Bioengineering Related Undergraduate Technical Courses
FALL 2019

In addition to the courses below, there are many other more general courses not specifically biology-related but that are useful for BIOE training. Please contact Angelina Toporov, Grad Advisor and Emphasis Coordinator for more details via email at atoporov@engineering.ucsb.edu. Please see individual departments for more information about these courses.

CH E 171, Introduction to Biochemical Engineering Introduction to biochemical engineering covering cell growth kinetics, bioreactor design, enzyme processes biotechnologies for modification of cellular information, and molecular and cellular engineering. *Instructors: Daugherty, 3 units.*

CH E 173, Omics-enabled Biotechnology Integrates genomic, transcriptomic, metabolomic, and proteomic approaches to quantify and understand intricate biological systems. Complementary bioinformatics approaches to curate the large datasets associated with these experiments will also be discussed. Recent examples from the literature will reinforce core concepts, ranging from applications to human health to the environment. By the end of the course, students should be able to design an integrated experiment that capitalizes on these "omics"-based approaches to enhance the scope of their research. *Instructors: O'Malley, 3 units.*

CHEM 112C, Biophysical Chemistry Laws of thermodynamics, chemical equilibria and ligand binding, phase equilibria, electrochemistry, nonelectrolyte solutions, applications to biochemical problems. *Instructors: Staff, 4 units.*

CHEM 112L, Biophysical and Bioanalytical Laboratory Application of modern biophysical and bioanalytical techniques to study the structure, function, and properties of biomolecules. Fluorescence spectroscopy, mass spectroscopy, FTIR, 2D-NMR, diffraction techniques, circular dichroism.*Instructors: Staff, 3 units.*

CHEM 145, Computational Bioechemistry Introduction to molecular modeling and molecular dynamics. Discussion of practical considerations of energy minimization, solvent modeling, structure-based drug design. Practical computer graphics experience. *Instructors: Staff, 3 units.*

CHEM 151, Post-translational Protein Processing Structure/function relationships in interesting macromolecules isolated from marine organisms. Focus is on well-characterized pathways from horseshoe crabs, abolones, mussels, and fish as well as others. *Instructors: Staff, 4 units.*

CHEM 162A, Drug Design Sources for new drugs. Biochemistry of diseases. Target validation techniques. Mechanism of action of enzymes and receptors. Enzyme inhibition and receptor binding studies. Structure based drug design: conformational analysis, docking and binding affinity calculations. Course also teaches proposal writing skills. *Instructors: Staff, 3 units.*

CMPSC 111, Introduction to Computational Science Introduction to computational science, emphasizing basic numerical algorithms and the informed use of mathematical software. Matrix computation, systems of linear and nonlinear equations, interpolation and zero finding, differential equations, numerical integration. Students learn and use the Matlab language. *Instructors: Petzold, 4 units.*

CMPSC 130A, Data Structures and Algorithms I The study of data structures and their applications. Correctness proofs and techniques for the design of correct programs. Internal and external searching. Hashing and height balanced trees. Analysis of sorting algorithms. Memory management. Graph traversal techniques and their applications. *Instructors: Gonzalez, 4 units.*

CMPSC 138, Automata and Formal Languages Formal languages; finite automata and regular expressions; properties of regular languages; pushdown automata and context-free grammars; properties of context-free languages; introduction to Turing machines and computability. *Instructors: Egecioglu, 4 units.*

CMPSC 165A, Artifical Intelligence Introduction to the field of artificial intelligence, which seeks to understand and build intelligent computational systems. Topics include intelligent agents, problem solving and heuristic search, knowledge representation and reasoning, uncertainty, probabilistic reasoning, and applications of AI. *Instructors: Turk, 4 units.*

CMPSC 174A, Fundamentals of Database Systems Database system architectures, relational data model, relational algebra, relational calculus, SQL, QBE, query processing, integrity constraints (key constraints, referential integrity), database design, ER and object- oriented data model, functional dependence, lossless join and dependency preserving decompositions, Boyce-Codd and Third Normal Forms. *Instructors: Su, 4 units.*

CMPSC 185, Human-Computer Interaction The study of human-computer interaction enables system architects to design useful, efficient, and enjoyable computer interfaces. This course teaches the theory, design guidelines, programming practices, and evaluation procedures behind effective human interaction with computers. *Instructors: Hollerer, 4 units.*

ECE 141A, Introduction To Nanoelectromechanical and Microelectromechanical Syst Introduction to nano- and microtechnology. Scaling laws and nanoscale physics are stressed. Individual subjects at the nanoscale including materials, mechanics, photonics, electronics, and fluidics will be described, with an emphasis on differences of behavior at the nanoscale and real-world examples. *Instructors: Pennathur, Turner, 3 units.*

ECE 162C, Optoelectronic Materials and Devices Optical transitions in solids. Direct and indirect gap semiconductors. Luminescence. Excitons and photons. Fundamentals of optoelectronic devices: semiconductor lasers, Led's photoconductors, solar cells, photo diodes, modulators. Photoemission. Integrated circuits.*Instructors: Meinhart, 3 units.*

