

22306

21819

3 Hours / 70 Marks

Seat No.

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- Instructions* –
- (1) All Questions are *Compulsory*.
 - (2) Answer each next main Question on a new page.
 - (3) Illustrate your answers with neat sketches wherever necessary.
 - (4) Figures to the right indicate full marks.
 - (5) Assume suitable data, if necessary.
 - (6) Use of Non-programmable Electronic Pocket Calculator is permissible.
 - (7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

- 1. Attempt any FIVE of the following: **10****
- a) Define:
 - (i) Moment of Inertia
 - (ii) Radius of Gyration
 - b) State the relation between young's modulus and bulk modulus.
 - c) Draw stress-strain diagram for mild-steel rod and show different limits on it.
 - d) Define point of contraflexure of a loaded beam with sketch.
 - e) Define section modulus and neutral axis.
 - f) State the condition for no tension at the base of a column.
 - g) Define the core of a section.

P.T.O.

2. Attempt any THREE of the following: 12

- a) A hollow square has inner dimensions $a \times a$ and outer dimensions $2a \times 2a$. Find moment of inertia about the outer side.
- b) In a bi-axial stress system the stresses along the two directions are $\sigma_x = 60 \text{ N/mm}^2$ (tensile) and $\sigma_y = 40 \text{ N/mm}^2$ (compressive). Find the maximum strain.
Take $E = 200 \text{ kN/mm}^2$ and $m = 4$.
- c) A simply supported beam of Span 5 m carries two point loads of 5 kN and 7 kN at 1.5 m and 3.5 m from the left hand support respectively. Draw S.F.D and B.M.D showing important values
- d) Explain the theory of pure torsion.

3. Attempt any THREE of the following: 12

- a) A cylindrical bar is 30 mm in diameter and 2000 mm long. The bar is subjected to uniform stress of 100 N/mm^2 in all directions. Calculate the modulus of rigidity and bulk modulus. If the modulus of elasticity is $1 \times 10^5 \text{ N/mm}^2$ and Poisson's ratio is 0.2.
- b) Find the bending stress induced in the steel flat 40 mm wide and 5 mm thick if it is required to bend into an arc of a circle of radius 2.5 m. Also calculate the moment required to bend the flat. Take $E = 2 \times 10^5 \text{ MPa}$.
- c) A cantilever beam of span 2.5 m carries three point loads of 1KN, 2KN and 3KN at 1 m, 1.5 m and 2.5 m from the fixed end. Draw S.F.D and B.M.D.
- d) A rectangular rod of size 50 mm \times 100 mm is bent into 'C' shape as shown in Fig. No. 1 and applied load of 40 kN at point A. Calculate the resultant stresses developed at section x-x.

