ME-614
Continuum Mechanics

Course Instructor

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Course Content

This course is designed to provide first year graduate students with a general introduction to the fundamentals of the mechanics of continuous media. The specific topics covered will include vector and tensor analysis, kinematics associated with finite deformation, the stress tensor, the balance laws of mechanics, i.e., the conservation of mass, linear momentum, angular momentum and energy. In addition, the course will discuss constitutive equations for linear and non-linear elastic solids and Newtonian fluids. The role of material invariance under superposed rigid body motion will be emphasized.

Course Audience

The course is for graduate students in Mechanical, Civil and Biomedical Engineering and students of Applied Mathematics.

Course Objectives

At the end of the course, the student should be proficient in the following

1. Able to use Cartesian tensors and vectors in three dimensions, using both index and bold face notation.
2. Understand the relationship between the surface tractions and the stress tensor.
3. Be able to derive and use the basic kinematics relationships associated with a body undergoing large deformations.
4. Grasp the importance of the basic conservation laws and their use to solve practical problems.
5. Understand the concept of a constitutive equation and know the assumptions made in connecting the stress to the appropriate kinematic quantities.
6. Be able to use invariance requirements to achieve restrictions of the constitutive equations.

Prerequisites

Undergraduate mechanics, mathematics (linear algebra, differential equations and vector calculus) and familiarity with elementary theories of fluids and solids that are typically covered in undergraduate fluids and solid mechanics courses.

Recommended Text

Hozapfel, G. A., *Nonlinear Solid Mechanics: A Continuum Approach for Engineering*, John Wiley & Sons, New York, 2000.

Reference

Chadwick, *Continuum Mechanics*, Dover, New York, (1999).
Bowen, *Introduction to Continuum Mechanics for Engineers* (Mathematical Concepts and Methods in Science and Engineering, 39), New York: Plenum Press (1989).
Spencer, *Continuum Mechanics*, Dover, New York (1980)
Malvern, *Introduction to the Mechanics of a Continuous Media*, Prentice Hall, NJ, 1977.

Grading

Two in semester tests worth 20% each, Group Homework (assigned weekly) (25%) and a final (35%).