

**BIEN 4805 – Biomaterials  
Course Syllabus – Spring 2025**

**Instructor:** Professor Jennifer Cha  
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**Teaching Assistant** Jonathan Taasan  
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**Class Meeting Time:** M/W 1:55-3:10 in **A108**

**Office Hours:**

Jennifer Cha: Fridays, 2-3 pm, in front of my office, JSCBB D220

Abigail Harrell Thursdays, 9-10 AM, B1B90

Jonathan Taasan: Thursdays, 3-4 PM, C124

**Course Website:** This course will use Canvas.  
Canvas will contain announcements, supplementary material, lecture material, homework assignments, grades, solutions, corrections, etc. Please feel free to email your instructor or TA **but be sure to include “BIEN 4805” at the beginning of your subject line** so we can find it!

**Class Text:** Biomaterials: The Intersection of Biology and Materials Science by J.S. Temenoff and A.G. Mikos, Pearson Prentice Hall, 2008. **This text is recommended but not required. We will be uploading chapters or pages as needed onto Canvas.**

**Grading:**

In class exercises	5%
Homework	25%
Mid-term 1	20%
Mid-term 2	20%
Final Project	30%

**Homework:** Homework assignments will be due **by Friday at 11:59 pm and should be uploaded to Gradescope.**

Some homework assignments may include reading and interpreting journal articles from the literature. Discussion of homework problems with classmates is permitted and encouraged; however, direct copying

of solutions is not. The objective of the homework assignments is to expand on concepts presented in lecture and to prepare you for quizzes and exams.

**In Class Exercises:** We plan to run multiple workshops during class.

**Exams:** See schedule. Two in class exams will be given during the semester. The exams will be **closed book/closed notes**. The exams will cover the assigned material (note there will be material discussed in class that is not in the text), required reading sections in the text and any additional material, and all material covered in the reading assignments, in-class worksheets, quizzes, and homework assignments. Exams will consist of multiple choice, true/false, matching, short answer, and/or quantitative problems. The final exam is scheduled for TBD.

Exam	Date	Time	Location
#1	Wed, Feb 19	1:55-3:10 pm	in class
#2	Wed, April 9	1:55-3:10 pm	in class
Final Project	TBD	TBD	TBD

## Course Learning Goals:

### 1. Basic concepts in material science

- Understanding of fundamental concepts in material science (e.g., atomic structure and bonding, crystalline structures and defects) and interpretation of phase diagrams
- Understand major classes of materials used in medicine: metals, ceramics and polymers
- *Polymers:* Ability to determine molecular weights and molecular weight distributions, understanding of glassy and rubbery states, ability to correlate structural features to mechanical properties (e.g., moduli, deformation, and viscoelasticity), knowledge of polymerization reactions (e.g., chain vs. step, thermoplastics vs. thermosets), knowledge of degradation mechanisms.
- *Metals:* Knowledge of the basic structure and types of alloys (e.g., ferrous and nonferrous), ability to correlate structural features created in processing to general mechanical properties (e.g., stress-strain behavior, hardness, impact energy, fracture toughness, fatigue)
- *Ceramics and Glasses:* Ability to characterize crystalline vs. noncrystalline materials, understanding of mechanical properties and processing methods in relationship to structural features (e.g., brittle fracture, static fatigue, thermal shock, viscous deformation).
- *Surface Science:* Gain fundamental understanding of surface charge in water vs ionic media, hydrophobicity/hydrophilicity, surface characterization

### 2. Biological response to biomaterials

- Familiarity with biocompatibility and hemocompatibility
- Understand mechanisms of the foreign body response to implanted biomaterials
- Understand biodegradation of biomaterials: intentional and un-intentional degradation mechanisms
- Knowledge of techniques to modify biomaterial surfaces to control the biological response and instrumentations to examine surface chemistry

### 3. Biomaterial applications

- Knowledge of biomaterial requirements for certain medical applications (
- Familiarity of biomaterials used in different medical applications (e.g., soft and hard tissue replacements, cardiovascular, drug delivery, biosensors, and tissue engineering).

