two (https://uctranslationalmedicine.org/curriculum/electives (https://uctranslationalmedicine.org/curriculum/electives/))		2
Business/Entrepreneurship Electives per approved study list		

Translational Medicine

BIO ENG 200 The Graduate Group Introductory Seminar 1 Unit

Terms offered: Fall 2025, Fall 2024, Fall 2023
An introduction to research in bioengineering including specific case studies and organization of this rapidly expanding and diverse field.
Rules & Requirements

Prerequisites: Enrollment in PhD Program in Bioengineering or consent of instructor

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of seminar per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

BIO ENG 201 Responsible Conduct in Bioengineering Research and in Practice 1 Unit

Terms offered: Spring 2025, Spring 2024, Spring 2023
This course will explore ethical issues likely to be faced by a bioengineer, and consider them in the context of responsible engineering. The content of the class is designed considering the NSF Standards of Ethical Conduct and the NIH Ethical Guidelines & Regulations in mind, and to serve as the Responsible Conduct of Research training for our PhD program.
Objectives & Outcomes

Course Objectives: The content of the class is designed considering the NSF Standards of Ethical Conduct and the NIH Ethical Guidelines & Regulations in mind, and to serve as the Responsible Conduct of Research training for our PhD program.

Student Learning Outcomes: To prepare bioengineering PhD students to perform their research and design responsibly.

Rules & Requirements

Prerequisites: Open only to Bioengineering graduate students

Hours & Format

Fall and/or spring: 10 weeks - 1 hour of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructor: Terry Johnson

BIO ENG 202 Cell Engineering 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023

This course will teach the main concepts and current views on key attributes of animal cells (somatic, embryonic, pluripotent, germ-line; with the focus on mammalian cells), will introduce theory of the regulation of cell function, methods for deliberate control of cell properties and resulting biomedical and bioengineering technologies.

Objectives & Outcomes

Course Objectives: The goal of this course to establish fundamental understanding of cell engineering technologies and of the key biological paradigms, upon which cell engineering is based, with the focus on biomedical applications of cell engineering.

Student Learning Outcomes: At the completion of this course students will understand how bioengineering technologies address the deliberate control of cell properties (and how this advances biomedicine); and students will learn the main concepts and current views on key attributes of animal cells (somatic, embryonic, pluripotent, germ-line; with the focus on mammalian cells).

Rules & Requirements

Prerequisites: BIOLOGY 1A or BIO ENG 11; or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 2 hours of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Conboy

BIO ENG 203 Tissue Engineering lab 4 Units

Terms offered: Prior to 2007

This class provides a conceptual and practical understanding of cell and tissue bioengineering that is vital for careers in medicine, biotechnology, and bioengineering. Students are introduced to cell biology laboratory techniques, including immunofluorescence, quantitative image analysis, protein quantification, protein expression, gene expression, and cell culture.

Objectives & Outcomes

Course Objectives: The goal of this course to provide students with conceptual and practical understanding of cell and tissue bioengineering.

Student Learning Outcomes: At the completion of this course, students will learn key cellular bioengineering laboratory techniques, will develop a conceptual and theoretical understanding of the reliability and limitations of these techniques and will enhance their skills in quantitative data analysis, interpretation and integration.

Rules & Requirements

Prerequisites: BIO ENG 114 or BIO ENG 202, or BIO ENG 11; or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 9 hours of laboratory and 1 hour of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Conboy

BIO ENG C208 Biological Performance of Materials 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
This course is intended to give students the opportunity to expand their knowledge of topics related to biomedical materials selection and design. Structure-property relationships of biomedical materials and their interaction with biological systems will be addressed. Applications of the concepts developed include blood-materials compatibility, biomimetic materials, hard and soft tissue-materials interactions, drug delivery, tissue engineering, and biotechnology.

Objectives & Outcomes

Course Objectives: The course is separated into four parts spanning the principles of synthetic materials and surfaces, principles of biological materials, biological performance of materials and devices, and state-of-the-art materials design. Students are required to attend class and master the material therein. In addition, readings from the clinical, life and materials science literature are assigned. Students are encouraged to seek out additional reference material to complement the readings assigned. A mid-term examination is given on basic principles (parts 1 and 2 of the outline). A comprehensive final examination is given as well. The purpose of this course is to introduce students to problems associated with the selection and function of biomaterials. Through class lectures and readings in both the physical and life science literature, students will gain broad knowledge of the criteria used to select biomaterials, especially in devices where the material-tissue or material-solution interface dominates performance. Materials used in devices for medicine, dentistry, tissue engineering, drug delivery, and the biotechnology industry will be addressed.

This course also has a significant design component (~35%). Students will form small teams (five or less) and undertake a semester-long design project related to the subject matter of the course. The project includes the preparation of a paper and a 20 minute oral presentation critically analyzing a current material-tissue or material-solution problem. Students will be expected to design improvements to materials and devices to overcome the problems identified in class with existing materials.

Student Learning Outcomes: Work independently and function on a team, and develop solid communication skills (oral, graphic & written) through the class design project.

- Develop an understanding of the social, safety and medical consequences of biomaterial use and regulatory issues associated with the selection of biomaterials in the context of the silicone breast implant controversy and subsequent biomaterials crisis.
- Design experiments and analyze data from the literature in the context of the class design project.

- Understanding of the origin of surface forces and interfacial free energy, and how they contribute to the development of the biomaterial interface and ultimately biomaterial performance.
- Apply math, science & engineering principles to the understanding of soft materials, surface chemistry, DLVO theory, protein adsorption kinetics, viscoelasticity, mass diffusion, and molecular (i.e., drug) delivery kinetics.
- Apply core concepts in materials science to solve engineering problems related to the selection biomaterials, especially in devices where the material-tissue or material-solution interface dominates performance.

Rules & Requirements

BIO ENG C209 Advanced Orthopedic Biomechanics 4 Units

Terms offered: Fall 2024, Fall 2023, Fall 2022
Students will learn the application of engineering concepts including statics, dynamics, optimization theory, composite beam theory, beam-on-elastic foundation theory, Hertz contact theory, and materials behavior. Topics will include forces and moments acting on human joints; composition and mechanical behavior of orthopedic biomaterials; design/analysis of artificial joint, spine, and fracture fixation prostheses; musculoskeletal tissues including bone, cartilage, tendon, ligament, and muscle; osteoporosis and fracture-risk predication of bones; and bone adaptation. Students will be challenged in a MATLAB-based project to integrate the course material in an attempt to gain insight into contemporary design/analysis/problems.

Objectives & Outcomes

Course Objectives: The purpose of this course is twofold:

- to learn the fundamental concepts of orthopaedic biomechanics;
- to enhance skills in mechanical engineering and bioengineering by analyzing the mechanical behavior of various complex biomedical problems.

Student Learning Outcomes: Working knowledge of various engineering concepts such as composite beam theory, beam-on-elastic-foundation theory, Hertz contact theory and MATLAB-based optimization design analysis. Understanding of basic concepts in orthopaedic biomechanics and the ability to apply the appropriate engineering concepts to solve realistic biomechanical problems, knowing clearly the assumptions involved.

