AE 321 – MECHANICS OF AEROSPACE STRUCTURES
Fall 2026

Location/time: 0035 CIF MWF 9-9:50am

Instructors: Prof. John Lambros
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TAs:

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Format: The course will be delivered in person at the above location and times. In order to provide further learning assistance, pre-recorded lectures will also be posted onto the course website. Please be aware that these lectures have been recorded from a prior term, so times and dates mentioned in the lectures do not refer to the current semester. Nonetheless, the hope is that having these recorded lectures will help supplement the in-person learning. **Posted lectures are not a substitute for class attendance. Class attendance is strongly recommended.**

Course Website: We will use the Canvas space for the course materials.
https://canvas.illinois.edu/courses/73678

Office Hours: All office hours will be over Zoom. The links will be posted on Canvas.
Mon: 2-4 pm, NN.
Tue: 3-5 pm, KK; 6 pm-8 pm DM.
Wed: 2-4 pm, JL.
Thu: 2-4 pm, KK.
Fri: 1-3 pm DM.

Notes: Course notes in the form of PowerPoint slides will be used in lectures for presenting the theoretical material. These slides will be posted as PDF files on the course website. They will be accompanied by written examples done in class.

Textbook: (recommended) "Elasticity: Theory, applications and numerics",
by Martin H. Sadd, Academic Press, 5th ed. (2025)
We will cover most of the material in Chapters 1-5, 7-9 (pp. 3-113, 147-153, 156-160, 165-176, 188-197, 245-253, 257-260)

Available online at UIUC Library through:
https://www-sciencedirect-com.proxy2.library.illinois.edu/book/monograph/9780443132452/elasticity

Other References: Fung, Y.C., “Foundations of Solid Mechanics”, Prentice Hall, 1965.
Gurtin, M.E., “An introduction to Continuum Mechanics”, Academic Press, 1981.
Gould, P.L., “Introduction to Linear Elasticity”, Springer, 1999
Timoshenko S., Goodier, J.N., “Theory of Elasticity”, McGraw-Hill, 1951.

Homework: Graded homework will be assigned roughly once a week. It will be available for download through the website and the solved homework should then be uploaded to the site before the due date. Please upload a **single file** and please be careful about the file size and image quality. Although the homework will be graded, the homework exercises should be viewed primarily as a learning tool to help you understand the material. It is impossible to master the material in the course without being in a position to solve a large proportion of these problems on your own. In this sense, your success in the course will depend highly upon your completing these homework exercises. Your chances of success in the exams will increase significantly if you do the homework on a regular basis. If you feel you need additional practice beyond the exercises handed out, you should try to solve additional problems that can be found in the various textbooks listed above and other similar sources. Solutions to the homework exercises will be posted on the web after the homework is handed in.

Homework Collaboration: Collaborating with your classmates, i.e., discussing, on the homework is allowed since you can certainly learn a lot from interactions with others in the class. However, the homework assignments are a personal effort, i.e., you are not allowed to verbatim copy the homework solutions from a classmate or from any other source (e.g., prior years solutions, AI tools etc.). Once you have reached a point of understanding the solution to a set of problems you should sit down on your own and write the solutions in your own words. This approach will help you be most successful in the exams, all of which will be in class.

Exams: Two in-class midterm exams (**tentatively scheduled for Week 7 on Friday October 9, 2026, and Week 13 Wednesday November 18, 2026**) and a final exam (**Monday December 14, 2026, 8am-11am**) will be held. All exams will be **closed book and closed notes** and the material covered in each is cumulative from the beginning of the semester. An equation sheet will be provided for each exam and calculators will not be allowed.

Grading: Homework: 15%
Midterm exams: 25% each
Final exam: 35%

Final grades will be allocated using a plus/minus scale. There is no grade allocation for class attendance. However, as outlined in the Student Code, “Regular class attendance is expected of all students at the University”, and we strongly encourage you to follow the classes, since many concepts will be discussed in a lot more detail than is presented in the printed slides. Additionally, excused absences are also discussed in Article 1, Part 5 of the Student Code.

