

BIOE 372/572**BIOMECHANICS****Instructor:** Jane Grande-Allen, Ph.D., grande@rice.edu

BRC 619, ext 3704

TAs: Jacob Cabler, jc258@rice.edu
Katherine Chen, kc128@rice.edu**Graders:** Shannon McGill, svm4@rice.edu
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(please use "BIOE 372" or "BIOE 572" in subject line when emailing)

Meeting Time: 9:25 am – 10:40 am Tuesday and Thursday BRC 282*Lectures will be held in person during class time. On occasion, they will be recorded and available online but that will not happen every lecture.***Office Hours:** Wednesdays from 6-7 pm, virtual (zoom) and as needed**TA Sessions:** TBD

Prerequisite: MECH 211 or MECH 202, if you are an undergraduate student. However, since some of you took this course more than a year ago, please review the textbook appendices that concern force and moment balances and moment of inertia. These will also be covered in the TA sessions.

Graduate students taking the course should meet with me to demonstrate a familiarity with engineering statics. As needed, review the textbook appendices that concern force and moment balances and moment of inertia.

Course Content: The objectives of this course are to introduce and analyze biomechanical principles using stress and strain, load and deformation, and material properties. Though the primary focus will be on tissue level mechanics, the modern field of cell biomechanics will also be addressed to some extent. Additionally, aspects of blood rheology, circulation, viscoelasticity of soft tissues, gait, and musculoskeletal mechanics will be addressed.

Class Materials: The course website is on Canvas. You need to be registered for the course and login with your Rice ID to have an access to course materials. Contact the TAs if you have a problem. The syllabus, any additional readings, quiz schedule, homework assignments and solutions, and team assignment information will be posted on the website as well. Emailed questions that are relevant for all class participants will be documented in the list of announcements on the website (these may be developed into a FAQ if needed). Please check this list before emailing your question. You will receive announcements in your email once new materials are uploaded to the website.

Important note regarding lectures

- Lectures will be mostly given using a tablet while I write notes, and occasionally using narrated slides
- Even though all lecture notes will be posted after the class, they are not a substitute for reading the textbook. It's a great textbook for bioengineers! Read it!

Textbooks: An Introduction to Biomechanics, 2nd ed. by Humphrey (Springer)

- If you choose to use a different edition, it is your own responsibility to make sure you do the correct homework problems (assigned or modified from the 2nd edition of the textbook).
- See the schedule for the dates we will be covering the different chapters of the textbooks.

Grading will be based on:

Homework assignments (6)*	25%	
Quizzes (7)	45%	Timed in-class quizzes, closed book
Team assignments*	25%	
Class participation	5%	

**graduate students must complete 1 additional homework assignment and 1 additional team assignment*

Final Course Grades (A, B, etc.) will be determined by the distribution of grades in the class, but you will not receive a letter grade lower than your average numerical grade (A+ = 98-100, A=92-97, A-=90-91, B+=88-89, B=82-87, B-=80-81, etc., Pass = 60 and above). Depending upon the class average, **there may be a curve but this is not guaranteed.**

These grades reflect student performance on the assignments turned in. If assignments totaling 10% or more of the final course grade are not turned in, the instructor retains the right to fail the student for the course.

Types of assignments:

- **Homework sets.** These will be due one week after they are assigned unless otherwise noted.
- **Team research proposal (TRP).** You and your teammates (team size TBD) will select a real-world biomechanics problem and work together to prepare a 2-page report describing and justifying research that you propose to address this problem. More information will be provided later in the semester. Important dates:
 - Feb 1, teams and topics chosen
 - Feb 13, problem description and challenges due
 - Feb 29, grad student teams turn in description of previous research on topic
 - March 5, turn in one page rough draft of "specific aims" with references
 - March 26, turn in second draft of specific aims due, 2 pages not counting references
 - April 30, final version of specific aims due, 2 pages not counting references
- **Quizzes.** There will be 7 timed quizzes, to be taken in class during the lecture period.

