B.E. (Fire Engineering) Third Semester (C.B.S.)

Theory of Structures

P. Pages : 4 **NIR/KW/18/3947**

Time : Three Hours * 1 7 5 9 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.
12. I.S. Code 456:2000 is permitted.

1. a) A load of 80 kN is jointly supported by three rods of 20 mm diameter as shown in the figure (1a). The rods are adjusted in such a way that they share the load equally. If an additional load of 50 kN is added, find the final stresses in steel and copper. Take E for copper as 100 GPa and for steel as 200 GPa. **7**

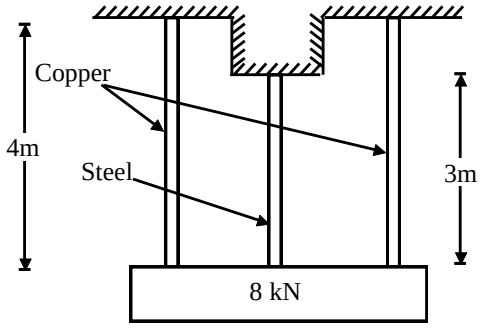

Fig. 1 (a)

b) A member ABCD is subjected to a point loads P_1, P_2, P_3 and P_4 as shown in the figure (1b). **6**

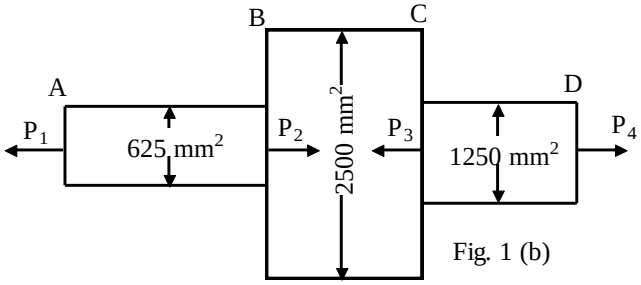

Fig. 1 (b)

Calculate the force P_2 necessary for equilibrium, If P_1 = 45 kN, P_3 = 450 kN and P_4 = 130 kN. Determine the total elongation of the member, assuming the modulus of elasticity to be 2.1×10^5 N / mm^2.

OR

2. a) Define the following terms : **6**

i) Principal plane ii) Principal stresses

iii) Angle of obliquity

b) At a point in a strained material, the principal stresses are 100 N/mm^2 tensile and 40 N/mm^2 compressive. Determine the resultant stress in magnitude and direction on a plane inclined at 60º to the axis of the major principal stress. What is the maximum intensity of shear stress in the material at that point ? **7**

3. a) Draw the shear force and bending moment diagram for the beam shown in the figure 3 (a). Determine the position in the central bay, at which the positive bending moment occurs. Also find the magnitude of maximum positive and negative bending moment. **8**

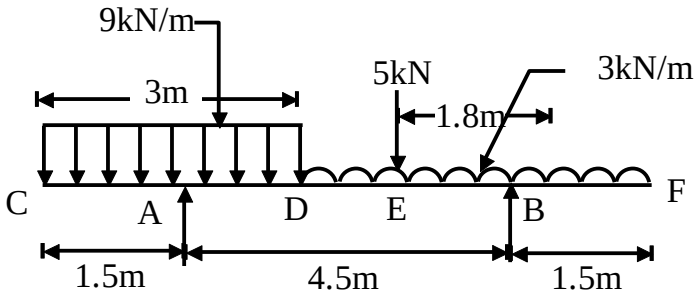

Fig. 3(a)

b) A simply supported beam 6 m long is carrying a uniformly distributed load of 5 kN/m over a length of 3 m from right end. Draw the shear force and bending moment diagrams for the beam and also calculate the maximum BM on the section. **6**

OR

4. a) Shear Force Diagram for a loaded beam is shown in the figure 4(a). Determine the loading on the beam and hence draw bending moment diagram. Locate the point of contraflexure, if any. All values are in kilonewtons. **8**

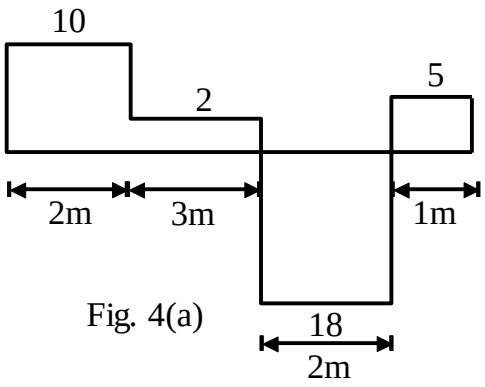

Fig. 4(a)

b) A simply supported beam of span 2.5 m is subjected to a uniformly distributed load and a clockwise couple as shown in figure fig. 4 (b) **6**

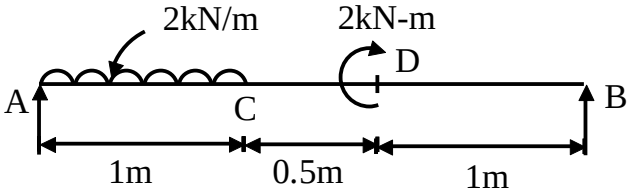

Fig. 4 (b)

Draw the shear force and bending moment diagrams for the beam.

