AE 321 – MECHANICS OF AEROSPACE STRUCTURES
Fall 2025

Instructor: Prof. Ioannis Chasiotis
Room 305A Talbot Lab
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Office Hours: Talbot 319N, Wednesdays 2-4 p.m.

Class Times: Monday, Wednesday, Friday: 9:00 - 9:50 am
3031 Campus Instructional Facility

Teaching Assistants:

HyeongJu Lee (email: hl72@illinois.edu)
Office Hours: Mondays 7:00 – 9:00 pm
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Dara Moronkeji (email: om6@illinois.edu)
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https://illinois.zoom.us/j/82336689917?pwd=ZyJmfZf4hNKiounYbcGKadR3oP90b3.1

Homework assignments: Weekly (except during exam weeks), **due on Canvas by 5:00 p.m. on Fridays.**

Textbook: **Elasticity** *Theory, Applications, and Numerics*
M. H. Sadd, Academic Press, 5th edition, 2025

Availability: Free digital copy for UIUC students through the UIUC Library:
https://www-sciencedirect-com.proxy2.library.illinois.edu/book/9780443132452/elasticity

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)

Class attendance: Attendance is not enforced but it **is STRONGLY recommended.** All exams will cover the material discussed in class which may not be in the homeworks or the textbook.

Homeworks: Graded homework will be assigned on Fridays, except in the weeks of Midterm exams, when there will be no homework due. The homework **assignments are due on Canvas BEFORE 5:00 p.m. of the following Friday. We CANNOT accept email attachments of your homework because we cannot upload them to Canvas on your behalf. Homeworks and solutions will be posted on Canvas**. The lowest ***non-zero*** homework grade will not be counted towards your final grade.

All course materials posted on Canvas are copyrighted and may not be posted on any other public website or shared with anyone.

Laboratory demonstration: There will be a 60-minute laboratory assignment in Talbot 201 on September 30 and October 2, 2025. The lab will take place in groups of 4-5 students and will include a homework assignment. Attendance is mandatory. **The homework assignment will not be graded for students who missed their time slot**. **There will be no make labs.** The lab assignment will demonstrate the mechanical testing of 1045CR (cold rolled) steel, and then each group of students will test a 7075-T6 and a 6061-T6 aluminum specimen coupon to determine their mechanical properties. The homework assignment is strictly PERSONAL effort, i.e. you can discuss but not copy from your team mates. Each student MUST sign up for a specific slot in advance. Details will be provided in late September.

BEFORE you enter the mechanical testing lab for AE 321, located in Talbot 201, you MUST complete the online laboratory safety training administered by the University of Illinois. To do so, you must login to complete all laboratory training modules showing as pending in your account under:

https://ovcrportal.research.illinois.edu/Training

When you finish, please upload to Canvas 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.

YOU WILL NOT BE ALLOWED TO THE LAB IF YOU HAVE NOT SUBMITTED YOUR SAFETY CERTIFICATE. NO EXCEPTIONS CAN BE MADE!

Quizzes: 5-min quizzes will be administered through Canvas at the end of most lectures to assess your understanding of the course material. **There will be no make up quizzes**. The three lowest quiz grades (including those due to absence) will not be counted towards the average quiz score.

Exams: There will be two in-class 50-minute midterm exams (during class time on October 10 and November 19, 2025 – see course outline below) and a final exam (8:00-11:00 p.m., Monday, December 15, 2025. **Location TBA**). **There will be no makeup midterm or final exams.** Midterms and Final will be **closed book and closed notes.** The material covered in both midterms and the

final exam will be incremental. A complete equations sheet will be provided. **Exams may be comprised of questions and problems from the lectures, homeworks, the textbook or entirely new problems.**

Grading:		
	In-class Quiz[1]:	**15 %**
	Homework[2]:	**20 %**
	Midterm #1[1]:	**15 %**
	Midterm #2[1]:	**25 %**
	Final exam[1]:	**25 %**

Final Grade Scale:

90-100%*	**[A-, A+]**
80-90%	**[B-, B+]**
70-80%	**[C-, C+]**
60-70%	**[D-, D+]**
<60%	**F**

***Percent ranges are calculated based on the highest score achieved in class.**

NOTE: Midterm exam scores will not be posted on Canvas. You are responsible to pick up your midterm exam in person during Chasiotis' office hours.

Course Objectives: This course will introduce fundamental concepts of elasticity, such as stress, strain, equilibrium, compatibility, material response, to solve Boundary Value Problems (BVPs) of elastic materials subjected to tractions and/or displacements. The specific objectives of this course are:

(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 and anisotropy,
(d) formulate and solve boundary value problems involving extension, bending and torsion, and planar problems of plane stress and plane strain,
(e) provide efficient mathematical descriptions of boundary conditions in view of St. Venant's principle,
(f) understand and apply the concept of stress function to solve more complex boundary value problems in Cartesian and Polar coordinates.

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[1] There will be no makeup quizzes, midterm or final exams.

