CE6101D THEORY OF ELASTICITY AND PLASTICITY

CLASS SCHEDULE

Module 1 (9 hours)

1. Introduction to the mathematical theory of elasticity
2. Elasticity, stress, strain, Hooke's law
3. Two-dimensional idealisations, plane stress and plane strain problems
4. Equations of equilibrium
5. Strain-displacement relations
6. Constitutive relations
7. Compatibility conditions, Displacement and traction boundary conditions
8. Two-dimensional problems in rectangular coordinates, Stress function, solution by polynomials, Saint Vénant's principle, Bending of a cantilever
9. Determination of displacements

Module 2 (12 hours)

10. Two-dimensional problems in polar coordinates
11. General equations, problems of axisymmetric stress distribution
12. Pure bending of curved bars
13. Effect of circular hole on stress distribution in plates
14. Concentrated force at a point on a straight boundary.
15. Introduction to Cartesian Tensors, transformation laws of cartesian tensors
16. Special tensors and tensor operations
17. Kronecker's delta, permutation tensor, the e-δ identity
18. Symmetry and skew-symmetry, contraction, derivatives and the comma notation,
19. Gauss' theorem, the base vectors and some special vector operations
20. Eigenvalue problem of a symmetric second order tensor
21. Equations of elasticity using index notation.

Module 3 (12 hours)

22. Stress and strain problems in three dimensions
23. Principal stresses, principal strains, three-dimensional problems.
24. Energy Theorems and Variational Principles of Elasticity
25. Strain energy and complementary energy
26. Clapeyron's theorem, Virtual work and potential energy principles
27. Principle of complementary potential energy, Betti's reciprocal theorem
28. Principle of linear superposition, uniqueness of elasticity solution.
29. Torsion of straight bars
30. Elliptic and equilateral triangular cross-section
31. Membrane analogy, narrow rectangular cross-section
32. Torsion of rectangular bars
33. Torsion of rolled profile sections, Hollow shafts and thin tubes

Module 4 (6 hours)

34. Introduction to plasticity, One-dimensional elastic-plastic relations
35. Isotropic and kinematic hardening
36. Yield function, flow rule
37. Hardening rule, incremental stress-strain relationship
38, 39 Governing equations of elastoplasticity

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