[4960]-35

M.E. (Civil)

STRUCTURES

Advanced Solid Mechanics

(2008 Pattern)

Time : 4 Hours]   *[Max. Marks : 100*

Instructions to the candidates:-

    1)   *Answer any two questions from each section.*

    2)   *Answers to the two sections must be written in separate books.*

    3)   *Neat diagrams must be drawn wherever necessary.*

    4)   *Figures to the right indicate full marks.*

    5)   *Use of electronic pocket calculator is allowed.*

    6)   *Assume suitable data, if necessary.*

SECTION - I

Q1) a)   What is compatibility of strains? Obtain Strain compatibility equation for 2D problem in elasticity?   **[10]**

    b)   A plane passing through point (x,y,z) in a stressed elastic body has its normal 'n' with direction cosines cos(n,x), cos(n,y), cos(n,z). Obtain expressions for the stress resultants (Tn) and its direction in terms of six independent components at that point.   **[15]**

Q2) a)   Define Airy's stress function 'Φ'. Prove that the stress function satisfies the Biharmonic Governing Equation in absence of body forces.   **[10]**

    b)   If Φ is a third degree polynomial function, obtain the stress distribution on the sides of rectangular plate of size L × 2h. Neglect body forces. Also check for static equilibrium of the plate under this stress distribution.**[15]**

Q3) a)   Explain the concept of stress Invariants? Hence, discuss the state of pure shear and hydrostatic state of stress?   **[10]**

    b)   Obtain the solution for stress distribution σ_r and $\sigma\theta$ in a hollow cylinder subjected to uniform external pressure 'P_o' and internal pressure 'P_i'?**[15]**

SECTION - II

Q4) a) Derive differential equation for the elastic line of a beam resting on an elastic foundation? **[10]**

b) A semi-infinite beam is subjected to a force 'P' and a moment 'M_o' at one end. Starting from the solution for an infinite beam, obtain the solution at a section 'z' from the beam end for **[15]**

   i) Deflection 'y'

   ii) Bending moment M_x.

Q5) a) What is axi-symmetric problem? Explain its stress and strain distribution? **[10]**

b) A thick cylinder of internal radius 75mm and external radius 150 mm is subjected to an internal pressure of $10 N/mm^2$. Determine variation of radial and hoop stresses in the cylinder wall? **[15]**

Q6) a) Derive Poisson's equation for torsion of prismatic bars of non-circular section in terms of stress function Φ using St. Venant's Theory. Neglect body forces. **[15]**

b) A shaft of elliptical c/s having semi major axis 100 mm and semi minor axis 50 mm is subjected to a torque of 1.5 kN-m, determine maximum and minimum shear stress developed in shaft. **[10]**

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