

42-101: Introduction to BME (12 units)

Instructor:

Professor Rosalyn Abbott

Office: Scott Hall 4N101

E-mail: rabbott@andrew.cmu.edu

Instructor Office Hours: Monday at 2:15PM on zoom or in-person following class

Zoom URL for class and office hours:

<https://cmu.zoom.us/j/95516275100?pwd=Sm41Ymg1Q3RibFdLSXBcaEZqSHRFQT09>

Meeting ID: 955 1627 5100

Passcode: 6SG9epCZ

Teaching Assistants and Contact Information:

TA	e-mail
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TA Office Hours: TBD based on poll

Classes: Monday, Wednesday, & Friday 1:25-2:15 PM

Recitation: Wednesday 1:25-2:45 PM

Description:

This class serves as an overview of the broad landscape of Biomedical Engineering (BME). For students considering a major/minor in BME, this class will provide insight into what biomedical engineers do professionally. The course is broken up into 4 different sections based on the BME tracks offered at CMU: 1) cellular and molecular biotechnology, 2) biomechanics, 3) biomaterials and tissue engineering, and 4) biomedical imaging and signal processing. In each section students will be introduced to key concepts in the field through lectures and practice problems, participate in an interactive lab demo, and identify a product or a scenario in the media where a BME engineer uses some of the concepts discussed to help solve engineering problems. Students will be assessed with homework assignments, quizzes, and exams. At the end of the class students will apply the concepts they have learned to present an informed perspective on an area of BME that excites them.

Pre-requisite or Co-requisite: 03-121 or permission of instructor

Learning Objectives:

By the end of this course, students will be able to:

- Explain and discuss what biomedical engineers do in their professional activities
- Identify and solve biomedical engineering problems with mathematical calculations, physical engineering principles, and biological concepts related to the following areas:
 - cellular and molecular biotechnology
 - biomechanics

- biomaterials and tissue engineering
- biomedical imaging and signal processing
- Interpret experimental data
- Describe and critique contemporary biomedical technologies

Format of the class:

Prior to Sept 20th this class will be remote to allow students to get vaccinated after travelling to CMU. The rest of the class will be in-person with some asynchronous (not happening at the same time) days designated in the course calendar. Asynchronous classes, denoted as **AS** in the calendar, involve individual assignments that can be completed at any point prior to the due date. If the whole class needs to go fully remote at any time, you will receive an email from me, and an announcement will be published on our course website on Canvas (<https://canvas.cmu.edu/courses/25312>). During the semester, we will use the same zoom link available on Canvas in the first module of the landing page and included at the beginning of this syllabus.

Resources

Required Textbook:

Saltzman, Biomedical Engineering, 2nd edition. Cambridge Texts in Biomedical Engineering, Cambridge University Press, ISBN 978-1-1070-3719-9

Class Website:

Visit the canvas website (<https://canvas.cmu.edu/courses/25312>) for announcements, course documents, recorded lectures, discussion, assignments, and grading.

Piazza:

We will be using Piazza for discussions outside of the classroom (sign up at: piazza.com/cmu/fall2021/42101a). The system is catered to getting students help fast and efficiently from classmates, the TAs, and the instructor. Rather than emailing questions to the teaching staff, **post your questions on Piazza** so we can all benefit from the collective clarifications and discussions.

Assessments

Grading:

- Exams (3): 45%
- Quizzes (4): 16%
- Canvas polls: 15%
- Discussion boards: 10%
- Technical Reviews (4): 8%
- Group Project – informed perspective: 6%

The following scale will be used to assign a final letter grade:

90 to 100%	A
80 to 89%	B
70 to 79%	C

60 to 69%
0 to 59%

D
R

Reading:

- Readings from the text will be assigned prior to covering a particular unit and are posted on the calendar on canvas.

Quizzes and Examinations – all open book and asynchronous:

- Short asynchronous module quizzes covering readings and lecture materials will be implemented through Canvas
- Three asynchronous open notes exams will be implemented through Canvas (Sept 29, Nov 3, Nov 22) covering readings, lecture materials, and problem sets.
- All students will take the exams and quizzes asynchronously and there will be no synchronous (same time) class on these days.

