Engineering Molecules 1
Instructors: Niren Murthy
Units : 3
Course Format: (3 hours lecture)
Prerequisites : Chem 3A
Grading: Letter

Short Course Description for General Catalog
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.

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.

Desired Course 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.

Grading policy. The students will be graded based on their performance on 2 midterms (300 points each), a final exam (300 points), and homeworks (all of the homeworks combined will be a 100 points). This course will be graded on the following grading scale
930 points and above A+
860 points- 929 points A-
790 points- 859 points B+
720 points- 789 points B
650 points- 719 points B-
590 points- 649 points C+
520 points- 589 points C
460 points-519 points C-
459 points and below D

Final Exam will be written

Textbook: Clayden, Greeves, Warren and Wothers, "Organic Chemistry" 2nd edition, Principles of Biochemistry by Albert Lehninger and additional readings. Reading materials will be uploaded online.

Full Course Description:
Week 1 Wednesday January 19-Monday January 24th.
Introduction and Chapters 5 and 6 of the Clayden book.
Chapter 5 Organic reactions.
Chapter 6 Nucleophilic addition to the carbonyl group.

Week 2: Wednesday January 26-Monday January 31st. Chapter 7 of the Clayden book and biological applications of hemiacetals and pi conjugated systems.
Biological applications of hemiacetals: Discussion of tenofovir

Chapter 7 Delocalization and conjugation
Biological applications of pi conjugated molecules: Imaging of reactive oxygen species and tumors with fluorescent dyes

Week 3: Wednesday February 2nd-Monday February 7th. Chapter 8, biological applications of pKa and Chapter 9.
Chapter 8 Acidity, basicity and pKa
Biological Applications of pKa: Solubility of drugs and lysosomal targeting
Chapter 9 Using organometallic reagents to make C-C bonds

Week 4: Wednesday February 9th-Monday February 14th. Chapters 10 and 11 of the Clayden book, and biological applications of carbonyl substitution reactions.
Chapter 10 Nucleophilic substitution at the carbonyl
Chapter 11 Nucleophilic substitution at carbonyl with a loss of carbonyl oxygen
Biological applications of carbonyl chemistry: Schiff bases and acetals as linkers in targeted drug delivery.

Week 5: Wednesday February 16th-Monday February 21nd. Chapter 13, solid phase DNA synthesis, synthesis of triphosphate bases and nucleoside prodrugs.
Chapter 13 H-NMR proton nuclear magnetic resonance
Solid phase DNA synthesis, synthesis of triphosphate bases, and synthesis of tenovofir and other nucleoside prodrugs

Week 6: Review and Exam I
Exam 1 will be from 2.10-3.00PM PST on Friday February 25. If class is held in person, then the exam will be in class, otherwise it will be given via Bcourses

Week 7: Chemical structure of amino acids and three dimensional structure of peptides and proteins
Chapters 3 and 4 of the Leningher book, pages 75-157
The coiled-coil motif and its applications in biotechnology

Week 8: Protein function and Enzymes
Chapters 5 and 6 of the Leningher book, pages 157-238
Structure based drug design and the design of Kras inhibitors for treating cancer

Week 9: Chemical structure of nucleic acids, three dimensional structure of DNA and RNA, DNA technologies
Chapters 8 and 9 of the Leningher book, pages 273-343
DNA sequencing and its impact on medicine

Week 10 DNA metabolism
Chapter 25 p 948-995 of the Leningher book
CRISPR based technologies and DNA repair pathways

Weeks 11: RNA metabolism
Chapter 26 p 995-1024 of the Leningher book
The development of mRNA vaccines

Week 12: Review and Midterm II
Exam 2 will be on Friday April 15 If class is held in person, then the exam will be in

class, otherwise it will be given via Bcourses.

Week 13: Protein metabolism
Chapter 27 p1024-1081 of the Leningher book
Ribosome targeting drugs

Week 14: Bioenergetics and metabolism
Chapters 13 and 16, p480-521 and p601-631 of the Leningher book

Week 15: RRR week.

Final Exam on Tuesday May 10th from 11.30AM-2.30PM. If class is held in person, then the exam will be in class, otherwise it will be given via Bcourses.

Course Policies

Inclusion: We are committed to creating a learning environment welcoming of all students. To do so, we intend to support a diversity of perspectives and experiences and respect each others' identities and backgrounds (including race/ethnicity, nationality, gender identity, socioeconomic class, sexual orientation, language, religion, ability, etc.). To help accomplish this:

- If you feel like your performance in the class is being impacted by a lack of inclusion, please contact the instructors, your ESS advisor, or the departmental Faculty Equity Advisor (list and information at: https://diversity.berkeley.edu/faculty-equity-advisors). An anonymous feedback form is also available at https://engineering.berkeley.edu/about/equity-and-inclusion/feedback/.
- If you have a name and/or set of pronouns that differ from your legal name, designate a preferred name for use in the classroom at: https://registrar.berkeley.edu/academic-records/your-name-records-rosters.
- As a participant in this class, recognize that you can be proactive about making other students feel included and respected.

Berkeley honor code: Everyone in this class is expected to adhere to this code: "As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others."

