Prerequisites:	Knowledge of strength of material and differential equations is required to take the class. Elementary knowledge of elasticity and plasticity is strongly recommended.
Catalog Description:	Applications of energy and variational methods in engineering mechanics to elastic, plastic and dynamical behavior of deformable media.
Text Book:	<u>Energy and Variational Methods in Applied Mechanics, by J.N. Reddy, Jone Willey & Sons, 1984</u>
Instructors:	Qu, Jasiuk, Lynch, McDowell, Neu, Zhou Mechanics of Materials Research Group

Goal:

- This class will emphasize the applications of energy and variational methods in engineering mechanics. Several energy and numerical methods that are derived from the variational principles will be introduced and their use will be illustrated through various examples including elasticity, plasticity, dynamics, etc.

Audience:

- First and second year graduate students in ME, AE, CE and MSE.

Topics

Review of Fundamental Equations
- Stresses, strains and their relationships
- Equations of equilibrium
- Compatibility conditions
- Boundary conditions
Review of variational calculus
- Functional and its first variation
- Euler equations
- Natural and essential boundary conditions
- Constraint conditions and Lagrange multiplier
Virtual work
- Principle of virtual work
- Principle of complimentary virtual work
Variational Principles
- Principle of minimum potential energy
- Principle of minimum complimentary potential energy
- Hellinger-Reissner principle
- Hu-Washizu principle
Energy theorems in mechanics
- Castigliano's theorems
- Rayleigh-Betti reciprocity theorem
Approximate methods
- Rayleigh­Ritz method
- Galerkin method
- Weighted residual methods
- Finite element method
- Boundary element method
Applications

    * flow theory
    * limit analysis
  - Composite materials
    * upper and lower bounds of effective properties

<u>Course Approval Form</u>