Bioengineering (BIO ENG)

Courses

BIO ENG 10 Introduction to Biomedicine for Engineers 4 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015

This course is intended for lower division students interested in acquiring a foundation in biomedicine with topics ranging from evolutionary biology to human physiology. The emphasis is on the integration of engineering applications to biology and health. The goal is for undergraduate engineering students to gain sufficient biology and human physiology fundamentals so that they are better prepared to study specialized topics, e.g., biomechanics, imaging, computational biology, tissue engineering, biomonitoring, drug development, robotics, and other topics covered by upper division and graduate courses in UC Berkeley departments of Molecular and Cell Biology, Integrative Biology, Bioengineering, Electrical Engineering and Computer Science, Mechanical Engineering, and courses in the UC San Francisco Division of Bioengineering. The specific lecture topics and exercises will include the key aspects of genomics and proteomics as well as topics on plant and animal evolution, stem cell biomedicine, and tissue regeneration and replacement. Medical physiology topics include relevant engineering aspects of human brain, heart, musculoskeletal, and other systems.

Introduction to Biomedicine for Engineers: Read More [+]

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Conboy, Kumar

Introduction to Biomedicine for Engineers: Read Less [-]

BIO ENG 11 Engineering Molecules 1 3 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016

This course focuses on providing students with a foundation in organic chemistry and biochemistry needed to understand contemporary problems in synthetic biology, biomaterials and computational biology.

Engineering Molecules 1: Read More [+]

Objectives Outcomes

Course Objectives: The goal of this course is to give students the background in organic chemistry and biochemistry needed understand problems in synthetic biology, biomaterials and molecular imaging. Emphasis is on basic mechanisms

Student Learning Outcomes: Students will learn aspects of organic and biochemistry required to begin the rational manipulation and/or design of biological systems and the molecules they are comprised of.

Rules & Requirements

Prerequisites: Chemistry 3A

Hours & Format

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

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Engineering Molecules 1: Read Less [-]

BIO ENG 24 Freshmen Seminar 1 Unit

Terms offered: Spring 2018, Spring 2017, Fall 2016

The Berkeley Seminar Program has been designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small-seminar setting. Berkeley seminars are offered in all campus departments, and topics vary from department to department and semester to semester.

Freshmen Seminar: Read More [+]

Hours & Format

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

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Freshmen Seminar: Read Less [-]

BIO ENG 25 Careers in Biotechnology 1 Unit

Terms offered: Spring 2018, Spring 2017, Spring 2016
This introductory seminar is designed to give freshmen and sophomores an opportunity to explore specialties related to engineering in the pharmaceutical/biotech field. A series of one-hour seminars will be presented by industry professionals, professors, and researchers. Topics may include biotechnology and pharmaceutical manufacturing; process and control engineering; drug inspection process; research and development; compliance and validation; construction process for a GMP facility; project management; and engineered solutions to environmental challenges. This course is of interest to students in all areas of engineering and biology, including industrial engineering and manufacturing, chemical engineering, and bioengineering.
Careers in Biotechnology: Read More [+]
Rules & Requirements

Repeat rules: Course may be repeated for credit.

Hours & Format

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

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam required.

Careers in Biotechnology: Read Less [-]

BIO ENG 26 Introduction to Bioengineering 1 Unit

Terms offered: Fall 2017
This introductory seminar is designed to give freshmen and sophomores a glimpse of a broad selection of bioengineering research that is currently underway at Berkeley and UCSF. Students will become familiar with bioengineering applications in the various concentration areas and see how engineering principles can be applied to biological and medical problems.
Introduction to Bioengineering: Read More [+]
Objectives Outcomes

Course Objectives: This course is designed to expose students to current research and problems in bioengineering. As a freshman/sophomore class, its main purpose is to excite our students about the possibilities of bioengineering and to help them to choose an area of focus.

Student Learning Outcomes: This course demonstrates the rapid pace of new technology and the need for life-long learning (2). In addition, the course, because of its state-of-the-art research content, encourages our students to explore new horizons (3).

Hours & Format

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

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Instructors: T. Johnson, H. Lam

Introduction to Bioengineering: Read Less [-]

BIO ENG 84 Sophomore Seminar 1 or 2 Units

Terms offered: Spring 2018, Spring 2017, Spring 2013
Sophomore seminars are small interactive courses offered by faculty members in departments all across the campus. Sophomore seminars offer opportunity for close, regular intellectual contact between faculty members and students in the crucial second year. The topics vary from department to department and semester to semester. Enrollment limited to 15 sophomores.
Sophomore Seminar: Read More [+]
Rules & Requirements

Prerequisites: At discretion of instructor

Repeat rules: Course may be repeated for credit as topic varies. Course may be repeated for credit when topic changes.

Hours & Format

Fall and/or spring:
5 weeks - 3-6 hours of seminar per week
10 weeks - 1.5-3 hours of seminar per week
15 weeks - 1-2 hours of seminar per week

Summer:
6 weeks - 2.5-5 hours of seminar per week
8 weeks - 1.5-3.5 hours of seminar and 2-4 hours of seminar per week

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: The grading option will be decided by the instructor when the class is offered. Final exam required.

Sophomore Seminar: Read Less [-]

BIO ENG 98 Supervised Independent Group Studies 1 - 4 Units

Terms offered: Spring 2018, Fall 2017, Spring 2017
Organized group study on various topics under the sponsorship of a member of the Bioengineering faculty.
Supervised Independent Group Studies: Read More [+]
Rules & Requirements

Prerequisites: Consent of instructor

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricul a section of this catalog.

Repeat rules: Course may be repeated for credit.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week

Summer: 8 weeks - 1-4 hours of directed group study per week

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Supervised Independent Group Studies: Read Less [-]

BIO ENG 99 Supervised Independent Study and Research 1 - 4 Units

Terms offered: Spring 2018, Fall 2017, Spring 2017
Supervised independent study for lower division students.
Supervised Independent Study and Research: Read More [+]
Rules & Requirements

Prerequisites: Freshman or sophomore standing and consent of instructor

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

Repeat rules: Course may be repeated for credit.

Hours & Format

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

Summer:
8 weeks - 1.5-7.5 hours of independent study per week
10 weeks - 1.5-6 hours of independent study per week

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Supervised Independent Study and Research: Read Less [-]

BIO ENG 100 Ethics in Science and Engineering 3 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
The goal of this semester course is to present the issues of professional conduct in the practice of engineering, research, publication, public and private disclosures, and in managing professional and financial conflicts. The method is through historical didactic presentations, case studies, presentations of methods for problem solving in ethical matters, and classroom debates on contemporary ethical issues. The faculty will be drawn from national experts and faculty from religious studies, journalism, and law from the UC Berkeley campus.
Ethics in Science and Engineering: Read More [+]
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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Lam, Hayley

Ethics in Science and Engineering: Read Less [-]

BIO ENG 101 Instrumentation in Biology and Medicine 4 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016
This course teaches the fundamental principles underlying modern sensing and control instrumentation used in biology and medicine.
The course takes an integrative analytic and hands-on approach to measurement theory and practice by presenting and analyzing example instruments currently used for biology and medical research, including EEG, ECG, pulsed oximeters, Complete Blood Count (CBC), etc.
Instrumentation in Biology and Medicine: Read More [+]
Objectives Outcomes

Course Objectives: Students should understand the architecture and design principles of modern biomedical sensor data-acquisition (sensor-DAQ) systems. They should understand how to choose the appropriate biomedical sensor, instrumentation amplifier, number of bits, sampling rate, anti-aliasing filter, and DAQ system. They will learn how to design a low-noise instrumentation amplifier circuit. They should understand the crucial importance of suppressing 60 Hz and other interferences to acquire high quality low-level biomedical signals. They should understand the design principles of building, debugging.

Student Learning Outcomes: Students will achieve knowledge and skills in biomedical signal acquisition. They will be assessed in their success with the Course Objectives through tests, homeworks, and laboratories. In particular, the tests will ensure that the students have absorbed the theoretical concepts. The laboratories will provide assessment of learning practical skills (e.g., building an ECG circuit).

Rules & Requirements

Prerequisites: El Eng 16A & 16B, Math 53, 54, Physics 7A-7B, 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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Conolly

Instrumentation in Biology and Medicine: Read Less [-]

BIO ENG 102 Biomechanics: Analysis and Design 4 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
This course introduces, develops and applies the methods of continuum mechanics to biomechanical phenomena abundant in biology and medicine. It is intended for upper level undergraduate students who have been exposed to vectors, differential equations, and undergraduate course(s) in physics and certain aspects of modern biology.
Biomechanics: Analysis and Design: Read More [+]
Objectives Outcomes

Course Objectives: This course introduces, develops and applies scaling laws and the methods of continuum mechanics to biomechanical phenomena related to tissue or organ levels. It is intended for upper level undergraduate students who have been exposed to vectors, differential equations, and undergraduate course(s) in physics and certain aspects of modern biology.

