ED 5092 Advanced Mechanics of materials

Important 13 Mark Questions

Unit I

1. What is stress function? Explain how the stress function in 2D problems are solved using a third-degree polynomial.
2. What are stress invariants and strain invariants? Explain.
3. Derive the general equations for elasticity in polar coordinates. Also write the significance of this equations and give some applications of it.
4. Derive all the relations between elastic constants in solid mechanics. How are they useful in simplifying problems in elasticity?
5. Derive and explain all constitutive equations. Explain the generalized Hooke's law. Discuss how these relations can be used to deduce expressions for plane stress conditions.

Unit II

1. Derive an expression for deflection of a cantilever beam of uniform cross-section I loaded by concentrated force acts its free end.
2. Explain about "Unsymmetrical bending".
3. Define shear centre. Discuss its practical applications.
4. Define Airy's stress function. Discuss how this function can be applied using polynomial method for finding solutions to 2-D plane strain problems.
5. Explain the maximum distortion energy theory.

Unit III

1. Derive the Winkler Bacher's theory for curved beams.
2. Derive the expression for radial stress distribution over the thickness of a spherical shell.
3. Derive the expression for the pure bending of a bar with rectangular cross section. An alloy steel cylinder has a 120 mm internal diameter and 444 mm outside diameter. If it is subjected to an internal pressure of 125 MPa, (Outside pressure = 0)
   (i) Determine the radial and tangential stress distribution and plot them.
   (ii) Determine the maximum principal shear stress.
4. Derive expression for stresses and strains in rotating discs. State and discuss all the assumptions made.

5. Explain:
   (i) Unsymmetrical bending
   (ii) Curved beams with circular cross-section

Unit IV

1. How will you find torsion effect in a solid bar of non-circular cross section? Give a standard methodology.
2. Explain about Prandtl's membrane analogy.
3. Derive the expression for torsional stress in hollow thin walled tubes.
4. With necessary assumptions, derive the expressions for evaluation of stresses using:
   (i) Castigliano's first theorem and
   (ii) Castigliano's second theorem

   Give any three practical applications

5. A flat ribbon spring steel 3.2 mm wide and 0.5 mm thick is wound round a cylinder 50 mm dia. Find the maximum stress and energy stored in ribbon per meter length of ribbon Take E = 220 Gpa.

Unit V

1. Derive the radial and tangential stresses induced in solid disc of uniform thickness and varying thickness.
2. Derive the formula for bending stress of a curved beam having rectangular cross-section.
3. Explain in detail any one method of determination of contact stress with suitable example.
4. Explain any one methods of computing contact stress-deflection of body in point contact.
5. Determine the intensities of principal stresses in flat steel disc of uniform thickness having a diameter of 1 m and rotating at 2400 rpm. What will be the stresses if the disc has a central hole of 0.2 in diameter.