Rules & Requirements

Prerequisites: ME C85/CE C30 or Bio Eng 102; concurrent enrollment OK. Proficiency in MatLab or equivalent. Prior knowledge of biology or anatomy is not assumed

Credit Restrictions: Students will not receive credit for this course if they have taken ME C176/Bio E C119.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 1 hour of laboratory per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructors: O'Connell, Keaveny

Also listed as: MEC ENG C210

BIO ENG 211 Cell and Tissue Mechanotransduction 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2018
This course will focus on biophysical and bioengineering aspects of mechanotransduction, the process through which living cells sense and respond to their mechanical environment. Students will learn how mechanical inputs to cells influence both subcellular biochemistry and whole-cell behavior. They will also study newly-engineered technologies for force manipulation and measurement in living cells, and synthetic strategies to control the mechanics and chemistry of the extracellular matrix. Finally, students will learn about the role of mechanotransduction in selected human organ systems and how these mechanisms may go awry in the setting of the disease. Instruction will feature lectures, discussions, analysis of relevant research papers, assembly of a literature review and a research proposal, and an oral presentation.

Rules & Requirements

Prerequisites: Undergraduate cell biology or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Kumar

BIO ENG C212 Heat and Mass Transport in Biomedical Engineering 3 Units

Terms offered: Spring 2008, Fall 2007, Spring 2006, Spring 2005
Fundamental processes of heat and mass transport in biological systems; organic molecules, cells, biological organs, whole animals. Derivation of mathematical models and discussion of experimental procedures. Applications to biomedical engineering.

Rules & Requirements

Prerequisites: 106 and 109 (106 and 109 may be taken concurrently)

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Formerly known as: Mechanical Engineering 212

Also listed as: MEC ENG C212

BIO ENG C213 Fluid Mechanics of Biological Systems 3 Units

Terms offered: Fall 2023, Spring 2019, Spring 2016
Fluid mechanical aspects of various physiological systems, the circulatory, respiratory, and renal systems. Motion in large and small blood vessels. Pulsatile and peristaltic flows. Other biofluidmechanical flows: the ear, eye, etc. Instrumentation for fluid measurements in biological systems and for medical diagnosis and applications. Artificial devices for replacement of organs and/or functions, e.g. blood oxygenators, kidney dialysis machines, artificial hearts/circulatory assist devices.

Rules & Requirements

Prerequisites: 106 or equivalent; 265A or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructors: Berger, Liepmann

Also listed as: MEC ENG C213

BIO ENG C214 Advanced Tissue Mechanics 3 Units

Terms offered: Spring 2025, Spring 2018, Spring 2017, Spring 2015
The goal of this course is to provide a foundation for characterizing and understanding the mechanical behavior of load-bearing tissues. A variety of mechanics topics will be introduced, including anisotropic elasticity and failure, cellular solid theory, biphasic theory, and quasi-linear viscoelasticity (QLV) theory. Building from this theoretical basis, we will explore the constitutive behavior of a wide variety of biological tissues. After taking this course, students should have sufficient background to independently study the mechanical behavior of most biological tissues. Formal discussion section will include a seminar series with external speakers.

Rules & Requirements

Prerequisites: 102A, 176, 185; graduate standing or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Also listed as: MEC ENG C214

BIO ENG C215 Molecular Biomechanics and Mechanobiology of the Cell 4 Units

Terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020
This course develops and applies scaling laws and the methods of continuum and statistical mechanics to understand micro- and nano-scale mechanobiological phenomena involved in the living cell with particular attention the nucleus and the cytoskelton as well as the interactions of the cell with the extracellular matrix and how these interactions may cause changes in cell architecture and biology, consequently leading to functional adaptation or pathological conditions.

Objectives & Outcomes

Course Objectives: This course, which is open to graduate students in diverse disciplines ranging from engineering to biology to chemistry and physics, is aimed at exposing students to subcellular biomechanical phenomena spanning scales from molecules to the whole cell.

Student Learning Outcomes: The students will develop tools and skills to (1) understand and analyze subcelluar biomechanics and transport phenomena, and (2) ultimately apply these skills to novel biological and biomedical applications.

Rules & Requirements

Prerequisites: MATH 54, PHYSICS 7A; BIO ENG 102 or MEC ENG C85; or instructor’s consent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Mofrad

Also listed as: MEC ENG C216

BIO ENG C216 Macromolecular Science in Biotechnology and Medicine 4 Units

Terms offered: Spring 2024, Spring 2023, Spring 2022
Overview of the problems associated with the selection and function of polymers used in biotechnology and medicine. Principles of polymer science, polymer synthesis, and structure-property-performance relationships of polymers. Particular emphasis is placed on the performance of polymers in biological environments. Interactions between macromolecular and biological systems for therapy and diagnosis. Specific applications will include drug delivery, gene therapy, tissue engineering, and surface engineering.

Rules & Requirements

Prerequisites: BIO ENG 115. Open to seniors with consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Healy

Also listed as: MAT SCI C216

BIO ENG C217 Biomimetic Engineering -- Engineering from Biology 3 Units

Terms offered: Fall 2017, Spring 2014, Fall 2010
Study of nature's solutions to specific problems with the aim of determining appropriate engineering analogs. Morphology, scaling, and design in organisms applied to engineering structures. Mechanical principles in nature and their application to engineering devices. Mechanical behavior of biological materials as governed by underlying microstructure, with the potential for synthesis into engineered materials. Trade-offs between redundancy and efficiency. Students will work in teams on projects where they will take examples of designs, concepts, and models from biology and determine their potential in specific engineering applications.

Rules & Requirements

Prerequisites: Graduate standing in engineering or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Dharan

Also listed as: INTEGBI C217/MEC ENG C217

BIO ENG C218 Stem Cells and Directed Organogenesis 3 Units

Terms offered: Spring 2015, Spring 2014, Spring 2013
This course will provide an overview of basic and applied embryonic stem cell (ESC) biology. Topics will include early embryonic development, ESC laboratory methods, biomaterials for directed differentiation and other stem cell manipulations, and clinical uses of stem cells.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 6 hours of laboratory and 1 hour of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Conboy

Also listed as: MCELLBI C237

BIO ENG C219 Protein Engineering 3 Units

Terms offered: Fall 2015, Fall 2014, Fall 2010
An in-depth study of the current methods used to design and engineer proteins. Emphasis on how strategies can be applied in the laboratory. Relevant case studies presented to illustrate method variations and applications. Intended for graduate students.
Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Tullman-Ercek

Also listed as: CHM ENG C270

BIO ENG 220L Cells and Biomaterials Laboratory 4 Units

Terms offered: Prior to 2007
The objective of this course is to teach graduate students the essential laboratory techniques in the design and characterization and analysis of cells and biomaterials. The course will cover basics on synthetic biomaterials and native matrix, cellular responses to biomaterials, three-dimensional culture, and tissue engineering. The course includes a lecture and a laboratory section each week. There will be a midterm exam, final exam, and a tissue engineering group project.
Rules & Requirements

Prerequisites: Cell and tissue engineering; upper division cell biology course or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 6 hours of laboratory per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Li

BIO ENG 221 Advanced BioMEMS and Bionanotechnology 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Biophysical and chemical principles of biomedical devices, bionanotechnology, bionanophotonics, and biomedical microelectromechanical systems (BioMEMS). Topics include basics of nano-& microfabrication, soft-lithography, DNA arrays, protein arrays, electrokinetics, electrochemical transducers, microfluidic devices, biosensor, point of care diagnostics, lab-on-a-chip, drug delivery microsystems, clinical lab-on-a-chip, advanced biomolecular probes, biomolecular spectroscopy, and etc.
Rules & Requirements

Prerequisites: Chemistry 3A, Physics 7A and 7B, Electrical Engineering 143 or equivalent

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Summer:
6 weeks - 7.5 hours of lecture per week
8 weeks - 5.5 hours of lecture per week
10 weeks - 4.5 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: L. Lee

BIO ENG 221L BioMEMS and BioNanotechnology Laboratory 4 Units

Terms offered: Fall 2025, Spring 2025, Spring 2024
Students will become familiar with BioMEMS and Lab-on-a-Chip research. Students will design and fabricate their own novel micro- or nano-scale device to address a specific problem in biotechnology using the latest micro- and nano-technological tools and fabrication techniques. This will involve an intensive primary literature review, experimental design, and quantitative data analysis. Results will be presented during class presentations and at a final poster symposium.

