

Chemistry 26:160:591 Syllabus

Special Topics in Materials Chemistry: Biomolecular Design and Nanotechnology

Class Time: Monday 6:00 – 9:00 PM (Spring recess 3/13/2021-3/21/2021)

Location: Zoom Meeting ID: 923 2371 4298 Password: 661759

Link: <https://rutgers.zoom.us/j/92323714298?pwd=aDI0d1hiOG5xTjJvdkFsY0RpOXJ1UT09>

Instructor: Prof. Fei Zhang, Ph.D.

Email: fei.zhang@rutgers.edu

Office Hour: Tuesday 9:00 – 10:00 am (please email me before attending the office hour to confirm the time and zoom link)

Course Guide

- Log in to Canvas using your NetID. Check the course announcement weekly. Class materials will be also posted before lectures.
- The lectures are on-line talk via Zoom. Here is “how to create your Rutgers Zoom account for students”: <https://it.rutgers.edu/zoom/knowledgebase/how-to-create-your-rutgers-zoom-account/>
- Please use your full name to join the meeting.
- The lecture materials only provide guidelines for the classes. We will have online “chalk talks” to complete the notes.
- The finished notes/lecture materials will be posted after each lecture. The Zoom lectures will be also recorded and posted.

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.

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	Jan 25	Course introduction & biochemistry and biological macromolecules	
2	Feb 1	Proteins and nucleic acids	
3	Feb 8	Biomolecular interactions and cellular functions	Homework1
4	Feb 15	Nucleic acid nanotechnology	
5	Feb 22	2D biomaterials and atomic force microscopy	
6	Mar 1	3D structures, X-ray crystallography, and cryo-electron microscopy	Homework2
7	Mar 8	Structural and computational software (lecture and computer lab)	Lab-1
8	Mar 22	Structural and computational software (lecture and computer lab)	Lab-2
9	Mar 29	Strand displacement and DNA computing	
10	Apr 5	Molecular motor, walker, and robots	
11	Apr 12	Student Presentations	Presentation
12	Apr 19	Aptamer and biosensor	
13	Apr 26	RNA based therapeutics	
14	May 3	Biological nanopore and artificial membrane protein	Homework3
15	May 10	Final Exam	Final Exam

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 outlook.

Computer Lab (20%): In each lab section, 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 = 90.0-100%;	B+ = 85.0-89.9%;	B = 80.0-84.9%;	C+ = 75.0-79.9%;
C = 60.0-74.9%;	F = 0-59.9%		

A/B+/B, 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.

Academic Integrity

As an academic community dedicated to the creation, dissemination, and application of knowledge, Rutgers University is committed to fostering an intellectual and ethical environment based on the principles of academic integrity. Academic integrity is essential to the success of the University's educational and research missions, and violations of academic integrity constitute serious offenses against the entire academic community. The entire Academic Integrity Policy can be found here: <http://academicintegrity.rutgers.edu/academic-integrity-policy/>

Accommodation and Support

Rutgers University Newark (RU-N) is committed to the creation of an inclusive and safe learning environment for all students. RU-N has identified the following resources to further the mission of access and support:

- **Students with Disabilities:** Rutgers University welcomes students with disabilities into all of the University's educational programs. The Office of Disability Services (ODS) is responsible for the determination of appropriate accommodations for students who encounter barriers due to disability. In order to receive consideration for reasonable accommodations, a student with a disability must contact ODS, register, have an initial appointment, and provide documentation. Once a student has completed the ODS process (registration, initial appointment, and documentation submitted) and reasonable accommodations are determined to be necessary and appropriate, a Letter of Accommodation (LOA) will be provided to the student. The student must give the LOA to each course instructor, followed by a discussion with the instructor. This should be completed as early in the semester as possible as accommodations are not retroactive. More information can be found at ods.rutgers.edu. Contact ODS: (973) 353-5375 or ods@newark.rutgers.edu.
- **Religious Holiday Policy and Accommodations:** Students are advised to provide timely notification to instructors about necessary absences for religious observances and are responsible for making up the work or exams according to an agreed-upon schedule. The Division of Student Affairs is available to verify absences for religious observance, as needed: (973) 353-5063 or DeanofStudents@newark.rutgers.edu.
- **Counseling Services:** Counseling Center Room 101, Blumenthal Hall, (973) 353-5805 or <http://counseling.newark.rutgers.edu/>.
- **Students with Temporary Conditions/Injuries:** Students experiencing a temporary condition or injury that is adversely affecting their ability to fully participate in their courses should submit a request for assistance at: <https://temporaryconditions.rutgers.edu>.
- **Students Who are Pregnant:** The Office of Title IX and ADA Compliance is available to assist students with any concerns or potential accommodations related to pregnancy: (973) 353-1906 or TitleIX@newark.rutgers.edu.

• **Gender or Sex-Based Discrimination or Harassment:** Students experiencing any form of gender or sex-based discrimination or harassment, including sexual assault, sexual harassment, relationship violence, or stalking, should know that help and support are available. To report an incident, contact the Office of Title IX and ADA Compliance: (973) 353-1906 or TitleIX@newark.rutgers.edu . To submit an incident report: tinyurl.com/RUNReportingForm. To speak with a staff member who is confidential and does NOT have a reporting responsibility, contact the Office for Violence Prevention and Victim Assistance: (973) 353-1918 or run.vpva@rutgers.edu .

Learning Resources:

• **Rutgers Learning Center** (tutoring services)

Room 140, Bradley Hall

(973) 353-5608

<https://sasn.rutgers.edu/student-support/tutoring-academic-support/learning-center>

• **Writing Center** (tutoring and writing workshops)

Room 126, Conklin Hall

(973) 353-5847

nwc@rutgers.edu