Expectations:*Of the Instructor*

- You should expect that the instructor and TAs will teach you about important biomechanics concepts that you will be able to use in your future core or elective BIOE courses (Capstone Design, Mechanical Testing Lab, Tissue Engineering, etc).
- Although there will be some detailed explanations and examples provided in the lecture, I will not be giving you all the information in the lectures that you need to solve the homework problems. I will attempt to balance depth and breadth of material, but it will not be possible to cover every biomechanics topic in a comprehensive manner. For some topics, I will provide information so that you can follow up on your own time.
- I will also attempt to engage your attention and interest with information about current topics in the field and by encouraging your interaction during class hours. I am here to learn as well...if I do not know the answer to your questions, I will try to find out and get back to you. **Fill out the Muddy Points surveys!**

Of the Students

- I expect you to take the initiative and responsibility in understanding the material. First and foremost, this means reading the textbook. **Reading assignments need to be completed before the class.** If you do not understand a topic, please read the

textbook. If you are still confused, please discuss the topic with Dr. Grande-Allen, the TAs, or your classmates, or venture to the library or online to seek more information.

- I expect you to participate in class actively. Ask me questions! **Expect that at some time during the semester, you will work with your team on sample problems together, and then one of you will share what you found with the class.**
- I expect you to take the concepts that you read about and that we discuss in class and apply these to the material in future lectures and in your own future.
- I also expect you to know when the homeworks are assigned and to turn them in on time. Forgetting that a homework was assigned will not earn you extra time to complete it. I also encourage you to study together for quizzes.
- Although discussion about homework is encouraged, turned in homework assignments are expected to represent individual work in accordance with the **Rice Honor Code**. Proper citations should be included for any and all work.

Assignment Policy:

Submit homework and TRP assignments online by uploading them in Canvas.

- All homeworks will be due at noon (12 pm central time) on their due date. This will most often be the day after the final lecture containing material for the upcoming quiz. Homework solutions will be published on Canvas one hour later (1 pm central time) to enable students to study for quizzes the following class period. **Therefore, no late homeworks can be accepted.** The lowest homework grade will be automatically dropped to account for any emergencies or other situations that may prevent students from submitting problem sets on time.
- All team proposal milestones are due in class, at the START of class (9:25 am) on the date that they are due.
- As stated above, if assignments totaling 10% or more of the final course grade are not turned in, the instructor retains the right to fail the student for the course.

Several of the homework problems assigned will be taken from the exact textbook above. If you choose to use an alternate version of the textbook it is YOUR responsibility to coordinate with a classmate to get the correct homework assignment. Some of the homework problems from the textbook may be modified by the instructor, in which case they will be fully described in the homework assignment posted on Canvas.

All assignments should be neatly prepared. It is expected that many of you will turn in problem sets that are handwritten in a tablet app. Please try to write neatly and large so the TAs and graders can read your writing. Team research proposal assignments must be typed. Showing your work on homework assignments is CRITICAL. Use a computer program (i.e., Excel, Matlab) to tabulate and plot data if necessary. Plots must be clearly labeled (title, axes, legend) and different data sets must be distinguishable when printed.

Turn in homework by uploading it into Canvas. If the TAs/graders cannot see your assignment or have trouble opening it, they will contact you to follow up. Please double check to make sure you uploaded the correct assignment for the correct class ☺. Do not turn in homework by emailing files to the instructor or TAs/grader.

All assignments must show:

- The assignment number, student name(s), course number, and date
- The statement of the problem, significant detail about the methods used in the solution
- A clearly identified solution (put a box around final answers)
- If you used reference material other than the textbooks in the preparation of any and all work, proper citations should be included (author, title of book/article/webpage, publishing information/URL).

Quizzes: Quizzes will be taken on paper. Each quiz will cover material in 2-3 lectures. You will be given a maximum of 40 minutes to complete the quiz unless otherwise noted. Quizzes are closed book, meaning that students are not allowed use the course textbook, notes, homework, homework solutions, previous exams/quizzes, quiz solutions, materials from previous courses, other students, or any other resources outside of the following: helpful equation sheets (provided with quiz), calculators for basic arithmetic (no graphing tools), and **one new handwritten letter page of notes (8.5x11 inch letter format, both sides) per quiz, in addition to your single note pages from the previous quizzes.** You may not communicate with anyone other than the instructor or TAs, nor use any type of communication system during quizzes. If you have any question about whether something you will do during a quiz is acceptable, you must receive approval from the instructor or TAs prior to doing it. Unless excused in writing by the instructor at least 1 day ahead of time, students must be physically present in class while taking the quiz in order to receive credit.