Topics include:
• Biosolid mechanics
• Stress, strain, constitutive equation
• Vector and tensor math
• Equilibrium
• Extension, torsion, bending, buckling
• Material properties of tissues

Student Learning Outcomes: The course will equip the students with a deep understanding of principles of biomechanics. The intuitions gained in this course will help guide the analysis of design of biomedical devices and help the understanding of biological/medical phenomena in health and disease.
The students will develop insight, skills and tools in quantitative analysis of diverse biomechanical systems and topics, spanning various scales from cellular to tissue and organ levels.

Rules & Requirements

Prerequisites: Math 53, 54; Physics 7A

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Mofrad

Biomechanics: Analysis and Design: Read Less [-]

BIO ENG 103 Engineering Molecules 2 4 Units

Terms offered: Fall 2017, Fall 2016

Thermodynamic and kinetic concepts applied to understanding the chemistry and structure of biomolecules (proteins, membranes, DNA, and RNA) and their thermodynamic and kinetic features in the crowded cellular environment. Topics include entropy, bioenergetics, free energy, chemical potential, reaction kinetics, enzyme kinetics, diffusion and transport, non-equilibrium systems, and their connections to the cellular environment.

Engineering Molecules 2: Read More [+]

Objectives Outcomes

Course Objectives: (1) To introduce the basics of thermodynamics and chemical kinetics for molecular to cellular biological systems; (2) To give students an understanding of biological size and timescales illustrated through computational exercises on model problems in physical biology.

Student Learning Outcomes: students will be able to (1) relate statistical thermodynamics and chemical kinetics to analyze molecular and cellular behavior beyond the ideal gas and Carnot cycle.

Rules & Requirements

Prerequisites: Bio1ogy 1A or Bioengineering 11, Physics 7A-7B, Math 1A, 1B, 53, 54

Credit Restrictions: Students will receive no credit for Bioengineering 103 after completing Chemistry 120B, or Molecular Cell Biology C100A/ Chemistry C130.

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Head-Gordon

Engineering Molecules 2: Read Less [-]

BIO ENG 104 Biological Transport Phenomena 4 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016

The transport of mass, momentum, and energy are critical to the function of living systems and the design of medical devices. Biological transport phenomena are present at a wide range of length scales: molecular, cellular, organ (whole and by functional unit), and organism. This course develops and applies scaling laws and the methods of continuum mechanics to biological transport phenomena over a range of length and time scales. The course is intended for undergraduate students who have taken a course in differential equations and an introductory course in physics. Students should be familiar with basic biology; an understanding of physiology is useful, but not assumed.

Biological Transport Phenomena: Read More [+]

Rules & Requirements

Prerequisites: Mathematics 53, 54, and Physics 7A

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Johnson

Biological Transport Phenomena: Read Less [-]

BIO ENG C106A Introduction to Robotics 4 Units

Terms offered: Fall 2017
An introduction to the kinematics, dynamics, and control of robot manipulators, robotic vision, and sensing. The course covers forward and inverse kinematics of serial chain manipulators, the manipulator Jacobian, force relations, dynamics, and control. It presents elementary principles on proximity, tactile, and force sensing, vision sensors, camera calibration, stereo construction, and motion detection. The course concludes with current applications of robotics in active perception, medical robotics, and other areas.
Introduction to Robotics: Read More [+]
Rules & Requirements

Prerequisites: Electrical Engineering 120 or equivalent, consent of instructor

Credit Restrictions: Students will receive no credit for Electrical Engineering and Computer Science C106A/Bioengineering C106A after completing EE C106A/BioE C125, Electrical Engineering 206A, or Electrical Engineering and Computer Science 206A.

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/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Bajcsy

Also listed as: EECS C106A

Introduction to Robotics: Read Less [-]

BIO ENG C106B Robotic Manipulation and Interaction 4 Units

Terms offered: Spring 2018
This course is a sequel to EECS C106A (http://guide.berkeley.edu/search/?P=EECS%20C106A)/Bioengineering C106A, which covers kinematics, dynamics and control of a single robot. This course will cover dynamics and control of groups of robotic manipulators coordinating with each other and interacting with the environment. Concepts will include an introduction to grasping and the constrained manipulation, contacts and force control for interaction with the environment. We will also cover active perception guided manipulation, as well as the manipulation of non-rigid objects. Throughout, we will emphasize design and human-robot interactions, and applications to applications in manufacturing, service robotics, tele-surgery, and locomotion.
Robotic Manipulation and Interaction: Read More [+]
Rules & Requirements

Prerequisites: Electrical Engineering and Computer Science C106A/Bioengineering C106A or consent of the instructor

Credit Restrictions: Students will receive no credit for Electrical Engineering and Computer Science C106B/Bioengineering C106B after completing Electrical Engineering C106B/Bioengineering C125B, Electrical Engineering 206B, or Electrical Engineering and Computer Science 206B.

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/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructors: Bajcsy, Sastry

Also listed as: EECS C106B

Robotic Manipulation and Interaction: Read Less [-]

BIO ENG 110 Biomedical Physiology for Engineers 4 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016
This course introduces students to the physiology of human organ systems, with an emphasis on quantitative problem solving, engineering-style modeling, and applications to clinical medicine.
Biomedical Physiology for Engineers: Read More [+]
Objectives Outcomes

Course Objectives: This 15-week course will introduce students to the principles of medical physiology, with a strong emphasis on quantitative problem solving, the physiological basis of human disease, and applications to biomedical devices and prostheses.

Student Learning Outcomes: Students will be exposed to the basic physiological systems which govern the function of each organ system, examples of diseases in which these systems go awry, and medical devices which have been developed to correct the deficits.

Rules & Requirements

Prerequisites: BioE 10, BioE 11 or Biology 1A; Math 54 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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Kumar

Biomedical Physiology for Engineers: Read Less [-]

BIO ENG 111 Functional Biomaterials Development and Characterization 4 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016
This course is intended for upper level engineering undergraduate students interested in the development of novel functional proteins and peptide motifs and characterization of their physical and biological properties using various instrumentation tools in quantitative manners. The emphasis of the class is how to develop novel proteins and peptide motifs, and to characterize their physical and biological functions using various analytical tools in quantitative manners.
Functional Biomaterials Development and Characterization: Read More [+]
Objectives Outcomes

Course Objectives: To provide students with basic and extended concepts for the development of the functional proteins and their characterization for various bioengineering and biomedical purposes.

Student Learning Outcomes: Upon completing the course, the student should be able:
1. To understand the directed evolution processes of functional proteins.
2. To identify the natural protein products from proteomic database.
3. To design various experiments to characterize the new protein products.
4. To develop novel functional proteins and characterize their properties.
5. To understand basic concepts and instrumentation of protein characterization tools.

Rules & Requirements

Prerequisites: Chemistry 1A or 4A, Bio Eng 11 or Biology 1A; Bio Eng 103 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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: SW Lee

Functional Biomaterials Development and Characterization: Read Less [-]

BIO ENG C112 Molecular Biomechanics and Mechanobiology of the Cell 4 Units

Terms offered: Spring 2016, Spring 2015, Spring 2014
This course applies methods of statistical continuum mechanics to subcellar biomechanical phenomena ranging from nanoscale (molecular) to microscale (whole cell and cell population) biological processes at the interface of mechanics, biology, and chemistry.
Molecular Biomechanics and Mechanobiology of the Cell: Read More [+]
Objectives Outcomes

Course Objectives: This course, which is open to senior undergraduate students or 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; BioE102 or MEC85 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/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Mofrad

Also listed as: MEC ENG C115

Molecular Biomechanics and Mechanobiology of the Cell: Read Less [-]

BIO ENG 113 Stem Cells and Technologies 4 Units

Terms offered: Fall 2015, Fall 2014, Fall 2013
This course will teach the main concepts and current views on key attributes of embryonic stem cells (ESC), will introduce theory of their function in embryonic development, methods of ESC derivation, propagation, and characterization, and will discuss currently developing stem cell technologies.
Stem Cells and Technologies: Read More [+]
Rules & Requirements

Prerequisites: 10 and Biology 1A, 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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Conboy

Stem Cells and Technologies: Read Less [-]

BIO ENG 114 Cell Engineering 4 Units

Terms offered: Fall 2017, Fall 2016
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 technologies. Techniques for primary cell-line derivation, propagation characterization and therapeutic use (transplantation and drug-screening) will be outlined. Current bioengineering strategies will be discussed.
Cell Engineering: Read More [+]
Objectives Outcomes

Course Objectives: The purpose of this course is to introduce the student to problems associated with the molecular regulation of cell properties, proper selection of in vitro and in vivo conditions and experimental techniques best suited for derivation, propagation and characterization of primary cell lines and provide knowledge of the currently developing cell and tissue engineering technologies. The level of course-work presupposes knowledge of fundamentals of cellular and molecular biology and of biomaterials at the freshman/sophomore undergraduate level.

