CBCS SCHEME

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21CV33

Third Semester B.E. Degree Examination, June/July 2023
Strength 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. Derive an expression for circular tapering bar. **(10 Marks)**

b. A steel bar ABCD of varying section is subjected to axial force as shown in Fig.Q1(b). Determine the value of 'P' necessary for equilibrium, if E = 20 kN/mm^2. Find the total elongation of the bar and also stress in each part.

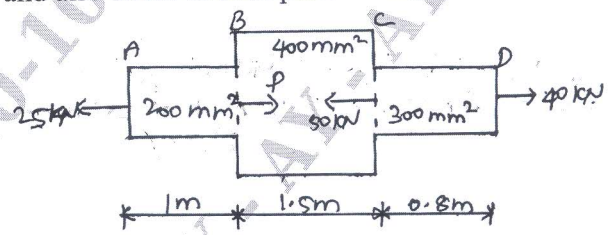

Fig.Q1(b) **(10 Marks)**

OR

2 a. A load 2 MN is applied on a column 500×500mm. The column is reinforced with 4 steel bars of 10mm diameter one in each corner. Find the stress in concrete and steel bars. Take E for steel as 2.1×10^5 N/mm^2 and for concrete as 1.4×10^4 N/mm^2. **(10 Marks)**

b. A 18mm diameter steel rod passes centrally through a copper tube of 26mm diameter (internal) and 38mm external diameter. The rod is 2.6 m long is closed at each end by rigid plates of negligible thickness. The nuts are tightened lightly none on the protecting parts of the rod. If the temperature of assembly is raised by 80°C calculate thermal stresses induced in copper and steel. Take $\alpha_{cu} = 17.5\times10^{-6}$/°C , $\alpha_s = 12\times10^{-6}$/°C , E_{st} = 210 GPa $E_{cu} = 1.05\times10^5$ N/mm^2. **(10 Marks)**

Module-2

3 a. What are the different types of load and supports? Explain the neat sketch. **(08 Marks)**

b. Draw BMD and SFD for the beam shown in Fig.Q3(b).

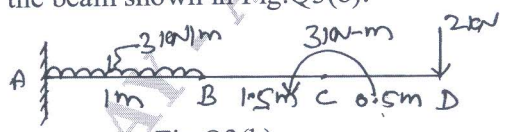

Fig.Q3(b) **(12 Marks)**

OR

4 a. Derive relationship between loading, shear force and bending moment. **(06 Marks)**

b. Draw BMD and SFD for the beam shown in Fig.Q4(b). Indicate maximum bending moment and its location. Also indicate the point of contraflexure.

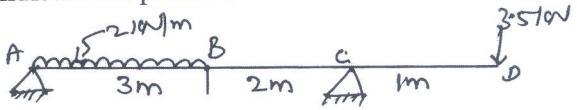

Fig.Q4(b) **(14 Marks)**

Module-3

5 a. What are the assumptions of simple bending? **(05 Marks)**

b. Derive Bernoulli's equation for bending stress. **(10 Marks)**

c. A rectangular beam 250 mm deep and 150mm width is simple supported over a span of 8m. What UDL per meter the beam can carry if the bending stress is not to exceed 140 N/mm^2. **(05 Marks)**

OR

6 a. Derive an expression for shear stress. **(10 Marks)**

b. A beam with an I-section consists of 180×15mm flanges and curb of 280mm depth and 15mm thickness. It is subjected to a bending moment of 120 kN-m and a shear force of 60 kN. Sketch the bending stress and shear stress distribution along the depth of section. **(10 Marks)**

Module-4

7 a. What are the assumptions of pure torsion? **(05 Marks)**

b. Derive torsion equation. **(08 Marks)**

c. A hollow shaft is required to transit 140 kW at 160 rpm. The total angle of twist in a length of 4m is not to exceed 2° and the shear stress is limited to 65 N/mm^2. C = 0.8×10^5 N/mm^2. Determine the inner and external diameter of the shaft. **(07 Marks)**

OR

8 a. Show that in a thin cylinder the hoop stress is twice the longitudinal stress. **(08 Marks)**

b. What are the assumptions made in Lame's equation? Derive Lame's equation. **(12 Marks)**

Module-5

9 a. Differentiate between short and long column. **(04 Marks)**

b. Describe the limitation of Euler's theory. **(04 Marks)**

c. Find Euler's load for a column 40mm × 50mm C/S and 2m long, if one of its end is fixed and other end is hinged. E for the material of the column is 200 N/mm^2. Find Rankine's load in the above case, if the yield stress in compression is 320 N/mm^2, $\alpha = 1/7500$. **(12 Marks)**

OR

10 a. Derive relationship between slope, deflection and radius of curvature. **(10 Marks)**

b. A simply supported beam spanning 8m carries a concentrated loads of 60 kN and 30 kN at distances of 2m and 4m from left support. Determine
(i) the slope at the ends (ii) The location and magnitude of the maximum deflection.
Assume E = 200 GPa and I = 20×10^8 mm^4. **(10 Marks)**

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