ME242 August - December 2018 3:0

Solid Mechanics

Instructor

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Email:

Department: Mechanical Engineering

Course Time:

Lecture venue: Mechanical Engineering Lecture Hall

Detailed Course Page:

Announcements

Brief description of the course

Solid Mechanics is one of the core courses for postgraduate (M.Tech) students in Mechanical Engineering. Also, it is essential for research students who work in the area of Solid Mechanics, Mechanics of Materials and Fracture mechanics. This course will introduce the students to advanced concepts in Solid Mechanics beyond what they have learnt in their undergraduate Strength of Materials course. Fundamental ideas pertaining to analysis of strain beginning with fully finite deformation kinematics and specializing to linearized theory, analysis of stress and equilibrium, constitutive equations of elasticity will be thoroughly discussed. Analysis of planar problems in elasticity using stress functions and energy methods will be presented.

Prerequisites

Undergraduate Strength of Materials or Mechanics of Materials course.

Syllabus

1. Introduction to Tensor Algebra and Tensor Calculus

2. Analysis of Strain - Finite deformations and linearized theory

3. Analysis of Stress and equilibrium

4. Equations of elasticity - anisotropic and isotropic material response.

5. Boundary Value problems in elasticity - Field equations, boundary conditions, Uniqueness of solutions, St.Venant Principle and Superposition.

6. Plane problems in elasticity in rectangular cartesian coordinates and polar coordinates.

7. St.Venant Torsion theory.

8. Energy Methods - Introduction to Calculus of Variations, Virtual work principle, Reciprocal theorems, Rayleigh-Ritz method.

Course outcomes

Understanding concepts in Solid Mechanics like stress, strain, equilibrium and constitutive equations is essential for a design engineer. This course will expose the student to advanced concepts in Solid Mechanics and Elasticity theory building on elementary Strength of materials which is taught in undergraduate programs. Emphasis will be placed on tensor character of stress, strain and governing field equations after a thorough introduction to tensor algebra and calculus. Important concepts such as Uniqueness of solutions, St.Venant principle, Minimum potential energy theorem will discussed. The student will learn about solution of elasticity problems using not only stress function / potential function methods but also using energy methods. The limitations of plane elasticity assumptions (plane strain and plane stress) will be emphasized. At the end of the course, the student is expected to have a thorough knowledge of Solid Mechanics and should be able to apply it for strength / stiffness based design of engineering components. Also, he /she would acquire adequate background to take more advanced courses such as Fracture Mechanics, Impact Mechanics and Contact Mechanics.

Grading policy

Assignments and Mid Term: 50%

Final Exam : 50%

Assignments

Many assignments which will help the student to apply the concepts learnt from the lectures to solve problems in Solid Mechanics and elasticity theory will be given.

Resources

1. Y.C. Fung, Foundations of Solid Mechanics, Prentice Hall.
2. I.S.Sokolnikoff, Mathematical theory of elasticity, Prentice Hall.
3. S.P.Timoshenko and J.N.Goodier, Theory of Elasticity, McGraw Hill.
4. C.S.Jog, Continuum Mechanics, Vol 1 : Solid Mechanics, Cambridge Press.
5. L.S.Srinath, Advanced Solid Mechanics, 2nd Edition, Tata McGraw Hill.