

Spring Semester 2025

COURSE	Materials Science and Engineering-MSE473: Biomolecular Materials Science	
LEVEL	Undergraduate/Graduate	
TIME	MWF 10:00-10:50 am. LOCATION: 3117 Everitt Laboratory	
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.	
INSTRUCTOR	Cecilia Leal, cecilial@illinois.edu Office: 302 MSEB	
OFFICE HOURS	MWF 10:50 am – 11 am, Canvas Discussion forums, and Fridays: 2-3 pm <u>Details:</u> <ul style="list-style-type: none">• MWF 10:50 am – 11 am. Ideal for: general questions about the course, class content, or clarifications on assignments• Canvas Discussion forum. Ideal for: general questions about the course, class content, or troubleshooting homework questions• Open office door most Fridays: 2-3 pm or upon request. Ideal for: specific situations/questions related to you and/or the course that are not suitable as general inquiries.	
ASSESSMENT	Problem sets (7, expected)	25%
	Research presentation	10%
	In-class quizzes	5%
	Mid-semester exams*	30%
	Final comprehensive exam**	30%
	* CBTF: 50 min and **CBTF: 1h50 min. Flexible dates.	
READINGS	Lecture Notes Books on reserve: “The Colloidal Domain”, Evans & Wennerström and “Intermolecular Forces”, Israelachvili.	
WEBSITE	https://canvas.illinois.edu/courses/54492 . Recorded lectures are provided <i>via</i> a Mediaspace link at Canvas Website for MSE473.	

TENTATIVE SCHEDULE

- Instructional breaks: Wed Jan 29 (selection of your presentation paper). March 17-21 (Spring break), and April 4 (EOH)
- Mid-semester Exams: March 10-12 (CBTF) and April 14-16 (CBTF)
- Research presentations: Due April 30, 11 pm–upload on Canvas
- FINAL EXAM: Finals week (CBTF)

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 2025 semester. Please note:** do NOT submit any HW answers before I activate and notify you on Canvas that a given HW is open. You may see HWs on PrairieLearn now but those are NOT finalized.

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. 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!

Homework solutions: The TA or Prof. Leal will go over homework solutions at office hours after the assignment is due.

2. EXAMS

All exams will be performed at the CBTF facility that have their own proctors. You normally have a period of a 3 days to book and perform your exam. The time and duration of the exam will be adjusted to accommodate DRES and/or different time zones. (See more information below). **If for health reasons**, there is a need that a student takes an exam online, this will be arranged. Please inform me ASAP if issues like this arise.

Computer-based testing facility (CBTF)

- This course uses the Grainger College of Engineering's [Computer-Based Testing Facility](#) 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 \(DRES\)](#) (<http://www.disability.illinois.edu/>) for exams, please submit your Letter of Accommodations (LOA) through the CBTF website (<https://cbtf.illinois.edu/students/dres>) as soon as possible. It can take up to five days for your LOA to be processed and if you make a reservation before your LOA has been processed, your reservation will not include your testing accommodations and you will be required to reschedule. This must be done each semester you use the CBTF.
- If you have any issue during an exam, inform the proctor immediately. Work with the proctor to resolve the issue at the time before logging off. If you do not inform a proctor of a problem during the test then you forfeit all rights to addressing the problem you experienced during your exam.
- Take the [CBTF Orientation](https://go.illinois.edu/student-orientation) (<https://go.illinois.edu/student-orientation>) (10 minutes) and review all instructions on the [CBTF website](https://cbtf.illinois.edu/students) (<https://cbtf.illinois.edu/students>) before your first exam.

3. PRESENTATIONS

You will select by yourself a paper from the journal **Proceedings of the National Academy of Sciences** (<https://www.pnas.org>). 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 Canvas 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.

Diversity, Equity, and Inclusion (DEI) Statement

The University of Illinois (UIUC), the Grainger College of Engineering, the Materials Science and Engineering department (MatSE), and MSE 473 operate under the guiding principle that “Our entire community benefits when individuals from different personal, cultural, and disciplinary perspectives are working together.” ***MSE 473 will be a safe and inclusive place for active learning with no tolerance for discrimination of any kind.***

I encourage all students to learn more about DEI activities in MatSE and MatSE’s DEI committee here: <https://matse.illinois.edu/about/diversity>. (Make sure to scroll down to see all content!). More generally, aspects of DEI in the UIUC community are well covered by the IDEA institute: <https://idea.illinois.edu>.

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.

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.