Student Learning Outcomes: Through class lectures and readings in the theory and experimental methods of cell science, material science and bioengineering the student will gain a fundamental understanding of the principles and techniques guiding the current cell and tissue engineering research. In addition, this course will aid the student in cultivating broad knowledge of the stem cell and regenerative medicine field and in learning about the interface with biomedical and translational sciences.

Rules & Requirements

Prerequisites: Bio1A or Bio Eng 11; 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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Conboy

Cell Engineering: Read Less [-]

BIO ENG 115 Cell Biology for Engineers 4 Units

Terms offered: Spring 2018, Fall 2017, Spring 2017
This course aims to provide a practical understanding of the nature of cell and tissue biology research. Students will be introduced to cell biology techniques as applied to cells and tissues including immunofluorescence, image analysis, protein quantification, protein expression, gene expression, and cell culture. The course culminates with a group project which synthesizes literature review, experimental design, implementation, troubleshooting, and analysis of results.
Cell Biology for Engineers: Read More [+]
Objectives Outcomes

Course Objectives: • To introduce a variety of basic cellular biology laboratory techniques, and develop a conceptual and theoretical understanding of the reliability and limitations of these tools.
• To support students in developing a research question, defining project goals and designing experiments that can be addressed within the constraints of the course.
• To engage students in applying their knowledge and research to others in professional activities such as presentations and papers.

Student Learning Outcomes: Students will gain an understanding of:
• Laboratory safety issues
• Appropriate methods for documenting laboratory procedures
• Phase contrast microscopy
• Fluorescent microscopy
• Image processing
• Cell culture
• Protein quantification, SDS-PAGE, and Western blotting
• Isolation and quantification of mRNA from cells
• RT-PCR
• Data analysis
• Experimental design

Rules & Requirements

Prerequisites: Bioengineering 103 or equivalent, Bioengineering 114 recommended (can be taken concurrently)

Hours & Format

Fall and/or spring: 15 weeks - 2 hours of lecture and 4 hours of laboratory per week

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructors: Lam, Hayley, Irina Conboy

Cell Biology for Engineers: Read Less [-]

BIO ENG 116 Cell and Tissue Engineering 4 Units

Terms offered: Spring 2016, Spring 2015, Spring 2014
The goal of tissue engineering is to fabricate substitutes to restore tissue structure and functions. Understanding cell function in response to environmental cues will help us to establish design criteria and develop engineering tools for tissue fabrication. This course will introduce the basic concepts and approaches in the field, and train students to design and engineer biological substitutes.
Cell and Tissue Engineering: Read More [+]
Objectives Outcomes

Course Objectives: (1) To introduce the basics of tissue engineering, including quantitative cell and tissue characterization, stem cells, cell-matrix interaction, cell migration, bioreactors, mechanical regulation, tissue preservation, and immuno-modulation/isolation; (2) To illustrate the cutting-edge research in tissue engineering; (3) To enhance the skills in analyzing and designing engineered tissue products.

Student Learning Outcomes: Students will be able to (1) use mathematical models to analyze cell functions (e.g., proliferation, apoptosis, migration) and mechanical property of tissues, (2) understand scientific and ethical issues of stem cells, (3) engineer natural matrix, biomaterials and drug delivery, (4) understand mass transport and design appropriate bioreactors, (5) understand clinical issues such as tissue preservation, immune responses, immunomodulation and immunoisolation, (6) apply the knowledge to engineering biological substitutes.

Rules & Requirements

Prerequisites: BioE 103 or equivalent, BioE 104

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Li

Cell and Tissue Engineering: Read Less [-]

BIO ENG C117 Structural Aspects of Biomaterials 4 Units

Terms offered: Spring 2018, Spring 2016, Fall 2013
This course covers the structure and mechanical functions of load bearing tissues and their replacements. Natural and synthetic load-bearing biomaterials for clinical applications are reviewed. Biocompatibility of biomaterials and host response to structural implants are examined. Quantitative treatment of biomechanical issues and constitutive relationships of tissues are covered in order to design biomaterial replacements for structural function. Material selection for load bearing applications including reconstructive surgery, orthopedics, dentistry, and cardiology are addressed. Mechanical design for longevity including topics of fatigue, wear, and fracture are reviewed. Case studies that examine failures of devices are presented.
Structural Aspects of Biomaterials: Read More [+]
Rules & Requirements

Prerequisites: Biology 1A, Engineering 45, Civil and Environmental Engineering 130 or 130N or Bioengineering 102, and Engineering 190

Credit Restrictions: Students will receive no credit for Mechanical Engineering C117 after completing Mechanical Engineering C215/ Bioengineering C222.

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Instructor: Pruitt

Also listed as: MEC ENG C117

Structural Aspects of Biomaterials: Read Less [-]

BIO ENG C118 Biological Performance of Materials 4 Units

Terms offered: Fall 2017, Fall 2015, Fall 2014
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.
Biological Performance of Materials: Read More [+]
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: 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.

• Design experiments and analyze data from the literature in the context of the class design project.
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.
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.
Work independently and function on a team, and develop solid communication skills (oral, graphic & written) through 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.

Rules & Requirements

Prerequisites: Engin 45; BioE 103 or equivalent; BioE 102 and BioE 104 recommended

Hours & Format

BIO ENG C119 Orthopedic Biomechanics 4 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
Statics, dynamics, optimization theory, composite beam theory, beam-on-elastic foundation theory, Hertz contact theory, and materials behavior. 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. MATLAB-based project to integrate the course material.
Orthopedic Biomechanics: Read More [+]
Rules & Requirements

Prerequisites: Mechanical Engineering C85, Civil Engineering C30, or Bioengineering 102, or equivalent; concurrent enrollment OK. Proficiency in MatLab or equivalent. Prior knowledge of biology or anatomy is not assumed

Hours & Format

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

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Keaveny

Also listed as: MEC ENG C176

Orthopedic Biomechanics: Read Less [-]

BIO ENG 121 BioMEMS and Medical Devices 4 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016
Biophysical and chemical principles of biomedical devices, bionanotechnology, bionanophotonics, and biomedical microelectromechanical systems (BioMEMS). Topics include basics of nano- and 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, etc.
BioMEMS and Medical Devices: Read More [+]

Rules & Requirements

Prerequisites: Chemistry 3A; Physics 7A and 7B

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: L. Lee

BioMEMS and Medical Devices: Read Less [-]

BIO ENG 121L BioMems and BioNanotechnology Laboratory 4 Units

Terms offered: Fall 2016, Fall 2015, Spring 2015
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.
BioMems and BioNanotechnology Laboratory: Read More [+]

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: BioE 103 or equivalent, BioE 104

Credit Restrictions: Students will receive no credit for 121L after taking 221L.

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/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: D. Liepmann

BioMems and BioNanotechnology Laboratory: Read Less [-]

BIO ENG 124 Basic Principles of Drug Delivery 3 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Basic Principles of Drug Delivery: Read More [+]
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

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: BioE 103 or equivalent

Hours & Format

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

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Murthy

Basic Principles of Drug Delivery: Read Less [-]

BIO ENG C125 Introduction to Robotics 4 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
An introduction to the kinematics, dynamics, and control of robot manipulators, robotic vision, and sensing. The course covers forward and inverse kinematics of serial chain manipulators, the manipulator Jacobian, force relations, dynamics, and control. It presents elementary principles on proximity, tactile, and force sensing, vision sensors, camera calibration, stereo construction, and motion detection. The course concludes with current applications of robotics in active perception, medical robotics, and other areas.
Introduction to Robotics: Read More [+]
Rules & Requirements

Prerequisites: EE 120 or equivalent, consent of instructor

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Bajcsy

Formerly known as: Electrical Engineering C125/Bioengineering C125

Also listed as: EL ENG C106A

Introduction to Robotics: Read Less [-]

BIO ENG C125B Robotic Manipulation and Interaction 4 Units

Terms offered: Spring 2017, Spring 2016
This course is a sequel to Electrical Engineering C106A/Bioengineering C125, which covers kinematics, dynamics and control of a single robot. This course will cover dynamics and control of groups of robotic manipulators coordinating with each other and interacting with the environment. Concepts will include an introduction to grasping and the constrained manipulation, contacts and force control for interaction with the environment. We will also cover active perception guided manipulation, as well as the manipulation of non-rigid objects. Throughout, we will emphasize design and human-robot interactions, and applications to applications in manufacturing, service robotics, tele-surgery, and locomotion.
Robotic Manipulation and Interaction: Read More [+]
Rules & Requirements

Prerequisites: Electrical Engineering C106A/Bioengineering C125 or consent of the instructor

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/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructors: Bajcsy, Sastry

Also listed as: EL ENG C106B

Robotic Manipulation and Interaction: Read Less [-]

BIO ENG 131 Introduction to Computational Molecular and Cell Biology 4 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
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; web-based computational biology tools will be used by students and programming projects will be given. Computational biology research connections to biotechnology will be explored.
Introduction to Computational Molecular and Cell Biology: Read More [+]
Objectives Outcomes

Course Objectives: To introduce the biological databases and file formats commonly used in computational biology. (2) To familiarize students with the use of Unix scripting languages in bioinformatics workflows. (3) To introduce common algorithms for sequence alignment, RNA structure prediction, phylogeny and clustering, along with fundamentals of probability, information theory and algorithmic complexity analysis.

