BMED 3410-A: Introduction to Biomechanics

Summer Term 2026

Credits: 3.0

Course Instructors:

Dr. Denis
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Office hours: Tuesdays, 2-3 pm
Location: Whitaker 1212

Teaching Assistant:

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Location: BME Learning Commons

Meeting Times:

Lectures:
Tuesdays and Thursdays, 12:30-1:45 pm at Molecular Sciences and Engineering (building 167), **Room 1201A**.

Problem Solving Studio:
Wednesdays, 3:30-5:45 pm at Molecular Sciences and Engineering (building 167), **Room G021**

Course Overview:

This is an introductory course covering mechanics applied to biomedical engineering problems. The course provides students with basic concepts and approaches for solving deformation and dynamics problems relevant to biomedical applications. The course will focus on the application of simple models from statics, mechanics of materials, kinematics, and dynamics.

Prerequisites:

Undergraduate Semester level MATH 2403 or MATH 2413 or MATH 2551 or MATH 2562 (Min D) or MATH 24X3 or MATH 2X52 (Min T) **and** COE 2001 (Min C)

Important Dates:

May 19 (Tue): First day of classes - PSS (Our first lecture is on May 20)
May 25 (Mon): Memorial Day, Holiday (We don't have classes on Mondays)
June 19 (Fri): Juneteenth, Holiday (We don't have classes on Fridays)
July 2 (Thu): Student recess day, Holiday
July 3 (Fri): Independence Day, Holiday (We don't have classes on Fridays)
July 5 (Sun): Withdrawal deadline.
July 28 (Tue): Last day of classes
August 6 (Thu): End of Term
August 10 (Mon): Grade submission deadline

Course Texts:

We do not require a specific textbook for this course. However, in the past, the course has used the following textbooks, which may be helpful

- Humphrey, J. Delange S., An Introduction to Biomechanics: Solids and Fluids, Analysis and Design, Springer, 2004. (ISBN: 9781441923189)
- J.L. Meriam and R.G. Kraige, Engineering Mechanics: Dynamics, 14th ed. (or whatever edition you can get, John Wiley & Sons, Inc, 2002
- Hibbeler, R., Engineering Mechanics: Dynamics, 11th ed, Prentice Hall, 2006. (ISBN: 0131561480)]

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Course Outcomes

Successful completion of this course will yield the following learning outcomes:

Outcome 1: Statics – stress, strain, and mechanical properties of materials.

1.1 Students will recall the key statics concepts.
1.2 Students will be able to draw free body diagrams (FBDs).

Outcome 2: Axial Loading – methods for finding the deformation of axially loaded materials.

2.1 Students will understand axial tension and compression stress concepts.
2.2 Students will apply FBDs to model axial loading conditions.
2.3 Students will be able to analyze strain of members under various axial loads.
2.4 Students will understand the pipeline of the model construction from geometry, material, and loading to stress, strain, and deformation.
2.5 Students will be able to solve axial loading problem with uniform and non-uniform geometry, material, and loads using graph-based integration.
2.6 Students 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 Students will understand the process of modeling shear stress and strain distributions based on geometry, materials, and torsional loading conditions.
3.2 Students 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 Students will understand the pipeline of the model construction from geometry, material, and loading to internal stress, strain, and deformation.
4.2 Students will be able to solve loading problem using graph-based integration.
4.3 Students 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 Students will understand the concept of the degree of freedom, resultant force, inertia, and acceleration.
5.2 Students will learn how to draw and use kinetic diagrams (KIN).
5.3 Students 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.
5.4 Students will be able to solve kinematic chain problems.
5.5 Students will learn how to calculate the rotational inertia using integration and the parallel axis theorem.
5.6 Students will be able to solve dynamics problems using D'Alembert's principle of inertial forces.

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Course Website

BMED 3410-A will use Canvas: https://gatech.instructure.com/courses/554088 as the course website. The instructor and TAs will upload assignments, solutions, and other material on Canvas, and will regularly post announcements. Please check the site frequently for updated information.

Piazza

We will also use Piazza for class discussions. The system is highly catered to getting help fast and efficiently from classmates and the TA. Rather than emailing questions to the teaching staff, we encourage you to post your questions on Piazza.
Find our class page on Canvas.

