

ME 727/827: Advanced Mechanics of Solids - Fall 2023

Instructor

Professor Mrityunjay Kothari
Office: Parsons Hall N137
Email: mrityunjay.kothari@unh.edu

Lectures

Thursdays 3:40 PM - 6:10 PM
Classroom: Kingsbury Hall, N345

Office Hours

By appointment.

Course Description

Mathematical preliminaries on vector and tensor algebra and calculus. Continuum mechanical description of deformable solids: concepts of deformations, strains, stress, energy, and how these connect together. Linear elastic constitutive laws. Formulations and solution procedures for boundary value problems in linear elasticity. Plane stress/strain, bending, and selection of 2D and 3D problems.

I will frequently recommend preparatory and/or follow-up reading to supplement lectures. These readings will be an important tool to aid in-class learning. Prereq: ME 526 or permission.

Course Objectives

1. Understand the mathematical and physical foundations of continuum mechanics of deformable solids including the notions of deformation, strains, and stresses;
2. Understand linear elastic constitutive relations and the associated simplifying approximations it affords;
3. Ability to formulate boundary value problems and apply principles of solid mechanics to mathematically describe (or in many cases, idealize), solve, analyze, and draw conclusions for engineering problems of interest;
4. Develop a strong background for other advanced solid mechanics classes.

Tentative Course Overview

1. Mathematical preliminaries
2. Kinematics of deformation

3. Strain tensor
4. Tractions and stress tensor
5. Balance of linear and angular momenta
6. Coordinate frame transformations
7. Principle strains and stresses
8. Constitutive law: stress-strain relationship
9. Strain energy
10. Implications of material symmetry and isotropy
11. Boundary value problems in linear elasticity
12. Variational principle, principle of virtual work, principle of minimum potential energy
13. Application and demonstration of solution procedures to various 2D and 3D examples

Textbooks

There is no *required* text for this course. Wherever necessary, I will upload the reading materials to Canvas. The following is a collection of good textbooks to follow or refer to for additional reading:

1. *Applied Mechanics of Solids* by Allan F. Bower (CRC Press). Online copy of the book freely available at solidmechanics.org.
2. *Elasticity: Theory, Applications, and Numerics, 4th Edition* by Martin H. Sadd (Elsevier).
3. *Continuum Mechanics: Concise Theory and Problems* by P. Chadwick (Dover).

Assesment

The overall grade will have the following components

- **Homeworks (40%):** There will be approximately 7-8 homeworks assigned on a weekly cadence. The due date (typically in one week) will be noted on each homework. Your work must be turned in by the deadline to receive credit. Late submissions or requests for extension to deadlines will not be entertained except in special circumstances (such as illness etc.). Out of all the assigned homeworks, I will drop the homework with the least score.
- **Midterms (20%)**
- **Final Exam (40%)**

Work Expectation

Over the course of the semester students will spend about 30 hours in lectures. Approximately 2.5 hours of review of lecture notes and preparatory/follow-up reading per class is assumed (~ 30 hours total). Approximately nine problem sets are expected to be assigned and each problem set is expected to take about 10 hours (~ 90 hours total). The midterm and final exams are expected to take about 35 hours of cumulative review time. The total time that is expected to be devoted to this course is about 185 hours.

Classroom Policy

The classroom is a collective learning space. To ensure that everyone has a distraction-free and conducive learning environment, **use of phone/laptops/tablets is strongly discouraged in the class unless it is for taking notes.** In my experience, these devices are not only distracting to your own learning but also to that of your fellow students. **I also encourage everyone to ask plenty of questions.** Chances are if you have a question, others have the same question too. And remember, there are no *stupid* questions!

Academic Honesty

Materials in this course are best learnt by discussion with fellow students. Therefore, discussions and collaborations on homeworks are encouraged. However, each student must submit their own independent homework. It is not acceptable to copy the work of another student or submit identical homeworks. You should also acknowledge the resources and students that helped you in the discussion. No discussion is permitted for the exams. All students are expected to uphold [UNH's Academic Honesty Policy](#).

Accessibility Services (Durham)

According to the Americans with Disabilities Act (as amended, 2008), each student with a disability has the right to request services from UNH to accommodate his/her/their disability. If you are a student with a documented disability or believe you may have a disability that requires accommodations, please contact Student Accessibility Services (SAS) at 201 Smith Hall. Accommodation letters are created by SAS with the student. Please follow-up with your instructor as soon as possible to ensure timely implementation of the identified accommodations in the letter. For more information refer to <https://www.unh.edu/studentaccessibility> or contact SAS at 603.862.2607, 711 (Relay NH) or sas.office@unh.edu.

Confidentiality and Mandatory Reporting of Sexual Violence or Harassment – Durham

The University of New Hampshire and its faculty are committed to assuring a safe and productive educational environment for all students and for the university as a whole. To this end, the university requires faculty members to report to the university's Title IX Coordinator (Laura Buchs, laura.buchs@unh.edu, 603-862-2930/1527 TTY) any incidents of sexual violence and harassment shared by students. If you wish to speak to a confidential support service provider who does not have this reporting responsibility because their discussions with clients are subject to legal privilege, you can contact SHARPP (Sexual Harassment & Rape Prevention Program) at (603) 862-7233/TTY(800) 735-2964. For more information about what happens when you report, how the university treats your information once a report is made to the Title IX Coordinator, your rights and reporting options at UNH (including anonymous reporting options) please visit [student reporting options](#).