Student Learning Outcomes: Students will be able to use knowledge from the lectures and lab sessions to write simple programs to parse bioinformatics file formats and execute basic algorithms, to analyze algorithmic complexity, to navigate and (for simple cases) set up biological databases containing biological data (including sequences, genome annotations and protein structures), and to use basic statistics to interpret results of compbio analyses.

Rules & Requirements

Prerequisites: BioE 11 or Bio 1A (may be taken concurrently), Math 53

Credit Restrictions: Students will receive no credit for 131 after taking 231.

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Holmes

Introduction to Computational Molecular and Cell Biology: Read Less [-]

BIO ENG 132 Genetic Devices 4 Units

Terms offered: Spring 2018, Fall 2014, Fall 2013
This senior-level course is a comprehensive survey of genetic devices. These DNA-based constructs are comprised of multiple "parts" that together encode a higher-level biological behavior and perform useful human-defined functions. Such constructs are the engineering target for most projects in synthetic biology. Included within this class of constructs are genetic circuits, sensors, biosynthetic pathways, and microbiological functions.
Genetic Devices: Read More [+]
Objectives Outcomes

Course Objectives: (1) To introduce the basic biology and engineering principles for constructing genetic devices including biochemical devices, microbiological devices, genetic circuits, eukaryotic devices, and developmental devices, (2) To familiarize students with current literature examples of genetic devices and develop literature searching skills; (3) To develop the students' ability to apply computational tools to the design of genetic devices.

Student Learning Outcomes: Students will be able to (1) use mathematical models to describe the dynamics of genetic devices, (2) comprehend and evaluate publications related to any type of genetic device, (3) perform a thorough literature search, (4) evaluate the technical plausibility of a proposed genetic device, (5) analyze a design challenge and propose a plausible solution to it in the form of a genetic device, and (6) assess any ethical or safety issues associated with a proposed genetic device.

Rules & Requirements

Prerequisites: Engineering 7 or Computer Science 61A, Mathematics 54, Chemistry 3A, and BioE 103 or equivalent

Credit Restrictions: Students will receive no credit for 132 after taking 232.

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Anderson

Genetic Devices: Read Less [-]

BIO ENG 133 Biomolecular Engineering 3 Units

Terms offered: Prior to 2007
This is an introductory course of biomolecular engineering and is required for all CBE graduate students. Undergraduates with knowledge of thermodynamics and transport are also welcome. The topics include structures, functions, and dynamics of biomolecules; molecular tools in biotechnology; metabolic and signaling networks in cellular engineering; and synthetic biology and biomedical engineering applications.
Biomolecular Engineering: Read More [+]
Objectives Outcomes

Course Objectives: Students are expected to become familiar with the terminologies, molecules, and mechanisms, i.e., the language of biomolecular engineering. At end of this course, you are expected to be able to analyze and critique modern literature in related research areas.

Student Learning Outcomes: Students will be able to (1) understand the biochemical basis for protein folding and enzymatic function, (2) mathematically analyze enzyme function, either individually or as part of a metabolic pathway, (3) engineer novel enzymes using rational, computational, and directed evolution based approaches, (4) understand principles of metabolic engineering and synthetic biology, (5) understand the dynamics and mechanisms of cellular signal transduction, and (6) understand principles for engineering cellular signaling and function.

Rules & Requirements

Prerequisites: Bioengineering 104 or Chemical and Biomolecular Engineering 150A-150B or consent of instructor. A course in statistical mechanics and/or thermodynamics is recommended

Credit Restrictions: Students will receive no credit for Bioengineering 133 after completing Chemical Engineering C274, Molecular and Cell Biology C274 or Bioengineering C233.

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Schaffer

Biomolecular Engineering: Read Less [-]

BIO ENG 134 Genetic Design Automation 4 Units

Terms offered: Fall 2017
Genetic Design Automation is the use of software to design and manage genetics experiments. This course introduces the interface between object-oriented programming and wetlab synthetic biology in a hands-on manner. Through a series of programming assignments, each student will build a computer program that automatically designs experiments starting from a formal specification. They will then independently build a new software module of their own design to augment the basic platform
Genetic Design Automation: Read More [+]
Objectives Outcomes

Course Objectives: (1) To develop the skill of translating experimental design into computer code, (2) Develop familiarity with state-of-the-art infrastructure for wetlab automation, (3) Develop proficiency in software development

Student Learning Outcomes: students will be able to (1) Describe molecular biology entities and operations in terms of data structures, (2) Develop moderately-sized computer programs, (3) Write tests and benchmarking suites for biological algorithms (4) Explore different algorithmic approaches to problems and assess their relative merits and efficiencies, (5) Develop proficiency in conceiving and implementing software projects of their own design as they relate to biological problems

Rules & Requirements

Prerequisites: CS61B; BioEng 103 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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: J. Christopher Anderson

Genetic Design Automation: Read Less [-]

BIO ENG 135 Frontiers in Microbial Systems Biology 4 Units

Terms offered: Spring 2017, Fall 2009
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 to identify unsolved problems and discusses possible novel approaches while encouraging students to develop ideas to explore new directions in their own research.
Frontiers in Microbial Systems Biology: Read More [+]
Rules & Requirements

Prerequisites: Upper division standing with background in differential equations and probability. Coursework in molecular and cell biology or biochemistry recommended

Credit Restrictions: Students will receive no credit for 135 after taking 235.

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructors: Arkin, Bischofs-Pfeifer, Wolf

Frontiers in Microbial Systems Biology: Read Less [-]

BIO ENG C136L Laboratory in the Mechanics of Organisms 3 Units

Terms offered: Spring 2015, Spring 2014, Spring 2013, Spring 2012
Introduction to laboratory and field study of the biomechanics of animals and plants using fundamental biomechanical techniques and equipment. Course has a series of rotations involving students in experiments demonstrating how solid and fluid mechanics can be used to discover the way in which diverse organisms move and interact with their physical environment. The laboratories emphasize sampling methodology, experimental design, and statistical interpretation of results. Latter third of course devoted to independent research projects. Written reports and class presentation of project results are required.
Laboratory in the Mechanics of Organisms: Read More [+]
Rules & Requirements

Prerequisites: Integrative Biology 135 or consent of instructor; for Electrical Engineering and Computer Science students, Electrical Engineering 105, 120 or Computer Science 184

Credit Restrictions: Students will receive no credit for C135L after taking 135L.

Hours & Format

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

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Formerly known as: Integrative Biology 135L

Also listed as: EL ENG C145O/INTEGBI C135L

Laboratory in the Mechanics of Organisms: Read Less [-]

BIO ENG C137 Designing for the Human Body 3 Units

Terms offered: Fall 2017
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.
Designing for the Human Body: Read More [+]
Objectives Outcomes

Course Objectives: The purpose of this course is twofold:
• to learn the fundamental concepts of designing devices to 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”.

Student Learning Outcomes: RELATIONSHIP OF THE COURSE TO ABET PROGRAM OUTCOMES
(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

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. Physics 7A, Math 1A and 1B

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 and 1-2 hours of laboratory per week

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

BIO ENG 140L Synthetic Biology Laboratory 4 Units

Terms offered: Fall 2015, Spring 2015, Fall 2014

This laboratory course is designed as an introduction to research in synthetic biology, a ground-up approach to genetic engineering with applications in bioenergy, heathcare, materials science, and chemical production. In this course, we will design and execute a real research project. Each student will be responsible for designing and constructing components for the group project and then performing experiments to analyze the system. In addition to laboratory work, we will have lectures on methods and design concepts in synthetic biology including an introduction to Biobricks, gene synthesis, computer modeling, directed evolution, practical molecular biology, and biochemistry.

