

# 22306

**11920**

**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) Write the formulae to find moment of Inertia of semi-circular section about its xx and yy centroidal axes.
  - b) Differentiate between single shear and double shear.
  - c) Define brittleness. Enlist any two names of brittle materials.
  - d) Define point of contraflexure.
  - e) State the relation between maximum shear stress and average shear stress for a solid circular section.
  - f) Draw a neat sketch to show core of a rectangular section of (B × D) dimensions.
  - g) State the condition for no tension at the base of a column.

P.T.O.

2. Attempt any THREE of the following: 12

- a) Calculate M.I. of a T-section about the centroidal xx axis. Top flange is 1200 mm × 200 mm and web is 1800 mm × 200 mm. Total height is 2000 mm.
- b) Draw stress - strain diagram with all salient points on it for ductile material and explain the term ultimate stress.
- c) For a certain material, modulus of elasticity is 169 MPa. If Poisson's ratio is 0.32, calculate the values of modulus of rigidity and bulk modulus.
- d) A cantilever of span 3 m carries a point load of 5kN at 2 m from the support and a u.d.l. of 4 kN/m over the entire span. Draw S.F. and B.M. diagrams.

3. Attempt any THREE of the following: 12

- a) State parallel axis theorem and use it to find moment of Inertia of an isosceles triangle of base 'b' and height 'h' about its base.
- b) A brass bar shown in Figure No. 1 is subjected to a tensile load of 40 kN. Find the total elongation of the bar if  $E = 1 \times 10^5 \text{ N/mm}^2$  and the maximum stress induced.

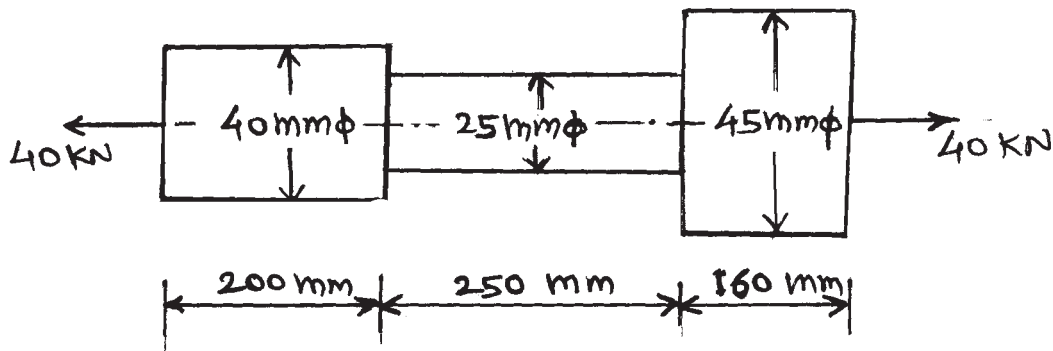


Fig. No. 1

- c) A simply supported beam of span 7 m carries an u.d.l. of 2kN/m over 4 m length from left hand support and a point load of 5kN at 2m from right hand support. Draw S.F. and B.M. diagrams.
- d) A C-clamp as shown in Figure No. 2, carries a load  $P = 25\text{ kN}$ . The cross-section of the clamp at  $x - x$  is rectangular, having width equal to twice the thickness. Assuming that the C-clamp is made of steel casting with an allowable stress of  $100\text{ N/mm}^2$ , find its dimensions  $b$  and  $t$ .

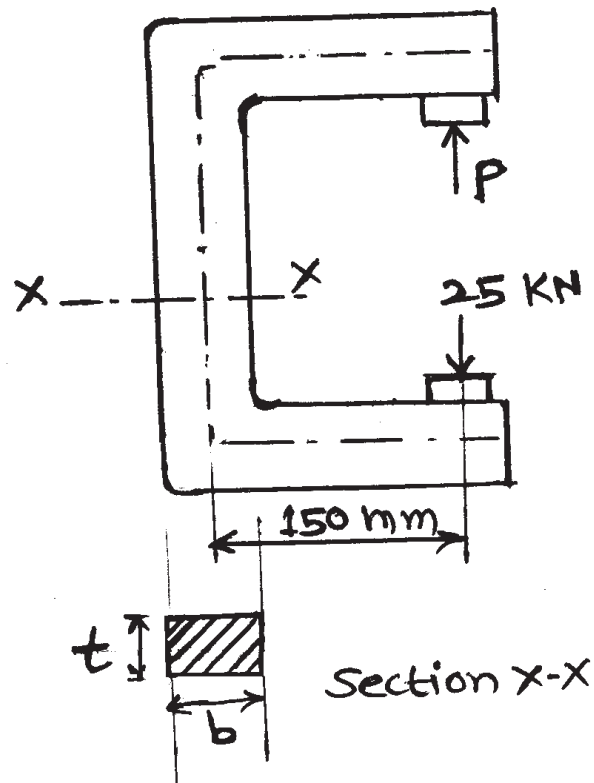


Fig. No. 2

4. Attempt any THREE of the following:

12

- a) A steel rail is 12.6m long and is laid at a temperature of 24°C. The maximum temperature expected is 44°C.

