BMED 3410 Syllabus

Introduction to Biomechanics
Spring 2027

Instructor Information

See course Canvas page for office hours.

Instructor	Email	PSS Session
Dr. Ellen Zerbe	ellen.zerbe@bme.gatech.edu	A01, A02
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General Course Information

Course Description

In Introduction to Biomechanics, you will explore the application of mechanical and dynamical principles to biological systems, with specific focus on biomedical applications. The course is split between lectures and problem-solving studios (PSS). The PSS is designed to allow you to apply your knowledge in a guided group setting. It will be graded based on participation/contribution.

We will use Canvas as the course website. You can find courses announcements, lecture schedule, assignments, and other resources there. You can also use Piazza to ask TAs and other students questions. We encourage you to use Piazza as the first step to resolving any questions or concerns. We will check class discussions regularly and address your questions and concerns where necessary.

Course Outcomes

Outcome 1: Statics – stress, strain, and mechanical properties of materials.
1.1 You will recall the key statics concepts.
1.2 You will be able to draw free body diagrams (FBDs).

Outcome 2: Axial Loading – methods for finding the deformation of axially loaded materials.
2.1 You will understand axial tension and compression stress concepts.
2.2 You will apply FBDs to model axial loading conditions.
2.3 You will be able to analyze strain of members under various axial loads.
2.4 You will understand the pipeline of the model construction from geometry, material, and loading to stress, strain, and deformation.
2.5 You will be able to solve axial loading problem with uniform and non-uniform geometry, material, and loads using graph-based integration.

2.6 You will be able to apply displacement constraints and the principle of superposition to solve statically indeterminate problems.

Outcome 3: Torsion – methods for finding deformation of materials under torsional loading.
3.1 You will understand the process of modeling shear stress and strain distributions based on geometry, materials, and torsional loading conditions.
3.2 You will be able to estimate failure strength of structures using torsional analysis.

Outcome 4: Bending – methods for finding deformation of materials caused by bending.
4.1 You will understand the pipeline of the model construction from geometry, material, and loading to internal stress, strain, and deformation.
4.2 You will be able to solve loading problems using graph-based integration.
4.3 You will master the technique for calculating area moments of inertia for complex cross-sections of bended beams.

Outcome 5: Dynamics – finding the effects of forces and torques on the motion of objects.
5.1 You will recall key concepts of statics, point mass models, circular motion, and differential equations
5.2 You will understand the concept of the degree of freedom, resultant force, inertia, and acceleration.
5.3 You will learn how to draw and use kinetic diagrams (KIN).
5.4 You will be able to build kinematic and dynamic models to relate position, velocity, and acceleration of point mass in 1D and 2D, and describe planar motion of rigid bodies.
5.5 You will be able to solve kinematic chain problems.
5.6 You will learn how to calculate rotational inertia using integration and the parallel axis theorem.
5.7 You will be able to solve dynamics problems using D'Alembert's principle of inertial forces.

Prerequisites

MATH 2403 or MATH 2413 or MATH 2551or MATH 2562 (Min D) or MATH 24X3 or MATH 2X52 (Min T) and COE 2001 (Min C).

Please note – We presume you to be fully responsible for the material taught in the prerequisite courses. We will provide you with review materials during the first week of classes. Beyond that, you are responsible for reviewing the prerequisite material and seeking help as necessary.

Required Course Materials

None required. In the past, the course has referenced the following textbooks, which you may find helpful. Please do not feel pressured to purchase the newest edition. The most cost-effective edition will suffice as an optional resource.

Hibbeler, R.C., Mechanics of Materials, 10th ed, Pearson, 2014 (ISBN-13 978-0134319650).