### 4. Biomaterials in Engineering Design

- Ability to apply fundamental principles for designing biomaterials to be used in a given medical application
- Familiarity with legal and ethical issues related to biomaterials used in medical applications

**Course Lectures: schedule is approximate and chapters mainly apply if you want to follow using the textbook (this is optional)**

Topic	Chapter	Approx. no. of Lectures
Introduction	Chapter 1: 1.1-1.6	2
Properties of Metals, Ceramics and Polymers	Chapter 1.7, Chapters 2-4	6
Surface Properties and Characterization	Chapter 7	2
Biomaterial Degradation	Chapter 5	2
Mechanics of Biomaterials	Chapter 4	4
Protein and Cell Interaction with Biomaterials	Chapters 8 and 9	4
Host Response to Biomaterials	Chapters 10, 11, 13, 14.1-14.3	3
Biomaterial Applications	Additional Reading Material	4
State of the Current Field	Chapter 6.7, Additional Reading Material	1

### **Policies and Procedures**

**This Syllabus rearticulates CU Boulder Required Syllabus Statements online:**

<https://www.colorado.edu/academicaaffairs/policies-customs-guidelines/required-syllabus-statements>

### **Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation**

The University of Colorado Boulder (CU Boulder) is committed to fostering a positive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct (including sexual assault, exploitation, harassment, dating or domestic violence, and stalking), discrimination, and harassment by members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or [cureport@colorado.edu](mailto:cureport@colorado.edu). Information about the OIEC, university policies, anonymous reporting, and the campus resources can be found on the OIEC website: <https://www.colorado.edu/oiec/>

Please know that faculty and instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about options for reporting and support resources.

### **Accommodation for Disabilities**

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to an instructor **as soon as possible** so that your needs can be addressed, **minimum one week prior**. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website: <https://www.colorado.edu/disabilityservices/>  
Contact Disability Services at 303-492-8671 or [dsinfo@colorado.edu](mailto:dsinfo@colorado.edu) for further assistance. If you have a temporary medical condition or injury, see Temporary Medical Conditions under the Students tab on the Disability Services website and discuss your needs with your professor.

### **Religious Holidays and Observances**

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with

scheduled exams, assignments or required attendance. In this class, please let an instructor know **as soon as possible** of an upcoming obligation, **minimum one week prior**.

### **Classroom Behavior**

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the policies on [classroom behavior](#) and the [Student Code of Conduct](#).

### **Requirements for COVID-19 as needed:**

As a matter of public health and safety due to the pandemic, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements, and public health orders in place to reduce the risk of spreading infectious disease. Required safety measures at CU Boulder relevant to the classroom setting include:

- maintain 6-foot distancing when possible,
- wear a face covering in public indoor spaces and outdoors while on campus consistent with state and county health orders,
- practice hand hygiene,
- follow public health orders, and
- if sick and you live off campus, do not come onto campus (unless instructed by a CU Healthcare professional), or if you live on-campus, please alert [CU Boulder Medical Services](#).

Students who fail to adhere to these requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to [Student Conduct and Conflict Resolution](#). For more information, see the policies on [COVID-19 Health and Safety](#) and [classroom behavior](#) and the [Student Code of Conduct](#). If you require accommodation because a disability prevents you from fulfilling these safety measures, please see the "Accommodation for Disabilities" statement on this syllabus.

Before returning to campus, all students must complete the [COVID-19 Student Health and Expectations Course](#). Before coming on to campus each day, all students are required to complete a [Daily Health Form](#).

Students who have tested positive for COVID-19, have symptoms of COVID-19, or have had close contact with someone who has tested positive for or had symptoms of COVID-19 must stay home and complete the [Health Questionnaire and Illness Reporting Form](#) remotely.

### **Preferred Student Names and Pronouns**

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

### **Honor Code**

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code ([honor@colorado.edu](mailto:honor@colorado.edu)); 303-492-5550). Students found responsible for violating the academic

integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found at the [Honor Code Office website](#).

The following list includes some examples of dishonest acts (not comprehensive!) for which a hearing may result:

1. Talking to each other during an exam time, inside or outside the exam room.
2. Bringing any unallowed information into the exam.
3. Searching for unallowed information during an exam.
4. Alteration, forgery, or falsification of official records (such as modification of graded homework problems or exams for which you are seeking additional credit, including regrades).
5. Allowing another person to take an exam or submit homework for you (false identification).
6. Knowingly providing material of your own or of others to a fellow student.
7. Possession or observation of examinations or solutions to examinations prior to the date and time of the exam.
8. Allowing another person to answer clicker questions for you, or answering clicker questions for someone else.
9. Attempting to bribe, threaten, or otherwise influence an instructor or TA, or having another person attempt to do this for you.