Determine:

- (i) The minimum gap between two rails to be left so that temperature stresses do not develop.  
 (ii) Thermal stresses developed in the rails if no expansion joint is provided.

Take  $E = 2 \times 10^5 \text{ N/mm}^2$  and  $\alpha = 12 \times 10^{-6}/^\circ\text{C}$ .

- b) Calculate the power a shaft of 30 mm diameter can transmit with a speed of 200 r.p.m. if the permissible shear stress is 120 N/mm<sup>2</sup>. Take maximum torque as 30% more than the average torque.  
 c) An overhanging beam is as shown in Figure No. 3. Draw S.F. and B.M. diagrams and locate the point of contraflexure.

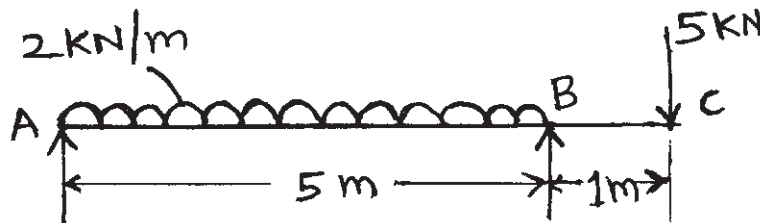


Fig No. 3

- d) A simply supported beam of span 8 m carries a point load of 60 kN at the centre of the span. Calculate the modulus of section required, if bending stress is not to exceed 150 MPa.  
 e) State the equation of torsion with the meaning of each term and use the torsional equation to find torque induced in a solid circular shaft of 50 mm diameter rotating at 100 r.p.m. The permissible shear stress is not to exceed 75 MPa.

5. Attempt any TWO of the following:

12

- a) A rectangular block loaded is shown in Figure No. 4. Find linear strains in X, Y and Z directions. Also find change in volume of the block. Take  $E = 200 \text{ GPa}$  and Poisson's ratio.  $\mu = 0.25$

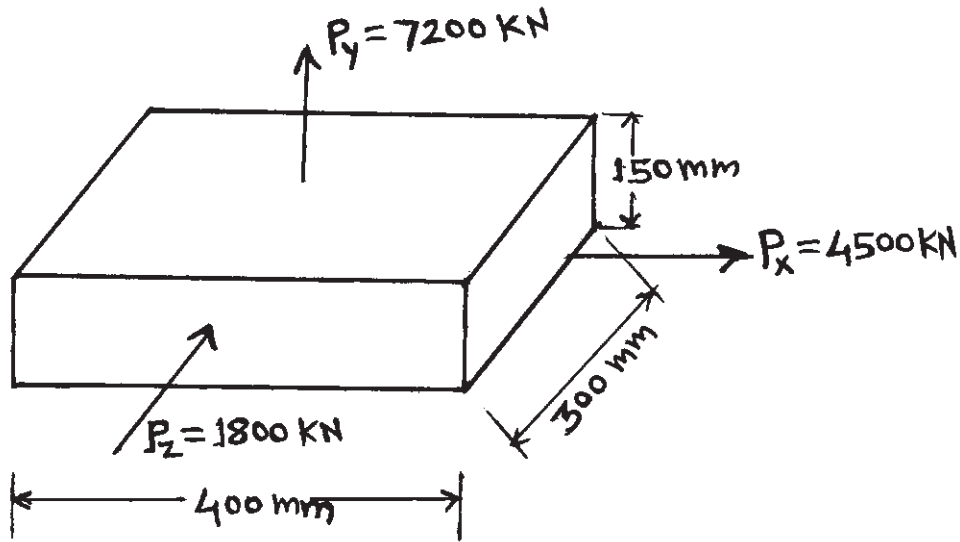


Fig No. 4

- b) A simply supported beam of span 8 m carries two point loads of 50 kN and 20 kN at 2 m and 6 m from the left hand support respectively. Draw bending moment diagram and also sketch the qualitative deflected shape of the beam.
- c) State any four assumptions in the theory of simple bending and apply the bending stress equation to determine the maximum bending stress developed in a rectangular beam of cross section  $50 \text{ mm} \times 150 \text{ mm}$  when a bending moment of 600 N.m is applied about x-x axis.

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

- a) A beam of square cross section  $100 \text{ mm} \times 100 \text{ mm}$  is subjected to a shear force of 30 kN. Calculate the maximum shear stress as well as shear stress induced across the section at a layer 20 mm away from the neutral axis. Sketch the shear stress distribution diagram for the given beam.
- b) A hollow circular shaft is required to transmit a torque of 24 kN.m. The inside diameter is 0.6 times external diameter. Calculate both the diameter, if allowable shear stress is 80 MPa.
- c) A rectangular column 150 mm wide and 100 mm thick carries a load of 150 kN at an eccentricity of 50 mm in the plane bisecting the thickness. Find the maximum and minimum intensities of stress at the base section. Draw the combined stress distribution diagram showing these values.

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