

Biomedical Engineering 335: Biomaterials (3 Credits)

Fall 2022

Time: MWF 1:00-1:50 pm; Location: SECC 213

Instructor: Dr. Jesse Placone

Office: SECC 352

Office Phone: 610-436-2832

E-mail: jplacone@wcupa.edu (Please include course title in subject line)

Office hours: Tues: 11am-1pm; Wed: 12-1pm; Thurs: 12-2pm; office hours also available by appointment

Course Description:

BME 335 is a required course in the BME major. This course provides an introduction to the interactions between cells and the surfaces of biomaterials. Topics include: materials commonly used in biomedical applications, chemical structure of biomaterials, physical and mechanical properties of biomaterials, the biocompatibility of those materials with the biological environment, and the immune response to biomaterials.

Required Materials:

1. Biomaterials: The Intersection of Biology and Materials Science, 1st Edition, by Temenoff and Mikos
2. A Scientific Calculator

Prerequisites:

BIO 265 and CHE 104 are required to enroll in the class unless specific permission is given by the instructor.

Course Student Learning Outcomes:

The student will be able to identify key material properties needed for use in biological systems and will be able to characterize and quantify these key properties using engineering approaches.

Program Learning Objectives/ABET Student Outcomes:

- Student Outcome #1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics (**Problem sets and Exams**)
- Student Outcome #2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors (**Problem Sets and Final Project**)

Meeting and Assessing Student Learning Outcomes:

- Student learning outcomes will be achieved by interactive lectures and students working on the assigned problems outside of class time. The primary form of assessment of the student learning outcomes will be exams and problem sets.

Course Web Page:

Syllabus and related material will be on D2L.

Evaluation and Grading:

Attendance and Preparation: 10%

Problem Sets: 15%

Midterm exams (2 x 15% each): 30%

Final Project: 20%

Final Exam: 25%

Attendance Policy:

Attendance is an important part of the class. Attendance will be taken at the start of each class period.

Excused absences are limited to those due to participation in University- sanctioned events (see policy in the

WCU undergraduate catalog) or those accompanied by written confirmation from a doctor, the Dean of Students, etc. If you are sick, you must obtain a doctor's note. Finally, whether your absence is excused or unexcused (or if you are late to class), you will be responsible for any material covered and any announcements that were made in class that day.

Reading:

Students are expected to keep up with the assigned reading in the textbook.

Problem Sets:

Problem sets will be assigned in class. If you miss class, please do not email to ask if anything was assigned - either stop by my office hours or ask another student. The assignments will consist primarily of selected problems from the textbook. Points will be deducted from assignments handed in late, and no credit will be given once solutions have been posted. Please do not dismiss the importance of homework assignments simply because they comprise only 15% of your total grade - doing homework problems is one of the primary ways to learn the material, and is critical for doing well on tests. When working on the problem sets, your focus should be on learning the material. No homework assignments will be accepted over email. All assignments must be submitted via D2L.

Final Project:

In this course, you will complete a final project. This will be a written assignment where you will discuss a current real-world application or problem and propose a biomaterial to address this need. The project will be assessed on the justification of the material selection, analysis of the properties of the material, the description of the intended environment the material will be subjected, any host reactions or cell interactions, as well as a discussion regarding the target population and how this could potentially improve patient well-being.

Exam policy:

There will be two tests over the course of the semester. An unexcused absence on the day of a test will result of a grade of zero for that test. In the case of a University sanctioned event, please schedule a makeup exam with me in advance. If you should miss an examination due to a certifiable emergency or illness, please notify me as soon as possible providing appropriate documentation and either a makeup exam will be arranged or your score on the final exam will replace the missed exam. **All unexcused absences will result in a grade of zero.** You are encouraged to bring a calculator to the exams, but the calculator cannot be a part of a cell phone, iPod, etc. (i.e., it must be ONLY a calculator).

Final Exam Policy:

This course follows the WCU Final Exam Policy. The final exam is cumulative and mandatory.