Canvas polls: Asynchronous pre-recorded lectures will be accompanied by in-class problem sets and activities during our synchronous time. To give me an idea of how well you are understanding the material in the pre-recorded lectures I will have checkpoints built into the movies where I will ask you to pause the video and go answer a poll on canvas. Polls will be graded for completion not accuracy.

Discussion boards: Every week we will have either a guest lecture or expert video interview that will be posted on a discussion board on canvas. You will be assigned a small group (that will stay the same throughout the semester) where you will answer a question and read responses from your group members. The first week of class we will do an activity for you to get to know your group. Again, completion will be what is graded. Feel free to reply to your group members posts to try to get extra credit.

Technical Reviews: For each module, students will be split into 2 groups. Students in the “review group” will each identify a product or a scenario in the media where an engineer uses some of the concepts we discussed to help solve biomedical engineering problems. Students will critically examine the technology/scenario to:

- Recommend improvements based on what you have learned.
- Identify other concepts that we discussed that should be considered (this can be from other modules as well!).
- Consider whether the biomedical engineering concept was accurately portrayed in the media. Often science is not communicated effectively to the general public.
- Provide the reference for the article (posting a link will be fine).
- Post the review as a discussion board on Canvas.

The students in the “response group” will comment on another student’s discussion board post, providing an additional link related to the content. The response can be supportive or provide another perspective to think about on the topic.

Group project – An informed perspective to be presented to the class at the end of the semester

Groups of 4 will research a BME technology discussed in the media (news article, social media, science fiction movie, etc.). Based on what they have learned in class, students will evaluate the technology and provide an “informed perspective” in the form of a short presentation (7 minutes, 3 minutes for questions). The format of the presentation will be to briefly give an overview of where the technology was discussed, and what the biomedical engineers did. Then you should address these key questions:

- In class, did we talk about any of the key concepts the biomedical engineers used in their approach?
- Based on what you have learned, what would you do differently?
- If the technology is proposed as something biomedical engineers can do (i.e. in a science fiction movie) does it have any basis in science? Based on what we learned in class, can you propose a way that it could *actually* be done?
- Did the media portray the biomedical engineering concepts accurately? Often science is not communicated effectively to the general public.

Note: Before the Thanksgiving break students will submit an outline on Canvas of their presentation for my feedback.

For assistance with the written or oral communication assignments in this class, visit the Global Communication Center (GCC). GCC tutors can provide instruction on a range of communication topics and can help you improve your papers and presentations. The GCC is a free service, open to all students, and located in Hunt library. You can make tutoring appointments directly on the GCC website: <http://www.cmu.edu/gcc>. You may also visit the GCC website to find out about communication workshops offered throughout the academic year.

Policies

Classroom Policy:

- We will be using Zoom for some of our synchronous sessions. If you are remote, please make sure that your Internet connection and equipment are set up to use Zoom and able to share audio and video during class meetings. (See [this page](#) from Computing Resources for information on the technology you are likely to need.) Let me know if there is a gap in your technology set-up (rabbott@andrew.cmu.edu) as soon as possible, and we can see about finding solutions.
- This semester involves regular use of technology during class – both for in-person and remote classes. Research has shown that divided attention is detrimental to learning, so I encourage you to close any windows not directly related to what we are doing while you are in class. Please turn off your phone notifications and limit other likely sources of technology disruption, so you can fully engage with the material, each other, and me. This will create a better learning environment for everyone.
- **Sharing video:** In this course, being able to see one another helps to facilitate a better learning environment and promote more engaging discussions. However, I also completely understand there may be reasons you would not want to have your cameras on. Note: You may use a background image in your video if you

wish; just check in advance that this works with your device(s) and internet bandwidth.

