Exam.Code:1014
Sub. Code: 35206

2076

M.E. (Mechanical Engineering)

First Semester

MME-103: Advanced Mechanics of Materials

Time allowed: 3 Hours **Max. Marks: 50**

NOTE: Attempt five questions in all, selecting atleast two questions from each part. Assume suitably the missing data, if any. ***Use usual notations and symbols for derivations. Assume suitably missing data if any. Present your answers legibly using atleast 0.7 mm blue pen for the write-up and atleast 2B pencil for diagrams and figures.*** *All questions carry equal marks.*

x-x-x

Question 1 Find the normal and shearing stresses on an oblique plane defined by $l = \sqrt{\frac{3}{13}}$. $m = \sqrt{\frac{1}{13}}$, and $n = \sqrt{\frac{9}{13}}$. The principal stresses are $\sigma_1 = 35$ MPa, $\sigma_2 = -14$ MPa, and $\sigma_3 = -28$ MPa, If this plane is on the boundary of a structural member, what should be the values of the surface traction forces t_x, t_y, and t_z,

Question 2 A rectangular steel parallelpiped ($E = 200$ GPa and $\nu = 0.3$) has dimensions $a = 250$ mm (length along x-axis), $b = 200$ mm (height along y-axis), and $c = 150$mm (width along z-axis). It is subjected to triaxial stresses $\sigma_x = -60$ MPa, $\sigma_y = -50$ MPa, and $\sigma_z = -40$ MPa acting on the x, y, and z faces respectively. Determine (a) the changes Δa, Δb, and Δc in the dimensions of the block, and (b) the change ΔV in the volume.

Question 3 A copper tube of 800 mm^2 cross-sectional area is held snugly between two rigid walls. If at 20 °C no axial force t_x exists in the tube, what will t_x be when the temperature rises to 120 °C. Let $E = 120$ GPa and $\alpha = 16.8 \times 10^{-6}$ per °C.

Question 4 A thin-walled cylindrical pressure vessel of diameter $d = 0.5$ m and wall thickness $t = 5$ mm is fabricated of a material with tensile yield strength $S_Y = 280$ MPa. Find the internal pressure p required to failure according to (a) the maximum distortion energy theory and (b) the maximum shear stress theory.

P.T.O.

Question 5 A wooden, simply supported beam of length L is subjected to a uniform load w. Determine the beam length and loading necessary to develop simultaneously $\sigma_{max} = 8.4$ MPa, and $\tau_{\max} = 0.7$ MPa. Take thickness $t = 0.05$ m and depth $h = 0.15$ m.

Question 6 Two thick-walled, closed-ended cylinders of the same dimensions are subjected to *internal* and *external* pressures, *respectively.* The outer diameter of each is twice the inner diameter. What is the ratio of the pressures for the following cases: (a) the maximum tangential stress has the same absolute value in each cyinder. (b) The maximum tangential strain has the same absolute value in each cylinder. Take $\nu = \frac{1}{3}$.

Question 7 A cirular shaft of length L is fixed at both ends and subjected to a torque T applied at point C a distance a from the *left* end. Determine reactions at supports A and B employing Castigliano's 1st Theorem. Note that the strain energy is expressed as $U = \frac{1}{2}\int GJ(\varphi')^2$ where φ is the angle of twist and GJ represents the torsional rigidity.

Question 8 Two in-line identical cantilevers of cross-sectional area A, rigidity EI, and coefficient of thermal expansion α are separated by a small gap δ. What temperature rise will cause the beams to (a) just touch and (b) buckle elastically?

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