Lab demo: There will be a 60-minute laboratory that takes place in the Mechanical Testing Instructional Laboratory (MTIL) in Talbot 201 during Week 6, and specifically on Tuesday September 29 and Thursday October 1, 2026. The lab will be run in groups of 4 students and will be followed by a homework assignment based on the laboratory measurements. A sign-up process will be used to allocate students to specific group time slots. **Each student must sign up for a specific time slot in advance.** More information on this will be provided later.

To prepare for the laboratory demo you need to do two things in advance:

1. You must complete the **online laboratory safety training** administered by the University of Illinois in order to work in MTIL. To do so, you must complete the (General) Laboratory Safety training found on the DRS web page at https://drs.illinois.edu/#Training. When you finish, please upload to Canvas (there will be an area set up for this) a PDF copy of your completed training certificate. If you have completed this lab safety training before (e.g. for another class), then go to the website above to create a PDF file of your certificate. You must redo the online laboratory safety training if your certificate has expired.

2. You will need to wear safety goggles throughout the laboratory period, and safety goggles will be provided for this purpose. Eye glasses are NOT a substitute for safety goggles. Note that although goggles will be provided for AE321, you will need to furnish your own safety glasses when you move to AE461 next year, so you may wish to purchase a pair this year and use them throughout. If you do wish to purchase your own goggles you may do so from any vendor you wish; Google “eye goggles” to see several options. However, the safety glasses **must be ANSI Z87.1 +** certified to protect against impact.

Course Objectives: This course is designed to introduce students to the fundamental concepts of elasticity, such as stress, strain, equilibrium, compatibility, material response and failure, and to allow students to solve Boundary Value Problems of elastic materials subjected to applied traction and/or displacement loading. The specific objectives of this course are for the students to be able to:
(a) manipulate tensorial quantities through the use of the tensor transformation equations and indicial notation,
(b) identify and compute the properties and components of stress and strain fields including principal values, principal directions, normal and shear components etc.,
(c) realize the physical meaning of stress-strain curves and the relationship between stress and strain in an elastic material, as well as the concepts of inhomogeneity, anisotropy and viscoelasticity,
(d) solve Saint-Venant type boundary value problems involving extension, bending and torsion, and planar boundary value problems including plane stress and plane strain.
(e) calculate failure points for engineering systems and design according to failure criteria such as Tresca and Von-Mises, and Miner’s rule in Fatigue.

Course Outline

WEEK	TOPIC
1	**Ch. 0 Introduction:** History of aircraft structures
	Ch. 1 Mathematical Preliminaries: indicial notation,
2	vector and tensor definitions, operations,
3	divergence, gradient and curl.
4	**Ch. 2 Traction, Stress, Equilibrium:** traction vector, stress tensor and stress components, equilibrium, principal stresses and directions, Mohr's circle.
5	**Ch. 3 Deformations (strain):** strain, compatibility, physical interpretation, finite strains.
6	**Ch. 4 Material Behavior:** uniaxial material behavior, generalized Hooke's law, material symmetry and anisotropy, composite materials, viscoelasticity, yield.
7	**Ch. 5 Problem Formulation:** superposition,
	EXAM #1: Friday October 9, 2026
8	**Ch. 6 Simple Solutions:** St. Venant's principle, bar under uniaxial
9	load, beam bending, beam torsion
10	**Ch. 7 Strength and Failure** Tresca and Von Mises criteria for yield, failure and fracture, fatigue.
11	**Ch. 8 Plane problems (2D Elasticity):** plane stress, plane strain
12	Airy stress potential, thick-walled cylinders, Shrink fit cylinders, stress concentration at a hole,
13	**EXAM #2:** Wednesday November 18
	THANKSGIVING BREAK
14	point load on half space, distributed loading, wedge problems.
	COURSE REVIEW.
	FINAL EXAM: Monday December 14, 2026, 8am-11am