

Course Syllabus for Fall 2023

BME/MSE/Macro 410 - Design and Applications of Biomaterials (3 Credits)

Semester: Fall, 2023

Days/Times: Monday/Wednesday 9 AM - 10:30 AM

Classroom: 2505 GGBL

We're very glad to be teaching you all, and we hope that you all have a safe, fun, and productive semester with us!

Instructional Staff:

Professor: Geeta Mehta, Ph.D., Associate Professor

Depts. of Materials Science and Engineering, Biomedical Engineering, and Macromolecular Science and Engineering

E-mail: mehtagee@umich.edu

Please see *Communications* section for notes about contacting instructor

Office Hours: Monday/Wednesday before or after the lecture. If these times don't work for you, you can send a message through Canvas Inbox to arrange an appointment at a different time. (Refer to Communications section for policy regarding email and online communications)

GSI: Kristina Chu Dept. of Biomedical Engineering

E-mail: chkris@umich.edu

Please see *Communications* section for notes about contacting GSI

GSI Office Hours: *By appointment.*

Relevant Course Materials

Prerequisites: One year of general biology or biochemistry and MSE 220 or 250.

Textbook: *Biomaterials Science: An Introduction to Materials in Medicine*, (Editors) William R. Wagner, Shelly E. Sakiyama-Elbert, Guigen Zhang, Michael J. Yaszemski, 4th Edition. Elsevier Academic Press, 2020. ISBN: 978-0-12-816137-1

(Book is available online via UMich Library: [Biomaterials Science 4th Ed \(Library UMich\)](#)[Links to an external site.](#)

DOI <https://doi.org/10.1016/C2017-0-02323-6>[Links to an external site.](#)

Pertinent Chapters from the textbook are posted on Canvas)

Course website: This course uses **Canvas**. Check the site frequently and thoroughly for all course content and learning resources. *The link to the course website is here: [BME/MSE/Macro 410 Fall 2023](#)* For information regarding organization of files and resources, please refer to *Course Outline* below.

Databases to know and use:

These are paid databases (these are amazing resources, and the university pays for them for us!) available to you as U-M students, that you should use for literature search:

- **SCOPUS:** <https://www.scopus.com/search/form.uri?display=basic#basic>[Links to an external site.](#)

Please go through the university's library page to land on Scopus, and you will also be able to download articles via 'M-Get-

It'. https://search.lib.umich.edu/databases/record/10049?query=scopus&utm_source=lib-home[Links to an external site.](#)

- **Engineering Village:** https://search.lib.umich.edu/databases/record/8551?filter.academic_discipline=Biomedical+Engineering&sort=title_asc[Links to an external site.](#)

<https://www.engineeringvillage.com/search/quick.url?database=1>[Links to an external site.](#)

- **PubMed with M-Get-It:** <https://pubmed-ncbi-nlm-nih-gov.proxy.lib.umich.edu/?otool=umichlib>[Links to an external site.](#)[Links to an external site.](#)
- **Web of Science:** <https://www-webofscience-com.proxy.lib.umich.edu/wos/woscc/basic-search>[Links to an external site.](#)
- View **ALL Databases** at UMich Library: https://search.lib.umich.edu/databases/browse?utm_source=lib-home[Links to an external site.](#)

(you will need to use these from an on-campus computer or with your umich username and password)

Communications Policy

All instructor communication must be conducted through **Canvas Inbox conversations** (<https://umich.instructure.com/conversations#filter=type=inbox>). Select “**Inbox**” from the left menu bar, choose “**BIOMEDE 410 FA 2023**” from the course list, and in the “**To:**” field type Geeta Mehta and Kristina Chu, these names will be easily available to message. However, any public communication related to course content should be made on Piazza.

Piazza: This term we will be using Piazza for class communications. The system is highly catered to getting you help fast and efficiently from classmates, the GSI, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com.

Find our class page at: [Piazza Fall 2023 BME 410](#)[Links to an external site.](#)

Please note: All communication will occur through a mix of Piazza, Canvas Inbox, Canvas Discussions, in-person meetings, and remote video meetings. Please email to arrange in-person meetings or meet me before or after the class.

Accommodations for Students with Disabilities:

If you think you need an accommodation for a disability, please let me know at your earliest convenience. Some aspects of this course, the assignments, the in-class activities, and the way we teach may be modified to facilitate your participation and progress. As soon as you make me aware of your needs, we can work with the [Office of Services for Students with DisabilitiesLinks to an external site.](#) (SSD) to help us determine appropriate accommodations. SSD (734-763-3000 or ssd.umich.edu) typically recommends accommodations through a Verified Individualized Services and Accommodations (VISA) form. I will treat any information you provide as private and confidential.

