CBCS SCHEME

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15ME/MA34

Third Semester B.E. Degree Examination, June/July 2018
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Define: i) True stress ii) Poissons ratio iii) Resilience iv) Rigidity Modulus. **(04 Marks)**

b. Derive an expression for the extension of a tapering bar whose diameter d_1 at one end tapers linearly to a diameter d_2 in a length L, under an axial pull 'P' and Young's modulus E. **(06 Marks)**

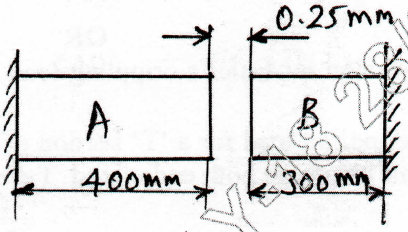
c. The tensile test was conducted on a mild steel bar. The following data was obtained from the test. Diameter of steel bar = 16mm, load at proportional limit = 72kN, load at failure = 80kN, diameter of the rod at failure = 12mm, gauge length = 80MM, extension at a load of 60kN = 0.115mm, final length = 104mm. Determine: i) Young's modulus ii) Proportionality limit stress iii) True breaking stress iv) Percentage Elongation in length v) Percentage reduction in area. **(06 Marks)**

OR

2 a. Derive relationship between Young's modulus (E), rigidity modulus (G) and bulk modulus (K). **(08 Marks)**

b. At room temperature the gap between bar A and bar B shown in Fig.Q.2(b) is 0.25mm. What are the stresses induced in the bars, if temperature rise is 35°C? Given.
$A_A = 1000mm^2$, $A_B = 800mm^2$,
$E_A = 2 \times 10^5$ N/mm^2, $E_B = 1 \times 10^5$ N/mm^2,
$\alpha_A = 12 \times 10^{-6}$/°C, $\alpha_B = 23 \times 10^{-6}$/°C,
$L_A = 400mm$, $L_B = 300mm$. **(08 Marks)**

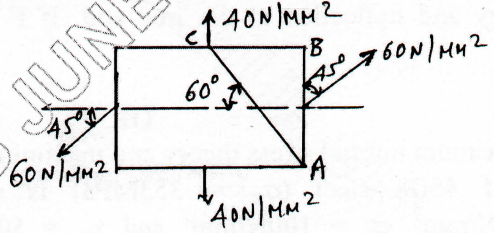
Fig.Q.2(b)



Module-2

3 a. An element is subjected to stresses as shown in Fig.Q.3(a). Determine: i) Principal stresses and their directions ii) Normal and tangential stress on plane AC. **(10 Marks)**

Fig.Q.3(a)



b. Prove that the change in volume in thin cylinder is equal to $\frac{Pd}{4tE}(5-4\mu)V$. **(06 Marks)**

OR

4 a. A pipe of 400mm internal diameter and 100mm thickness contains a internal fluid pressure 80N/mm^2. Calculate and sketch radial and hoop stress distribution across the section. **(10 Marks)**

b. Derive an expression for hoop stress and longitudinal stress for thin cylinder. **(06 Marks)**

Module-3

5 a. Classify beams and loads with sketch. **(04 Marks)**

b. Draw the shear force and bending moment diagrams for the beam shown in Fig.Q.5(b). Locate the salient point. **(12 Marks)**

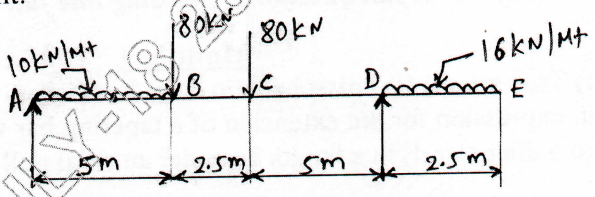


Fig.Q.5(b)

OR

6 a. A cast iron beam has an 'I' section with top flange 80mm × 40mm, web 120mm × 20mm and bottom flange 160mm × 40mm. If the tensile stress is not to exceed 30N/mm^2 and compressive stress 90N/mm^2, what is the maximum uniformly distributed load the beam carry over a simply supported span of 6m, if the large flange is in tension. **(10 Marks)**

b. Derive an expression for the maximum deflection of a cantilever beam carrying a point load at its free end. **(06 Marks)**

Module-4

7 a. State the assumption made in pure torsion and with usual notations derive torsion equation. **(08 Marks)**

b. A solid shaft is required to transmit 245 kW power at 240rpm. The maximum torque may be 1.5 times the mean torque. The shear stress in the shaft should not exceed 40N/mm^2 and the twist is 1°/meter length. Determine the diameter required, if the shaft is solid. G = 80kN/mm^2. **(08 Marks)**

OR

8 a. Derive the expression for Euler's crippling load for a column when both ends are hinged or pinned. **(08 Marks)**

b. Determine the crippling load for a 'T' section of dimensions 100mm × 100mm × 20mm and length of column 12m with both ends fixed. Take E = 210 GPa. **(08 Marks)**

Module-5

9 a. Define: i) Strain energy ii) Castigliano's theorem iii) Modulus of resilience iv) Toughness. **(08 Marks)**

b. A cantilever beam of uniform cross section carries a point load at the free end. Determine strain energy and deflection at the free end. If F = 200kN, E = 200GPa, L = 3mt and I = 10^{-4}m^4. **(08 Marks)**

OR

10 a. Explain maximum normal stress theory and maximum shear stress theory. **(08 Marks)**

b. A plate of 45C8 steel (σ_{yt} = 353MPa) is subjected to the following stresses. σ_x = 150 N/mm^2, σ_y = 100N/mm^2 and τ_{xy} = 50N/mm^2. Find the factor of safety by i) Rankine's theory ii) Guest's theory. **(08 Marks)**

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