Synthetic Biology Laboratory: Read More [+]

Rules & Requirements

Prerequisites: Molecular biology, basic chemistry and biochemistry, and differential equations; 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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Anderson

Synthetic Biology Laboratory: Read Less [-]

BIO ENG 143 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); BioE Content: Biological.

Computational Methods in Biology: Read More [+]

Rules & Requirements

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

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Head-Gordon

Computational Methods in Biology: Read Less [-]

BIO ENG 144 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.

Introduction to Protein Informatics: Read More [+]

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. No prior coursework in biology is required. This course includes no programming projects and prior experience in programming is not required

Credit Restrictions: BioE 244 or BioE C244L/PMB C244

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Sjolander

Formerly known as: Bioengineering C144/Plant and Microbial Biology C144

Introduction to Protein Informatics: Read Less [-]

BIO ENG 144L Protein Informatics Laboratory 3 Units

Terms offered: Fall 2008
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.
Protein Informatics Laboratory: Read More [+]
Rules & Requirements

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

Credit Restrictions: Bio Eng 244L or Bio Eng C244L/PMB C244L

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Sjolander

Formerly known as: Bioengineering C144L/Plant and Microbial Biology C144L

Protein Informatics Laboratory: Read Less [-]

BIO ENG 145 Intro to Machine Learning in Computational Biology 4 Units

Terms offered: Fall 2017
This course will review the fundamentals of Data Science and data mining techniques. We will begin by reviewing Data Science across the disciplines, including guest lectures from data scientists on campus. As the semester progresses, we will focus increasingly on data science techniques in computational biology and bioinformatics, illustrating major methods and issues from these fields. Finally, we will discuss ethical issues related to data from biomedical research and genomics.
Intro to Machine Learning in Computational Biology: Read More [+]
Objectives Outcomes

Course Objectives: This course aims to equip students with a foundational understanding of machine learning techniques used in genomics and computational biology. Desired Course Outcomes: Students completing this course should have stronger programming skills, the ability to apply simple machine learning techniques to complex biosequence and genomics data, and an understanding of some of the challenges in genomics and bioinformatics.

Student Learning Outcomes: Students completing this course should have stronger programming skills, the ability to apply simple machine learning techniques to complex biosequence and genomics data, and an understanding of some of the challenges in genomics and bioinformatics.

Rules & Requirements

Prerequisites: CS61B, CS70 or Math 55; CS170 or STAT 132 or STAT 133 (http://guide.berkeley.edu/search/?P=STAT%20133) (may be taken concurrently); BioE 144L (may be taken concurrently)

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: K. Sjolander

Intro to Machine Learning in Computational Biology: Read Less [-]

BIO ENG C145L Introductory Electronic Transducers Laboratory 3 Units

Terms offered: Fall 2014, Fall 2013, Fall 2012
Laboratory exercises exploring a variety of electronic transducers for measuring physical quantities such as temperature, force, displacement, sound, light, ionic potential; the use of circuits for low-level differential amplification and analog signal processing; and the use of microcomputers for digital sampling and display. Lectures cover principles explored in the laboratory exercises; construction, response and signal to noise of electronic transducers and actuators; and design of circuits for sensing and controlling physical quantities.
Introductory Electronic Transducers Laboratory: Read More [+]
Hours & Format

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

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Derenzo

Also listed as: EL ENG C145L

Introductory Electronic Transducers Laboratory: Read Less [-]

BIO ENG C145M Introductory Microcomputer Interfacing Laboratory 3 Units

Terms offered: Spring 2013, Spring 2012, Spring 2011
Laboratory exercises constructing basic interfacing circuits and writing 20-100 line C programs for data acquisition, storage, analysis, display, and control. Use of the IBM PC with microprogrammable digital counter/timer, parallel I/O port. Circuit components include anti-aliasing filters, the S/H amplifier, A/D and D/A converters. Exercises include effects of aliasing in periodic sampling, fast Fourier transforms of basic waveforms, the use of the Hanning filter for leakage reduction, Fourier analysis of the human voice, digital filters, and control using Fourier deconvolution. Lectures cover principles explored in the lab exercises and design of microcomputer-based systems for data acquisitions, analysis and control.
Introductory Microcomputer Interfacing Laboratory: Read More [+]
Rules & Requirements

Prerequisites: EE 16A & 16B

Hours & Format

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

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Derenzo

Also listed as: EL ENG C145M

Introductory Microcomputer Interfacing Laboratory: Read Less [-]

BIO ENG 147 Principles of Synthetic Biology 4 Units

Terms offered: Fall 2016, Fall 2015, Fall 2014
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.
Principles of Synthetic Biology: Read More [+]
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 and 54; BioE 103 or equivalent or consent of instructor

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

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/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Instructor: Arkin

Principles of Synthetic Biology: Read Less [-]

BIO ENG 148 Bioenergy and Sustainable Chemical Synthesis: Metabolic Engineering and Synthetic Biology Approaches 3 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Bioenergy and Sustainable Chemical Synthesis: Metabolic Engineering and Synthetic Biology Approaches: Read More [+]
Objectives Outcomes

Course Objectives: (1) Learn the common engineered metabolic pathways for biofuel biosynthesis
(2) analytical methods
(3) synthetic biology approaches
(4) Industry technologies and opportunities

Student Learning Outcomes: Students will learn (1) the common pathways used for biofuel synthesis and framework for the biosynthesis of specialty chemicals, (2) analytical methods for quantitative measurements of metabolic pathways, (3) synthetic biology approaches for increasing overall pathway performance, and how to (4) utilize available online resources for culling information from large data sources.

Rules & Requirements

Prerequisites: Chem 3A, BioE 103 or equivalent

Hours & Format

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

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Dueber

Bioenergy and Sustainable Chemical Synthesis: Metabolic Engineering and Synthetic Biology Approaches: Read Less [-]

BIO ENG 150 Introduction of Bionanoscience and Bionanotechnology 4 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
This course is intended for the bioengineering or engineering undergraduate students interested in acquiring a background in recent development of bio-nanomaterials and bio-nanotechnology. The emphasis of the class is to understand the properties of biological basis building blocks, their assembly principles in nature, and their application to build functional materials and devices.
Introduction of Bionanoscience and Bionanotechnology: Read More [+]
Objectives Outcomes

Course Objectives: I. Basic building blocks and governing forces:
This part is intended to enhance the understanding of the structures and properties of biological basic building blocks and their governing forces to assemble the biological materials. This part covers the chemical structures of amino acids, ribonucleic acids, hydrocarbonates, and lipids, and their physical properties depending on the chemical and physical structures. In addition, governing forces (hydrogen bonding, ionic interaction, van der Waals interaction, hydrophobic interactions, etc) to assemble the basic building blocks to form nanostructures will be covered. Tools and methodologies to analyze the chemical structure of the molecules will be introduced. Quantitative analysis of the properties of biological basic building blocks will also be addressed.
II. Case study of the molecular level structures of biological materials. This part is intended to study the examples of biological molecules to enhance understanding the assembly principle of biological materials, including collagens, keratins, spider webs, silks, bio-adhesives as protein based robust materials, bones, sea shells, diatoms, sponges, and, other biominerals as hierarchical nanostructures, and butterfly wings and insect eyes, other periodic structures for optical applications. Through the case study, we will learn how natural materials are designed to solve the challenging problem to be faced in the natural environments and exploit their design principle to develop novel functional materials and devices.
III. Case study of the artificial nanomaterials and devices inspired by biological nature. This part is intended to enhance understanding the recently developed nanostructures and devices to mimic the natural biological materials and organisms. Hybrid functional nanomaterials and devices, such as biological basic building blocks conjugated with inorganic nanocomponents, such as quantum dots, nanowires, nanotubes will be discussed to fabricate various devices including, bio-sensor, bio-nano electronic materials and devices, bio-computing. Nano medicine and bio imaging will also be covered.
The goal is for the bioengineering students to gain sufficient chemical and physical aspects of biological materials through the case study of spider webs, silks, sea shells, diatoms, bones, and teeth, as well as recently developed self-assembled nanostructures inspired by nature.

Student Learning Outcomes: This course is intended for the undergraduate students interested in acquiring a background of recent development of bio-nanomaterials and bio-nanotechnology focused on the materials point of view. Through this course, students will understand the assembly principle of biological materials and their application in bio-nanotechnology.