The lowest quiz grade will be dropped. The dropped quiz accounts for illness, challenges due to factors outside of the class, emergencies, and so on. No quiz make-ups will be given unless approved by the instructor due to extraordinary, well-documented circumstances. Contact Dr. Grande-Allen as soon as an emergency arises.

Regrade requests will be considered, but ONLY if you turn in your original assignment AND a neatly prepared document justifying why you believe why your answer is correct. Only the material in question will be regraded, so **there is no risk in asking for a regrade**, but you MUST justify your request with your own clear explanation of the answer.

Attendance Policy:

Students are expected to attend all lectures, but if you cannot attend class you will find the lecture notes online. The lectures will be recorded and posted online. There are also a few days when I will have to record the lecture ahead of time and post it online due to a schedule conflict.

- Attendance will be taken periodically throughout the first few weeks of class in order for the instructor to learn student names.
- Attending class regularly and asking/answering questions will contribute to your in-class participation portion of the grade.

TA sessions will be optional, but strongly encouraged. The TAs will be available for review sessions (indicated above) to work sample problems, go over previous homework assignments, and answer questions about current homework assignments and upcoming quizzes.

Class participation will be 5% of your grade and will be earned in class by voluntarily answering (or asking) questions. There also will be periodic opportunities for you to earn extra credit.

Generative AI:

Provide appropriate citations for all literature sources. Even paraphrasing, if you are describing someone else's idea or conclusion, needs to be cited. When you are describing your own opinion, make it evident by starting with "I think" or "In my opinion".

Regarding the use of Generative AI (adapted from Dr. Scott Solomon, Biosciences)

The following uses of generative AI are considered acceptable: checking spelling and grammar, checking English phrasing for ESL reasons, idea generation, simplification of complex ideas for personal use, answering a question where the use of AI is specifically requested, and

rephrasing awkwardly written sentences, so long as AI is cited appropriately. If you use AI for idea generation, you are strongly recommended to confirm that the idea has a basis in reality.

The following uses of generative AI are NOT acceptable: generating text longer than a phrase (meaning a sentence or more), any use of generative AI without a citation.

How to cite the use of generative AI:

- Any text generated using AI should be cited within the sentence in which it was used
 - Example: Another way to say citing a text is “referencing a source” (phrase in quotes was generated using ChatGPT)
- For any use of AI other than generating text (according to the acceptable uses above), a disclaimer at the end of the assignment should be added that specifies exactly how AI was used.
 - Example: “ChatGPT was used in the early stages of this project to generate a list of ideas and to aid in the author’s understanding of some of the references.”

Diversity & Disability Policies:

As your instructor, I value diversity, equity, and inclusion; I am committed to a climate of mutual respect and full participation. My goal is to create learning environments that are usable, equitable, inclusive, and welcoming. If there are aspects of the instruction or design of this course that result in barriers to your inclusion or accurate assessment or achievement, please notify me as soon as possible.

Students with any disabilities are encouraged to contact the instructor and Disability Resource Center (DRC) in the Allen Center. It is the mission of the DRC to be committed to providing access to the educational environment for students. The DRC also assists faculty, staff, and visitors with accommodation requests to help ensure equal access and opportunity. If you have a documented disability that may affect academic performance, you should: 1) make sure this documentation is on file with Disability Resource Center (Allen Center, Room 111 / adarice@rice.edu / x5841) to determine the accommodations you need; and 2) contact me to discuss your accommodation needs.

Covid-19 policy:

Masking is not required, but students should use their best judgement in wearing a mask. Some of you may feel more comfortable if you are wearing a mask. Any policies that Rice University implements later in the semester will supersede the policy in this syllabus. For the most up-to-date COVID policy, please see <https://coronavirus.rice.edu/policies>.

If you test positive for Covid-19, RSV, influenza, or something else that is contagious, (1) please prioritize taking care of your health needs, (2) make plans to isolate, and (3) contact me to make arrangements for missing lecture(s) and turning in any pending assignments.