Objectives & Outcomes

Course Objectives: Students will become familiar with research associated with BioMEMS and Lab-on-a-Chip technologies. Students will gain experience in using creative design to solve a technological problem. Students will learn basic microfabrication techniques. Working in engineering teams, students will learn how to properly characterize a novel device
by choosing and collecting informative metrics. Students will design and carry out carefully controlled experiments that will result in the analysis of quantitative data.

Student Learning Outcomes: Students will learn how to critically read BioMEMS and Lab-on-a-Chip primary literature. Students will learn how to use AutoCAD software to design microscale device features. Students will gain hands-on experience in basic photolithography and soft lithography. Students will get experience with a variety of fluid loading interfaces and
microscopy techniques. Students will learn how to design properly controlled uantitative experiments. Students will gain experience in presenting data to their peers in the form of powerpoint presentations and also at a poster symposium.

Rules & Requirements

Prerequisites: BIO ENG 104, BIO ENG 221, and/or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 6 hours of laboratory and 2 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructors: Liepmann, Streets

BIO ENG C222 Advanced Structural Aspects of Biomaterials 4 Units

Terms offered: Fall 2024, Spring 2023, Fall 2020
This course covers the structure and mechanical functions of load bearing tissues and their replacements. Biocompatibility of biomaterials and host response to structural implants are examined. Quantitative treatment of biomechanical issues and constitutive relationships of materials are covered in order to design implants for structural function. Material selection for load bearing applications including reconstructive surgery, orthopedics, dentistry, and cardiology are addressed.

Rules & Requirements

Credit Restrictions: Students should not receive credit if they've taken ME ME C117 or Bio Eng C117.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Also listed as: MEC ENG C215

BIO ENG C223 Polymer Engineering 3 Units

Terms offered: Fall 2025, Fall 2023, Fall 2021
This course provides an overview of engineering polymers and an introduction to polymer physics. The molecular variables that play a role in structural performance of polymer systems are examined. The assessment of structural behavior of macromolecules and engineering polymers are addressed for functional design in broad applications including medical devices as well as product design. Environmental impact and novel applications of plastics are evaluated.

Rules & Requirements

Prerequisites: MECENG 108, BIOENG 102, MATSCI 113 or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Also listed as: MEC ENG C223

BIO ENG 224 Basic Principles of Drug Delivery 3 Units

Terms offered: Fall 2024, Fall 2023, Fall 2021
This course focuses on providing students with the foundations needed to understand contemporary literature in drug delivery. Concepts in organic chemistry, biochemistry, and physical chemistry needed to understand current problems in drug delivery are emphasized.
Objectives & Outcomes

Course Objectives: The goal of this course is to give students the ability to understand problems in drug delivery. Emphasis is placed on the design and synthesis of new molecules for drug delivery.

Student Learning Outcomes: At the completion of this course students should be able to design new molecules to solve drug delivery problems.

Rules & Requirements

Prerequisites: BIO ENG 11 or CHEM 3B; BIO ENG 103; and BIO ENG 104

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Murthy

BIO ENG 225 Biomolecular Structure Determination 3 Units

Terms offered: Spring 2025, Spring 2023, Spring 2021
The detailed, atomic-level structure of biomolecules is at the basis of our understanding of many biochemical processes. The knowledge of these 3D structures has provided fundamental insights in the organization and inner workings of the living cell and has directly impacted the daily lives of many through the development of novel therapeutic agents. This graduate level course is designed to provide students with an in-depth understanding of
crystallography for macromolecular structure determination.
The underlying theory, computational approaches, and practical considerations for each step in the process will be discussed.
Objectives & Outcomes

Course Objectives: (1) Introduce students to the atomic structure of macromolecules,
2) review methods for structure determination, (3) describe the basic theory of diffraction, and (4) provide students with a detailed knowledge of macromolecular crystallography. At the end of the course students will have a solid theoretical and practical understanding of how macromolecular structures are determined to atomic resolution using crystallographic methods. The application of the method to problems in biomolecular engineering will be reviewed.

Student Learning Outcomes: The students will be able to (1) interpret diffraction data to determine reciprocal and real space parameters, (2) plan diffraction experiments, (3) use computational methods to solve the crystallographic phase problem (an inverse problem), (4) interpret complex 3-dimensional maps to build atomic models, (5) determine which optimization methods are appropriate for obtaining a refined, validated model, and (6) apply the knowledge to the engineering of biomolecules.

Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Paul Adams

BIO ENG C230 Implications and Applications of Synthetic Biology 3 Units

Terms offered: Spring 2007
Explore strategies for maximizing the economic and societal benefits of synthetic biology and minimizing the risks; create "seedlings" for future research projects in synthetic biology at UC Berkeley; increase multidisciplinary collaborations at UC Berkeley on synthetic biology; and introduce students to a wide perspective of SB projects and innovators as well as policy, legal, and ethical experts.
Rules & Requirements

Prerequisites: Consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructors: Arkin, Keasling

Also listed as: CHM ENG C295L

BIO ENG 231 Introduction to Computational Molecular and Cellular Biology 4 Units

Terms offered: Fall 2018, Fall 2017, Fall 2016
Topics include computational approaches and techniques to gene structure and genome annotation, sequence alignment using dynamic programming, protein domain analysis, RNA folding and structure prediction, RNA sequence design for synthetic biology, genetic and biochemical pathways and networks, UNIX and scripting languages, basic probability and information theory. Various "case studies" in these areas are reviewed and web-based computational biology tools will be used by students and programming projects will be given.
Rules & Requirements

Prerequisites: BIO ENG 11 or BIOLOGY 1A (may be taken concurrently); and a programming course (ENGIN 7 or COMPSCI 61A)

Credit Restrictions: Students will receive no credit for BIO ENG 231 after completing BIO ENG 131, or BIO ENG C231. A deficient grade in BIO ENG 231 may be removed by taking BIO ENG C231, or BIO ENG C231.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1.5 hours of laboratory per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Holmes

BIO ENG C231 Introduction to Computational Molecular and Cell Biology 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023, Fall 2022
This class teaches basic bioinformatics and computational biology, with an emphasis on alignment, phylogeny, and ontologies. Supporting foundational topics are also reviewed with an emphasis on bioinformatics topics, including basic molecular biology, probability theory, and information theory.
Rules & Requirements

Prerequisites: BIO ENG 11 or BIOLOGY 1A (may be taken concurrently); and a programming course (ENGIN 7 or COMPSCI 61A)

Credit Restrictions: Students will receive no credit for BIO ENG C231 after completing BIO ENG 231. A deficient grade in BIO ENG C231 may be removed by taking BIO ENG 231, or BIO ENG 231.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Holmes

Also listed as: CMPBIO C231

BIO ENG 234 Biodesign Automation 4 Units

Terms offered: Not yet offered
Biodesign Automation is a fusion of computer science principles and synthetic biology, focusing on developing students' programming skills within biological frameworks. The course dives deep into essential computer science concepts such as data structures, algorithmic thinking, and software testing, all through the lens of synthetic biology. Students will engage in practical exercises that blend these computational methods with real-world biological and chemical problems.The course journey culminates in a comprehensive project where students apply their computational skills to develop an AI-assisted system for biodesign applications, thereby bridging the gap between theoretical knowledge and practical biotechnological innovation.

