D 33155 (Pages : 2) Name.....

Reg. No.....

FOURTH SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION
FEBRUARY 2013

ME 04 405—ADVANCED MECHANICS OF SOLIDS

Time : Three Hours Maximum : 100 Marks

Answer **all** *questions.*

Part A

I. (a) Explain with sketch the three-dimensional stress at a point.

(b) Explain the variation of stress at the boundary of a body.

(c) Explain about stress concentration.

(d) What is known as Airy's stress function ?

(e) Explain the principle of superposition.

(f) State Castigliano's I and II theorems.

(g) State Saint Venant's principle.

(h) Give examples for members subjected to :

(i) Pure bending alone. (ii) Torsion alone.

(iii) Bending and torsion.

(8 × 5 = 40 marks)

Part B

II. (a) For a material with G = 80 GPa and E = 200 GPa, determine the strain tensor for a state of stress given by

$$\begin{bmatrix} 20 & -4 & 5 \\ -4 & 0 & 10 \\ 5 & 10 & 15 \end{bmatrix} \text{MPa.}$$

Or

(b) Show that the following stress components satisfy the equilibrium equations of elastic body whose body forces are zero :

$$\sigma_x = Azx^2 - \frac{Bx^3}{3} \quad \sigma_y = -Bxy^2 + \frac{Cy^3}{3} \quad \sigma_z = C\,yz^2 + \frac{Az^3}{3}$$

Turn over

$$\tau_{xy} = B x^2 y \quad \tau_{yz} = -C y^2 z \quad \tau_{zx} = -A z^2 x$$

III. (a) Consider a thick-walled cylinder of inner and outer radii r_i and r_0, respectively. When the cylinder is subjected to a uniform external pressure P_0, the circumferential stress σ_θ at r_i has the magnitude σ. It is required to reduce the magnitude of this stress to 0.8 σ by the simultaneous applications of a uniform internal pressure P_i, determine the relation of P_0 to P_i.

Or

(b) A solid disk 300 mm in diameter rotates at 10,000 r.p.m. and is subjected at its outer rim to a radial tension of 100 MPa. The disk material is steel for which v = 0.28 and the specific weight = 78 kN/m^3. If the thickness at the disk center is 20 mm, find the thickness at the outer rim for a risk of uniform strength. What is the value of the maximum stress in a solid disk of uniform thickness of 20 mm operating under the same conditions ?

IV. (a) A wooden, simply supported beam of length L is subjected to a uniform load p. Determine the beam length and the loading necessary to develop simultaneously σ_{max} = 0.7 MPa and τ_{max} = 0.7 MPa. Take thickness t = 0.05 m and depth h = 0.15 m.

Or

(b) Investigate the following stress function. Determine the loading and boundary conditions that satisfy

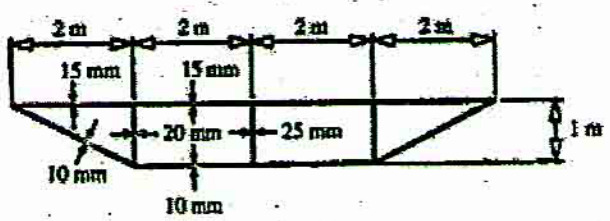
$$\phi = -\frac{F}{d^3} xy^2 (3d - 2y).$$

Applied to the region included in $y = 0, y = d, x = 0$ on the side x positive.

V. (a) A steel bar of slender rectangular cross-section (5 mm × 125 mm) is subjected to twisting moments of 80 N.m at the ends. Calculate the maximum shearing stress and the angle of twist per unit length. Take G = 80 GPa.

Or

(b) A thin walled bridge deck having singly symmetric cross-section as shown in the figure below Determine the torsional stiffness of the section, T/θ', in (kN m^2 /degree) if, the shear modulus is constant throughout and of value 70,000 N/mm^2.



(4 × 15 = 60 marks)