

Course Number: 28588

Course Name: Variational Methods in Applied Mechanics

Course Type:
Prerequisite: Continuum Mechanics
Level: Graduate
Group: Applied mechanics

Type & Max Unit: 3
Corequisite:
First Presentation:
Last Edition:

Objectives:

Topics:

1- Basics of Calculus of Variations ; fundamental lemma of calculus of variations, the Euler-Lagrange equation, some fundamental theorems from advanced calculus, first integral(s) of the Euler-Lagrange equation(s), first variation, second variation,...., surface of revolution with minimum area, the Brachistochrone problem, geodesics, several dependent variables, essential and natural boundary conditions, end points lying on some curves, Brachistochrone arc from a given curve to a fixed point, isoperimetric problems, function constraints, variational operator, functionals involving functions with higher derivatives, more theorems from advanced calculus, the inverse method,

2- Elastostatic Problems ; strain energy density function and its positive definiteness, complementary (strain) energy density function, integral principle of equilibrium, the total potential energy and its minimum nature, the complementary potential energy and the complementary integral principle, bending equilibrium of beams, plates, shells, and membranes, torsion of shafts of arbitrary cross sections, Lagrange's stress tensor and Kirchhoff's stress tensor, large deformations and elastic stability of columns, large deformations and elastic stability of plates,

3- Elastodynamics Problems ; integral principle of motion, Hamilton's principle, small and large deformational motions of vibrating strings, small and large deformational motions of vibrating membranes, Large deformational motion of a solid body, small and large deformational motions of plates and shells

References:

- 1- *Energy and Variational Methods in Applied Mechanics*, J.N. Reddy
- 2- *Energy Methods in Applied Mechanics*, H. L. Langhaar
- 3- *Solid Mechanics, a Variational Approach*, C. L. Dym and I .H. Shames