Letter grade scale:

| Grade | Quality Points | Percentage Equivalents | Interpretation |
|-------|----------------|------------------------|----------------|
| A | 4.00 | 93-100 | Excellent |
| A- | 3.67 | 90-92 | Excellent |
| B+ | 3.33 | 87-89 | Superior |
| B | 3.00 | 83-86 | Superior |
| B- | 2.67 | 80-82 | Superior |
| C+ | 2.33 | 77-79 | Average |
| C | 2.00 | 73-76 | Average |
| C- | 1.67 | 70-72 | Average |
| D+ | 1.33 | 67-69 | Below Average |
| D | 1.00 | 63-66 | Below Average |
| D- | 0.67 | 60-62 | Below Average |
| F | 0 | < 60% | Failure |

Refer to the Undergraduate Catalog for description of NG (No Grade), W, Z, and other grades.

BME 335 Fall 2022, Tentative Course Schedule

The following schedule is subject to change at the discretion of the instructor. Every effort will be made to announce changes in advance, but students are responsible for changes.

| Week | Reading | Topic | Sections |
|------|---------|---|------------------|
| 1 | Ch 1 | Materials for Biomedical Applications | 1.1-1.2, 1.3-1.4 |
| | | Processing, properties and basic chemistry | 1.5-1.7 |
| 2 | Ch 2 | Chemical Structure of Biomaterials | 2.1-2.2 |
| | | Structure of Ceramics | 2.3 |
| 3 | | Structure of Polymers | 2.4 |
| | | Material Characterization | 2.5 |
| 4 | Ch 3 | Physical Properties of Biomaterials | 3.1-2 |
| | | | 3.3-3.4 |
| 5 | | Crystallinity of polymeric materials Remote Review on Oct 12th | 3.5 |
| | | Exam 1 Ch 1-3 Oct 14th | |
| 6 | Ch 4 | Mechanical Properties | 4.1-4.2 |
| | | | 4.3-4.4 |
| 7 | | | 4.5-4.6 |
| | | | |
| 8 | Ch 5 | Biomaterial Degradation | 5.1-5.3, 5.4 |
| | | | |
| 9 | Ch 6 | Biomaterial Processing | 6.1-6.2 |
| | | | 6.3-6.4 |
| 10 | Ch 7 | Surface Properties | 7.1-7.2 |
| | | | |
| 11 | Ch 8 | Surface Properties and Protein Interactions | 7.3-7.6; 8.1-8.4 |
| | | | |
| 12 | Ch 9 | Cell Interactions | 9.2-9.4 |
| | | Exam 2 Ch 4-7 | 9.5-9.6 |
| 13 | Ch 10 | Implantation and acute inflammation | 10.1-10.2; 10.5 |
| | | <i>Thanksgiving Break</i> | |
| 14 | Ch 11 | Wound Healing | 11.1-11.5 |
| 15 | Ch 12 | Immune Response | 12.1; 12.5-12.6 |
| | | | |
| 16 | | Cumulative Final Exam TBD | |

Bibliography: Additional resources that may be of interest:

1. **Biomaterials Science. An introduction to materials in medicine. 3rd Edition. Editors: B. Ratner, A. Hoffman, F. Schoen, J. Lemon.**
2. **Surface Modification of Polymeric Biomaterials. Editors: B. Ratner and D. Castner.**

Statements Common to All WCU Undergraduate Syllabi:

ACADEMIC & PERSONAL INTEGRITY

It is the responsibility of each student to adhere to the university's standards for academic integrity. Violations of academic integrity include any act that violates the rights of another student in academic work, that involves misrepresentation of your own work, or that disrupts the instruction of the course. Other violations include (but are not limited to): cheating on assignments or examinations; plagiarizing, which means copying any part of another's work and/or using ideas of another and presenting them as one's own without giving proper credit to the source; selling, purchasing, or exchanging of term papers; falsifying of information; and using your own work from one class to fulfill the assignment for another class without significant modification. Proof of academic misconduct can result in the automatic failure and removal from this course. For questions regarding Academic Integrity, the No-Grade Policy, Sexual Harassment, or the Student Code of Conduct, students are encouraged to refer to the Department Undergraduate Handbook, the Undergraduate Catalog, the Ram's Eye View, and the University website at www.wcupa.edu.

STUDENTS WITH DISABILITIES

If you have a disability that requires accommodations under the Americans with Disabilities Act (ADA), please present your letter of accommodations and meet with me as soon as possible so that I can support your success in an informed manner. Accommodations cannot be granted retroactively. If you would like to know more about West Chester University's Services for Students with Disabilities (OSSD), please visit them at 223 Lawrence Center. Their phone number is 610-436-2564, their fax number is 610-436-2600, their email address is ossd@wcupa.edu, and their website is at <https://www.wcupa.edu/universityCollege/ossd/>. In an effort to assist students who either receive or may believe they are entitled to receive accommodations under the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973, the University has appointed a student advocate to be a contact for students who have questions regarding the provision of their accommodations or their right to accommodations. The advocate will assist any student who may have questions regarding these rights. The Director for Equity and Compliance/Title IX Coordinator has been designated in this role. Students who need assistance with their rights to accommodations should contact them at 610-436-2433.