Your success in this class is important to me. If you are not formally registered with [Office of Services for Students with DisabilitiesLinks to an external site.](#) (SSD) and have anxiety, depression, learning disabilities or any other issues that affect your ability to fully participate and learn in this class, you are encouraged to check-in with me so that I can best help you do well. Please set up a meeting with me via e-mail.

Please note:

We understand that students have a wide array of circumstances and situations that might make earning particularly difficult for some. Please do not hesitate to reach out to us (by Canvas Inbox, or through scheduling in person or video meetings) so that we can work with you regarding your personal experience.

Inclusion and Diversity:

I create an inclusive classroom in my teaching practice. I value all students regardless of their background, country of origin, race, religion, ethnicity, disability status, gender, sexual orientation, etc., and am committed to providing a climate of excellence and inclusiveness within all aspects of the course. If there are aspects of your culture or identity that you would like to share with me as they relate to your success in this class, I am happy to meet to discuss. Likewise, if you have any concerns in this area or are facing any special issues or challenges, you are encouraged to discuss this matter with me (set up a meeting via e-mail) with an assurance of full confidentiality (only exception being mandatory reporting of academic integrity/honor code violations and sexual harassment).

Student Mental Health and Well-being:

The University of Michigan is committed to advancing the mental health and wellbeing of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, contact **Counseling and Psychological Services (CAPS)** at (734) 764-8312 and <https://caps.umich.edu/Links to an external site.> during and after hours, on weekends and holidays, or through its counselors physically located in schools on both North and Central Campus. You may also consult **University Health Service (UHS)** at (734) 764-8320 and <https://www.uhs.umich.edu/mentalhealthsvcsLinks to an external site.>, or for alcohol or drug concerns, see www.uhs.umich.edu/aodresourcesLinks to an external site. For a listing of other mental health resources available on and off-campus, visit <http://umich.edu/~mhealth/Links to an external site.>

Normal levels of stress and anxiety are exacerbated by the continued uncertainties associated with the COVID-19 global pandemic. The College of Engineering has resources specifically designed to support students through this especially difficult time (<https://care.engin.umich.edu/>). Prof. Mehta is willing to contact the C.A.R.E center on behalf of any students (with their consent). Please don't hesitate to reach out!

Religious Observances

The University of Michigan, as an institution, does not observe religious holidays. However, we will make every reasonable effort to help students avoid negative academic consequences when their religious obligations conflict with academic requirements. If you find that an exam or assignment due date conflicts with religious observance, it is your obligation to let Prof. Mehta know at least 2 weeks in advance of the conflict. You will be given every opportunity to make up the work without penalty unless it interferes unreasonably with course delivery. Read the University of Michigan's full policy

here: http://www.provost.umich.edu/calendar/religious_holidays18-19.html#conflicts[Links to an external site.](#)

It is recommended that you review all other general University of Michigan College of Engineering policies, academic rules, information and more in the online bulletin, which can be found at <https://bulletin.engin.umich.edu/>[Links to an external site.](#)

Policy on Generative Artificial Intelligence (GAI) for BME/MSE/Macro 410:

Learning how to use AI functions such as ChatGPT is important for all of us. Used properly, ChatGPT can enhance our work; used improperly, it can border on plagiarism.

Any and all use of machines that emulate human capabilities (eg. ChatGPT, Bard, Stable Diffusion) to perform assignments or other works in the course must be disclosed. This includes all graded deliverables as well as other course works and activities.

If you have used GAI on anything you submit for BIOMEDE 410, please include an explanation as to (1) what was your original prompt to the chatbot; (2) what are some examples of incorrect data that the chatbot provided to you; and, (3) how did you rework and revise so that your final document was both factually accurate and reflected your writing voice and style.

In addition, an explanatory appendix is required for each and every unique usage to describe in clear steps how such a machine was used, including which machine, iteration, editing, etc.

The use of GAI tools is not permitted in this course for the following activities:

- Impersonating you in classroom contexts, such as by using the tool to compose discussion board prompts assigned to you.
- Completing group work that your group has assigned to you, unless it is mutually agreed upon that you may utilize the tool.
- Writing a draft of a writing assignment.
- Writing entire sentences, paragraphs or project report to complete class assignments.

Course Structure and Expectations:

1. Course Goals

- To provide orientation and introduction to the broad field of contemporary biomaterials.
- To develop a global perspective of interdisciplinary fields (biology, materials science, chemistry, and engineering) involved in biomaterials.
- To provide examples of various applications of biomaterials in different parts of the human body.
- To learn how to design, synthesize, evaluate, and analyze various types of biomaterials.

