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Third Semester B.E. Degree Examination, June/July 2024 Mechanics of Materials

Time: 3 hrs.

Max. Marks: 100

- Note:** 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Any missing data may be suitably assumed.

Module-1

- 1 a. Derive the equilibrium equation for a 3-D stress system. (10 Marks)
b. With neat sketches, explain stress-strain curves for ductile and brittle materials. (10 Marks)

OR

- 2 a. Derive an expression for the extension of a tapering bar whose diameter 'D' at one end taper linearly to a diameter 'd' in a length L, under an axial pull 'F' and Young's Modulus E. (10 Marks)
b. At room temperature the gap between bar A and bar B is shown in Fig Q2(b) is 0.25mm, what are the stresses induced in the bars. If the temperature rise is 35°C.
Take : $A_A = 1000\text{mm}^2$; $E_A = 2 \times 10^5 \text{ N/mm}^2$; $\alpha_A = 12 \times 10^{-6}/^\circ\text{C}$
 $A_B = 800\text{mm}^2$; $E_B = 1 \times 10^5 \text{ N/mm}^2$; $\alpha_B = 23 \times 10^{-6}/^\circ\text{C}$ (10 Marks)

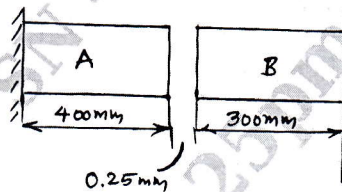


Fig Q2(b)

Module-2

- 3 a. Draw the shear force and bending moment diagram for a overhanging beam as shown in Fig Q3(a) locate the point of contra flexure. (10 Marks)

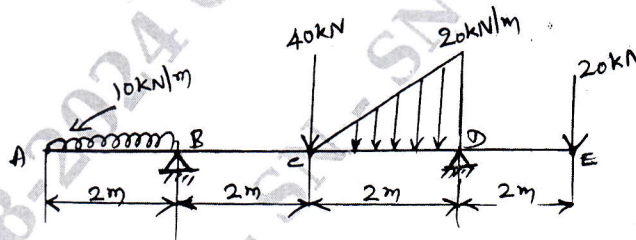


Fig Q3(a)

- b. Draw shear force and bending moment diagram for the beam shown in Fig Q3(b), calculate maximum bending moment.

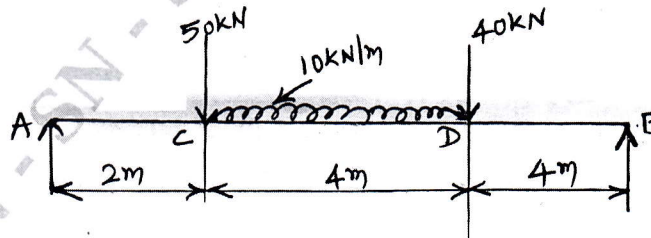


Fig Q3(b)

(10 Marks)

OR

- 4 a. Derive the Euler-Bernoulli's beam theory equation. (10 Marks)
 b. A T- shaped cross –section of a beam shown in Fig Q4(b) is subjected to a vertical shear force of 100kN. Calculate the shear stress at the neutral axis, junction and flange, moment of inertia about horizontal, neutral axis is 0.0001134 m^4 .

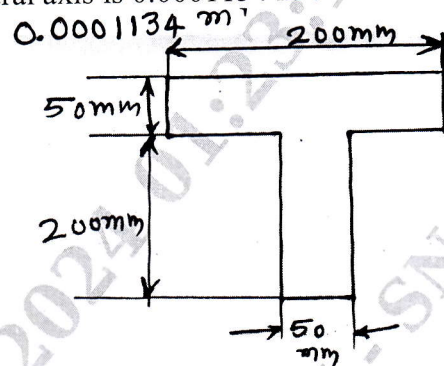


Fig Q4(b)

(10 Marks)

Module-3

- 5 a. Derive the deflection equation $EI \frac{d^2y}{dx^2} = M$. (06 Marks)
 b. A simply supported beam having uniform cross-section is 14m span and is simply supported at its ends. It carries a concentrated load of 120kN and 80kN at its two points at 3m and 4.5m from the left and right end respectively. If the M.I of the section is $160 \times 10^7 \text{ mm}^4$ and $E = 200 \text{ GPa}$. Calculate the deflection of the beam at load points and mid span by using Macaulay's method. (14 Marks)

OR

- 6 a. State the assumption made in pure Torsion theory and derive Torsion equation. (10 Marks)
 b. A solid shaft rotating at 1000 rpm transmits 50kW. Maximum torque is 20% more than the mean torque. Shaft material has allowable shear stress of 50MPa and modulus of rigidity 80GPa. Angle of twist in the shaft should not exceed 1° in one meter length. Determine the diameter of the shaft. (10 Marks)

Module-4

- 7 a. Explain the principle of virtual work for a particle and write the statements. (10 Marks)
 b. Define principles of virtual work for a rigid body and state the difference between principle of virtual work and complementary virtual work. (10 Marks)

OR

- 8 a. State and explain Castigliano's I and II theorem. (10 Marks)
 b. State and derive Maxwell's reciprocal theorem. (10 Marks)

Module-5

- 9 a. Define Fracture, with sketches explain. Type I, II and III fractures. (10 Marks)
 b. Define Creep, with neat sketch, explain the different stages of creep. (10 Marks)

OR

- 10 a. Draw typical S-N curves for mild steel and Aluminum and explain S-N-diagram in detail. (10 Marks)
 b. Write down the factors affecting Fatigue life. (10 Marks)