Objectives & Outcomes

Course Objectives: 1. Develop skills in translating experimental design into software code.
2. Apply computational tools in synthetic biology.
3. Create functional components for AI-enhanced bioengineering applications.

Rules & Requirements

Prerequisites: COMPSCI 61A, or ENGIN 7, or equivalent Python experience. BIO ENG 11, or BIO 1A, or equivalent molecular biology and biochemistry background

Credit Restrictions: Students will receive no credit for BIO ENG 234 after completing BIO ENG 134.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Anderson

BIO ENG 235 Frontiers in Microbial Systems Biology 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2022
This course is aimed at graduate and advanced undergraduate students from the (bio) engineering and chemo-physical sciences interested in a research-oriented introduction to current topics in systems biology. Focusing mainly on two well studied microbiological model systems--the chemotaxis network and Lambda bacteriophage infection--the class systematically introduces key concepts and techniques for biological network deduction, modelling, analysis, evolution and synthetic network design. Students analyze the impact of approaches from the quantitative sciences--such as deterministic modelling, stochastic processes, statistics, non-linear dynamics, control theory, information theory, graph theory, etc.--on understanding biological processes, including (stochastic) gene regulation, signalling, network evolution, and synthetic network design. The course aims identify unsolved problems and discusses possible novel approaches while encouraging students to develop ideas to explore new directions in their own research.

Rules & Requirements

Prerequisites: Designed for graduates with background in differential equations and probability. Course work in molecular cell biology or biochemistry helpful

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructors: Arkin, Bischofs-Pfeifer, Wolf

BIO ENG C237 Adv Designing for the Human Body 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2019, Fall 2018
The course provides project-based learning experience in understanding product design, with a focus on the human body as a mechanical machine. Students will learn the design of external devices used to aid or protect the body. Topics will include forces acting on internal materials (e.g., muscles and total replacement devices), forces acting on external materials (e.g., prothetics and crash pads), design/analysis of devices aimed to improve or fix the human body, muscle adaptation, and soft tissue injury. Weekly laboratory projects will incorporate EMG sensing, force plate analysis, and interpretation of data collection (e.g., MATLAB analysis) to integrate course material to better understand contemporary design/analysis/problems.

Objectives & Outcomes

Course Objectives: The purpose of this course is twofold:

- to learn the fundamental concepts of designing devices that interact with the human body;
- to enhance skills in mechanical engineering and bioengineering by analyzing the behavior of various complex biomedical problems;
- To explore the transition of a device or discovery as it goes from “benchtop to bedside”.
- Three separate written projects evaluating devices that interact with the body. Projects will focus on 1) biomechanical analysis, 2) FDA regulations and procedures, and 3) design lifecycle.

Student Learning Outcomes: Working knowledge of design considerations for creating a device to protect or aid the human body, force transfer and distribution, data analysis, and FDA approval process for new devices. Understanding of basic concepts in orthopaedic biomechanics and the ability to apply the appropriate engineering concepts to solve realistic biomechanical problems, knowing clearly the assumptions involved. Critical analysis of current literature and technology.

Rules & Requirements

Prerequisites: Proficiency in MatLab or equivalent. Prior knowledge of biology or anatomy is not assumed

Credit Restrictions: There will be no credit given for MEC ENG C178 / BIO ENG C137 after taking MEC ENG 178.

Hours & Format

Fall and/or spring: 15 weeks - 1-3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: O'Connell

Also listed as: MEC ENG C278

BIO ENG 241 Probabilistic Modeling in Computational Biology 4 Units

Terms offered: Spring 2025, Spring 2023, Spring 2022
This course covers applications of probabilistic modeling to topics in bioinformatics, with an emphasis on literature study and novel tool development. Areas covered vary from year to year but typically include finite-state Markov models as models of point substitution processes; graphical models and dynamic programming; basic coalescent theory; grammar theory; birth-death processes and the Thorne-Kishino-Felsenstein model of indels; general PDE methods and applications to continuous-state models; the Chinese restaurant process in population genetics and ecology; data compression algorithms; general techniques including conjugate priors, MCMC, and variational methods.

Objectives & Outcomes

Course Objectives: To introduce the most commonly used statistical models and associated inference techniques for the analysis and organization of biological sequences, with a focus on models based on evolutionary theory.

Student Learning Outcomes: Students will be familiar with the bioinformatics literature and underyling theory for discrete Markov processes, Bayesian networks, stochastic grammars, birth-death processes, Chinese restaurant processes, data compression algorithms, and related methods such as dynamic programming and MCMC.

Rules & Requirements

Prerequisites: Recommended preparation: MATH 53 (multivariable calculus), MATH 54 (linear algebra), MATH 126 (partial differential equations); or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Holmes

BIO ENG C242 Machine Learning, Statistical Models, and Optimization for Molecular Problems 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
An introduction to mathematical optimization, statistical models, and advances in machine learning for the physical sciences. Machine learning prerequisites are introduced including local and global optimization, various statistical and clustering models, and early meta-heuristic methods such as genetic algorithms and artificial neural networks. Building on this foundation, current machine learning techniques are covered including deep learning artificial neural networks, Convolutional neural networks, Recurrent and long short term memory (LSTM) networks, graph neural networks, decision trees.
Objectives & Outcomes

Course Objectives: To build on optimization and statistical modeling to the field of machine learning techniques
To introduce the basics of optimization and statistical modeling techniques relevant to chemistry students
To utilize these concepts on problems relevant to the chemical sciences.

Student Learning Outcomes: Students will be able to understand the landscape and connections between numerical optimization, stand-alone statistical models, and machine learning techniques, and its relevance for chemical problems.

Rules & Requirements

Prerequisites: Math 53 and Math 54; Chem 120A or 120B or BioE 103; or consent of intructor

Credit Restrictions: Students will receive no credit for BIO ENG C242 after completing BIO ENG 242. A deficient grade in BIO ENG C242 may be removed by taking BIO ENG 242.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Teresa Head-Gordon

Formerly known as: Bioengineering C242/Chemistry C242

Also listed as: CHEM C242

BIO ENG 243 Computational Methods in Biology 4 Units

Terms offered: Fall 2011, Fall 2010, Fall 2009
An introduction to biophysical simulation methods and algorithms, including molecular dynamics, Monte Carlo, mathematical optimization, and "non-algorithmic" computation such as neural networks. Various case studies in applying these areas in the areas of protein folding, protein structure prediction, drug docking, and enzymatics will be covered. Core Specialization: Core B (Informatics and Genomics); Core D (Computational Biology); Bioengineering Content: Biological.
Rules & Requirements

Prerequisites: MATH 53 and MATH 54; and programming experience preferred but not required

Credit Restrictions: Students will receive no credit for 243 after taking 143.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 2 hours of laboratory per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Head-Gordon

BIO ENG 244 Introduction to Protein Informatics 4 Units

Terms offered: Spring 2017, Fall 2008, Fall 2007
This course will introduce students to the bioinformatics algorithms used by biologists to identify homologs, construct multiple sequence alignments, predict protein structure, estimate phylogenetic trees, identify orthologs, predict protein-protein interaction, and build hidden Markov models. The focus is on the algorithms used, and on the sources of various types of errors in these methods. This class includes no programming, and no programming background is required.
Objectives & Outcomes

Course Objectives: This course is designed to provide a theoretical framework for protein sequence and structure analysis using bioinformatics software tools. Students completing this course will be prepared for subsequent in-depth studies in bioinformatics, for algorithm development, and for the use of bioinformatics methods for biological discovery. It is aimed at two populations: students in the life sciences who need to become expert users of bioinformatics tools, and students in engineering and mathematics/computer science who wish to become the developers of the next generation of bioinformatics methods. As virtually all the problems in this field are very complex, there are many opportunities for research and development of new methods.

