BE 526, BE ME MS726 Biomaterials (Fall 2022)

The primary objective of this course series (Biomaterials 526/726) is to teach the engineering skills needed to solve challenges in the biomaterials and tissue engineering area. BE526 and BE ME MS726 introduce the first half of a two-semester sequence that is divided into four sections – macromolecular chemistry & material science, physical characterization & properties, materials & biology, and focused biomaterial sections.

Biomaterials 526/726 will concentrate on fundamental principles in biomedical engineering, material science, chemistry, and mechanics of materials. This course uses a combination of lectures, guest lectures, student presentations, and self-directed learning to examine the structure and properties of hard materials (ceramics, metals) and soft materials (polymers, hydrogels). For each section of the course, I will provide a theoretical description of the relevant phenomena, give examples of experimental measurements, highlight specific applications, and discuss the physiological requirements/relevance. *Only for BE/ME/MS 726***,** there will be a weekly laboratory section that will cover principles of biomaterial characterization.

Course information: The class meets from 8 to 9:45am on Mondays and Wednesdays in PHO210. Prerequisites for this class include probability (BE200 or equivalent), chemistry (CH101 or CH131), and physics (PY212). Attendance is required for all lectures.

Instructors:	Prof. Michael Smith	Yixin Mei	Hao Zang
	msmith@bu.edu	meiyx@bu.edu	hzn1848@bu.edu
Office hrs:	Tuesdays 10:30am to Noon		

Learning Objectives: After successfully completing this course, students will be able to:

1. Understand the fundamental principals in biomedical engineering, material science and chemistry, and how they contribute to biomaterial development and performance.
2. Apply the math, science, and engineering knowledge gained in the course to biomaterial selection and design.
3. Critically review papers from the scientific literature and identify areas of research opportunities

Reading Support:

- Biomaterials Science: An Introduction to Materials in Medicine - by William Wagner, Shelly Sakiyama-Elbert, Guigen Zhang, Michael Yaszemski (Elsevier; ISBN 9780128161388). Note that older editions are much cheaper (used 3rd editions as low as $20, 2nd edition is free), and do contain most of the material in the 4th edition, but it will be your responsibility to cross-reference to the correct material in the older versions.

You will be responsible for reading in the textbook to keep up with the class lectures and homework assignments. Further readings will be required to review pertinent literature in the bioengineering field for a variety of topics as part of the final group presentation.

Grading: Students will be assessed based on their grades on midterms, homework assignments, Material Olympics assignments, and a final group project. There will be a total of 3 midterm, non-cumulative examinations. Undergraduate and graduate students will be required to complete 4 homework assignments as well as a group project. Graduate students will also be required to attend a weekly lab section and submit regular lab reports.

Undergraduate Grading:	Homework	20%
	Material Olympics	10%
	Midterms	45%
	Group Design Project	25%
Graduate Grading:	Homework	15%
	Material Olympics	5%
	Midterms	45%
	Group Design Project	15%
	Lab Reports	20%

Midterms: The midterms are closed-book tests for which you are only required to bring a calculator and a pen. The tests will use a combination of multiple choice and true/false questions along with short essays to evaluate your performance. There are no make-up exams. There is no final for the course.

Homework: HW consists of problems and exercises that test your understanding of the material and help you prepare for the exams. All assignments should be submitted to the instructors by the specified due date. If unable to meet the prescribed deadline, it is your responsibility to negotiate an alternative date. Failure to submit work by the due date (or negotiated deadline) will result in a zero for that assignment.

Material Olympics: The goal of these mini projects is to focus on material design choices. Details will be provided later.

Final Course Grade: The course grade is computed based on the individual assessment grades using the indicated percentages.

*Group Project on a Medical Device***:** Details will be given later

Community of Learning: Class and University Policies

1. We ALL maintain responsibility for ensuring a positive learning environment.
2. *Attendance & Absences***:** The class experience is richer, more fun, and more conducive to learning when you participate in the lectures. I also affirm our *Policy on Religious Observance*.
3. *Completion and Late Submission*: If unable to meet the prescribed deadline, it is your responsibility to negotiate an alternative date. Failure to submit work by the due date (or negotiated deadline) will result in a zero.
4. *Academic Conduct:* Note that the BU Academic Conduct Code can be found here: *https://www.bu.edu/academics/policies/academic-conduct-code/*
5. *Inclusion***:** I consider this classroom to be a place where you will be treated with respect, and I welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and nonvisible differences. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment for every other member of the class.
6. *Accommodations for Students with Documented Disabilities*: If you are a student with a disability or believe you might have a disability that requires accommodations, requests for accommodations must be made in a timely fashion to Disability & Access Services, 25 Buick St, Suite 300, Boston, MA 02215; 617-353-3658 (Voice/TTY). Students seeking academic accommodations must submit appropriate medical documentation and comply with the established policies and procedures *http://www.bu.edu/disability/accommodations/*

7 Sept	Course Introduction and Logistical Considerations	
12 Sept	Biology and Materials	Sec 1.1, 2.1.3, 2.1.4
14 Sept	Mech characterization I	Sec 1.2.1 - 1.2.3, chapter on BB
19 Sept	Mech characterization II	Hmwk 1 DUE
21 Sept	Mech characterization III (bone, tendon, cartilage)	
26 Sept	Metals	Sec 1.3.3 – 1.3.3C
28 Sept	Ceramics	Hmwk 2 DUE, Sec 1.3.4-1.3.4B
3 Oct	Exam 1 (7 to 26 Sept material)	
5 Oct	Ceramics	
10 Oct	*NO CLASS*: Indigenous Peoples' Day	
11 Oct	(Substitute for 10 Oct): Polymers	Sec 1.3.2 – 1.3.2C
12 Oct	Polymers / Surface and Grafting	
17 Oct	Surface and Grafting	Sec 1.4.1 – 1.4.5
19 Oct	Biocompatibility and Testing	Sec 2.3.1 – 2.3.4
24 Oct	Biocompatibility and Testing / Natural Polymers	Hmwk 3 DUE
26 Oct	Natural Polymers	Sec 1.3.6 – 1.3.6B
31 Oct	Exam 2 (28 Sept to 24 Oct material)	
2 Nov	Natural Polymers	Sec 1.3.6 – 1.3.6B
7 Nov	Synthetic Polymers	
9 Nov	Polymer Degradation	Sec 2.4.1 – 2.4.4
14 Nov	Surfaces and Interfaces	
16 Nov	Surface Characterization	
21 Nov	Colloids, Surfactants, and Emulsions	
23 Nov	*NO CLASS*: Thanksgiving	
28 Nov		
30 Nov	Exam 3 (26 Oct to 28 Nov material)	
5 Dec	Presentations	
7 Dec	Presentations	
12 Dec	Presentations	