- To develop an understanding of how the different biomaterials interact with cell, tissues, and biological systems, and to recognize the consequences of these interactions.
- To familiarize with the current challenges, unsolved problems and future opportunities in biomaterials science.

2. Grading distribution

Grade components and distribution

Component	Distribution
Active Learning/Quizzes/Class Participation (Individual)	20% of grade
Perusall annotations (Best 6 out of 8) and Intro Video (Individual)	20% of grade
Biomaterial of the Day Video (Group)	35% of grade
Project Proposal (Group)	25% of grade

3. Exams

There will be no formal exams in this course. They will be replaced with different assignments and group projects, as described above. Yay!

4. Homework

First HW in this course is to create an Introduction video. Instructions are posted under Assignments. This HW will be submitted via Canvas.

Other HWs in this course will feature annotations of the assigned reading via Perusall. HWs will be submitted via Perusall. Additionally, out of the 8 Perusall homework, the bottom two with the lowest grade will be dropped.

HWs discussion with other students in the class: You may discuss HWs with your classmates. You must submit individual work that is not a verbatim copy of any other student's work. Do not forget that even when working in groups, you are individually responsible for your learning.

Late HW Policy:

12 hours late HW:	15% deduction
24 hours late HW:	50% deduction
24 plus hours HW:	100% deduction

5. Active Learning/Quizzes/Class participation

Active learning is very important to success in this course. To ensure active learning and engagement in class, we will be making small groups in lectures. You will need access to the internet for some class discussions. Your responses to in-class quizzes will be recorded through Canvas, the in-class discussion chats are recorded on Canvas, and these will go towards your participation points. We will also conduct active learning exercises during each class. Your participation is essential for these activities and will count towards your participation points.

6. Course Evaluation

Your feedback is extremely important to make this course better and to improve your learning experience. To encourage course evaluation, I will be awarding extra points:

- If more than 90% of the class completes the final class evaluations, 5 points (from the active participation/quizzes/discussion points) will be awarded to all students.

Please note that the course evaluations are anonymous, and the final evaluations aren't available to me until after your final course grades have been submitted.

7. Other Textbooks and References

Adamson, A. W.; Gast, A. *Physical Chemistry of Surfaces*, 6th Ed, John Wiley & Sons, New York, 1997

Lodish, G.; Berk, A.; Zipursky, L. S.; Matsudaira, P. *Molecular Cell Biology*, 7th Ed, WH Freeman, 2012

Alberts, B.; Bray, D.; Lewis, J.; Raff, M.; Roberts, K.; Watson, J. D. *Molecular Biology of the Cell*, 5th Ed, Garland Publishing, New York, 2007.

Atala, A; Mooney, D. J. Eds, *Synthetic Biodegradable Polymer Scaffolds*, Springer Verlag, New York, 1997

Black, J.; Hastings, G. *Handbook of Biomaterials Properties*, Chapman/Hall, London, 1998

Janeway, C. A. Jr.; Travers, P. *ImmunoBiology: The Immune System in Health and Disease*, 5th Ed, Garland Publishing, New York, 2001.

Lanza, R. P.; Langer, R.; Vacanti, J., Eds. *Principles of Tissue Engineering*, 2nd Ed., Academic Press, San Diego, 2000.

Park, J. B.; Lakes R. S. *Biomaterials An Introduction*, 3rd Ed., Plenum Press, New York, 2007.

Temenoff, J. S.; Mikos A. G. *Biomaterials: The Intersection of Biology and Materials Science*, Prentice Hall, New Jersey, 2008.

Pruitt L. A.; Chakravartula A. M., *Mechanics of Biomaterials: Fundamental Principles for Implant Design*, Cambridge Texts in Biomedical Engineering, Cambridge University Press, New York 2011

8. Honor Code Statement

All students in the BME/MSE/Macro 410 are presumed to be decent and honorable, and as such, are bound by the College of Engineering Honor Code. You may not seek to gain an unfair advantage over your fellow students; you may not consult, look at, or possess the unpublished work of another without their permission; and you must appropriately acknowledge your use of

another's work. Any violation of the honor policies appropriate to each piece of course work will be reported to the Honor Council, and if guilt is established penalties may be imposed by the Honor Council and Faculty Committee on Discipline.

9. Posting or Sharing Course Materials

The materials developed for all of the parts of online instruction (including asynchronous and synchronous content, HWs, projects, proposals, etc.) are the intellectual property of the course instructor (Geeta Mehta). Do not post any of the course materials online or share them with any of your friends, family, or anyone else. If you find any portion of the course materials on any online formats (except the Canvas course page) please notify me immediately.