Student Learning Outcomes: Students completing this course are likely to find several potential areas of research of interest, which they may want to work on as independent study projects during undergraduate work, or take on as Master's or Ph.D. thesis topics for advanced work.

Rules & Requirements

Prerequisites: Prior coursework in algorithms (e.g., COMPSCI 170) is highly recommended. The class does not include programming, and no prior programming experience is required, although students need to be comfortable reading and writing pseudocode (precise text descriptions of algorithms

Credit Restrictions: BioE 144 or previous BioE/PMB C144

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Sjolander

Formerly known as: Bioengineering C244/Plant and Microbial Biology C244

BIO ENG 244L Protein Informatics Laboratory 3 Units

Terms offered: Prior to 2007
This course is intended to provide hands-on experience with a variety of bioinformatics tools, web servers and databases that are used to predict protein function and structure. This course will cover numerous bioinformatics tasks including: homolog detection using BLAST and PSI-BLAST, hidden Markov model construction and use, multiple sequence alignment, phylogenetic tree construction, ortholog identification, protein structure prediction, active site prediction, cellular localization, protein-protein interaction and phylogenomic analysis. Some minimal programming/scripting skills (e.g., Perl or Python) are required to complete some of the labs.
Rules & Requirements

Prerequisites: One upper-division course in molecular biology or biochemistry (e.g., MCELLBI C100A/CHEM C130). Python programming (e.g., COMPSCI 61A) and experience using command-line tools in a Unix environment

Credit Restrictions: BioE 144L or BioE C144L/PMB C144L

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of laboratory and 2 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Sjolander

Formerly known as: Bioengineering C244L/Plant and Microbial Biology C244L

BIO ENG 245 Introduction to Machine Learning for Computational Biology 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Genome-scale experimental data and modern machine learning methods have transformed our understanding of biology.This course investigates classical approaches and recent machine learning advances in genomics including:
1)Computational models for genome analysis.
2)Applications of machine learning to high throughput biological data.
3)Machine learning for genomic data in health.
This course builds on existing skills to introduce methodologies for probabilistic modeling, statistical learning, and dimensionality reduction, while grounding these methods in understanding genomic information.
Objectives & Outcomes

Course Objectives: This course aims to equip students with a foundational understanding of computational and machine learning techniques used in genomics and computational biology.

Student Learning Outcomes: Students completing this course should have a better understanding of some of the challenges in machine learning as applied to biology
Students completing this course should have stronger programming skills.
Students completing this course should have the ability to apply simple statistical and machine learning techniques to complex genomics data

Rules & Requirements

Prerequisites: Bio 1A or BioE 11, Math 54, CS61B; CS70 or Math 55 recommended

Credit Restrictions: Students will receive no credit for BIO ENG 245 after completing BIO ENG 145.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Lareau

BIO ENG 247 Principles of Synthetic Biology 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
The field of synthetic biology is quickly emerging as potentially one of the most important and profound ways by which we can understand and manipulate our physical world for desired purposes. In this course, the field and its natural scientific and engineering basis are introduced. Relevant topics in cellular and molecular biology and biophysics, dynamical and engineering systems, and design and operation of natural and synthetic circuits are covered in a concise manner that then allows the student to begin to design new biology-based systems.
Objectives & Outcomes

Course Objectives: (1) To introduce the basics of Synthetic Biology, including quantitative cellular network characterization and modeling, (2) to introduce the principles of discovery and genetic factoring of useful cellular activities into reusable functions for design, (3) to inculcate the principles of biomolecular system design and diagnosis of designed systems, and (4) to illustrate cutting-edge applications in Synthetic Biology and to enhance skull sin analyzing and designing synthetic biological applications.

Student Learning Outcomes: The goals of this course are to enable students to: (1) design simple cellular circuitry to meet engineering specification using both rational/model-based and library-based approaches, (2) design experiments to characterize and diagnose operation of natural and synthetic biomolecular network functions, and (3) understand scientific, safety and ethical issues of synthetic biology.

Rules & Requirements

Prerequisites: MATH 53, MATH 54, and BIO ENG 103; or consent of instructor

Credit Restrictions: Students will receive no credit for 247 after taking 147.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Arkin

BIO ENG 248 Bioenergy and Sustainable Chemical Synthesis: Metabolic Engineering and Synthetic Biology Approaches 3 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
This course will cover metabolic engineering and the various synthetic biology approaches for optimizing pathway performance. Use of metabolic engineering to produce biofuels and general "green technology" will be emphasized since these aims are currently pushing these fields. The course is meant to be a practical guide for metabolic engineering and the related advances in synthetic biology as well the related industrial research and opportunities.

Rules & Requirements

Prerequisites: CHEM 3A; and MCELLBI C100A/CHEM C130A or equivalent

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Dueber

BIO ENG C249 Computational Functional Genomics 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
This course provides a survey of the computational analysis of genomic data, introducing the material through lectures on biological concepts and computational methods, presentations of primary literature, and practical bioinformatics exercises. The emphasis is on measuring the output of the genome and its regulation. Topics include modern computational and statistical methods for analyzing data from genomics experiments: high-throughput RNA sequencing data, single-cell data, and other genome-scale measurements of biological processes. Students will perform original analyses with Python and command-line tools.

Objectives & Outcomes

Course Objectives: This course aims to equip students with practical proficiency in bioinformatics analysis of genomic data, as well as understanding of the biological, statistical, and computational underpinnings of this field.

Student Learning Outcomes: Students completing this course should have stronger programming skills, practical proficiency with essential bioinformatics methods that are applicable to genomics research, understanding of the statistics underlying these methods, and awareness of key aspects of genome function and challenges in the field of genomics.

Rules & Requirements

Prerequisites: Math 54 or EECS 16A/B; CS 61A or another course in python; BioE 11 or Bio 1a; and BioE 131. Introductory statistics or data science is recommended

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Lareau

Also listed as: CMPBIO C249

BIO ENG C250 Nanomaterials in Medicine 3 Units

Terms offered: Fall 2022, Fall 2021, Fall 2020
The course is designed for graduate students interested in the emerging field of nanomedicine. The course will involve lectures, literature reviews and proposal writing. Students will be required to formulate a nanomedicine research project and write an NIH-style proposal during the course. The culmination of this project will involve a mock review panel in which students will serve as peer reviewers to read and evaluate the proposals.

Objectives & Outcomes

Course Objectives: To review the current literature regarding the use of nanomaterials in medical applications; (2) To describe approaches to nanomaterial synthesis and surface modification; (3) To understand the interaction of nanomaterials with proteins, cells and biological systems; (4) To familiarize students with proposal writing and scientific peer review.

