

## **ME280B - Finite Element Methods in Non-linear Continua**

### **COURSE OUTLINE**

#### **Part 1: General developments**

##### **I. Brief review of continuum mechanics**

1. Kinematics of deformation.
2. Basic physical principles (balance laws).
3. Invariance under superposed rigid-body motions.

##### **II. Consistent linearization**

1. Gâteaux and Fréchet differentials.
2. Consistent linearization of kinematic variables and balance laws.

##### **III. Incremental formulations**

1. Weak forms of the balance laws.
2. Total- and updated-Lagrangian methods.
3. Co-rotational methods.
4. Arbitrary Lagrangian-Eulerian methods.
5. Eulerian methods.

##### **IV. Solution of non-linear field equations**

1. Generalities.
2. Newton's method and its variants.
3. Continuation methods.
4. Computational treatment of constraints.

#### **Part 2: Selected applications**

##### **V. Constitutive modeling of deformable continua**

1. Non-linear elasticity.
2. Elasto-plasticity at finite strains.
3. Physically coupled problems.
4. Newtonian viscous flow.

## Part 3: Recent developments

### VI. Multiscale methods

1. Overview of relevant multiscale physical laws.
2. Handshake methods.
3. The quasicontinuum approach.