

**BENG186A: Principles of Biomaterials Design**  
**Spring 2022**

**Instructor:** Professor Ester J. Kwon (ejkwon@ucsd.edu)  
**Office Hours:** Fridays 3-4 pm via Zoom and by appointment

**Class time and location:** Tu/Th 5-6:20 PM MANDE B-210

**Teaching Assistants:** Yazmin Hernandez  
Katelyn Miyasaki  
Bianca Peña  
Jason Wu

**Discussion sections:**

Please choose one discussion section to attend. Teaching assistants will lead you through writing workshops to support your quarter project. Writing workshops will be held in-person during the discussion sections throughout the quarter – please see the schedule for which weeks there will be meetings.

W 3-3:50 PM CENTR 203 – Jason Wu

W 4-4:50 PM CENTR 203 – Yazmin Hernandez

F 10-10:50 AM CENTR 203 – Bianca Peña

F 2-2:50 PM CENTR 203 – Katelyn Miyasaki

**Instructor's note:**

Dear class,

I'm excited to be teaching you for Principles of Biomaterials Design for Spring 2022! I anticipate that the course will be in-person for lecture and discussion sections. Lecture will have an option to join remotely for when you are unable to attend in-person and notes will be posted. I know there are still many of you who are or will be affected by the COVID, and I ask that you communicate as soon as possible when problems arise so that I can appropriately accommodate your individual situations. Similarly, your teaching assistants and I may be affected and we will do our best to communicate these developments as they occur.

Below are some suggestions on how to do well in this course. Your grade is composed of two major types of assessments: exams and a quarter-long team project. The exams are based on information presented in lecture and your ability to apply these concepts to problems. There are several resources in addition to weekly lectures to help you learn the material:

- Supplemental reading from the textbook – this book is available through the UCSD library online catalog and can offer another perspective or more in-depth information about subject matter. It is not necessary to complete the reading to do well in the course.
- Homework – Homework and solutions will be posted on Canvas. While homework is not graded, I recommend that you complete the homework fully without looking at the solution set. Once solutions are posted, come to class, office hours, or discussion sections with your questions.
- Sample exams – As the exams near, I will provide a sample exam to give you an idea of the scope and difficulty of exam questions. The solutions will not be posted, but you are welcome to ask your specific questions during office hours or review sessions.

The purpose of the quarter-long project is to apply the basic fundamentals of biomaterials design into a specific application of your choice. Because the world of biomaterials and medical problems are vast, the engineering problems and solutions that arise from the intersection are unique. Therefore, this project is an opportunity to practice the engineering design process for biomaterials. To help you do well on the project, we will guide you through 4 writing workshops and also provide feedback on 2 drafts. The more effort you put into these workshops and drafts, the better feedback you will receive to do well on the final proposal.

I look forward to spring quarter!

Best,  
Prof. Kwon

**Supplemental Reading:** Biomaterials Science: An Introduction to Materials in medicine  
Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen, Jack E. Lemons  
Available online from UCSD library

## **Course Objectives**

At the end of this course you should be able to:

- Describe what a biomaterial is.
- List the major classes of biomaterials and their applications.
- Know major methods for the characterization of biomaterials.
- Be able to provide a rational justification for recommendation of the best material for an application.
- List different strategies to modify and/or design biomaterials.
- Explain how biomaterials interact with the “host”.
- Understand basic principles of federal regulation, intellectual property protection, and economics of biomaterials implementation.
- Read, understand, and analyze scientific publications pertaining to the field of biomaterials and have a broad understanding of biomaterials research.
- Learn how to communicate a biomaterial design in written form.

## **Course communication**

Canvas (canvas.ucsd.edu) will be used as the main hub for class resources and communication. In order to facilitate fair access to information for all students, all questions related to class material must be asked via Canvas. Log into Canvas to do the following:

- Download lecture notes and recordings
- Get access to syllabus, reading, and assignments
- Check exam dates and due dates
- Receive general course announcements
- Writing instruction

Course related questions will only be answered on Canvas discussion board to ensure fair access to information. Keep all posts professional and related to the course.