- Our synchronous meetings will involve breakout room discussions. Those will work better if everyone in your small group has their camera turned on.
- During large group debriefs, you may keep your video off.
- During our remote class meetings, please keep your mic muted unless you are sharing with the class or your breakout group.
- Class participation is highly encouraged! Please let me know if you are confused or need clarification at any time, chances are if you are lost – someone else is too! If you are remote and have a question or want to answer a question, please use the chat or unmute and ask directly.
- Every effort will be made to start and end lectures on time. For in-person attendance: if you are late, please enter the class with minimal disruptions. If you have to leave early, please make your exit as quickly and quietly as possible. Please keep in mind that these guidelines are necessary to maintain an environment that is conducive for learning.
- All synchronous classes will be recorded via Zoom so that students in this course (and only students in this course) can watch or re-watch past class sessions. Please note that breakout rooms will not be recorded. I will make the recordings available on Canvas as soon as possible after each class session (usually within 3 hours of the class meeting). Recordings will live in our Canvas. Please note that you are not allowed to share these recordings. This is to protect your FERPA rights and those of your fellow students.

In person attendance:

- In order to attend class in person, I expect that you will abide by all behaviors indicated in [A Tartan's Responsibility](#),
- A laptop and set of headphones will be required for our in-person classes, so If you do not have access to either, please email me (rabbott@andrew.cmu.edu) as soon as possible so we can find a solution.

Challenges to grades:

- Accepted within **7 days** of grade release and **by email only**. An important skill is the ability to concisely, coherently, and courteously express your viewpoint. You might be wondering - "Why doesn't Professor Abbott discuss my regrade request in person?" The answer is that I prefer to look at all the regrades at once so that I can compare them with the key and with each other. This is the fairest way to do it. This is also why regrades are only accepted 7 days after release.
- There are three scenarios that warrant a regrade:
 1. There was an arithmetic error in adding up points. In this case, email me a brief note referencing the assignment.
 2. Your answer is the same as the one on the answer key, but the grader didn't realize it. Your explanation should make it clear why you believe your answer is the same. For example, "The answer key says we were expected

to write 'anterior pituitary gland', and I wrote 'adenohypophysis', which is another name for the same gland."

3. Your answer is different from the one provided on the answer key, but your answer is also correct. Your explanation should make it clear that you have read the answer key, and why you think that your answer is equally good.
- I will handle all regrade requests, this is not the responsibility of TAs.
 - Any regrade request automatically triggers a thorough re-examination of the **entire assignment or exam**, not merely the portion under appeal. Accordingly, reexamination may have a favorable, adverse, or neutral effect on your overall score.

Makeup and Late Policies:

- Athletic schedules and observance of religious holidays should be presented to me at the beginning of the semester. Interviews, conferences and other acceptable planned absences must be given in writing at least 2 class periods in advance.
- Other emergencies, such as illnesses, must be presented to me immediately following the missed quiz/exam.
- All assignments have due dates indicated on the syllabus. In general, submitting assignments on time lets the instructional team provide feedback in a more timely and efficient manner. Assignments build on each other, so timely submissions are crucial to your progress in the class. However, sometimes life happens. If you cannot submit an assignment on time, the default will be that you will be eligible for 90% of the grade the first 48 hours that the assignment is late. If you have to submit beyond 48 hours past the due date, please contact me (rabbott@andrew.cmu.edu) as soon as possible so we can make arrangements.

Accommodations due to Disabilities:

If you have a disability and have an accommodations letter from the Disability Resources office, please discuss your accommodations and needs with me as early in the semester as possible. I will work with you to ensure that accommodations are provided as appropriate. If you suspect that you may have a disability and would benefit from accommodations but are not yet registered with the Office of Disability Resources, please contact them at access@andrew.cmu.edu.

Academic Integrity

Academic integrity is about enhancing your education and being a trusted member of the CMU community. Honesty and transparency are important features of good scholarship. On the flip side, plagiarism and cheating are serious academic offenses with serious consequences. If you are discovered engaging in either behavior in this course, you will earn a failing grade on the assignment in question, and further disciplinary action may be taken.

In this hybrid/remote environment for Fall 2021, you might have questions about what is and is not acceptable. For a clear description of what counts as plagiarism, cheating, and/or the use of unauthorized sources, please see the University's Policy on Academic

Integrity: http://www.cmu.edu/policies/documents/Academic_Integrity.html All graded work in this class, except for the group project, must be completed independently.

However, I **encourage you to work together to study** and to make use of campus resources like Academic Development, the Global Communication Center, and the Intercultural Communication Center to assist you in your pursuit of academic excellence. I **strongly endorse** collaborative learning, when it increases your ability to succeed in this class and when it enhances your education and learning.