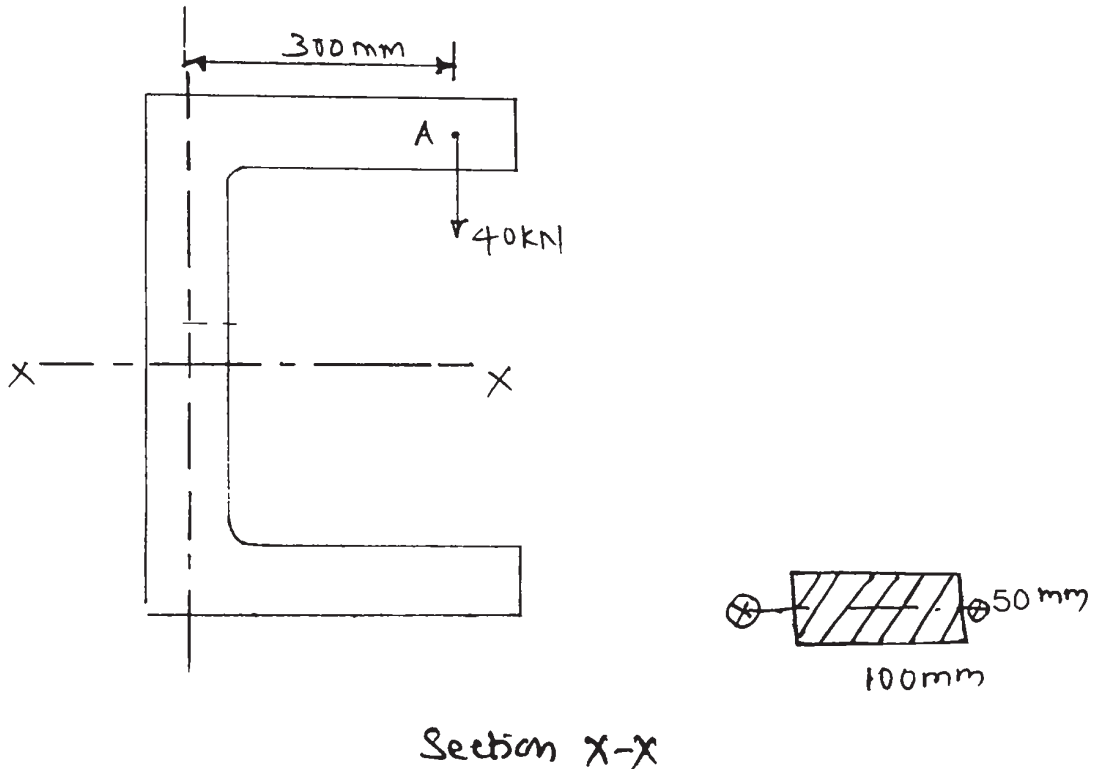
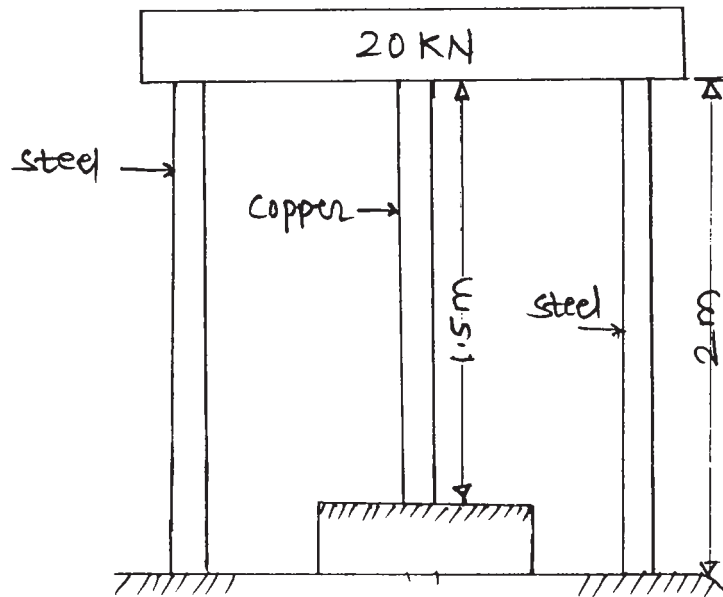


Fig. No. 1

4. Attempt any THREE of the following: 12
- State and explain perpendicular axis theorem of moment of Inertia.
 - A steel bar 50 mm × 50 mm in section, 3 m long is subjected to an axial pull of 20 kN. Calculate the change in length and change in side of the bar. Take $E = 200 \text{ GPa}$ and Poisson's ratio = 0.3
 - Two steel rods and one copper rod each of 20 mm in diameter together support a load of 20 kN as shown in Fig. No. 2. Find the stresses in the rod, $E_s = 210 \text{ GPa}$ and $E_c = 110 \text{ GPa}$.

**Fig. No. 2**

- d) Calculate safe axial load in tension for a steel bar of cross-section $75 \text{ mm} \times 12 \text{ mm}$, if allowable maximum stress is 155 MPa .
- e) A bar of 30 mm diameter is subjected to a pull of 60 kN . The measured extension on gauge length of 200 mm is 0.09 mm and the change in diameter is 0.0039 mm . Calculate the Poisson's ratio and modulus of elasticity.

5. Attempt any TWO of the following:

12

- a) A Cantilever beam 4 m long carries a u.d.l. of 2 kN/m over 2 m from free end and point load of 4 kN at free end. Draw S.F and B.M diagrams.
- b) Select a suitable diameter for a solid circular shaft to transmit 200 HP . At 180 r.p.m . The allowable shear stress is 80 N/mm^2 and the allowable angle of twist is 1° in a length of 3 m . Take $C = 0.82 \times 10^5 \text{ N/mm}^2$.
- c) A diamond shaped pier with diagonals 3 m and 6 m is subjected to an eccentric load of 1500 kN at a distance of 1 m from centroid and on the longer diagonal. Calculate the maximum stress induced in the section.

6. Attempt any TWO of the following:**12**

- a) A cantilever is 2m long and is subjected to a u.d.l. of 2 kN/m. The cross section of cantilever is tee section with flange 80 mm × 10 mm and web of 10 mm × 120 mm such that its total depth is 130 mm. The flange is at the top and web is vertical. Determine maximum tensile stress and compressive stress developed and their positions.
- b) (i) A steel rod 800 mm long and 60 mm × 20 mm in cross section is subjected to an axial push of 89 kN. If the modulus of elasticity is 2.1×10^5 N/mm². Calculate the stress, strain and reduction in the length of rod.
- (ii) Differentiate between linear and lateral strain.
- c) A hollow rectangular beam section square in size having outer dimensions 120 mm × 120 mm with uniform thickness of material 20 mm is carrying a shear force of 125 kN. Calculate the maximum shear stress induced in the section.
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