[2] All homeworks contribute equally to the average homework score irrespective of the points assigned. ***Homeworks must be submitted as a single file through Canvas. Email submissions will not be accepted.***

Course Outline

WEEK	TOPICS
1-2	**Mathematical background:** indicial notation, vector and tensor definitions, operations, divergence, gradient and curl using indicial notation
3	**Traction, stress, equilibrium:** traction vector, stress tensor and stress components, equilibrium equations
4-6	**Principal stresses** and directions, application of Mohr's circle **Failure criteria:** Maximum normal stress, Coulomb-Mohr, Tresca, von Mises)
6	**Mechanical testing laboratory: MANDATORY** (September 30 and October 2, 2025)
7	**MIDTERM #1** (October 10, 2025) **covering weeks 1-6**
7-8	**Deformation:** strain, compatibility, finite strains
9	**Mechanical behavior of materials:** Generalized Hooke's law, material symmetry and anisotropy, isotropy, homogeneity, Beltrami-Mitchell compatibility equations
10	**Boundary Value Problem formulation** and simple solutions using elasticity: superposition, St. Venant's principle, bar under uniaxial load, beam bending
11	**Boundary value problems:** examples
12	**Torsion** of bars
13	**MIDTERM #2** (November 19, 2025) **covering weeks 7-11**
13	**Airy stress function:** plane stress and plane strain problems
14	**THANKSGIVING RECESS (NOVEMBER 22 – NOVEMBER 30)**
15-16	**Axisymmetric problems in elasticity:** thick walled cylinders, shrink fit cylinders, stress concentration at a circular/elliptical hole.
	FINAL EXAM (8:00-11:00 p.m., Monday, December 15, 2025) **Final exam will be incremental and cover weeks 12-16.**

Academic Integrity

Violations of academic integrity are unacceptable. The University of Illinois at Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: http://studentcode.illinois.edu/.

Academic dishonesty will result in a sanction proportionate to the severity of the infraction, with possible sanctions described in 1-404 of the Student Code (https://studentcode.illinois.edu/article1/part4/1-404/). Every student is expected to review and abide by the Academic Integrity Policy as defined in the Student Code: https://studentcode.illinois.edu/article1/part4/1-401/. As a student it is your responsibility to refrain from infractions of academic integrity and from conduct that aids others in such infractions. A short guide to academic integrity issues may be found at https://provost.illinois.edu/policies/policies/academic-integrity/students-quick-reference-guide-to-academic-integrity/. Ignorance of these policies is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

General Emergency Response Recommendations

Run > Hide > Fight

Emergencies can happen anywhere and at any time. It is important that we take a minute to prepare for a situation in which our safety or even our lives could depend on our ability to react quickly. When we're faced with any kind of emergency – like fire, severe weather or if someone is trying to hurt you – we have three options: Run, hide or fight.

Run

Leaving the area quickly is the best option if it is safe to do so.

- Take time now to learn the different ways to leave your building.
- Leave personal items behind.
- Assist those who need help, but consider whether doing so puts yourself at risk.
- Alert authorities of the emergency when it is safe to do so.

Hide

When you can't or don't want to run, take shelter indoors.

- Take time now to learn different ways to seek shelter in your building.
- If severe weather is imminent, go to the nearest indoor storm refuge area.
- If someone is trying to hurt you and you can't evacuate, get to a place where you can't be seen, lock or barricade your area, silence your phone, don't make any noise and don't come out until you receive an Illini-Alert indicating it is safe to do so.

Fight

As a last resort, you may need to fight to increase your chances of survival.

- Think about what kind of common items are in your area which you can use to defend yourself.
- Team up with others to fight if the situation allows.
- Mentally prepare yourself – you may be in a fight for your life.

Please be aware of persons with disabilities who may need additional assistance in emergency situations.

Other resources

- **police.illinois.edu/safe** for more information on how to prepare for emergencies, including how to run, hide or fight and building floor plans that can show you safe areas.
- **emergency.illinois.edu** to sign up for Illini-Alert text messages.
- **Follow the University of Illinois Police Department** on Twitter and Facebook to get regular updates about campus safety.

The following guidelines are provided by the Office of Campus Emergency Planning. There are two basic methods to respond in emergencies that may affect persons on campus, and more specifically, individual buildings: Building Evacuation (**GET OUT**) and Shelter-In-Place (**STAY IN**).

ONLY FOLLOW THESE ACTIONS IF SAFE TO DO SO. When in doubt, follow your instincts - you are your best advocate!

Building Evacuation (GET OUT) — Action taken to leave an area for personal safety.

- Take the time to learn the different ways to leave your building **BEFORE** there is an emergency.
- Evacuations are mandatory for fire alarms and when directed by authorities! No exceptions!
- Evacuate immediately. Pull manual fire alarm to prompt a response for others to evacuate.
- Take critical personal items only (keys, purse, and outerwear) and close doors behind you.
- Assist those who need help, but carefully consider whether you may put yourself at risk.
- Look for **EXIT** signs indicating potential egress/escape routes.
- If you are not able to evacuate, go to an Area of Rescue Assistance, as indicated on the front page of this plan.
- Evacuate to Evacuation Assembly Area, as indicated on front page of this plan.
- Remain at Evacuation Assembly Area until additional instructions are given.
- Alert authorities to those who may need assistance.
- Do not re-enter building until informed by emergency response personnel that it is safe to return.

Shelter-in-Place (STAY IN) — Action taken to seek immediate shelter indoors when emergency conditions do not warrant or allow evacuation.

- Severe Weather
    - If you are outside, proceed to the nearest protective building.
    - If sheltering-in-place due to severe weather, proceed to the identified Storm Refuge Area or to the lowest, most interior area of the building away from windows or hazardous equipment or materials.
- Security Threat
    - If you cannot safely evacuate, find a secure area within your building to stay and await further information.
    - Assist those who need help, but carefully consider whether you may put yourself at risk.
    - Once within a safe place, attempt to secure the space (i.e.: lock doors, close windows/blinds).
    - If unable to lock the door, secure it by any means possible.
    - Remain quiet, unless making noise would be beneficial to your safety (i.e.: rescue recovery).
    - Without jeopardizing your safety, try to obtain additional clarifying information by all possible means, including the Illini-Alert Emergency Text Notification System.

Important links:

http://police.illinois.edu/emergency-preparedness/run-hide-fight/resources-for-instructors
http://police.illinois.edu/emergency-preparedness/run-hide-fight