CBE 274 Biomolecular Engineering (Fall 2014)
MWF 11-12, 219 Dwinelle

Instructor:

David Schaffer, schaffer@berkeley.edu, 274 Stanley Hall, x3-5963
Office hours: 4-5 pm Wednesday and Friday @ 274 Stanley.

Graduate Student Instructor:

Jorge Marchand, marchand@berkeley.edu
Office hours: Monday 4pm @ 124 Lewis Hall
Discussion section: Library Room E, most Mondays 4-5pm

Course Description and Objective:

CBE 274 is an introductory course of biomolecular engineering and is required for all CBE graduate students*. 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. 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 preparation:

It is expected that the students have the knowledge and background equivalent of senior-level CBE students. Reading of course references may be helpful.

Course structure:

- No required textbooks.
- References
  - Molecular and Cell Biology by Lodish *et al*, 2007, 6th edition. (whfreeman.com/lodish6e/)
  - Receptors: Models for Binding, Trafficking, and Signaling by Lauffenburger, 1996.
  - Biochemical Engineering by Clark and Blanch, 1997.
  - Mechanics of motor proteins and the cytoskeleton, Jonathon Howard, 2001.
- Course website: look for CBE 274 S14 in bSpace.

Grading:

- Problem sets (10 %).
- Midterm exam (**October 17th**, written) (20 %).
- Final exam (written) (20%).
- Final project (50 %): The class will (ideally) be divided into groups of 3 students. A project of literature analysis and critique will be assigned to each group. The required outcome includes a 25-minute oral presentation of the objectives, pressing issues of the field, state-of-the-art approaches and outcomes, and your perspectives of the assigned topic. Each of you will also independently write a term paper up to 10 pages on your analysis and critiques of the assigned topic. The oral and written part each counts 25% of the final grading.

- Presentation guide: 25 minutes in total, please allow 3-5 minutes for questions. List contributions from team members in the final slide, and no need to include acknowledgements.
- Grading rubrics for the presentation (10 points): 3 points on clarity, including timing, 2 points on teamwork, and 5 points on understanding.
- Term paper guide: 1" margins, font size no smaller than Times New Roman 11 pt. The entire report cannot exceed 10 pages.
- Grading rubrics for the term paper (10 points): 2 points on clarity, including organization (sub-sections should at least include Abstract, Introduction, Analysis, Conclusion), 2 points on the work of literature search, 4 points on quality of analysis and general understanding, and 2 point on conclusion, including your perspectives.

Course Outline: 40 class meetings (including 1 midterm and ~6 presentation days)

Part I: Molecular engineering

1. Primer on biochemistry
2. Structures, thermodynamics, and statistical mechanics of biomolecules
   a. DNA structures, interactions, and mechanics
   b. Protein folding and protein structure prediction
   c. Lipids and biological membranes
   d. Carbohydrate structures, interactions, and mechanics
3. Enzymatic reactions
   a. Chemical mechanisms
   b. Kinetics
   c. Enzymes in reactors
4. Fundamentals of biotechnology.
   a. Protein engineering and design.
   b. Recombinant DNA technology.

Midterm

Team selection and final project assignment

Part II: Cellular engineering

1. Primer on cell biology
   a. Parts and organelles of cells
   b. Prokaryotic and eukaryotic cells
2. Metabolic networks
   a. Natural and engineered metabolic pathways
   b. Synthetic biology and genome mining
3. Signaling networks
4. Cell growth
   a. Biology and models
   b. Bioreactor development

Final-project presentations (~6 class periods)