

MSE485/791: BIOMATERIALS

INSTRUCTORS:

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Office Hours: by appointment

COURSE HOMEPAGE on Moodle

Class Goals: The course introduces fundamental aspects associated with synthesis, properties, processing/fabrication and application of materials derived from or associated with bio-entities. The course focuses on biomaterials with broad applications beyond medical or clinical uses. The course emphasizes the biological systems unique machinery and function in the context of desired outcome that utilizes a material or materials' systems. Fundamental concepts covered in the course include: differences among classes of biomaterials; toxicity vs biocompatibility of biomaterials; bulk vs surface properties of biomaterials; interactions of biomaterials with different environments; biomaterials stability and degradation; biomaterials for sensing and bioelectronics applications; biomaterials for energy, soft robotics and responsive materials applications; biomaterials for drug delivery, multiplexing and theranostic applications.

STUDENT LEARNING OBJECTIVES After completing this course, students will be able to:

- Explain the properties of various biomaterials;
- Select appropriate methods that can help address specific materials, properties and processing;
- Apply the chemistry and engineering knowledge gained to solve challenges in biomaterials;
- Critically review papers from the scientific literature and identify areas of research opportunities.

POLICIES AND PROCEDURES

1. All students must have access to the EOS computing system.
2. Attendance is expected. *Absences and late or missed assignments can be excused as defined in NCSU's attendance policy.* Any arrangements for making up missed work must be made with the instructor at least 48 hours in advance for non-emergency excused absences and immediately upon your return to class for emergency absences. In all cases, contact the instructor prior to non-emergency absences or as soon as possible for emergency absences to receive an excused absence. Verification of all absences will be required. If a student misses a class and doesn't contact the instructor regarding making up the work a zero for the assignment will be given. For complete attendance and excused absence policies, please see <http://policies.ncsu.edu/regulation/reg-02-20-03>
3. Homework assignments, exams, and projects **must be completed individually**. Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct found at <http://policies.ncsu.edu/policy/pol-11-35-01>. Cheating and plagiarism will result in loss of credit for the assignment in question and filing of the Report of an Academic Integrity Violation.
4. Students are responsible for reviewing the PRRs which pertain to their course rights and responsibilities. These include <http://policies.ncsu.edu/policy/pol-04-25-05> (Equal Opportunity and Non-Discrimination Policy Statement), <http://oied.ncsu.edu/oied/policies.php> (Office for Institutional Equity and Diversity), <http://policies.ncsu.edu/policy/pol-11-35-01> (Code of Student Conduct), and <http://policies.ncsu.edu/regulation/reg-02-50-03> (Grades and Grade Point Average).
5. **Electronically-Hosted Course Components.** Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web postings, where relevant to the course. Examples include online discussions of class topics, and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.
6. **Accommodations.** Reasonable accommodation will be made for students with verifiable disabilities. In order to take advantage of available accommodation, students must register with the Disability Resource Office. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation (REG02.20.01) (<https://policies.ncsu.edu/regulation/reg-02-20-01/>).

7. **Non-Discrimination Policy.** NC State provides equal opportunity and affirmative action efforts, and prohibits all forms of unlawful discrimination, harassment, and retaliation ("Prohibited Conduct") that are based upon a person's race, color, religion, sex (including pregnancy), national origin, age (40 or older), disability, gender identity, genetic information, sexual orientation, or veteran status (individually and collectively, "Protected Status"). Additional information as to each Protected Status is included in NCSU REG 04.25.02 (Discrimination, Harassment and Retaliation Complaint Procedure). NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at <http://policies.ncsu.edu/policy/pol-04-25-05> or <https://oied.ncsu.edu/divweb/>. Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 919-515-3148.
8. **Late Work Policy.** Unexcused late assignments will incur a reduction of 10% for each 24 hours they are late.

Required Reading: Reading assignments in the form of research papers, reviews, and/or book chapters will be assigned throughout the semester.

Class participation: Regular attendance is mandatory for all in-person students. If you anticipate any absences due to extenuating circumstances, please notify the instructor in advance. Weekly submission of lecture notes and summary paragraphs is required and will be graded.

Quizzes: In-class quizzes will be given periodically.

Homeworks: Homeworks will be assigned approximately bi-weekly and submitted through Moodle.

Final Project: The student will prepare a proposal that focuses on biomaterials and includes preliminary calculations based on the fundamental topics discussed during the class. The proposal can be focused on the development of a novel biomaterial(s) or employment of an existing biomaterial(s) in order to either improve upon a current medical device or develop an entirely new biomedical device.

Grading: Approximately 10% of the course grade will be based on class participation, 30% on homeworks, 10% on in-class quizzes, 20% on the exams, and 30% on the final project.

Course grades will be assigned following the usual NCSU REGULAR GRADING SCALE AND GRADE POINTS.

Requirements for Credit-Only (S/U) Grading. The grade of "S" will be given if 70% of the grade is achieved.

Requirements for Auditors (AU). Information about and requirements for auditing a course can be found at <http://policies.ncsu.edu/regulation/reg-02-20-04>.

Policies on Incomplete Grades. If an extended deadline is not authorized, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) by the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. The university policy on incomplete grades is located at <http://policies.ncsu.edu/regulation/reg-02-50-03>.

<i>Week</i>	<i>Approximate Schedule of Topic</i>
1	Intro, biocompatibility, bonding
2	Biomolecules
3	Biomolecules, cells
4	Cells, cellular communications, and tissues
5	Self-assembling structures and biological systems
6	Micellization, packing parameter
7	Solubility
8	Surface properties, adhesion, and wetting phenomena

9	Surface-proteins interactions
10	Spring Break
11	Surface erosion, Biodegradability
12	Biodegradability
13	Drug delivery and tissue engineering
14	Bionics, Robotics, and responsive biomaterials applications
15	Final project presentations

DISCLAIMER Information in this syllabus is subject to minor changes and the possession of it does not ensure that you have all the correct information required to successfully complete the semester. Announcements of changes will be made and students are responsible for obtaining additional information by attending class.

Health and Well-Being Resources

As a student you may experience a range of personal issues that can impede learning, such as strained relationships, increased anxiety, alcohol/drug concerns, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may impact your ability to participate in daily activities. It is very important that you have a support system and that you ask for help when you are struggling. The Counseling Center at NC State offers confidential mental health services for full time NC State students, including same-day emergency services. Please visit <https://counseling.dasa.ncsu.edu/> to get connected.

Everyone is encouraged to take care of themselves and their peers. If you need additional support, there are many resources on campus to help you:

- WolfPack Wellness Resources (<https://wellness.ncsu.edu/resources/>)
- Counseling Center (<https://counseling.dasa.ncsu.edu/>)
- Health Center (<https://healthypack.dasa.ncsu.edu/>)
- If the personal behavior of a classmate concerns or worries you, either for the classmate's wellbeing or yours, we encourage you to report this behavior to the NC State CARES team: (<https://advising.dasa.ncsu.edu/resources-for-advisors/advisors-toolkit/cares/>)
- If you or someone you know are experiencing food, housing or financial insecurity, please see the Pack Essentials Program (<https://dasa.ncsu.edu/pack-essentials/>).

Other Important Resources

- Keep Learning: <https://dasa.ncsu.edu/students/keep-learning/>
- NC State Protect the Pack Resources for Students: <https://www.ncsu.edu/coronavirus/reactivating-campus/resources-for-students/>
- NC State Keep Learning, tips for students opting to take courses remotely: <https://dasa.ncsu.edu/students/keep-learning/>