Grading Policy

Grades will be determined based on demonstrated proficiency on **homework quizzes, problem solving studios,** and **exams**. The points associated with each graded event are shown below. Consider the following numbers as a plan subject to change if necessary:

Problem Solving Studio:	12.0% (eight sessions, 1.5 point each)
Homework Quizzes:	18.0% (six quizzes, 3 points each)
Midterm Exam 1:	23.0%
Midterm Exam 2:	23.0%
Final Exam:	24.0%

Your final grade will be assigned according to the accumulated score. The specific cutoffs will be determined at the end of the course, but we will try to stay as close as possible to the following targeted values:

A ("Excellent"):	$\geq 90\%$
B ("Good"):	$\geq 80\%$
C ("Satisfactory"):	$\geq 70\%$
D ("Passing"):	$\geq 60\%$
F ("Failure"):	$< 40\%$

Homework Assignments

There will be a total of six (6) homework assignments. You will not submit your homework for grading, and you will have access to the homework answers. Nonetheless, we strongly recommend that you carefully work through the homework problems and do so without looking at the provided solutions until you have an answer about which you are confident. Doing the homework is the best way to do well at the associated homework quizzes.

Homework Quizzes

The homework quizzes will be designed to reward people who have done the homework. For each of the six (6) homework assignments, there will be an associated homework quiz on the day by which the homework should have been completed. These will be in-person, closed book quizzes accessible within class period. Each quiz will be given a grade between 0 and 100 points (scaled to give 18 points in total for 6 quizzes). The quizzes will be designed such that people who have done the associated homework will be likely to perform well. Each quiz may be a modified version of a problem from the homework or a different problem of similar difficulty.

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Problem Solving Studio Assessment

PSS will be graded based on participation/contribution (not just a physical presence). No paper submissions will be required. Each session will be given a grade between 0 and 1.5 (adding to maximal 12 points in total for 8 studios).

Course Schedule

The following lists all of the topics covered in BMED 3410-A, a tentative schedule for quizzes and exams, and the corresponding points that determine the final grade (as outlined above).

Week	Date	Class	Topic	HW posting	Points
1	5/19	Lecture	Introduction, Syllabus, Statics	HW1	
	5/20	PSS0	Problems on Statics		1.5
	5/21	Lecture	Simple Axial Loading		
2	5/26	Lecture	Model of Axial Loading I	HW2	
	5/27	PSS1, Q1	Problems on Axial Loading, Quiz 1 – Statics and Simple Axial Loading (week 1)		1.5 + 3
	5/28	Lecture	Model of Axial Loading II		
3	6/02	Lecture	Indeterminate Systems		
	6/03	PSS2, Q2	Problems on Indeterminate Systems, Quiz 2 – General Axial Loading (week 2)		1.5 + 3
	6/04	Lecture	More Examples on Axial Loading Models		
4	6/09	Lecture	Review	HW3	
	6/10	Exam1	Statics and Axial Loading (weeks 1-3)		23
	6/11	Lecture	Torsional Loading I		
5	6/16	Lecture	Torsional Loading II	HW4	
	6/17	PSS3, Q3	Problems on Torsional Loading, Quiz 3 – Torsional Loading (weeks 4)		1.5 + 3
	6/18	Lecture	Model of Bending I		
6	6/23	Lecture	Model of Bending II		
	6/24	PSS4, Q4	Problems on Bending I and II, Quiz 4 – Bending (weeks 5)		1.5 + 3
	6/25	Lecture	Model of Bending III		
7	6/30	Lecture	Model of Bending IV		
	7/01	Exam 2	Torsion and Bending (4-7)		23
	7/02	Holiday	No class		

8	7/07	Lecture	Point Mass	HW5	
	7/08	PSS6	Problems on Point Mass		1.5
	7/09	Lecture	Circular Motion		
9	7/14	Lecture	Rigid Body Kinematics	HW6	
	7/15	PSS7	Problems on Kinematics and Circular Motion, Quiz 5 – Point Mass (week 8)		1.5 + 3
	7/16	Lecture	More Examples on Kinematics		
10	7/21	Lecture	Lagrange Mechanics	HW+	
	7/22	PSS8	Problems on Lagrange Mechanics, Quiz 6 – Kinematics (week 9)		1.5 + 3
	7/23	Lecture	More Examples on Lagrange Mechanics		
11	7/28	Lecture	Course Review		
	7/23		Reading Period		
	7/24		Reading Period		
12	TBA	Final Exam	Cumulative Exam (weeks 1-12)		24
	8/10		Grade submission due		

Course Policies

The following are policies meant to promote a fair and productive learning environment for all students. Please feel free to ask any questions you may have about these policies.