Humphrey, J., Delange. S., An Introduction to Biomechanics: Solids and Fluids, Analysis and Design, Springer, 2004. (ISBN: 9781441923189)

Hibbeler, R.C, Engineering Mechanics: Dynamics, 11th ed, Prentice Hall, 2006. (ISBN: 0131561480)

Meriam, J.L., Kraige, R.G., Engineering Mechanics: Dynamics, 14th ed, John Wiley & Sons, Inc., 2002. (ISBN-13: 978-0471406457)

Core Impacts

Not applicable

Grading and Assignments

Grade Distribution

Course grades will be determined based on the distribution outlined below, which is subject to change as necessary. Regular attendance and engagement in PSS sessions will constitute a participation grade.

Homework Quizzes:	15%	A	≥ 90%
PSS Participation:	10%	B	≥ 80%
Data Science Project:	10%	C	≥ 70%
Midterm Exam 1:	20%	D	≥ 60%
Midterm Exam 2:	20%	F	< 60%
Cumulative Final Exam:	25%		

Grade Disputes

No requests to submit supplemental work or increase your grades for any reason outside of the grading policies outlined in this syllabus will be considered. Opportunities for extra credit are built into every homework quiz. Quiz or Midterm Exam regrade requests will be considered on an individual basis, if submitted within a week of grade release. If an

assessment is submitted for a regrade, please note that the entire assessment will be regraded, which may result in a decrease of your score.

Homework

Six ungraded homework assignments will cover the major units of this course (broken down below), along with homework solutions. We strongly encourage you to attempt the problems on your own and use Piazza or Canvas to ask questions prior to going over the solutions. Therefore, homework solutions will be made available on Canvas no earlier than the Friday before the quiz.

Homework Quizzes

A total of **six** homework quizzes will be administered throughout the semester, based on their corresponding homework assignments (i.e. Quiz 1 is based on Homework 1, Quiz 2 is based on Homework 2, etc.). These quizzes will make up 15% of your final grade. Extra credit is available – each quiz will be graded out of 10 points, with a maximum possible score of 12 on each quiz. An equation sheet will be provided for each assessment; no crib sheets are allowed. Doing the homework and participating in PSS are the best ways to ensure success on the quizzes.

Homework 1/Quiz 1: Review of Statics

Homework 2/Quiz 2: Axial Loading

Homework 3/Quiz 3: Torsion and Thin-Walled Vessels

Homework 4/Quiz 4: Transverse Loading (Model of Bending)

Homework 5/Quiz 5: Point Mass and Circular Motion

Homework 6/Quiz 6: Rigid Body Kinematics

Exams

Two midterm exams and one cumulative final exam will make up 65% of your final grade. An equation sheet will be provided for each assessment; no crib sheets are allowed. See Canvas calendar for exam dates.

Exam 1: Review of Statics, Axial Loading, Thin-Walled Vessels

Exam 2: Torsional and Transverse Loading

Final Exam: Cumulative, weighted towards Kinematics and Dynamics

Data Science Project

In order to introduce applications of the materials taught in this course, a semester project will make up 10% of your final grade. Familiarity with Excel, MATLAB, Python, and/or Autodesk Fusion is encouraged, and resources will be available to help.

Course Policies

Attendance Policy

Attendance is required at PSS sessions. Students with unexcused absences will not be allowed to make up any exam or quiz and will receive a grade of zero for the missed assessment. Students with excused absences will be permitted to make up the missed assessment within one week of the date of the original assessment. You will be responsible for scheduling this make-up assessment at an available office hour within the one-week period. It is imperative to inform your PSS instructor and PSS TA of an absence by e-mail before the class to be missed (not after).

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (404-894-2563) as soon as possible to make an appointment to discuss your special needs and to obtain a letter of accommodation. Please also e-mail your instructor as soon as possible in order to set up a time to discuss your learning needs.

Academic Honesty

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. You are expected to act according to the highest ethical standards. Review Georgia Tech's Honor Code and the Student Code of Conduct. Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, along with a recommendation of a zero grade for the assignment/exam in question and a full letter grade reduction for the course grade.

Student-Faculty Expectations

At Georgia Tech we believe that it is important to continually strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. See Student-Faculty Expectations for an articulation of some basic expectations – that you can have of us, and that we have of you. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, we encourage you to remain committed to the ideals of Georgia Tech while in this class.