Student Learning Outcomes: Students should be able to (1) identify the important properties of metal, polymer and ceramic nanomaterials used in healthcare; (2) understand the role of size, shape and surface chemistry of nanomaterials in influencing biological fate and performance; (3) understand common methods employed for surface modification of nanomaterials; (4) comprehend the range of cell-nanomaterial interactions and methods for assaying these interactions; (5) read and critically review the scientific literature relating to nanomedicine; (6) formulate and design an experimental nanomedicine research project; (7) understand the principles of the peer review system.

Rules & Requirements

Prerequisites: Graduate Standing

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Messersmith

Also listed as: MAT SCI C250

BIO ENG 251 Micro/Nanofluidics for Bioengineering and Lab-On-A-Chip 4 Units

Terms offered: Spring 2015, Spring 2014, Spring 2013
Introduction and in-depth treatment of theory relevant to fluid flow in microfluidic and nanofluidic systems supplemented by critical assessment of recent applications drawn from the literature. Topics include low Reynolds Number flow, mass transport including diffusion phenomena, and emphasis on electrokinetic systems and bioanalytical applications of said phenomena.

Objectives & Outcomes

Course Objectives: The course is an introduction to the physicochemical dynamics associated with fluid flow in nanoscale and microscale devices for graduate students and advance undergraduate students. The course has been created in response to the active field of microfluidics and nanofluidics, as well as the associated interest from industry, government, and academic research groups. The course provides an theoretical treatment of micro/nanofluidic phenomena that complements the well-established laboratory and research content offered in the Department.
We will study mass and momentum transport phenomena of microscale and nanoscale flow devices. Throughout the course, we will place an emphasis on bioanalytical microfluidic system applications where electrophoresis, electroosmosis, molecular diffusion, and/or Brownian motion effects dominate. Successful completion of the course will prepare students to design micro/nanofluidic engineering solutions, as well as critically assess academic and industrial developments in these areas.

Student Learning Outcomes: 1.
To introduce students to the governing principles of fluid flow in microfluidic and nanofluidic regimes, with emphasis on phenomena relevant to bioanalytical devices.
2.
To provide students with an understanding of scaling laws that define the performance of microfluidic and nanofluidic systems.
3.
To provide students with a detailed investigation of applications that do and do not benefit from miniaturization.
4.
To give students adequate didactic background for critical assessment of literature reports and conference presentations regarding advances in the topical areas of microfluidics and nanofluidics.

Rules & Requirements

Prerequisites: BIO ENG 11 or CHEM 3B; and BIO ENG 104 or MEC ENG 106; or consent of instructor

Credit Restrictions: Students will receive no credit for 251 after taking 151.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Herr

BIO ENG 252 Clinical Need-Based Therapy Solutions 2 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Students will be introduced to clinical areas with unmet needs, be introduced to the current standard of care or state of the art solutions for those needs, and learn to methodically conceptualize potential alternatives. The course will emphasize interaction between students and subject matter experts in these clinical areas and in the related fields of medtech and biotech innovation. Open innovative ideas from students are encouraged during the course.
Objectives & Outcomes

Course Objectives: (1) To expose students to clinical areas with major unmet need; (2) Expose students to current state of the art in therapy solutions for the above clinical need; (3) Stimulate innovation concept targeting high-impact clinical needs

Student Learning Outcomes: Students will be able to (1) Immerse in an enabling innovation environment stemming from the solution ideas by the students and mentor faculties; (2) Obtain potential avenues to enable capstone projects, UCSF collaborations, SBIR, etc.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Hossiany

BIO ENG 253 Biotechnology Entrepreneurship: Impact, History, Therapeutics R&D, Entrepreneurship & Careers 2 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
This course is designed for students interested in an introduction to the biotechnology entrepreneurship, biotherapeutics R and D, and careers in the industry. Students should be interested in the impact of biotechnology on medicine and society, the history of the field (including individual scientists, entrepreneurs and companies), key methodologies, therapeutic product classes, entrepreneurship and innovation within the life sciences. Students will learn principles of drug and biologics discovery, development and commercialization, and will be exposed to the range of careers in the biopharmaceutical industry. Students should be considering careers in the biopharmaceutical and life sciences fields.
Objectives & Outcomes

Course Objectives: To educate students on careers in the biopharmaceutical industry
To educate students on the history of the field and industry, including key methodologies, technologies, scientists, entrepreneurs, and companies
To foster understanding and appreciation for the medical and societal impact of the biopharmaceutical field and industry
To introduce the key steps in the process of discovery, development and commercialization of novel therapeutics
o educate students on biopharmaceutical company entrepreneurship and innovation through team-based hands on virtual company creation

Student Learning Outcomes: Entrepreneurship principles, including those defined by the Lean Launchpad approach (including the Business Model Canvas, the Minimum Viable Product and Customer Discovery)
The history of the biotech industry
The impact of the biopharmaceutical industry on medicine and society
The methods, product technologies and development methodologies that have driven the evolution of the field
The nature of the ecosystem and specific careers in the biopharmaceutical industry
The product design and development process (with a focus on biotherapeutics), including opportunities and challenges

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Kirn

BIO ENG C261 Medical Imaging Signals and Systems 4 Units

Terms offered: Fall 2025, Fall 2024, Fall 2023
Biomedical imaging is a clinically important application of engineering, applied mathematics, physics, and medicine. In this course, we apply linear systems theory and basic physics to analyze X-ray imaging, computerized tomography, nuclear medicine, and MRI. We cover the basic physics and instrumentation that characterizes medical image as an ideal perfect-resolution image blurred by an impulse response. This material could prepare the student for a career in designing new medical imaging systems that reliably detect small tumors or infarcts.
Objectives & Outcomes

Course Objectives:
- understand how 2D impulse response or 2D spatial frequency transfer function (or Modulation Transfer Function) allow one to quantify the spatial resolution of an imaging system.
- understand 2D sampling requirements to avoid aliasing
- understand 2D filtered backprojection reconstruction from projections based on the projection-slice theorem of Fourier Transforms
- understand the concept of image reconstruction as solving a mathematical inverse problem.
- understand the limitations of poorly conditioned inverse problems and noise amplification
- understand how diffraction can limit resolution---but not for the imaging systems in this class
- understand the hardware components of an X-ray imaging scanner
-
- understand the physics and hardware limits to spatial resolution of an X-ray imaging system
- understand tradeoffs between depth, contrast, and dose for X-ray sources
- understand resolution limits for CT scanners
- understand how to reconstruct a 2D CT image from projection data using the filtered backprojection algorithm
- understand the hardware and physics of Nuclear Medicine scanners
- understand how PET and SPECT images are created using filtered backprojection
- understand resolution limits of nuclear medicine scanners
- understand MRI hardware components, resolution limits and image reconstruction via a 2D FFT
- understand how to construct a medical imaging scanner that will achieve a desired spatial resolution specification.

