



CBCS SCHEME

17ME34

Third Semester B.E. Degree Examination, Jan./Feb. 2021 Mechanics of Materials

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- 1 a. Define :
 - (i) Hook's law (ii) Poisson's ratio (iii) Modulus of rigidity (iv) Modulus of elasticity (v) Bulk modulus. (05 Marks)
 - b. Draw stress-strain diagram of a mild steel and name the salient points. (05 Marks)
 - c. A brass bar having cross-sectional area 300 mm^2 is subjected to axial forces as shown in Fig.Q1(c). Find the total elongation of the bar. $E = 84 \text{ GPa}$. (10 Marks)

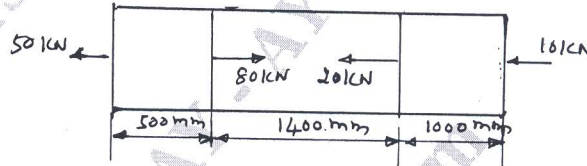


Fig.Q1(c)

OR

- 2 a. Define :
 - (i) Elasticity (ii) Plasticity (iii) Stiffness (iv) Resilience (v) Toughness (05 Marks)
 - b. Derive a relation between modulus of elasticity, modulus of rigidity and bulk modulus. (05 Marks)
 - c. At room temperature the gap between two bars as shown in Fig.Q2(c) is 0.25 mm . What are the stresses induced in the bars, if temperature rise is 35°C . Given $A_A = 1000 \text{ mm}^2$, $A_B = 800 \text{ mm}^2$, $E_A = 2 \times 10^5 \text{ MPa}$, $E_B = 1 \times 10^5 \text{ MPa}$, $\alpha_A = 12 \times 10^{-6} \text{ per } ^\circ\text{C}$, $\alpha_B = 23 \times 10^{-6} \text{ per } ^\circ\text{C}$.

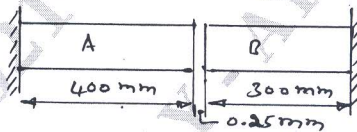


Fig.Q2(c)

(10 Marks)

Module-2

- 3 a. Define principal plane and principal stress. (02 Marks)
- b. Derive an expression for hoop stress and longitudinal stress for thin cylinder. (06 Marks)
- c. At a point in a strained material the stress condition shown in Fig.Q3(c). Find
 - (i) Normal and shear stresses on the inclined plane AB.
 - (ii) Principal stress and principal planes
 - (iii) Maximum shear stress. (12 Marks)

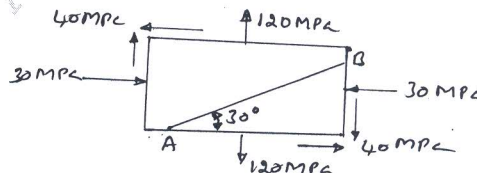


Fig.Q3(c)

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Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

OR

- 4 a. Derive Lamé's equation for thick cylinder. (08 Marks)
 b. A pipe of 500 mm internal diameter and 75mm thick is filled with a fluid at a pressure of 6 N/mm^2 . Find the maximum and minimum hoop stress across the cross-section of the cylinder. Also sketch the radial pressure and hoop stress distribution across the section. (12 Marks)

Module-3

- 5 a. Derive the relations between intensity of load 'W', shear force 'F' and bending moment 'M' in the beam. (06 Marks)
 b. Draw bending moment and shear force diagram for the beam shown in Fig.Q5(b). Clearly indicate the point of contraflexure. (14 Marks)

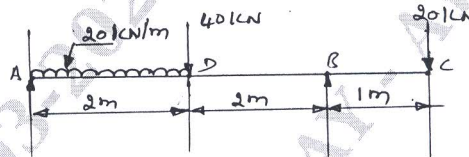


Fig.Q5(b)

OR

- 6 a. Derive the relationship between bending stress and radius of curvature. (06 Marks)
 b. The T-section shown in Fig.Q6(b) is used as a simply supported beam over a span of 4 meters. It carries an uniformly distributed load of 8 kN/m over its entire span. Calculate the maximum tensile and compressive stresses occurring in the section. (14 Marks)

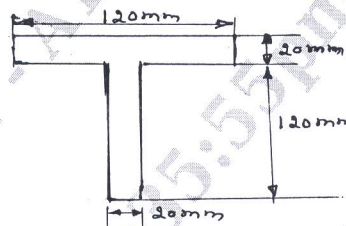


Fig.Q6(b)

Module-4

- 7 a. Derive the torsional equation. (10 Marks)
 b. A solid shaft rotating at 1000 rpm transmits 50 kW. Maximum torque is more than 20% of mean torque. Material of the shaft had the allowable shear stress of 50 MPa and $G = 80 \text{ GPa}$. Angle of twist in the shaft should not exceed 1° per meter length. Determine the diameter of the shaft. (10 Marks)

OR

- 8 a. Derive the expression for crippling load for a column when both ends are hinged. (10 Marks)
 b. Determine the crippling load for a T-section of dimensions $100 \text{ mm} \times 100 \text{ mm} \times 20 \text{ mm}$ and length of column 12m with both ends fixed. Take $E = 210 \text{ GPa}$. (10 Marks)

Module-5

- 9 a. Explain : (i) Castigliano's first theorem (ii) Castigliano's second theorem (10 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 $F = 200 \text{ kN}$, $E = 200 \text{ GPa}$, $L = 3 \text{ m}$ and $I = 10^{-4} \text{ m}^4$. (10 Marks)

OR

- 10 a. Explain maximum normal stress theory and maximum shear stress theory. (10 Marks)
 b. A machine member made of C40 steel having the yield stress of 328.6 MPa is loaded as follows. $\sigma_x = 60 \text{ MPa}$, $\sigma_y = -20 \text{ MPa}$ and $\tau_{xy} = 30 \text{ MPa}$. Determine the factor of safety by (i) Maximum normal stress theory (ii) Maximum shear stress theory. (10 Marks)

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