ME185 - Introduction to Continuum Mechanics

COURSE OUTLINE

I. Introduction to the course; generalities (1)

1. Solids and fluids as continuous media.
2. Elements of the history of continuum mechanics.

II. Mathematical preliminaries (3)

1. Elements of set theory.
2. Linear (vector) spaces.
3. Points, vectors and tensors in the Euclidean 3-space.
4. Direct and indicial notation for vectors and tensors.
5. Vector and tensor calculus.

III. Kinematics of deformation (8)

1. Bodies, configurations and motions.
2. The deformation gradient and other measures of deformation.
3. Velocity gradient, rate of deformation and vorticity.
4. Superposed rigid-body motions.

IV. Basic physical principles (8)

1. Divergence theorem, Reynolds' transport and localization theorem.
2. Mass and mass density.
3. The principle of mass conservation.
4. The principles of balance of linear and angular momentum.
5. Stress vector and stress tensor.
6. Local form of the equations of motion.
7. Stress measures and their rates.

8. Invariance under superposed rigid-body motions.
9. The principle of balance of energy.
10. The Green-Naghdi-Rivlin theorem.

V. The special case of infinitesimal deformations (2)

1. The Gâteux differential.
2. Consistent linearization of kinematic and kinetic variables.

VI. Selected mechanical constitutive theories (6)

1. Invariance requirements and other general considerations.
2. Inviscid fluid.
3. Newtonian viscous fluid.
4. Non-linear elastic solid.
5. Linear elastic solid.
6. Viscoelastic solid.