BIOE 140
Biomolecular Engineering
Fall 2017

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Lecture: F 10:30 am - 1:20 pm, CLSSRM 262

Required Text: This course requires two textbooks (one for each of its two parts)
1) Fundamentals of Biochemistry by Donald Voet, Judith G. Voet & Charlotte W. Pratt. Wiley ISBN: 978-0470570951
2) Protein Engineering and Design by Sheldon J. Park & Jennifer R. Cochran. CRC Press ISBN: 978-1420076585

Additional readings: Additional readings can be found at the UC Merced Kolligian Library, or through the ILL system.

Course Overview: This course focuses on the structural and quantitative analysis as well as the design of custom biomolecules, including proteins, nucleic acids, and macromolecular complexes. The students will learn the fundamental concepts of biomolecular structure and function and the experimental and computational tools/approaches for engineering biomolecules and how to apply these new technologies to solving some of the most pressing problems in biotechnology, medicine and bioengineering. The covered approaches range from rational and computational design to combinatorial and evolutionary optimization and biophysical characterization, whereas the target products span customized enzymes, molecular switches and actuators, recombinant biosensors, therapeutic antibodies, and protein and DNA assemblies.

Course Learning Goals and Outcomes: *By the end of this course, students will be able to:*
1. Describe, understand and use the fundamental tools and techniques employed for the structural and functional analysis of biomolecules
2. Compare and contrast various experimental and computational strategies for engineering and designing biomolecules
3. Learn the basic concepts of biomolecular structure and function and their connection with the strategies for engineering and designing new biomolecules

4. Show mastery of fundamental topics in biomolecular engineering and design, including sequence/structure/function relationships; physical factors determining biomolecular structure, folding and stability; methods and techniques for structural and functional analysis of biomolecules; enzymatic catalysis; protein chemistry; directed molecular evolution; combinatorial biochemistry; computational approaches to biomolecular design. At the end of the course, the students should be able to converse with scientists and read technical literature about all these topics
5. Articulate the scientific vocabulary used in communicating scientific information in biomolecular engineering and design.

Relation to the following BIOE Problem Learning Outcomes (PLOs):
The course learning outcomes relate to the following BIOE program learning outcomes:
PLO #1 An understanding of biology and physiology. (Course objectives #1 and 4)
PLO #2 The capability to apply advanced mathematics (including differential equations and statistics), science, and engineering to solve problems at the interface of engineering and biology; (Course objectives #2 and 4)
PLO #3 The ability to make measurements on, and interpret data from, living systems. (Course objectives #1, 3 and 4)
PLO #4 The ability to address problems associated with the interaction between living and non-living materials and systems. (Course objective #4)
PLO #5 Professional and ethical responsibility. (Course objective #3)
PLO # 6 The ability to communicate effectively in written, spoken, and visual formats with technical, professional, and broader communities. (Course objective #5)

Relation to the following ABET Problem Learning Outcomes (PLOs):
(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
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(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.

Prerequisites by Topic: MATH 21, PHYS 9 or 19, CHEM 8 and 10, BIO 102

Course Policies: Attendance is mandatory. This course requires the user of clickers to answer questions during class, so each student is responsible for bringing a clicker in working condition. Scientific calculator will be needed for the review sessions. No cell phone or recording

devices are allowed in class.

Grading for BIOE 114

50% Exams (20% Midterm and 30% Final)
25% Class Participation (Students will be quizzed regularly during each class using clicker technology. The students will be informed of their cumulative score to date from class participation at mid term and two weeks before the final exam)
25% Projects (Assignments and Oral Presentation)

The final course grade will be calculated from the overall numerical score obtained during the course converted onto a letter grade according to the following recipe:

A : 85-100%	C+ : 60-65%
A- : 80-85%	C : 55-60%
B+ : 75-80%	C- : 50-55%
B : 70-75%	D : 45-50%
B- : 65-70%	F : <45

Academic Dishonesty Statement:
a. Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy. Any work submitted by a student in this course for academic credit will be the student's own work. b. You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e mail, an e mail attachment file, a diskette, or a hard copy. Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action.
c. During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

Disability Statement: Accommodations for Students with Disabilities: The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.

Lecture Schedule: Fall 2016

Week 1	Aug 25-1	Course Introduction
	Aug 25-2	Matlab tutorial for Biomolecular Engineering
Week 2	Sep 1-1	***Chemical and Physical Properties of Water***
	Sep 1-2	Computer lab: pH titrations and buffers
Week 3	Sep 8-1	***Aminoacids, Protein Sequence, Isolation and Characterization***
	Sep 8-2	Discussion Session on Protein Purification
Week 4	Sep 15-1	***Protein Three-Dimensional Structure***
	Sep 15-2	Computer lab: analyzing protein structure
Week 5	Sep 22-1	***Protein Stability and Folding***
	Sep 22-2	Computer lab: analyzing stability and folding kinetics
Week 6	Sep 29-1	***Protein Function: Ligand Binding and Cooperativity***
	Sep 29-2	Computer lab: ligand binding and molecular cooperativity
Week 7	Oct 6-1	***Enzymes: Catalysis, Inhibition and Control***
	Oct 6-2	Computer lab: analysis of enzymatic experiments
Week 8	Oct 13-1	**MIDTERM Exam**
	Oct 13-2	**MIDTERM Exam**
Week 9	Oct 20-1	Nucleic Acids Structure and Function
	Oct 20-2	Computer lab: bioinformatics analysis of DNA sequences
Week 10	Oct 27-1	***Recombinant DNA Technology***
	Oct 27-2	Discussion session on Recombinant DNA
Week 11	Nov 3-1	***Amplification and Sequencing of DNA, site-directed mutagenesis***
	Nov 3-2	Practicum: sequencing DNA and designing oligos for PCR
Week 12	Nov 10-1	*Veterans day*
	Nov 10-2	*Veterans day*
Week 13	Nov 17-1	***Protein Expression and Protein Engineering***
	Nov 17-2	Computer lab: mapping protein interactions using Prot. Eng.
Week 14	Nov 24-1	*Thanksgiving*
	Nov 24-2	*Thanksgiving*
Week 15	Dec 1-1	***Combinatorial Protein Engineering & Directed Evolution***
	Dec 1-2	Discussion session on combinatorial protein engineering
Week 16	Dec 8-1	***Protein Design***
	Dec 8-2	Computer lab: stereo-chemical design of a coiled-coil

Final Exam: Dec 13 03:00 pm - 06:00 am, COB 262

Suffix -1 indicates the period from 10:30 am to 12:30 am whereas suffix -2 indicates the period from 12:30 am to 2:20 pm. During second periods we will have either discussion session (CLSSRM 262) on the topic covered in the previous period, or computer practicum (to be held on CLSSRM 281) on the topics shown in the schedule.