

Spring Semester 2021

COURSE: Materials Science and Engineering 473
TITLE: Biomolecular Materials Science
LEVEL: Undergraduate/Graduate
CREDIT: 3 hours lecture; 3 semester hours.
TIME: MWF, 10:00-10:50 AM, CDT. Fully online, synchronous delivery. Recorded lectures will be available for asynchronous view.
LOCATION: Online via Zoom. Zoom link for synchronous delivery is available on compass2g (<https://compass2g.illinois.edu/webapps/login/>). Lecture notes and lecture videos will be available on compass2g.

DESCRIPTION: This class will cover the chemical and physical foundations of biomolecular materials science. The course will consist of a series of modules on the structures and functions of basic classes of biological molecules, including lipid membranes, nucleic acids, and proteins. We will study how these biological materials self-assemble and often interact with one another into their functional forms. These aspects of biomolecular materials constitute a fundamental tool to design biomimetic systems.

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OFFICE HOURS: On Zoom upon request

DISCUSSION: Questions related to MSE473 homeworks, exams, and all course contents should be posted in compass2g [Question and Answer Forum](#).

TEACHING ASST: TBA

ASSESSMENT:

Problem sets (5)	20%
Research presentation	15%
Mid-semester exam, 1 hr.	25%
Final, comprehensive exam, 3 hrs.	40%

READINGS: Lecture notes and Books on reserve: "The Colloidal Domain", Evans & Wennerström and "Intermolecular Forces", Israelachvili.

TENTATIVE SCHEDULE

Instructional breaks: February 17, March 24, and March 26 (EOH)

Midterm Exam: Friday March 10, 10:00 – 10:50 AM

Research presentations: Due end of April 30th, 5 pm– upload on compass2g

FINAL EXAM: Friday, May 14, 8:00-11:00 a.m

ASSESEMENT

1. HOMEWORKS

Homeworks (HW) will be offered on PrairieLearn (<https://prairielearn.engr.illinois.edu/>). **Please log in with your Illinois netID and enroll at MSE473 Spring 2021 semester.** You will have infinite attempts to provide the right answer. If you complete the HW late you get 30% up to a week late. Past that, you get no credit but you can still practice the HW. Homeworks must be completed by the due date at 5 PM, CDT. Leaving HW to the last-minute results in overloading of the system and errors leading to late delivery of the HW. Do your homework early!

2. EXAMS

All exams will be performed at CBTF on-line (<https://cbtf.engr.illinois.edu/cbtf-online/index.html>) with proctoring by Zoom. The time and duration of the exam will be automatically adjusted to accommodate DRES and/or different time zones. (See more information below).

3. PRESENTATIONS

You will select by yourself a paper from the journal **Nature Materials** (<https://www.nature.com/nmat/>). That's the only allowed journal to select papers from. I want to make sure that you have access to a broad scope of topics in biomolecular materials. This paper can be a letter or a full paper, but it can not be a review paper. You have to read the paper and present it in a concise powerpoint presentation, recording yourself presenting in a maximum of 5 minutes. You shall post the presentation in compass2g by the due date stated above. Presentation templates and review criteria will be discussed in class.

TENTATIVE TOPICS

Basic Classes of Biomolecular Materials

1. Nucleic acids
 - Structure & function of DNA and RNA
 - Bending and Polyelectrolyte behavior
2. Proteins
 - Hierarchical organization
 - Physical basis of secondary structures
 - Relationship between structure and function
3. Lipids & membranes
 - Self-assembly
 - Membrane elasticity
 - Lipid polymorphism

Interactions Between Biomolecular Materials

1. Van der Waals interactions
2. Electrostatic interactions
3. Hydrogen bonding & hydrophobic interactions

Applications and Characterization of Biomaterials

1. Gene and Drug delivery
2. Biodegradable materials

3. Active Matter
4. Spectroscopic and Imaging techniques

COURSE OBJECTIVES

- To review physics and chemistry necessary for an understanding of biomaterials.
- To teach students the basic interactions governing biology from the nanoscale to the mesoscale.
- To teach students the basic materials science of the membrane.
- To teach students the basic materials science of nucleic acids.
- To teach students the basic materials science of proteins.
- Give students an opportunity for teamwork in research.
- Give students practice in basic expository research presentation

CBTF online

This course uses the College of Engineering [Computer-Based Testing Facility](#) service CBTF Online for its exams.

The policies of the CBTF are the policies of this course, and academic integrity infractions related to the CBTF are infractions in this course.

If you have accommodations identified by the [Division of Rehabilitation-Education Services \(DRES\)](#) for exams, please email your Letter of Accommodations (LOA) to CBTF Manager Carleen Sacris at sacris1@illinois.edu before you make your first exam reservation.

If you have any issue during an exam, please inform the proctor immediately. Work with the proctor to resolve the issue at the time before logging off.

Review all instructions on the CBTF website before your first exam: <https://cbtf.engr.illinois.edu/cbtf-online/index.html>

Diversity, Equity, and Inclusion Statement

The University of Illinois, the Grainger College of Engineering, the Materials Science and Engineering department, and MSE473 operate under the guiding principle that “Our entire community benefits when individuals from different personal, cultural, and disciplinary perspectives are working together.” (<https://grainger.illinois.edu/about/diversity>). MSE473 will be a safe and inclusive place for active learning with no tolerance for discrimination of any kind.

Academic Integrity Policy

The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. According to the Student Code, “It is the responsibility of each student to refrain from infractions of academic integrity, from conduct that may lead to suspicion of such infractions, and from conduct that aids others in such infractions.”

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: <http://studentcode.illinois.edu/>. Ignorance is not an excuse for academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

See also this quick reference guide to academic integrity:

<https://provost.illinois.edu/policies/policies/academic-integrity/students-quick-reference-guide-to-academic-integrity/>

Academic Accommodations

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TDD), or

e-mail a message to disability@uiuc.edu. <http://www.disability.illinois.edu>. DRES accommodations will be implemented in the CBTF on-line.

Family Educational Rights and Privacy Act

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See <https://registrar.illinois.edu/academic-records/ferpa> for more information.

Sexual Misconduct Policy and Reporting

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options. A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found at <https://wecare.illinois.edu/resources/students/#confidential>. Other information about resources and reporting is available at: <https://wecare.illinois.edu>

Community of Care

As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regards to their well-being or yours, we encourage you to refer this behavior to the Student Assistance Center (217-333-0050 or <http://odos.illinois.edu/community-ofcare/referral/>). Based on your report, the staff in the Student Assistance Center reaches out to students to make sure they have the support they need to be healthy and safe. Further, we understand the impact that struggles with mental health can have on your experience at Illinois. Significant stress, strained relationships, anxiety, excessive worry, alcohol/drug problems, a loss of motivation, or problems with eating and/or sleeping can all interfere with optimal academic performance. We encourage all students to reach out to talk with someone, and we want to make sure you are aware that you can access mental health support at the Counseling Center (<https://counselingcenter.illinois.edu/>) or McKinley Health Center (<https://mckinley.illinois.edu/>). For mental health emergencies, you can call 911 or walk in to the Counseling Center, no appointment needed.