Please direct personal matters to Prof. Kwon by email.

## **Discussion boards policy**

All questions regarding the course content should be asked on the Discussion boards on Canvas and not by direct email. If you have a question, one of your classmates probably have the same question.

Discussion boards will be moderated between Monday 9 am to Friday 5 pm. The turnaround time for any question will be 24 hours. For example, a question asked Friday at 6:45 pm will not necessarily be answered until Tuesday morning. It is strongly recommended you answer each other’s questions on the discussion board – there has been very good explanations by other students and in-depth discussions in past years that enrich the course. The accuracy of content will be moderated by Prof. Kwon and TAs.

## **Guidelines for the online classroom**

When using video meetings, use headphones to reduce audio feedback.

Keep your microphone on mute unless you are actively speaking to minimize noise so everyone can hear.

Be mindful of your background and your screen during video calls so you do not accidentally share anything you don’t want to.

Keep all posts online professional and related to the course.

## **Integrity of Scholarship**

Academic dishonesty will not be tolerated. This applies to all course content, including exams and the project. All exams will be the sole work of individual students. Projects will be completed in groups of up to 4 students and no content will be taken directly from any source, including past projects.

The Department of Bioengineering adheres to the UCSD Policy on Integrity of Scholarship. An excerpt of this Policy states that "*Students are expected to complete the course in compliance with the instructor's standards. No student shall engage in any activity that involves attempting to receive a grade by means other than honest effort....*" Any suspected incident will be dealt with in accordance with UCSD policy, which includes reporting the misconduct to the Dean. More information on UCSD's academic dishonesty policy can be found at: <http://senate.ucsd.edu/Operating-Procedures/Senate-Manual/Appendices/2>

### **Class Policies**

The following policies help ensure that the class is run fairly and efficiently.

- Post all non-personal questions on Canvas
- Late policy: Any assignments turned in late will have a 20% reduction in points every 24 hours it is late.
- Grading: If there is a grade discrepancy, submit the original assignment along with a written request for a re-grade within one week from the date the assignment is returned. If re-grading is requested, the entire assignment or project is subject to re-grading.
- Exams may not be missed without prior instructor approval at least 1 week before the exam date. For emergencies, please contact Prof. Kwon directly as soon as possible.
- You may not reproduce, distribute or display any course materials (lectures, lecture notes, tests, project outlines, etc.) without my express prior written consent. All course materials are protected by U.S. copyright law and by University policy. You may only use the materials for your own use.

### **Assessment**

- 4% Writing exercises (Yellow)
- 6% Proposal drafts (Green)
- 30% Final proposal (Pink)
- 30% Midterm exam (Blue)
- 30% Final exam (Blue)

## Class Schedule

Week	Date	Lectures	Reading	Due Friday 5 PM
1	3/29	Syllabus, course overview, introduction		Form project group teams
	3/31	Material Properties	I.1.1-I.1.3	
2	4/5	Metals, Ceramics	I.2.3-I.2.4	Background & Significance
	4/7	Polymers	1.2.2	
3	4/12	Hydrogels and Natural Materials	I.2.5, 1.2.7	Specific Aims
	4/14	Degradation of Biomaterials	II.4	
4	4/19	Surface and Biological Interactions	I.1.5, II.1.2, I.2.12	Background & Significance
	4/21	Structures of Biomaterials	I.2.14-16	
5	4/26	Cell Interactions	II.1.3	
	4/28	Midterm (Week 1-4 of material)		
6	5/3	Inflammation and Wound healing	II.2.2	Specific Aims
	5/5	Immune response	II.2.3-4	
7	5/10	Proposal workshop		Research Design and Methods
	5/12	Proposal workshop		
8	5/17	Potential Problems in Biomaterial Implantation	II.2.5-8, II.4.5	Human & Animal Subjects
	5/19	Sterilization and Biomaterials Testing	III.1.2	
9	5/24	Wound Healing Case study		
	5/26	FDA and Biomaterials	III.2.9	
10	5/31	Applications: Drug delivery systems	II.5.16	
	6/2	Full proposal due		
	6/9	Final exam 7-10 PM		