Course syllabus

Department of Civil Engineering, Indian Institute of Technology Madras

CECE2310 - Mechanics of materials

Credit Distribution: C:11 L:3 T:1 P:0 E:1 O:6 TH:0

Course Type: Theory

Description: To enable learning of the stress and displacement in deformable bodies subjected to various loads. To find whether the body would fail under a given loading condition.

Course Content:

- Mathematical preliminaries: Linear algebra, vectors, matrix.
- Kinetics: Concepts of force, traction, stress; relation between force and components of stress, transformation of stress components due to change in coordinate system; Mohr's circle, extremum normal stress and shear stress, octahedral stress, plane stress, pure shear & deviatoric stress.
- Kinematics: Concepts of displacement, deformation, relative displacement, stretch, strain; relation between displacement and components of linearized strain; transformation of linearized strain components due to change in coordinate system, principal strain and its meaning, plane strain.
- Basic equations: Equilibrium equations in Cartesian and cylindrical polar coordinates; Constitutive relations, elasticity; Hooke's law, material modulus and their relations, isotropy; strain energy, energy theorems.
- Boundary value problems: Displacement formulation for linearized elasticity; Axial element, columns, trusses, cables; Bending moment and shear force diagrams for statically determinate beams; Bending action; Euler Bernoulli assumption, symmetrical and unsymmetrical bending, composite sections, deflections; Twisting action & Torsion of circular shafts, thin walled closed sections, Empirical expressions for thin open sections, stress distribution in cylinders and spheres thick and thin walled.
- Yield and failure theories: Ductile and brittle failure; Yield condition, Tresca and von Mises criteria; Rankine failure theory, Mohr's failure theory; Fatigue failure, S-N curve.
- Structural Instability: Behavior of ideal column; Euler theory; behavior of real columns, effect of imperfections.

Text Books:

- Beer F.P., Johnson E.R., and DeWolf, J.T., Mechanics of Materials, Tata McGraw-Hill, 2004.
- Popov E.P., Engineering Mechanics of Solids, Prentice Hall of India Private Limited, 2004.

Reference Books

- Dias da Silva V., Mechanics and Strength of Materials, Springer, 2006
- Timoshenko, S.P. and Gere, J.D., Mechanics of Materials, CBS; 2nd edition, 2006 3. Gere, J.M., and Goodno, B.J., Mechanics of Materials, Global Engineering, 8th edition, 2012.

Prerequisite: NIL

Prepared in January 2021