10. Course Outline

Please note:

- Topics covered may be different than what are listed below, based on how slow or fast we are moving in class
- All course content is ONLINE. Lecture content consists of live in-person lectures. See the top of the syllabus for the information to attend the lectures
- The discussions in the live lectures will be conducted in a similar style to discussions in other courses, with a focus on the application of concepts and review of the material

Tentative Schedule

#	Date	Topic	Reading (not required)	Assignments: Homeworks, Biomaterial of Day (group), Project Proposal (group)
1	August 28 (Mon)	Orientation and Introduction to Biomaterials	Chapter 1.1.1, 1.1.2	
2	August 30 (Wed)	Introduction to Biomaterials, Introduction to Cells, Stem Cells	Chapter 2.1.1, 2.1.3, 2.1.4	
	September 4 (Mon)	Labor Day (Holiday)		
	September 5 (Tues)			HW#1 Due on <u>Tuesday</u>, <u>September 5th</u> (Video introduction)

3	September 6 (Wed)	Introduction to Cells, Stem Cells, Cell injury response	Chapter 2.1.3, 2.1.4	
4	September 11 (Mon)	Material Properties	Chapter 1.2.1, 1.2.2, 1.2.3	
	September 12 (Tues)			HW#2 Due on Tuesday, September 12 (Perusall)
5	September 13 (Wed)	Surface Characterization	Chapter 1.2.3, 1.2.4	
6	September 18 (Mon)	Surface Characterization	Chapter 1.2.4	
7	September 20 (Wed)	Surface Characterization	Chapter 1.2.4	
	September 22 (Fri)			HW#3 Due on Friday, September 22 (Perusall)
8	September 25 (Mon)	Polymers	Chapter 1.3.2	
9	September 27 (Wed)	Polymers	Chapter 1.3.2	
10	October 2 (Mon)	Polymers	Chapter 1.3.2	
11	October 4 (Wed)	Polymers	Chapter 1.3.2	
	October 6 (Fri)			HW#4 Due on October 6th (Perusall)
12	October 9 (Mon)	Hydrogels	Chapter 1.3.2E	
13	October 11 (Wed)	Hydrogels	Chapter 1.3.2E	
	October 13 (Fri)			BMoD Topic Claim Due Friday Oct 13th (Group)

	October 16 (Mon)	Fall Study Break		
14	October 18 (Wed)	Hydrogels, Smart Polymers	Chapter 1.3.2E, 1.3.2G	
	October 20 (Fri)			HW#5 Due on Friday October 20 (Perusall)
15	October 23 (Mon)	Hydrogels, Smart Polymers	Chapter 1.3.2E, 1.3.2G	
16	October 25 (Wed)	Smart Polymers	Chapter 1.3.2G	
17	October 30 (Mon)	Medical Fibers and Biotextiles	Chapter 1.4.6	
	October 31 (Tues)			HW#6 Due on Tuesday October 31st (Perusall)
18	November 1 (Wed)	Medical Fibers and Biotextiles	Chapter 1.4.6	
19	November 6 (Mon)	Biodegradable materials	Chapter 1.3.2F	Biomaterial of the Day Abstract Due
	November 7 (Tues)			HW#7 Due Tuesday November 7th (Perusall)
20	November 8 (Wed)	Biodegradable materials	Chapter 1.3.2F	
21	November 13 (Mon)	Natural materials	Chapter 1.3.6, 1.3.6A	
22	November 15 (Wed)	Natural materials, Surface Modification	Chapter 1.3.6, 1.3.6A, 1.4.2, 1.4.4	
23	November 20 (Mon)	Surface Modification, Surface Patterning	Chapter 1.4.2, 1.4.4, 1.4.5	BMoD Slides and Video Due
	November 21 (Tues)			Biomaterial of the Day - Team Members' Peer Reviews Due

	November 23 (Thurs)			HW#8 Perusal Due
24	November 27 (Mon)	Metals, Ceramics and Glasses	Chapter 1.3.3, 1.3.4	
25	November 29 (Wed)	Metals, Ceramics and Glasses	Chapter 1.3.3, 1.3.4, 1.3.4A	
	December 1 (Fri)			Project Plan - Group Members' Peer Reviews Due
26	December 4 (Mon)	Metals, Ceramics and Glasses	Chapter 1.3.3, 1.3.4	
27	December 6 (Wed)	Composites, Pyrolytic Carbon, Porous materials	Chapter 1.3.7, 1.3.5, 1.4.7	
	December 7 (Thurs)			HW#9 Perusal Due
	December 8 (Fri)			Final Project Plan Due (group)
	December 10 (Sun)			Project Plan - Group Members' Peer Reviews Due