Student Learning Outcomes:
- students will be tested for their understanding of the key concepts above
- undergraduate students will apply to graduate programs and be admitted
- students will apply this knowledge to their research at Berkeley, UCSF

BIO ENG 263 Principles of Molecular and Cellular Biophotonics 4 Units

Terms offered: Fall 2024, Fall 2022, Fall 2018
Topics in the emerging field of biophotonics with an emphasis on fluorescence spectroscopy, biosensors, and devices for optical imaging and detection of biomolecules. The course will cover the photophysics and photochemistry of organic molecules, the design and characterization of biosensors, and their applications within diverse environments, ranging from the detection of single molecules in vitro and in cells to studies of detection, diagnosis, and monitoring of specific health conditions and disease.
Rules & Requirements

Prerequisites: 102 or consent of instructor, and Chemistry 3A and Physics 7B

Credit Restrictions: Students will receive no credit for 263 after taking 163.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Marriott

BIO ENG 263L Molecular and Cellular Biophotonics Laboratory 4 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
This course provides undergraduate and graduate bioengineering students with an opportunity to acquire essential experimental skills in fluorescence spectroscopy and the design, evaluation, and optimization of optical biosensors for quantitative measurements of proteins and their targets. Groups of students will be responsible for the research, design, and development of a biosensor or diagnostic device for the detection, diagnosis, and monitoring of a specific biomarker(s).
Rules & Requirements

Prerequisites: BIO ENG 263; experience in a research lab; and consent of instructor

Credit Restrictions: Students will receive no credit for 263L after taking 163L.

Hours & Format

Fall and/or spring: 15 weeks - 6 hours of laboratory and 2 hours of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Marriott

BIO ENG C265 Principles of Magnetic Resonance Imaging 4 Units

Terms offered: Spring 2025, Spring 2023, Spring 2021
Fundamentals of MRI including signal-to-noise ratio, resolution, and contrast as dictated by physics, pulse sequences, and instrumentation. Image reconstruction via 2D FFT methods. Fast imaging reconstruction via convolution-back projection and gridding methods and FFTs. Hardware for modern MRI scanners including main field, gradient fields, RF coils, and shim supplies. Software for MRI including imaging methods such as 2D FT, RARE, SSFP, spiral and echo planar imaging methods.
Objectives & Outcomes

Course Objectives: Graduate level understanding of physics, hardware, and systems engineering description of image formation, and image reconstruction in MRI. Experience in Imaging with different MR Imaging systems. This course should enable students to begin graduate level research at Berkeley (Neuroscience labs, EECS and Bioengineering), LBNL or at UCSF (Radiology and Bioengineering) at an advanced level and make research-level contribution

Rules & Requirements

Prerequisites: EL ENG 120 or BIO ENG C165/EL ENG C145B or consent of instructor

Credit Restrictions: Students will receive no credit for Bioengineering C265/El Engineering C225E after taking El Engineering 265.

Repeat rules: Course may be repeated for credit under special circumstances: Students can only receive credit for 1 of the 2 versions of the class,BioEc265 or EE c225e, not both

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture, 1 hour of discussion, and 3 hours of laboratory per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructors: Conolly, Vandsburger

Also listed as: EL ENG C225E/NUC ENG C235

BIO ENG 266 Biomedical Imaging Systems II: Targeted Molecular Imaging in Disease 4 Units

Terms offered: Spring 2024, Spring 2023, Spring 2022
This course is designed as an introduction to the growing world of molecular imaging in medicine and research. The course is divided into five modules based on common imaging modalities (optical imaging, ultrasound methods, radiography, nuclear imaging, and magnetic resonance approaches). Within each module the fundamental physics and engineering behind each modality, corresponding methods for targeted molecular imaging including contrast mechanisms and probe design, and signal and image processing algorithms are covered. Homework assignments will utilize imaging data from either clinical or research studies in order to provide training in MATLAB based image analysis techniques.
Objectives & Outcomes

Course Objectives: Discuss limitations to each targeted approach including non-specific binding, unbound probe clearance, signal decay, etc
Discuss the design of targeted molecular contrast agents for each modality across myriad biological applications
Establish a foundational understanding of MRI (multi-spectral), PET/SPECT, Ultrasound (including photo-acoustic imaging), and emerging methods including MPI
Establish proficiency in the use of MATLAB as a tool for analyzing biomedical imaging data
Reinforce mathematical principles relevant to image analysis including linear algebra, convolution and differential equations
To discuss imaging ethics in the context of data interpretation
To expose students interested in biomedical research or clinical practice to fundamentals of modern imaging methods and interpretation
To learn quantitative approaches to analyze biomedical images (includes pharmacokinetic models, attenuation correction, cross modality registration, etc.)

Student Learning Outcomes: Analyze imaging data derived from imaging studies using commonly utilized image processing techniques
Critically evaluate scientific publications in the molecular imaging space.
Understand the devices, techniques and protocols used for in vivo imaging in research and clinical settings

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture and 1 hour of discussion per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Vandsburger

BIO ENG 271 Interface Between Neuroethology & Neural Engineering 3 Units

Terms offered: Spring 2025, Spring 2023, Spring 2021
The course will provide students with an overview of the tight interface between neural engineering and neuroethological approaches in the field of neuroscience. This course will also discuss the concepts of causal manipulations, such as the control of brain circuits using optics and genetic engineering. Lastly, students will also inquire and discuss what discoveries have yet to be made and how neuroethological approaches can inform neural engineering designs that will revolutionize the future of neural medicine.
Objectives & Outcomes

Course Objectives: Understand the close interface between studies of the nervous system and technology

Student Learning Outcomes: The course will review the utilization, development and implementation of a wide diversity of neural engineering technologies to the study of the brain. Students will discuss the bidirectional road between the two approaches
The overreaching goal of this course is to expose student interested in neural engineering to the remarkable history of neuroethological approaches that have been a foundation of discoveries in the field.

Rules & Requirements

Prerequisites: BIO ENG 105; and BIO ENG 101 or EECS 16A and EECS 16B; or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Yartsev

BIO ENG 280 Ethical and Social Issues in Translational Medicine 1 Unit

Terms offered: Spring 2025, Spring 2024, Spring 2023
This class is designed to introduce MTM students to their professional responsibilities
as engineers and translational scientists. By the end of it, students will have
experience communicating their ideas appropriately and effectively to their peers,
their superiors, and those whom they manage or mentor. We will also discuss
methods for having a successful graduate school experience - choosing and working
on a project and preparing to meet post-graduate goals. Finally, some of the ethical
challenges likely to be met by a working bioengineer will be explored.
While this syllabus is meant to be an accurate description of the course and its content,
it may be modified at the instructor's discretion.
Objectives & Outcomes

Course Objectives: Objectives
Communications skills and best practices
Research ethics in translational medicine
Professional development for MTM graduate students

Student Learning Outcomes: MTM students will become aware of ethical issues commonly confronted in
translational medicine and learn how to evaluate and act accordingly. They will also
leave capable of independently considering new ethical issues that arise during their
careers.

