Math/Phys 266E Introduction to Solid Mechanics
Tu,Th 11:00 - 12:15, Roop 212
W 8:00 - 8:50, Roop 212

Required Text: *Continuum Mechanics*, A.J.M. Spencer, Dover.
Suggested Text: *Continuum Mechanics: Concise Theory and Problems*, P. Chadwick, Dover.

Prerequisite: Math 237 and Math 238 or permission of instructor.

Instructor: Dr. Debra Polignone Warne, Office: Roop 107, Ph: 568 - 2546
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Office Hours: W 9:00-12:00, Th 1:30-2:30, and by appointment.

Course Goals: The student should develop an understanding of the mathematics and mechanics underlying the deformation and motion of bodies comprised of solid materials subjected to external forces, as well as how to pose mathematical models within a physically and mathematically consistent framework.

Course Content: Solid Mechanics is one branch of Continuum Mechanics. Continuum mechanics is the mathematical study of large-scale material behavior, and governing principles of such behavior, for solids and fluids. Thus, matter is regarded as a continua (macroscopic instead of microscopic viewpoint), and interest is in analysis of the deformation and motion of materials undergoing various loading scenarios. The equations of continuum mechanics are of two main kinds: universal physical laws, such as conservation of mass and energy, which apply to all materials, and constitutive equations which describe the mechanical behavior of particular materials, consistent with the laws of thermodynamics. When specialized, one obtains the equations governing the behavior of various types of materials, e.g, linear elastic solids, nonlinear elastic solids, fluids, visco-elastic bodies, etc. Such equations or systems of equations constitute mathematical models of material response due to applied forces, which can be analyzed both mathematically and computationally to understand the behavior of materials under stress. This course will introduce the student to the applications of vector and tensor calculus to the description of continua, and will focus on those quantities important in studying solid mechanics. Course topics will proceed (more or less) as follows:
I. Introduction to continuum mechanics and basic underlying premises
II. Particle kinematics: bodies, configurations, displacement, velocity, time rates of change, acceleration
III. Vectors and Tensors: Notations and Operations
IV. Motions, Deformations, and Strains and associated matrix algebra, eigenvalues, eigenvectors.
V. Stress: traction, stress components, equilibrium equations, states of stress
VI. Conservation Laws: Mass, Momentum, Energy
VII. Constitutive Equations: Material description, Symmetry, Elasticity. (Connecting IV–VI).
VIII. Modeling Problems in Continuum Mechanics: Nonlinear Elastic Solids, Newtonian Fluids, Biomechanics, etc...

Attendance: I should not need to tell you that class attendance is a critical component for success.

Grading Policy: 90 -100: A- to A range; 80 - 89: B- to B+ range; 70 - 79: C- to C+ range; 60 - 69: D to D+ range; 59 and below: F.

Evaluation Policy:

1. **Homework Sets: 25 % .** Homework will be assigned and selected problems graded throughout the course. Students are permitted and encouraged to work together on homework, however, each student must turn in his/her own work.

2. **Midterm: 35 % .** The "midterm" exam will be given some time late February/March. Students will be given one-week prior notice of the midterm date.

3. **Final Project and Presentation: 40 %.** Students will work in groups of three (determined by the instructor) to choose a final project which could involve original research, an in-depth study of a paper from the solid mechanics literature, or some combination of these endeavors. Topics must be approved by the instructor and students must present a formal proposal for the study/progression of their chosen topic. This proposal will comprise 15% of the final course grade and will be due in early April. If the proposal is not approved, then anything from a minor revision to a completely new project proposal may be required. The remaining 25% of the final course grade will be determined from the final write-up and presentation of the project. Project presentations will take place during the final exam time of Tues. May 1, 10:30 AM–12:30 PM.