- **Grade Disputes/Reviews**: Please note that students' final grades will be based solely on the collected points as outlined above. Regrettably, to do otherwise would be arbitrary and unfair; Accordingly, requests from students to be allowed to submit supplemental material after the end of term to increase their grades cannot be entertained. Similarly, requests to arbitrarily increase student grades for personal reasons cannot be entertained.
- **Late/Delayed Assignments**: Students who are absent because of participation in a particular religious observance will be permitted to make up the work missed during their absence with no late penalty, provided the student informs the course instructor of the upcoming absence, in writing, within the first two weeks of class, and provided the student makes up the missed material within the timeframe established by the course instructor.

  Students who are absent because of participation in approved Institute activities (e.g. field trips and athletic events) will be permitted to make up the work missed during their absences. Timing of the missed assignment turn-in will be determined by the instructor.
- **Collaboration**: Although you are encouraged to study together, all your quizzes and exams must be your own original work. You must take all your quizzes and exams using only a primitive writing utensil (pencil or pen) and the materials provided to you for the quiz or exam by the class TAs and instructors. You also are not allowed to communicate in any way with people other than the class TAs and instructors during a quiz or exam. Likewise, you are not allowed to look at the work of other students during a quiz or exam. Any violations will be

prosecuted through the Office of Student Integrity. See *Academic Integrity* section for additional info.

- **Individuals with Special Needs:** If you are a student with learning needs that require special accommodation, contact the Office of Disability Services (often referred to as ADAPTS) at (404)894-2563 or http://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Also, please e-mail your instructor as soon as possible in order to set up a time to discuss your learning needs.

Additional Instruction and Class Discussion

Supplemental instruction by the instructor or TA is a valuable resource available to any student having difficulty with a particular concept in the course. Get help when you have a problem! *Students are highly encouraged to attend office hours or make an appointment via email.*

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor, and your compliance with Georgia Tech's Academic Honor Code (www.honor.gatech.edu) is fully expected. Any evidence of cheating will be referred to the Dean of Students for a review, along with a recommendation of a zero grade for the assignment/exam in question and a full letter grade reduction for the course grade.

Honor code violations include, but are not limited to, the following:

- **Unauthorized Access**: Possessing, using, or exchanging improperly acquired written or verbal information in the preparation of a problem set, laboratory report, essay, examination, or other academic assignment.
- **Plagiarism**: Submission of material that is wholly or substantially identical to that created or published by another person(s), without adequate credit notations indicating the authorship.
- **False Claims of Performance**: False claims for work that has been submitted by a Student.
- **Grade Alteration**: Alteration of any academic grade or rating so as to obtain unearned credit.
- **Deliberate Falsification**: Deliberate falsification of a written or verbal statement of fact to a Faculty member and/or Institute Official, so as to obtain unearned academic credit.

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 http://www.catalog.gatech.edu/rules/22.php 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.

Consent to participate in research

You may be asked to participate in educational research while enrolled in this course in the form of interviews, observations, questionnaires, or surveys, helping the BME department gain a deeper understanding of and promote practices that increase inclusivity within the classroom.

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Participation in this project in completely voluntary, anonymous, and has minimum to no risk. Participation in this research will not affect your grade in any way, and you may withdraw from the research at any point. If you agree to participate, you will need to read, sign, and return a consent form that you will receive from your instructor.

Special Notes for BMED 3410 in Summer 2025 due to Covid-19

For the most resent updates, please refer to
https://health.gatech.edu/coronavirus/institute-operations

CARE Center, Counseling Center, Stamps Health Services, and the Student Center
These uncertain times can be difficult, and many students may need help in dealing with stress and mental health. The **CARE Center** and the **Counseling Center**, and **Stamps Health Services** will offer both in-person and virtual appointments. Face-to-face appointments will require wearing a face covering and social distancing, with exceptions for medical examinations. Student Center services and operations are available on the **Student Center** website. For more information on these and other student services, contact the Vice President and Dean of Students or the **Division of Student Life**.