ME 202 ADVANCED MECHANICS OF SOLIDS

Module 1

Introduction to stress analysis in elastic solids - stress at a point – stress tensor – stress components in rectangular and polar coordinate systems - Cauchy's equations – stress transformation – principal stresses and planes - hydrostatic and deviatoric stress components, octahedral shear stress - equations of equilibrium

Displacement field – engineering strain - strain tensor *(basics only)* – analogy between stress and strain tensors - strain-displacement relations *(small-strain only)* – compatibility conditions

Module 2

Constitutive equations – generalized Hooke's law – equations for linear elastic isotropic solids - relation among elastic constants – Boundary conditions – St. Venant's principle for end effects – uniqueness theorem

2-D problems in elasticity - Plane stress and plane strain problems – stress compatibility equation - Airy's stress function and equation – polynomial method of solution – solution for bending of a cantilever with an end load

Module 3

Equations in polar coordinates (2D) – equilibrium equations, strain-displacement relations, Airy's equation, stress function and stress components *(only short derivations for examination)*

Application of stress function to Lame's problem and stress concentration problem of a small hole in a large plate *(only stress distribution)*
Axisymmetric problems – governing equations – application to thick cylinders,, rotating discs.

Module 4

Unsymmetrical bending of straight beams *(problems having c/s with one axis of symmetry only)* – curved beams *(rectangular c/s only)* - shear center of thin walled open sections *(c/s with one axis of symmetry only)*

Strain energy of deformation – special cases of a body subjected to concentrated loads, moment or torque - reciprocal relation – strain energy of a bar subjected to axial force, shear force, bending moment and torque

Module 5

Maxwell reciprocal theorem – Castigliano's first and second theorems – virtual work principle – minimum potential energy theorem.
Torsion of non-circular bars: Saint Venant's theory - solutions for circular and elliptical cross-sections

Module 6

Prandtl's method - solutions for circular and elliptical cross-sections - membrane analogy.

Torsion of thin walled tubes, thin rectangular sections, rolled sections and multiply connected sections