5. a) Three beams have the same length the same allowable stress and the same bending moment. The cross-sections of the beams are a square, a rectangle with depth twice the width and a circle as shown in the figure 5 (a). **6**

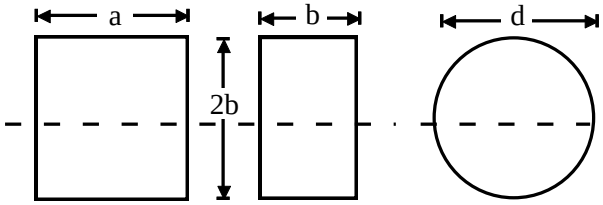

Fig. 5 (a)

Find the ratios of weights of the circular and the rectangular beams with respect to the square beam.

b) The cross-section of a beam is shown in the fig. 5 (b) the beam is made of material with permissible stress in compression and tension equal to 100 MPa and 140 MPa respectively. **7**

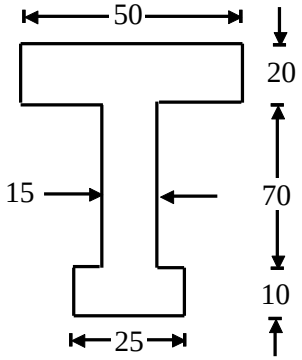

Fig. 5 (b)

Cal the moment of resistance of the cross-section when subjected to moment causing compression at top and tension at the bottom.

OR

6. a) A solid shaft of 200 mm diameter has the same cross-sectional area as a hollow shaft of the same material with inside diameter of 150 mm. Find the ratio of **8**

i) Power transmitted by both the shafts at the same angular velocity
ii) Angles of trust in equal lengths of these shafts, when stressed to the same intensity.

b) A solid steel shaft has to transmit 100 kW at 160 rpm. Taking allowable shear stress as 70 MPa find the suitable diameter of the shaft. The maximum torque transmitted in each revolution exceeds the mean by 20%. **5**

7. A continuous beam ABCD, simply supported at A, B, C and D is loaded as shown in the figure (7). **13**

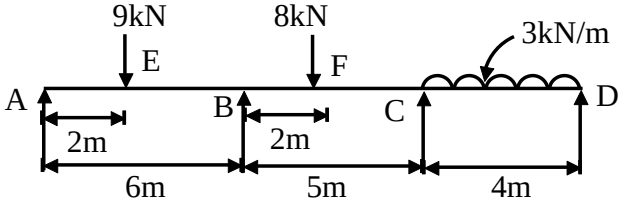

Fig. (7)

Find the moments over the beam and draw bending moment and shear force diagrams.

OR

8. A simply supported beam AB of span 9 m carries a point load of 120 kN at a section C, 6m from A. The moment of Inertia of the beam section is equal to I for part AC and 2I for part BC. Find the slope at A, the deflection under the load and also the maximum deflection. Take E = 200 kN/mm^2 and $I = 1.25 \times 10^9$ mm^4. **13**

9. Analyse the continuous beam ABCD shown in the figure (9) by moment distribution method. Draw bending moment and shear force diagram. **13**

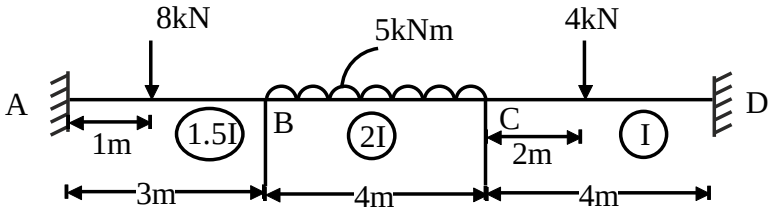

Fig. (9)

OR

10. Analyse the frame shown in the fig (10) and draw the bending moment diagram. **13**

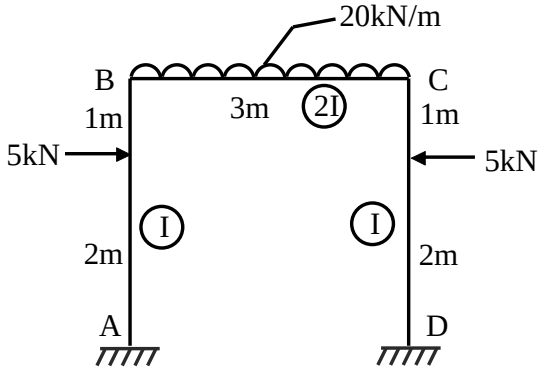

Fig. (10)

11. Design a two way slab for a room measuring 3 x 5 m. The slab has one long edge continuous and all other edges discontinuous. The slab carries a live load of 3 kN/m^2 and Floor Finish load of 1 kN/m^2. Use M20 concrete and Fe 415 steel. Sketch the Reinforcement details. **14**

OR

12. a) A reinforced concrete beam of rectangular section 300 mm x 650 mm is reinforced with 4 bars of 32 mm diameter bars. Compute moment of resistance of the beam. Use M20 grade concrete and Fe 415 HYSD bars. Take effective cover of 50 mm. **5**

b) i) Explain balanced section, under reinforced section and over reinforced section. **9**

ii) Explain Anchorage bond and Flexure bond.

iii) Differentiate between limit state of collapse and limit state of serviceability.

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