Chemistry 26:160:591 Syllabus

Special Topics in Materials Chemistry: Biomolecular Design and Nanotechnology

Class Time: Monday 6:00 – 9:00 PM
Location: Life Science Center II, Room 130
Instructor: Prof. Fei Zhang, Ph.D. **Email:** (TBD)
Office Hour: (TBD) **Office location:** (TBD)

Course Description

This course introduces the principles of biomolecular design for self-assembly of nanomaterials, focusing on nucleic acids, peptides, and proteins. Fundamental knowledge, practical applications, and state-of-the-art research topics will be reviewed. The course will begin with an overview of the structures, properties, and cellular functions of the four major classes of biomolecules. The main content of the course will focus on the development of structural nucleic acid nanotechnology, including design and modelling of programmable biomaterials, DNA computing and molecular programming, and DNA/RNA/Protein-based nanomachines and devices. Upon successful completion of this course, students will acquire the knowledge of biomolecular self-assembly, learn to use 3D graphics software, and have a holistic view of research at the interface between biochemistry, materials, computation, and nanotechnology.

Course Objectives

Upon successful completion of this course:

- Students will have knowledge of structure and function of the major biomolecules
- Students will gain an understanding of self-assembly, programmability of biomolecules, and kinetics and mechanical properties of biomaterials.
- Student will study research articles and learn the cutting-edge techniques in structural design and molecular programming
- Students will have a holistic view of interdisciplinary research between materials, biochemistry, computation, engineering, and nanotechnology.

Grading

Homework	30%
Presentation	20%
Lab	20%
Final Exam	30%

Homework (30%): The course will have three homework with the due dates shown in the class schedule.
Presentation (20%): Students will search, select, and present research papers (up to 3) in the related research fields. A guideline template for the presentation slides will be provided, which includes background introduction, motivation, current solution, discussion, and future thinking.
Computer Lab (20%): In each lab, a small practice project will be assigned (10% for each).
Final Exam (30%): Final exam will cover the general topics in this course.

Approximate Grading Boundaries:
A (90-100%); B (80-89.9%); C (65-79.9%); D (60-64.9%); E (≤59.9%)

A+/A/A-, etc., grade designations will be made at the discretion of the instructor depending on overall class performance. We reserve the right to adjust the score requirements for each letter grade depending on the overall performance of the class. It is the responsibility of the student to retain evidence of his/her grades should a dispute regarding grades arise. Final percentage grades are rounded to the nearest tenth of a percent.

Reading List

Recommended:

• Biochemistry: A Short Course (3rd Edition) by John L. Tymoczko, Jeremy M. Berg, and Lubert Stryer (2015) Publisher: W. H. Freeman.

• Biomaterials Science: An Introduction to Materials in Medicine (3rd Edition) by Buddy Ratner, Allan Hoffman, Frederick Schoen, and Jack Lemons (2012) Publisher: Academic Press

• Structural DNA Nanotechnology, by Nadrian C. Seeman (2016) Publisher: Cambridge University Press

Other review articles and recent research papers will be provided in the lectures.

Course Schedule

Week	Date	Topics	Due Date
1	Sep 9	Course introduction & biochemistry and biological macromolecules	
2	Sep 16	Proteins and nucleic acids	
3	Sep 23	Biomolecular interactions and cellular functions	Homework-1
4	Sep 30	nucleic acid nanotechnology and applications	
5	Oct 7	2D biomaterials and atomic force microscopy	
6	Oct 14	3D structures, X-ray crystallography, and cryo-electron microscopy	Homework-2
7	Oct 21	Structural and computational software (lecture and computer lab)	Lab-1
8	Oct 28	Structural and computational software (lecture and computer lab)	Lab-2
9	Nov 4	Strand displacement and DNA computing	
10	Nov 11	Molecular motor, walker, and robots	
11	Nov 18	Student Presentations	Presentation
12	Nov 25	Aptamer and biosensor	
13	Dec 2	RNA based therapeutics	
14	Dec 9	Biological nanopore and artificial membrane protein	Homework-3
15	Dec 16	Final Exam	Final Exam