If you have questions about the integration of the university's policy into this course, please do not hesitate to ask: the aim is to foster an environment where you can learn and grow, while ensuring that the work we all do is honest and fair.

For more resources/definitions see:

- Carnegie Mellon Code (<http://www.cmu.edu/student-affairs/theword/code.html>)
- Cheating (<http://www.cmu.edu/academic-integrity/defining/cheating.html>)
- Plagiarism (<http://www.cmu.edu/academic-integrity/defining/plagiarism.html>)
- Unauthorized Assistance (<http://www.cmu.edu/academic-integrity/collaboration/index.html>)

Consequences:

Any disciplinary actions regarding charges of cheating or plagiarism will follow the procedures described in the "CMU Undergraduate Academic Disciplinary Actions Overview" (<http://www.cmu.edu/policies/documents/AcadRegs.html>).

Creating an inclusive environment

We must treat every individual with respect. We are diverse in many ways, and this diversity is fundamental to building and maintaining an equitable and inclusive campus community. Diversity can refer to multiple ways that we identify ourselves, including but not limited to race, color, national origin, language, sex, disability, age, sexual orientation, gender identity, religion, creed, ancestry, belief, veteran status, or genetic information. Each of these diverse identities, along with many others not mentioned here, shape the perspectives our students, faculty, and staff bring to our campus. We, at CMU, will work to promote diversity, equity and inclusion not only because diversity fuels excellence and innovation, but because we want to pursue justice. We acknowledge our imperfections while we also fully commit to the work, inside and outside of our classrooms, of building and sustaining a campus community that increasingly embraces these core values.

Each of us is responsible for creating a safer, more inclusive environment.

Unfortunately, incidents of bias or discrimination do occur, whether intentional or unintentional. They contribute to creating an unwelcoming environment for individuals and groups at the university. Therefore, the university encourages anyone who experiences or observes unfair or hostile treatment on the basis of identity to speak out

for justice and support, within the moment of the incident or after the incident has passed. Anyone can share these experiences using the following resources:

Center for Student Diversity and Inclusion: csdi@andrew.cmu.edu, (412) 268-2150

Report-It online anonymous reporting platform: reportit.net username: tartans password: plaid

Research to Improve the Course

For this class, I am conducting research on teaching and learning. This research will involve some student work. You will not be asked to do anything above and beyond the normal learning activities and assignments that are part of this course. You are free not to participate in this research, and your participation will have no influence on your grade for this course or your academic career at CMU. If you do not wish to participate, please send an email to Chad Hershock (hershock@andrew.cmu.edu). Participants will not receive any compensation. The data collected as part of this research will include student grades. All analyses of data from participants' coursework will be conducted after the course is over and final grades are submitted. The Eberly Center may provide support on this research project regarding data analysis and interpretation. The Eberly Center for Teaching Excellence & Educational Innovation is located on the CMU-Pittsburgh Campus and its mission is to support the professional development of all CMU instructors regarding teaching and learning. To minimize the risk of breach of confidentiality, the Eberly Center will never have access to data from this course containing your personal identifiers. All data will be analyzed in de-identified form and presented in the aggregate, without any personal identifiers. If you have questions pertaining to your rights as a research participant, or to report concerns to this study, please contact Chad Hershock (hershock@andrew.cmu.edu).

Final Words

Take care of yourself. This semester is unlike any other. We are all under a lot of stress and uncertainty at this time. Make sure to move regularly, eat well, and reach out to your support system or me (rabbott@andrew.cmu.edu) if you need to.

We can all benefit from support in times of stress, and this semester is no exception. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful. If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. Counseling and Psychological Services (CaPS) is here to help: call 412-268-2922 and visit their website at <http://www.cmu.edu/counseling/>. Consider reaching out to a friend, faculty or family member you trust for help getting connected to the support that you need.

Approximate Topics Schedule:

Week 1-2: Introduction, Review of Fundamentals, Homeostasis

Week 3-4: Cellular & Molecular Biotechnology

Week 5-7: Biomechanics

Week 8-10: Biomaterials and Tissue Engineering

Week 11-13: Biomedical Imaging and Signal Processing

Week 14: Informed perspectives