Rules & Requirements

Prerequisites: BioE 11 or Biology 1A, Chem 1A

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/Undergraduate

BIO ENG 151 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.
Micro/Nanofluidics for Bioengineering and Lab-On-A-Chip: Read More [+]
Objectives Outcomes

Course Objectives: 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.
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.

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: BioE 11 or Chem 3B, BioE 104 or ME 106 or consent of instructor

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

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Herr

Micro/Nanofluidics for Bioengineering and Lab-On-A-Chip: Read Less [-]

BIO ENG 163 Principles of Molecular and Cellular Biophotonics 4 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
This course provides undergraduate and graduate bioengineering students with an opportunity to increase their knowledge of topics in the emerging field of biophotonics with an emphasis on fluorescence spectroscopy, biosensors and devices for optical imaging and detection of biomolecules. This course will cover the photophysics and photochemistry of organic molecules, the design and characterization of biosensors and their applications within diverse environments.
Principles of Molecular and Cellular Biophotonics: Read More [+]
Rules & Requirements

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

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Instructor: Marriott

Principles of Molecular and Cellular Biophotonics: Read Less [-]

BIO ENG 163L Molecular and Cellular Biophotonics Laboratory 4 Units

Terms offered: Spring 2018, Spring 2017, Spring 2015
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).
Molecular and Cellular Biophotonics Laboratory: Read More [+]
Rules & Requirements

Prerequisites: Bioengineering 163 and ok to take concurrently

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

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Marriott

Molecular and Cellular Biophotonics Laboratory: Read Less [-]

BIO ENG 164 Optics and Microscopy 4 Units

Terms offered: Fall 2010, Fall 2009, Fall 2008
This course teaches fundamental principles of optics and examines contemporary methods of optical microscopy for cells and molecules. Students will learn how to design simple optical systems, calculate system performance, and apply imaging techniques including transmission, reflection, phase, and fluorescence microscopy to investigate biological samples. The capabilities of optical microscopy will be compared with complementary techniques including electron microscopy, coherence tomography, and atomic force microscopy. Students will also be responsible for researching their final project outside of class and presenting a specific application of modern microscopy to biological research as part of an end-of-semester project.
Optics and Microscopy: Read More [+]
Rules & Requirements

Prerequisites: Physics 7A-7B or 8A-8B or equivalent introductory physics course

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Fletcher

Optics and Microscopy: Read Less [-]

BIO ENG C165 Medical Imaging Signals and Systems 4 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Medical Imaging Signals and Systems: Read More [+]
Rules & Requirements

Prerequisites: Electrical Engineering 16A and 16B

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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Conolly

Also listed as: EL ENG C145B

Medical Imaging Signals and Systems: Read Less [-]

BIO ENG 168L Practical Light Microscopy 3 Units

Terms offered: Fall 2017, Spring 2015, Fall 2013
This laboratory course is designed for students interested in obtaining practical hands-on training in optical imaging and instrumentation. Using a combination of lenses, cameras, and data acquisition equipment, students will construct simple light microscopes that introduce basic concepts and limitations important in biomedical optical imaging. Topics include compound microscopes, Kohler illumination, Rayleigh two-point resolution, image contrast including dark-field and fluorescence microscopy, and specialized techniques such as fluorescence recovery after photobleaching (FRAP). Intended for students in both engineering and the sciences, this course will emphasize applied aspects of optical imaging and provide a base of practical skill and reference material that students can leverage in their own research or in industry.
Practical Light Microscopy: Read More [+]
Hours & Format

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

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Instructor: Fletcher

Practical Light Microscopy: Read Less [-]

BIO ENG C181 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 placed 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-the-art research.
The Berkeley Lectures on Energy: Energy from Biomass: Read More [+]
Rules & Requirements

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

Repeat rules: 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/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

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

Also listed as: CHEM C138/CHM ENG C195A/PLANTBI C124

The Berkeley Lectures on Energy: Energy from Biomass: Read Less [-]

BIO ENG 190 Special Topics in Bioengineering 1 - 4 Units

Terms offered: Fall 2017, Fall 2016, Spring 2016
This course covers current topics of research interest in bioengineering. The course content may vary from semester to semester.
Special Topics in Bioengineering: Read More [+]
Rules & Requirements

Prerequisites: Consent of instructor

Repeat rules: Course may be repeated for credit.

Hours & Format

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

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam required.

Special Topics in Bioengineering: Read Less [-]

BIO ENG 192 Senior Design Projects 4 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
This semester-long course introduces students to bioengineering project-based learning in small teams, with a strong emphasis on need-based solutions for real medical and research problems through prototype solution selection, design, and testing. The course is designed to provide a "capstone" design experience for bioengineering seniors. The course is structured around didactic lectures, and a textbook, from which assigned readings will be drawn, and supplemented by additional handouts, readings, and lecture material. Where appropriate, the syllabus includes guest lectures from clinicians and practicing engineers from academia and industry. The course includes active learning through organized activities, during which teams will participate in exercises meant to reinforce lecture material through direct application to the team design project.
Senior Design Projects: Read More [+]
Rules & Requirements

Prerequisites: Senior standing

Hours & Format

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

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Instructor: Herr

Senior Design Projects: Read Less [-]

BIO ENG H194 Honors Undergraduate Research 3 or 4 Units

Terms offered: Spring 2016, Fall 2015, Spring 2015
Supervised research. Students who have completed 3 or more upper division courses may pursue original research under the direction of one of the members of the staff. May be taken a second time for credit only. A final report or presentation is required. A maximum of 4 units of this course may be used to fulfill the research or technical elective requirement or in the Bioengineering program.
Honors Undergraduate Research: Read More [+]
Rules & Requirements

Prerequisites: Upper division technical GPA 3.3 or higher and consent of instructor and adviser

Repeat rules: Course may be repeated for a maximum of 8 units.Course may be repeated for a maximum of 8 units.

Hours & Format

Fall and/or spring: 15 weeks - 3-4 hours of independent study per week

Summer:
8 weeks - 1.5-7.5 hours of independent study per week
10 weeks - 1.5-9 hours of independent study per week

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Letter grade. Final exam not required.

Honors Undergraduate Research: Read Less [-]

BIO ENG 195 Bioengineering Department Seminar 1 Unit

Terms offered: Not yet offered
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.
Bioengineering Department Seminar: Read More [+]
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.

Hours & Format

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

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Instructor: Faculty

Bioengineering Department Seminar: Read Less [-]

BIO ENG 196 Undergraduate Design Research 4 Units

Terms offered: Fall 2017, Summer 2016 10 Week Session, Spring 2016
Supervised research. This course will satisfy the Senior Bioengineering Design project requirement. Students with junior or senior status may pursue research under the direction of one of the members of the staff. May be taken a second time for credit only. A final report or presentation is required.
Undergraduate Design Research: Read More [+]
Rules & Requirements

Prerequisites: Junior or senior status, consent of instructor and faculty adviser

Repeat rules: Course may be repeated for credit once.Course may be repeated for a maximum of 8 units.

Hours & Format

Fall and/or spring: 15 weeks - 4 hours of independent study per week

Summer: 10 weeks - 6 hours of independent study per week

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Letter grade. Alternative to final exam.

Undergraduate Design Research: Read Less [-]

BIO ENG 198 Directed Group Study for Advanced Undergraduates 1 - 4 Units

Terms offered: Spring 2018, Fall 2017, Spring 2017
Group study of a selected topic or topics in bioengineering, usually relating to new developments.
Directed Group Study for Advanced Undergraduates: Read More [+]
Rules & Requirements

Prerequisites: Upper division standing and good academic standing. (2.0 grade point average and above)

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricula section of this catalog.

Repeat rules: Course may be repeated for credit.

Hours & Format

Fall and/or spring: 15 weeks - 1-4 hours of directed group study per week

Summer:
6 weeks - 2.5-10 hours of directed group study per week
8 weeks - 1.5-7.5 hours of directed group study per week

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Directed Group Study for Advanced Undergraduates: Read Less [-]

BIO ENG 199 Supervised Independent Study 1 - 4 Units

Terms offered: Fall 2016, Spring 2016, Fall 2015
Supervised independent study.
Supervised Independent Study: Read More [+]
Rules & Requirements

Credit Restrictions: Enrollment is restricted; see the Introduction to Courses and Curricul a section of this catalog.

Repeat rules: Course may be repeated for credit.

Hours & Format

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

Summer:
6 weeks - 2.5-10 hours of independent study per week
8 weeks - 1.5-7.5 hours of independent study per week
10 weeks - 1.5-6 hours of independent study per week

Additional Details

Subject/Course Level: Bioengineering/Undergraduate

Grading/Final exam status: Offered for pass/not pass grade only. Final exam not required.

