CENG 4640 Biomolecular Engineering - Syllabus

Instructor: Fei Sun (kefsun@ust.hk)

TA: Francis Fok (hkffok@connect.ust.hk)

Venue: 6602

Time: Mon 9-10:20 and Wed 9-10:20

Tutorials: LTH, Fri 11-11:50

Objectives:

1. Understand the structure-property relationship in biomacromolecules
2. Learn common ways to predict, characterize, and engineer biomacromolecular properties
3. Appreciate the significance of biomacromolecular engineering in biology and biotechnology
4. Explore the integration of biomacromolecular engineering with other disciplines such as synthetic biology, genome engineering, epigenetics, brain science, and regenerative medicine.

Format: Lecture, Discussion, Project, and Homework

Grade: Letter (Attendance 10%, Homework 20%, Final Exam 50%, Project 20%)

Credit: 3

Length of the Course: 2 lectures per week, 15 weeks per semester (30 hours)

Synopsis:

Section 1. Introduction (3 hours)

1.1. Define macromolecules and biomacromolecules

1.2. Fundamentals of polymer science

Section 2. Protein (8 hours)

2.1. Overview

2.2. Protein structure and function

2.3. Prediction of protein structure and function

2.4. Protein folding and assembly

2.5. Introduction to enzymology

2.6. Directed evolution

2.7. Overview of protein design

2.8. Rational design of enzymes

Section 3. DNA (6 hours)

3.1. Overview

3.2. DNA structure

3.3. DNA origami

3.4. DNA tiling

3.5. DNA machines

3.6. Prediction of DNA structure

Section 4. RNA (4 hours)

4.1. Overview

4.2. RNA structure

4.3. Prediction of RNA structure

4.4. RNAzyme

4.5. The RNA world

4.6. Current RNA roles

Section 5. Polysaccharides (4 hours)

5.1. Overview

5.2. Structures and roles of polysaccharides

5.3. Interaction with other biomacromolecules

5.4. Biosynthesis and variation

Section 6. Perspectives & Outlook (2 hours)

6.1. Macromolecular biosystems (biomacromolecules in context)

6.2. Convergence of biopolymers and synthetic polymers 6.3. Molecular epigenetics

Project Presentation (2 hours)

Final Exam

References: No particular textbook. Collected papers from literature. Suggested readings for each chapter. The students are required to read the assigned papers before the lecture.

Homework: There will be homework every other week due in two weeks. The homework can be in a variety of forms.

Project: Select a case study of biomolecular engineering from literature (pending advisor's approval); discuss the corresponding fundamental principles (refresh from lecture); propose a potential future study.