EXCUSED ABSENCES POLICY

Students are advised to carefully read and comply with the excused absences policy, including absences for university-sanctioned events, contained in the WCU Undergraduate Catalog. In particular, please note that the "responsibility for meeting academic requirements rests with the student," that this policy does not excuse students from completing required academic work, and that professors can require a "fair alternative" to attendance on those days that students must be absent from class in order to participate in a University-Sanctioned Event.

REPORTING INCIDENTS OF SEXUAL VIOLENCE

West Chester University and its faculty are committed to assuring a safe and productive educational environment for all students. In order to comply with the requirements of Title IX of the Education Amendments of 1972 and the University's commitment to offering supportive measures in accordance with the new regulations issued under Title IX, the University requires faculty members to report incidents of sexual violence shared by students to the University's Title IX Coordinator. The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. **Faculty members are obligated to report sexual violence or any other abuse of a student who was, or is, a child (a person under 18 years of age) when the abuse allegedly occurred to the person designated in the University Protection of Minors Policy.**

Information regarding the reporting of sexual violence and the resources that are available to victims of sexual violence is set forth at: <https://www.wcupa.edu/admin/diversityEquityInclusion/sexualMisconduct/default.aspx>

INCLUSIVE LEARNING ENVIRONMENT AND ANTI-RACIST STATEMENT

Diversity, equity, and inclusion are central to West Chester University's mission as reflected in our [Mission Statement](#), [Values Statement](#), [Vision Statement](#) and [Strategic Plan: Pathways to Student Success](#). We disavow racism and all actions that silence, threaten, or degrade historically marginalized groups in the U.S. We acknowledge that all members of this learning community may experience harm stemming from forms of

oppression including but not limited to classism, ableism, heterosexism, sexism, Islamophobia, anti-Semitism, and xenophobia, and recognize that these forms of oppression are compounded by racism.

Our core commitment as an institution of higher education shapes our expectation for behavior within this learning community, which represents diverse individual beliefs, backgrounds, and experiences. Courteous and respectful behavior, interactions, and responses are expected from all members of the University. We must work together to make this a safe and productive learning environment for everyone. Part of this work is recognizing how race and other aspects of who we are shape our beliefs and our experiences as individuals. It is not enough to condemn acts of racism. For real, sustainable change, we must stand together as a diverse coalition against racism and oppression of any form, anywhere, at any time.

Resources for education and action are available through WCU's [Office for Diversity, Equity, and Inclusion](#) (ODEI), DEI committees within departments or colleges, the student [ombudsperson](#), and centers on campus committed to doing this work (e.g., [Dowdy Multicultural Center](#), [Center for Women and Gender Equity](#), and the [Center for Trans and Queer Advocacy](#)).

Guidance on how to report incidents of discrimination and harassment is available at the University's [Office of Diversity, Equity and Inclusion](#).

EMERGENCY PREPAREDNESS

All students are encouraged to sign up for the University's free WCU ALERT service, which delivers official WCU emergency text messages directly to your cell phone. For more information, visit www.wcupa.edu/wcualert. To report an emergency, call the Department of Public Safety at 610-436-3311.

ELECTRONIC MAIL POLICY

It is expected that faculty, staff, and students activate and maintain regular access to University provided e-mail accounts. Official university communications, including those from your instructor, will be sent through your university e-mail account. You are responsible for accessing that mail to be sure to obtain official University communications. Failure to access will not exempt individuals from the responsibilities associated with this course.

BASIC NEEDS STATEMENT

WCU is committed to ensuring that all students are able to reach their full academic potential. We know that basic needs are essential for effective learning, and we are working to address economic insecurity among our students in a number of ways. In particular, the WCU Resource Pantry is open to all students who lack access to food and supplies. Resources are also available for students facing housing insecurity. Please contact the Office of Service-Learning & Volunteer Programs for more information. As these factors directly affect academics, students who are comfortable doing so should contact faculty for further support.