Supervised Independent Study: Read Less [-]

BIO ENG 200 The Graduate Group Introductory Seminar 1 Unit

Terms offered: Spring 2018, Fall 2017, Spring 2017
An introduction to research in bioengineering including specific case studies and organization of this rapidly expanding and diverse field.
The Graduate Group Introductory Seminar: Read More [+]
Rules & Requirements

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

Repeat rules: Course may be repeated for credit.

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.

The Graduate Group Introductory Seminar: Read Less [-]

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

Terms offered: Spring 2018
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.
Responsible Conduct in Bioengineering Research and in Practice: Read More [+]
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

Responsible Conduct in Bioengineering Research and in Practice: Read Less [-]

BIO ENG C208 Biological Performance of Materials 4 Units

Terms offered: Fall 2017, Fall 2015
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.
Biological Performance of Materials: Read More [+]
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

Prerequisites: Engineering 45; Chemistry C130/Molecular and Cell Biology C100A or Engineering 115 or equivalent; Bioengineering 102 and 104 recommended

BIO ENG C209 Advanced Orthopedic Biomechanics 4 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Advanced Orthopedic Biomechanics: Read More [+]
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

Advanced Orthopedic Biomechanics: Read Less [-]

BIO ENG 211 Cell and Tissue Mechanotransduction 3 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Cell and Tissue Mechanotransduction: Read More [+]
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

Cell and Tissue Mechanotransduction: Read Less [-]

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.
Heat and Mass Transport in Biomedical Engineering: Read More [+]
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

Heat and Mass Transport in Biomedical Engineering: Read Less [-]

BIO ENG C213 Fluid Mechanics of Biological Systems 3 Units

Terms offered: Spring 2016, Spring 2014, Spring 2011
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.
Fluid Mechanics of Biological Systems: Read More [+]
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

Fluid Mechanics of Biological Systems: Read Less [-]

BIO ENG C214 Advanced Tissue Mechanics 3 Units

Terms offered: 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.
Advanced Tissue Mechanics: Read More [+]
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

Advanced Tissue Mechanics: Read Less [-]

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

Terms offered: Spring 2016, Spring 2015, Spring 2014
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.
Molecular Biomechanics and Mechanobiology of the Cell: Read More [+]
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; BioE 102 or ME 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

Molecular Biomechanics and Mechanobiology of the Cell: Read Less [-]

BIO ENG C216 Macromolecular Science in Biotechnology and Medicine 4 Units

Terms offered: Spring 2018, Spring 2017, Spring 2015, Spring 2014
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.
Macromolecular Science in Biotechnology and Medicine: Read More [+]
Rules & Requirements

Prerequisites: Bioengineering 115 or equivalent; 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

Macromolecular Science in Biotechnology and Medicine: Read Less [-]

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.
Biomimetic Engineering -- Engineering from Biology: Read More [+]
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

Biomimetic Engineering -- Engineering from Biology: Read Less [-]

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.
Stem Cells and Directed Organogenesis: Read More [+]
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

Stem Cells and Directed Organogenesis: Read Less [-]

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.
Protein Engineering: Read More [+]
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

Protein Engineering: Read Less [-]

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.
Cells and Biomaterials Laboratory: Read More [+]
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

Cells and Biomaterials Laboratory: Read Less [-]

BIO ENG 221 Advanced BioMEMS and Bionanotechnology 4 Units

Terms offered: Spring 2018, Spring 2017, Fall 2016
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.
Advanced BioMEMS and Bionanotechnology: Read More [+]
Rules & Requirements

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

Repeat rules: Students will receive no credit for 221 after taking 121.

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

Advanced BioMEMS and Bionanotechnology: Read Less [-]

BIO ENG 221L BioMEMS and BioNanotechnology Laboratory 4 Units

Terms offered: Fall 2016, Spring 2015, Spring 2014
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.
BioMEMS and BioNanotechnology Laboratory: Read More [+]
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: BioE 103 or equivalent, BioE 104

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.

Instructor: D. Liepmann

BioMEMS and BioNanotechnology Laboratory: Read Less [-]

BIO ENG C222 Advanced Structural Aspects of Biomaterials 4 Units

Terms offered: Spring 2018, Spring 2016, Fall 2013
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.
Advanced Structural Aspects of Biomaterials: Read More [+]
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

Advanced Structural Aspects of Biomaterials: Read Less [-]

BIO ENG C223 Polymer Engineering 3 Units

Terms offered: Fall 2017, Fall 2015, Fall 2014
A survey of the structure and mechanical properties of advanced engineering polymers. Topics include rubber elasticity, viscoelasticity, mechanical properties, yielding, deformation, and fracture mechanisms of various classes of polymers. The course will discuss degradation schemes of polymers and long-term performance issues. The class will include polymer applications in bioengineering and medicine.
Polymer Engineering: Read More [+]
Rules & Requirements

Prerequisites: Civil Engineering 130, Engineering 45

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

Polymer Engineering: Read Less [-]

BIO ENG 224 Basic Principles of Drug Delivery 3 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Basic Principles of Drug Delivery: Read More [+]
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: BioE 103 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: Murthy

Basic Principles of Drug Delivery: Read Less [-]

BIO ENG 225 Biomolecular Structure Determination 3 Units

Terms offered: Fall 2017
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.
Biomolecular Structure Determination: Read More [+]
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

Biomolecular Structure Determination: Read Less [-]

BIO ENG C230 Implications and Applications of Synthetic Biology 3 Units

Terms offered: Prior to 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.
Implications and Applications of Synthetic Biology: Read More [+]
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

Implications and Applications of Synthetic Biology: Read Less [-]

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

Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Introduction to Computational Molecular and Cellular Biology: Read More [+]
Rules & Requirements

Credit Restrictions: Students will receive no credit for 231 after taking 131.

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

Introduction to Computational Molecular and Cellular Biology: Read Less [-]

BIO ENG 232 Genetic Devices 4 Units

Terms offered: Spring 2018, Fall 2014, Fall 2013
This graduate-level course is a comprehensive survey of genetic devices. These DNA-based constructs are comprised of multiple "parts" that together encode a higher-level biological behavior and perform useful human-defined functions. Such constructs are the engineering target for most projects in synthetic biology. Included within this class of constructs are genetic circuits, sensors, biosynthetic pathways, and microbiological functions.
Genetic Devices: Read More [+]
Objectives Outcomes

Course Objectives: (1) To introduce the basic biology and engineering principles for constructing genetic devices including biochemical devices, microbiological devices, genetic circuits, eukaryotic devices, and developmental devices, (2) To familiarize students with current literature examples of genetic devices and develop literature searching skills; (3) To develop the students' ability to apply computational tools to the design of genetic devices.

Student Learning Outcomes: Students will be able to (1) use mathematical models to describe the dynamics of genetic devices, (2) comprehend and evaluate publications related to any type of genetic device, (3) perform a thorough literature search, (4) evaluate the technical plausibility of a proposed genetic device, (5) analyze a design challenge and propose a plausible solution to it in the form of a genetic device, and (6) assess any ethical or safety issues associated with a proposed genetic device.

Rules & Requirements

Prerequisites: Engineering 7 or Computer Science 61A, Mathematics 54, Chemistry 3A, and BioE103 or equivalent

Credit Restrictions: Students will receive no credit for 232 after taking 132.

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

Genetic Devices: Read Less [-]

BIO ENG 235 Frontiers in Microbial Systems Biology 4 Units

Terms offered: Spring 2017, Fall 2009
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.
Frontiers in Microbial Systems Biology: Read More [+]
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

Frontiers in Microbial Systems Biology: Read Less [-]

BIO ENG C237 Adv Designing for the Human Body 3 Units

Terms offered: Fall 2017
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.
Adv Designing for the Human Body: Read More [+]
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 - 3-3 hours of lecture and 1-2 hours of laboratory per week

Additional Details

Subject/Course Level: Bioengineering/Graduate

Grading: Letter grade.