ECE 179D, Introduction to Robotics: Dynamics and Control Dynamic modeling and control methods for robotic systems. LaGrangian method for deriving equations of motion, introduction to the Jacobian, and

modeling and control of forces and contact dynamics at a robotic end effector. Laboratories encourage a problem-solving approach to control.*Instructors: Meinhart, 4 units.*

ECE 181, Introduction to Computer Vision Overview of computer vision problems and techniques for analyzing the content of images and video. Topics include image formation, edge detection, image segmentation, pattern recognition, texture analysis, optical flow, stereo vision, shape representation and recovery techniques, issues in object recognition, and case studies of practical vision systems.*Instructors: Meinhart, 4 units.*

EEMB 146, BIOMETRY Linear models and least squares fitting: simple and multiple linear regression; analysis of variance (fixed, random and mixed models; crossed and nested effects; balanced and unbalanced designs); analysis of covariance, factorial designs; incomplete layouts; use of tranformations. *Instructors: Rice, 5 units.*

MCDB 126C, Basic Pharmacology Introduction to the current concepts of immunology. Emphasis on immunoglobulin structure and function, cell-cell cooperation in the immune response, and the role of major histocompatibility complex and cytokines in regulating immune responsiveness. *Instructors: Sears, 5 units.*

MCDB 133L, Molecular and Cellular Immunobiology Lab Introduction to modern laboratory methods in immunology; properties and characterization of immunoglobulins and immunoglobulin-secreting cells; introduction to hybridoma technology; characterization of effector and regulatory T cells using functional assays. *Instructors: Sears, 5 units.*

MCDB 138, Medical Immunology Interplay between the immune system and human disease is mechanistically evaluated by examining protective immunity against parasites and cancer, and immune dysfunction in transplantation, allergic, and autoimmune diseases, and AIDS. Computer exercises evaluate medical, case-based studies of human immune disorders. *Instructors: Sears, 4 units.*

MCDB 139, Medical Microbiology Study of the characteristics of bacteria and viruses, both pathogenic and adventitious, as they are associated with diseases of humans. *Instructors: Staff, 4 units.*

MCDB 146, Stem Cell Biology in Health and Disease Basic biology of embryonic and adult stem cells and nuclear transfer, with emphasis on latest findings from the current literature. *Instructors: Clegg, 4 units.*

MCDB 194, Intro Course offered in conjunction with Sansum-SB Clinic and Cottage Hospitals and involves a series of lectures/discussions dealing with various aspects of health care delivery and modern biotechnology. Students also spend a period of time working with a physician or medical research scholar. *Instructors: Staff, 3 units.*

MCDB 194, Introduction to Health Care and Biomedical Technology Course offered in conjunction with Sansum-SB Clinic and Cottage Hospitals and involves a series of lectures/discussions dealing with various aspects of health care delivery and modern biotechnology. Students also spend a period of time working with a physician or medical research scholar. *Instructors: Staff, 3 units.*

ME 146, Molecular and Cellular Biomechanics Course introduces fundamental concepts in molecular and cellular biomechanics. Will consider the role of physical, thermal and chemical forces, examine their influence on cell strength and elasticity, and explore the properties of enzymatically-active materials. *Instructors: Valentine, 3 units.*

MTRL 135, PHYS 135, Biophysics and Biomolecular Materials Structure and function of cellular molecules (lipids, nucleic acids, proteins, and carbohydrates). Genetic engineering techniques of molecular biology. Biomolecular materials and biomedical applications (e.g., bio-sensors, drug delivery systems, gene carrier systems). *Instructors: Safinya, Staff, 3 units.*

PHYS 135, Biophysics and Biomolecular Materials Structure and function of cellular molecules (lipids, nucleic acids, proteins, and carbohydrates). Genetic engineering techniques of molecular biology. Biomolecular materials and biomedical applications (e.g., bio-sensors, drug delivery systems, gene carrier systems). *Instructors: Staff, 3 units.*

PHYS 144L, Experimental Research in Biophysics Offers qualified undergraduates the opportunity to work in research laboratories in biophysics. *Instructors: Staff, 3 units.*

PSTAT 10, Principles of Data Science with R Offers qualified undergraduates the opportunity to work in research laboratories in biophysics. *Instructors: Holmes, 5 units.*

PSTAT 122, Design and Elements of Experiments An Introduction to statistical design and analysis of experiments. Covers: principles of randomization, blocking and replication; fixed, random and mixed effects models; block designs, factorial designs and nested designs; analysis of variance and multiple comparison. *Instructors: HSU, 4 units.*

PSTAT 134, Statistical Data Science Overview and use of data science tools in R and Python for data retrieval, analysis, visualization, reproducible research and automated report generation. Case studies will illustrate practical use of these tools. *Instructors: HSU, 4 units.*