Academic honesty. You are encouraged to form study groups and work together to understand course material, but all written work as well as responses to in-class questions should be your own.

Student Conduct: Ethical conduct is of utmost importance in your education and career. The instructors, the College of Engineering, and U.C. Berkeley are responsible for supporting you by enforcing all students' compliance with the Code of Student Conduct (https://sa.berkeley.edu/code-of-conduct) and the policies listed in the CoE Student Guide (https://engineering.berkeley.edu/students/undergraduate-guide/policies-procedures/). The Center for Student Conduct is set up to support you when you have

been affected by actions that may violate these community rules. This includes an organized and transparent process, student participation in the process, mechanisms for appeals, and other mechanisms to protect fairness (https://sa.berkeley.edu/conduct).

Accommodation policy: We honor and respect the different learning needs of our students, and are committed to ensuring you have the resources you need to succeed in our class. If you need accommodations for any reason (e.g. religious observance, health concerns, insufficient resources, etc.) please discuss with your instructor or academic advisor how to best support you. We will respect your privacy under state and Federal laws, and you will not be asked to share more than you are comfortable sharing. The disabled student program is a related resource, listed below.

Support during Remote Learning:
We understand that your specific situation may present challenges to class participation. Please contact the instructors if you would like to discuss these and co-develop strategies for engaging with the course.

The Student Technology Equity Program (STEP) is available to help access a laptop, Wi-Fi hotspot, and other peripherals (https://technology.berkeley.edu/STEP).

You will be alerted as to when synchronous sessions are about to be recorded. If you prefer not to be recorded, you may turn your video and microphone off.

Please set your Zoom name to be the name you would like the instructors to call you. You may optionally include your personal pronouns.

Please set your Zoom picture to an appropriate profile picture of you to foster a sense of community and enhance interactions. If you are not comfortable using an image of yourself, you may use an appropriate picture of an avatar.

We encourage participating with your video on to foster a sense of community and enhance interactions. However, we understand that some students are not comfortable with video or may not be able to participate by video.

Resources

Center for Access to Engineering Excellence (CAEE)
The Center for Access to Engineering Excellence (227 Bechtel Engineering Center; https://engineering.berkeley.edu/student-services/academic-support) is an inclusive center that offers study spaces, nutritious snacks, and tutoring in >50 courses for Berkeley engineers and other majors across campus. The Center also offers a wide range of professional development, leadership, and wellness programs, and loans iclickers, laptops, and professional attire for interviews.

Disabled Students' Program (DSP)
The Disabled Student's Program (260 César Chávez Student Center #4250; 510-642-0518; http://dsp.berkeley.edu) serves students with disabilities of all kinds. Services are individually designed and based on the specific needs of each student as identified by DSP's Specialists. If you have already been approved for accommodations through DSP, please know that DSP is ready to quickly adjust your accommodations if your situation changes.

Counseling and Psychological Services
University Health Services Counseling and Psychological Services staff are available to you at the Tang Center (http://uhs.berkeley.edu; 2222 Bancroft Way; 510-642-9494) and in the College of Engineering (https://engineering.berkeley.edu/students/advising-counseling/counseling/; 241 Bechtel Engineering Center), and provide confidential assistance to students managing problems that can emerge from illness such as financial, academic, legal, family concerns, and more. Long wait times at the Tang Center in the past led to a significant expansion to include a 24/7 counseling line at (855) 817-5667. This line will connect you with help in a very short time-frame. Short-term help is also available from the Alameda County Crisis hotline: 800-309-2131. If you or someone you know is experiencing an emergency that puts their health at risk, please call 911.

The Care Line (PATH to Care Center)
The Care Line (510-643-2005; https://care.berkeley.edu/care-line/) is a 24/7, confidential, free, campus-based resource for urgent support around sexual assault, sexual harassment, interpersonal violence, stalking, and invasion of sexual privacy. The Care Line will connect you with a confidential advocate for trauma-informed crisis support including time-sensitive information, securing urgent safety resources, and accompaniment to medical care or reporting.

Ombudsperson for Students
The Ombudsperson for Students (102 Sproul Hall; 642-5754; http://students.berkeley.edu/Ombuds) provides a confidential service for students involved in a University-related problem (academic or administrative), acting as a neutral complaint resolver and not as an advocate for any of the parties involved in a dispute. The Ombudsman can provide information on policies and procedures affecting students, facilitate students' contact with services able to assist in resolving the problem, and assist students in complaints concerning improper application of University policies or procedures. All matters referred to this office are held in strict confidence. The only exceptions, at the sole discretion of the Ombudsman, are cases where there appears to be imminent threat of serious harm.

UC Berkeley Food Pantry
The UC Berkeley Food Pantry (#68 Martin Luther King Student Union; https://pantry.berkeley.edu) aims to reduce food insecurity among students and staff at UC Berkeley, especially the lack of nutritious food. Students and staff can visit the pantry as many times as they need and take as much as they need while being mindful that it is a shared resource. The pantry operates on a self-assessed need basis; there are no eligibility requirements. The pantry is not for students and staff who need supplemental snacking food, but rather, core food support