MECH 5312/MECH 6312: Solid Mechanics II

Fall 2023

Instructor:	Armanj D. Hasanyan	**Time:**	MW 1:30 pm to 2:50 pm
Email:	adhasanyan@utep.edu	**Place:**	College of Business Admin 304

Office Hours: Regular office hours will be held on **Fridays, 10:00 am to 12:00 pm at A106, or by appointment**. If you want to meet Dr. Hasanyan outside of the office hours, please send an email at least 24 hours in advance for arrangements. Unexpected visits without an appointment or on short notice cannot be guaranteed. Additional office hours will be available depending on homework and exam due dates.

Objectives: Solid Mechanics II is an advanced course that explores more in-depth concepts in the mechanics of materials. Building upon the foundational principles from Solid Mechanics I, this course focuses on advanced topics related to stress, strain, deformation, and failure analysis of materials under various loading conditions. Initial emphasis will be on advanced mathematical methods such as tensor analysis and variational calculus. This will allow for derivation of mathematical theories for modeling nonlinear deformation of solids and structures, such as plasticity, viscoelasticity, and energy methods.

Prerequisites: This course is intended for graduate and upper level undergraduate students. Initial background in Solid Mechanics I (MECH 5302/MECH 6302), or equivalent is recommended, but not required. The students should have knowledge on topics such as stresses, strains and/or displacement, compatibility conditions, constitutive relations, solving boundary value problems, etc.

Required Textbook: Class notes will be sufficient. However, for reference, consider the following textbook,

- P. L. Gould, *Introduction to Linear Elasticity*, Springer, 2013.

For additional references, consider the following:

- M. H. Saad, *Elasticity: Theory, Applications, and Numerics*, Academic Press, 2009.
- A. F. Bower, *Applied mechanics of solids*, CRC press, 2009.
- Y. C. Fung, *Foundations of solid mechanics Prentice-Hall*, Inc, New Jersey, 1965.
- R. W. Ogden, *Non-linear elastic deformations*, Courier Corporation, 1997.

Computational Software: MATLAB or Mathematica will be required to do homework.

Homework: Homework is due at the beginning of class. Homework sets are given every 2 weeks (approximately), and you will get 2 weeks to complete them. **Late submissions will not be accepted**. Collaborations are allowed, but copying homework will be strictly prohibited. In your homework, please box the final answer of each problem, so that grader can easily grade your homework. Illegible solutions will be deducted. Make sure handwriting and plots are clearly explained and legible. Homework solution will be posted online after submission.

Midterm Exams: One midterm exam will be held during class hours.

Final Exam: All students must take the final exam at the time and place designated by the university. Do not make travel plans that conflict with the final exam date.

Classroom Attendance: In-person student attendance is essential and expected. There will not be online lectures available. Excessive unexcused absences (over 10 times) are not acceptable and will automatically result in F.

Course Grade: Homework (40%), Midterm (30%), Final (30%). The grade scale is as follows:

100 - 90 %	A
90 - 80 %	B
80 - 70 %	C
70 - 60 %	D
less than 60 %	F

Misconduct: Lack of knowledge of the academic honesty policy is not a reasonable explanation for a violation. Please refer to the UTEP academic misconduct policy.

Other Policies: Be on time in the classroom. Turn off your cell phone during the classes.

Important Dates: Tentative dates for exams:

Midterm	October 1 - 16 (to be finalized later)
Final Exam	To Be Announced

Topics Covered:

1. **Introduction and Mathematical Preliminaries:** scalar, vector, and tensor; indicial notation; coordinate transformation; tensor algebra and calculus; integral theorems.

2. **Stress and Equilibrium:** forces and tractions; state of stress; stress transformation; principal stresses; stress invariants; equilibrium equations.

3. **Displacement and Strain:** general deformation; small deformation theory; strain tensor; compatibility.

4. **Linear Elasticity:** strain energy; generalized Hooke's Law; anisotropic and isotropic elastic constants; displacement equations of motion; boundary conditions; general solution procedures.

5. **Example Boundary Value Problems:** plane-stress and plane-strain equations; axisymmetric problems;

6. **Selected Problems:** Plasticity, Viscoelasticity (to be chosen).