Instructor: O'Connell

Also listed as: MEC ENG C278

Adv Designing for the Human Body: Read Less [-]

BIO ENG 241 Probabilistic Modeling in Computational Biology 4 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016
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.
Probabilistic Modeling in Computational Biology: Read More [+]
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 (or equivalent)
Math 54: linear algebra (or equivalent),
Math 126: partial differential equations (or equivalent)
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

Probabilistic Modeling in Computational Biology: Read Less [-]

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.
Computational Methods in Biology: Read More [+]
Rules & Requirements

Prerequisites: Mathematics 53 and 54; 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

Computational Methods in Biology: Read Less [-]

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.
Introduction to Protein Informatics: Read More [+]
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., CS 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

Introduction to Protein Informatics: Read Less [-]

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.
Protein Informatics Laboratory: Read More [+]
Rules & Requirements

Prerequisites: One upper-division course in molecular biology or biochemistry (e.g., MCB 100A/Chem C130 or equivalent). Python programming (e.g., CS 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

Protein Informatics Laboratory: Read Less [-]

BIO ENG 245 Intro to Machine Learning in Computational Biology 4 Units

Terms offered: Fall 2017
This course will review the fundamentals of Data Science and data mining techniques. We will begin by reviewing Data Science across the disciplines, including guest lectures from data scientists on campus. As the semester progresses, we will focus increasingly on data science techniques in computational biology and bioinformatics, illustrating major methods and issues from these fields. Finally, we will discuss ethical issues related to data from biomedical research and genomics.
Intro to Machine Learning in Computational Biology: Read More [+]
Objectives Outcomes

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

Student Learning Outcomes: Students completing this course should have stronger programming skills, the ability to apply simple machine learning techniques to complex biosequence and genomics data, and an understanding of some of the challenges in genomics and bioinformatics.

Rules & Requirements

Prerequisites: CS61B, CS70 or Math 55; CS170 or STAT 132 or STAT 133 (http://guide.berkeley.edu/search/?P=STAT%20133) (may be taken concurrently); BioE 144L (may be taken concurrently)

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: Kimmen Sjolander

Intro to Machine Learning in Computational Biology: Read Less [-]

BIO ENG 247 Principles of Synthetic Biology 4 Units

Terms offered: Fall 2016, Fall 2015, Fall 2014
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.
Principles of Synthetic Biology: Read More [+]
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 53/54, BioE 103 or equivalent, 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

Principles of Synthetic Biology: Read Less [-]

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

Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Bioenergy and Sustainable Chemical Synthesis: Metabolic Engineering and Synthetic Biology Approaches: Read More [+]
Rules & Requirements

Prerequisites: Chemistry 3A and Molecular and Cell Biology C100A/ Chemistry 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

Bioenergy and Sustainable Chemical Synthesis: Metabolic Engineering and Synthetic Biology Approaches: Read Less [-]

BIO ENG C250 Nanomaterials in Medicine 3 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Nanomaterials in Medicine: Read More [+]
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

Nanomaterials in Medicine: Read Less [-]

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.
Micro/Nanofluidics for Bioengineering and Lab-On-A-Chip: Read More [+]
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: BioE 11 or Chem 3B, BioE 104 or ME 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

Micro/Nanofluidics for Bioengineering and Lab-On-A-Chip: Read Less [-]

BIO ENG 252 Clinical Need-Based Therapy Solutions 2 Units

Terms offered: Fall 2017, Fall 2016
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.
Clinical Need-Based Therapy Solutions: Read More [+]
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

Clinical Need-Based Therapy Solutions: Read Less [-]

BIO ENG C261 Medical Imaging Signals and Systems 4 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Medical Imaging Signals and Systems: Read More [+]
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, the national labs or elsewhere
• students will be hired by companies that create, sell, operate or consult in biomedical imaging

Rules & Requirements

Prerequisites: El Eng 20N and Engineering 7 or equivalent. Knowledge of Matlab or linear algebra assumed

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.

BIO ENG 263 Principles of Molecular and Cellular Biophotonics 4 Units

Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Principles of Molecular and Cellular Biophotonics: Read More [+]
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

Principles of Molecular and Cellular Biophotonics: Read Less [-]

BIO ENG 263L Molecular and Cellular Biophotonics Laboratory 4 Units

Terms offered: Spring 2018, Spring 2017, Spring 2015
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).
Molecular and Cellular Biophotonics Laboratory: Read More [+]
Rules & Requirements

Prerequisites: 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

Molecular and Cellular Biophotonics Laboratory: Read Less [-]

BIO ENG C265 Principles of Magnetic Resonance Imaging 4 Units

Terms offered: Spring 2018, Spring 2017, Spring 2016, Spring 2015
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.
Principles of Magnetic Resonance Imaging: Read More [+]
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: Either Electrical Engineering 120 or Bioengineering C165/ Electrical Engineering C145B or consent of instructor

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

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: Lustig, Conolly

Also listed as: EL ENG C225E

Principles of Magnetic Resonance Imaging: Read Less [-]

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

Terms offered: Spring 2018, Spring 2017, Fall 2016
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.
Ethical and Social Issues in Translational Medicine: Read More [+]
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

Ethical and Social Issues in Translational Medicine: Read Less [-]

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.
Introduction to Nano-Science and Engineering: Read More [+]
Rules & Requirements

Prerequisites: Major in physical science such as chemistry, physics, etc., or engineering; consent of advisor or 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: Gronsky, S.W. Lee, Wu

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

Introduction to Nano-Science and Engineering: Read Less [-]

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.
The Berkeley Lectures on Energy: Energy from Biomass: Read More [+]
Rules & Requirements

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

Repeat rules: 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

The Berkeley Lectures on Energy: Energy from Biomass: Read Less [-]

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

Terms offered: Spring 2018
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.
Model-Based Design of Clinical Therapies: Read More [+]
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 or equivalent (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

Model-Based Design of Clinical Therapies: Read Less [-]

BIO ENG 290 Advanced Topics in Bioengineering 1 - 4 Units

Terms offered: Spring 2018, Spring 2017, Fall 2016
This course covers current topics of research interest in bioengineering. The course content may vary from semester to semester.
Advanced Topics in Bioengineering: Read More [+]
Rules & Requirements

Prerequisites: Consent of instructor

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

Repeat rules: Course may be repeated for credit.

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.

Advanced Topics in Bioengineering: Read Less [-]

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.
Advanced Technical Communication: Proposals, Patents, and Presentations: Read More [+]
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

Advanced Technical Communication: Proposals, Patents, and Presentations: Read Less [-]

BIO ENG 295 Bringing Biomedical Devices to Market 3 Units

Terms offered: Spring 2017
Engineering design is the process by which an idea is generated, developed, constructed, tested, and managed. Typical bioengineering courses often focus on idea conception and construction. True engineering design integrates not only these two essential elements, but also the process of evaluating, planning, and testing a product. This course highlights the context and value of product development: the formalized process bridging the gap between device proof-of-concept and an FDA approved biomedical product in the marketplace. Instructor led lectures and student led case studies and exercises will form the core of the coursework.
Bringing Biomedical Devices to Market: Read More [+]
Objectives Outcomes

Course Objectives: To provide students with a fundamental understanding of the biomedical device R&D pathway including: design proof-of-concept, design input/output, design verification and validation, and regulatory approval.
• To give graduates the tools to be leaders in the medtech/biotech industry with a clear understanding of the design development process.
• To give students the opportunity to apply and implement the strategies learned in concurrent leadership and capstone coursework

Student Learning Outcomes: Students will gain an understanding of:
• Biomedical Device Design & Development
• Design Risk Analysis
• Design Documentation
• Verification & Validation Testing
• FDA Design Control
• Quality Systems (cGMP)
• Regulatory Clearance/Approval Strategy
• Device Commercialization Pathways

Rules & Requirements

Prerequisites: Engineering 271 or equivalent recommended

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: H. Lam, S. Patel

Bringing Biomedical Devices to Market: Read Less [-]

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.
MTM Capstone Project: Read More [+]
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

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

MTM Capstone Project: Read Less [-]

BIO ENG 297 Bioengineering Department Seminar 1 Unit

Terms offered: Not yet offered
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.
Bioengineering Department Seminar: Read More [+]
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.

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

Bioengineering Department Seminar: Read Less [-]

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

Terms offered: Spring 2018, Fall 2017, Spring 2017
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.
Group Studies, Seminars, or Group Research: Read More [+]
Rules & Requirements

Repeat rules: Course may be repeated for credit.

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.

Group Studies, Seminars, or Group Research: Read Less [-]

BIO ENG 299 Individual Study or Research 1 - 12 Units

Terms offered: Spring 2018, Fall 2017, Spring 2017
Investigations of advanced problems in bioengineering.
Individual Study or Research: Read More [+]
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit.

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.

Individual Study or Research: Read Less [-]

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.
Individual Study or Research: Read More [+]
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit.

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.

Individual Study or Research: Read Less [-]

BIO ENG 301 Teaching Techniques for Bioengineering 1 Unit

Terms offered: Fall 2017, Fall 2016, Fall 2015
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.
Teaching Techniques for Bioengineering: Read More [+]
Rules & Requirements

Prerequisites: Graduate standing

Repeat rules: Course may be repeated for credit.

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

Teaching Techniques for Bioengineering: Read Less [-]