Rules & Requirements

Prerequisites: Open only to students in the Masters of Translational Medicine Graduate program

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructors: Johnson, Terry

BIO ENG C280 Introduction to Nano-Science and Engineering 3 Units

Terms offered: Spring 2015, Spring 2013, Spring 2012
A three-module introduction to the fundamental topics of Nano-Science and Engineering (NSE) theory and research within chemistry, physics, biology, and engineering. This course includes quantum and solid-state physics; chemical synthesis, growth fabrication, and characterization techniques; structures and properties of semiconductors, polymer, and biomedical materials on nanoscales; and devices based on nanostructures. Students must take this course to satisfy the NSE Designated Emphasis core requirement.
Rules & Requirements

Prerequisites: Major in physical science such as chemistry, physics, etc., or engineering; consent of advisor or instructor

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructors: Gronsky, S.W. Lee, Wu

Also listed as: MAT SCI C261/NSE C201/PHYSICS C201

BIO ENG C281 The Berkeley Lectures on Energy: Energy from Biomass 3 Units

Terms offered: Fall 2015, Fall 2014, Fall 2013
After an introduction to the different aspects of our global energy consumption, the course will focus on the role of biomass. The course will illustrate how the global scale of energy guides the biomass research. Emphasis will be places on the integration of the biological aspects (crop selection, harvesting, storage, and distribution, and chemical composition of biomass) with the chemical aspects to convert biomass to energy. The course aims to engage students in state-of-art research.
Rules & Requirements

Prerequisites: Biology 1A; Chemistry 1B or 4B, Mathematics 1B

Repeat rules: Course may be repeated for credit under special circumstances: Repeatable when topic changes with consent of instructor.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructors: Bell, Blanch, Clark, Smit, C. Somerville

Also listed as: CHEM C238/CHM ENG C295A/PLANTBI C224

BIO ENG 282 Model-Based Design of Clinical Therapies 3 Units

Terms offered: Spring 2025, Spring 2024, Spring 2023
Students will learn how to translate a clinically relevant physical system into a governing equation with boundary conditions, and how to use this mathematical model to test and improve the design of medical devices and therapies. Problems of mass, heat, and momentum transport; the interaction of electromagnetic fields with materials (including tissue); and the mechanics of fluids and solids will be explored.
Objectives & Outcomes

Course Objectives: •
Develop skills in translating physical problem statement into quantitative applied math construction
•
Emphasis will be on constructing problems statements into mathematical equations and boundary conditions.

Student Learning Outcomes: •
Use quantitative applied math construction to estimate dominant parameters or dimensionless groups in cutting-edge, industry-relevant problem statements
•
Students become well-versed in quantitative analysis of real life products and therapeutic applications

Rules & Requirements

Prerequisites: Calculus (MATH 54); BIO ENG 104 (preferred but not required); and/or consent of instructor

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Syed Hossiany

BIO ENG 290 Advanced Topics in Bioengineering 1 - 4 Units

Terms offered: Spring 2025, Spring 2024, Fall 2023
This course covers current topics of research interest in bioengineering. The course content may vary from semester to semester.
Rules & Requirements

Prerequisites: Consent of instructor

Credit Restrictions: One hour of lecture per week per unit.

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

BIO ENG C290D Advanced Technical Communication: Proposals, Patents, and Presentations 3 Units

Terms offered: Spring 2018, Spring 2016, Spring 2012, Spring 2011
This course will help the advanced Ph.D. student further develop critically important technical communication traits via a series of lectures, interactive workshops, and student projects that will address the structure and creation of effective research papers, technical reports, patents, proposals, business plans, and oral presentations. One key concept will be the emphasis on focus and clarity--achieved through critical thinking regarding objectives and context. Examples will be drawn primarily from health care and bioengineering multidisciplinary applications.

Hours & Format

Fall and/or spring: 15 weeks - 3 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructors: Keaveny, Pruitt

Also listed as: MEC ENG C290X

BIO ENG 291 Project Management for Translational Medicine 2 Units

Terms offered: Fall 2025, Fall 2024
This course emphasizes practical examples of medical innovation projects. The classroom pedagogy draws on industry professionals sharing real-world experiences. The goal is twofold: first, for students to get a better appreciation for why health innovation projects need to be managed differently to successfully navigate the clinical world; second, to gain familiarity with specific aspects and topics in medical product development that need to be done for successful implementation. Some speakers will provide insights into relevant careers in project management for medical technology.

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: Rodriguez

BIO ENG 296 MTM Capstone Project 3 Units

Terms offered: Spring 2016, Fall 2015, Spring 2015
Members of the MTM Program Committee will help design several capstone projects in collaboration with clinical, academic, and/or industry partners, aiming to incorporate emerging technologies, industry requirements, and the potential for significant economic or social impact with regard to medicine and health care. All projects will be designed and vetted by the MTM Program Committee and in consultation with the MTM Advisory Board. For each selected project, an Academic Senate member from the Department of Bioengineering or BTS will serve as research adviser.

Objectives & Outcomes

Course Objectives: The objective of the one year professional MTM program is to develop engineering leaders who can synthesize the technical, environmental, economic, and social issues involved in the design and operation of complex engineering devices, systems, and organizations. Students will develop and demonstrate this skill at synthesis through the capstone project.

Student Learning Outcomes: Projects will provide practical instruction and experience in solving real problems in translational medicine, and it is anticipated that some will lead to innovations with commercial potential. This experience, undertaken by each student as a member of a team and marked by extensive interaction with faculty, peers, and industry partners, enables the student to integrate the leadership and technical dimensions of the professional MTM curriculum.

Rules & Requirements

Prerequisites: Graduate status in the MTM program

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 9-9 hours of independent study per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructors: Li, Song

BIO ENG 297 Bioengineering Department Seminar 1 Unit

Terms offered: Fall 2025, Spring 2025, Fall 2024
This weekly seminar series invites speakers from the bioengineering community, as well as those in related fields, to share their work with our department and other interested parties on the Berkeley campus. The series includes our annual Bioengineering Distinguished Lecture and Rising Star lecture.
Objectives & Outcomes

Course Objectives: •
To introduce students to bioengineering research as it is performed at Berkeley and at other institutions
•
To give students opportunities to connect their own work to work in the field overall
•
To give students an opportunity to meet with speakers who can inform and contribute to their post-graduation career paths

Student Learning Outcomes: To introduce students to the breadth of bioengineering research, both here at Berkeley and at other institutions, and help them to connect their work here at Berkeley to the field overall.

Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of seminar per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructor: Faculty

BIO ENG 298 Group Studies, Seminars, or Group Research 1 - 8 Units

Terms offered: Fall 2025, Spring 2025, Fall 2024
Advanced studies in various subjects through special seminars on topics to be selected each year. Informal group studies of special problems, group participation in comprehensive design problems, or group research on complete problems for analysis and experimentation.
Rules & Requirements

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1-8 hours of directed group study per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

BIO ENG 299 Individual Study or Research 1 - 12 Units

Terms offered: Fall 2025, Summer 2025 Second 6 Week Session, Spring 2025
Investigations of advanced problems in bioengineering.
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 0 hours of independent study per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

BIO ENG N299 Individual Study or Research 1 - 6 Units

Terms offered: Summer 2013 10 Week Session, Summer 2012 10 Week Session, Summer 2009 10 Week Session
Investigations of advanced problems in bioengineering.
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Summer:
6 weeks - 2.5-15 hours of independent study per week
8 weeks - 2-11.5 hours of independent study per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Offered for satisfactory/unsatisfactory grade only.

BIO ENG 301 Teaching Techniques for Bioengineering 1 Unit

Terms offered: Fall 2025, Fall 2024, Fall 2022

Weekly seminars and discussions of effective teaching techniques. Use of educational objectives, alternative forms of instruction, and special techniques for teaching key concepts and techniques in bioengineering. Course is intended to orient new graduate student instructors to teaching in the Bioengineering department at Berkeley.

Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit without restriction.

Hours & Format

Fall and/or spring: 15 weeks - 1 hour of seminar per week

Additional Details

Subject/Course Level: Bioengineering/Professional course for teachers or prospective teachers

Grading: Offered for satisfactory/unsatisfactory grade only.

Instructor: Johnson