# 17304

**11920**

**3 Hours / 100 Marks** Seat No. | | | | | | | | |

*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.** a) **Attempt any SIX of the following :** **12**

(i) Define ductility and malleability.

(ii) Define principal plane and principal stress.

(iii) State the parallel axis theorem.

(iv) Define direct load and eccentric load.

(v) State torsion equation along with meaning of each term used in it.

(vi) Define bulk modulus.

(vii) Define hoop stress. State its formula.

(viii) Define middle third rule.

**Marks**

b) **Attempt any TWO of the following :** **8**

(i) A metal rod 24 mm diameter and 2 m long is subjected to an axial pull of 40 kN. If the elongation of the rod is 0.5 mm. Find the stress induced and the value of Young's modulus.

(ii) A simply supported beam of span 5 m carries two point load of 5kN and 7 kN at 1.5 m and 3.5 m from the left hand support respectively. Draw shear force and bending moment diagram.

(iii) A circular beam of 120 mm diameter is simply supported over a span of 10 m and carries a udl of 1000 N/m. Find the maximum bending stress produced.

**2. Attempt any FOUR of the following :** **16**

a) (i) Define the term modular ratio?

(ii) State any four assumption made in Euler's theory.

b) A hollow steel tube of 200 mm external diameter and 25 mm thick is 4 m long used as a column. If its one end is fixed and the other end is hinged. Find the load the column can carry. Use Euler's formula and FOS = 2, Take $E = 2 \times 10^5$ N/mm$^2$.

c) A rod has a length of 10 m at 10°C and its temperature is raised to 70°C. If the free expansion is prevented. Find the magnitude and nature of stress produced. Take E = 210 kN/mm$^2$ and $\alpha = 12 \times 10^{-6}$/°C.

d) A copper wire 20 mm$^2$ in cross section and steel wire 30 mm$^2$ in cross section both 1m long are rigidty connected to plates on either side. They jointly share load of 8 kN. $E_{Steel} = 20 \times 10^5$ N/mm$^2$. Determine $E_{copper} = 1 \times 10^5$ N/mm$^2$. Find the stresses produced in each material.

e) A bar is subjected to a tensile stress of 100 N/ mm$^2$. Determine the normal and tangential stresses on a plane making an angle of 60° with the axis of tensile stress.

f) A gas cylinder of internal diameter 1.2 m and thickness 24 mm is subjected to maximum tensile stress of 90 MPa. Find allowable pressure of gas inside cylinder.

**Marks**

**3. Attempt any FOUR of the following :** **16**

a) Define shear force and bending moment.

b) Draw SF and BM diagram for a simply supported beam of span L carrying a udl w/unit length over the entire span.

c) A simply supported beam of span 6 m carries two point loads of 20 kN each at 2 m and 4 m from left hand support. It also carries udl of 30 kN/m between two point loads. Draw SFD and BMD.

d) A cantilever is loaded as shown in Figure No. 1 Draw SFD and calculate B.M. at point A.

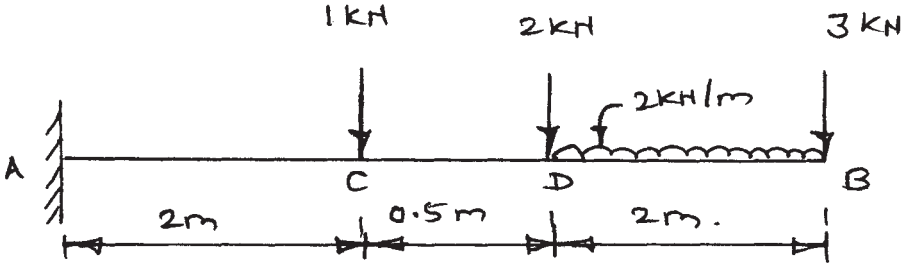


**Fig. No. 1**

e) A simply supported beam of span 7 m carries a udl of 2 kN/m over 4 m length from the left support and a point load of 5 kN at 2 m from the right support. Draw S.F. and B.M. diagram.

f) Find the M.I. of a 'T' section about the centroidal axis xx. Top flange is 1200 × 200 mm and web is 1800 mm × 200 mm. Total height is 2000 mm.

**4. Attempt any FOUR of the following :** **16**

a) State with neat sketches parallel axis theorem and perpendicular axis theorem.

b) A hollow C.I. pipe, with external diameter 100 mm and thickness of metal 10 mm is used as a strut. Calculate the moment of inertia and radius of gyration about its diameter.

c) A symmetrical I-section has the following dimensions. Calculate polar M.I. of the section flanges = 100 mm × 10 mm, web = 10 mm × 100 mm.

**Marks**

d) An I-section consist of top flange 80 × 20 mm, web 120 mm × 20 mm and bottom flange 120 × 20 mm. Calculate moment of inertia about xx-axis.

e) State any four assumption made in the theory of simple bending.

f) A beam 100 mm wide and 250 mm deep is subjected to a shear force of 40 kN at a certain section. Find the maximum shear stress and draw the shear stress variation diagram.

**5. Attempt any FOUR of the following :** **16**

a) A timber beam has a cross - section 120 mm × 200 mm. It is simply supported over a span of 4 m and carries a udl of 1 kN/m over the entire span. Calculate the maximum bending stress induced in the beam and the radius of curvature to which the beam will bend at that section.

b) Sketch the shear stress distribution diagram for a rectangular beam of 600 mm × 200 mm deep subjected to shear force of 20 kN.

c) A hollow circular column having external and internal diameter of 40 cm and 30 cm respectively carries a vertical load of 150 kN at the outer edge of the column. Calculate the maximum and minimum intensities of stress in the section.

d) A M.S. link as shown in Figure No. 2 transmit a pull of 80 kN. Find the dimensions $b$ and $t$, if $b = 3t$. Assume the permissible tensile stress as 70 MPa.

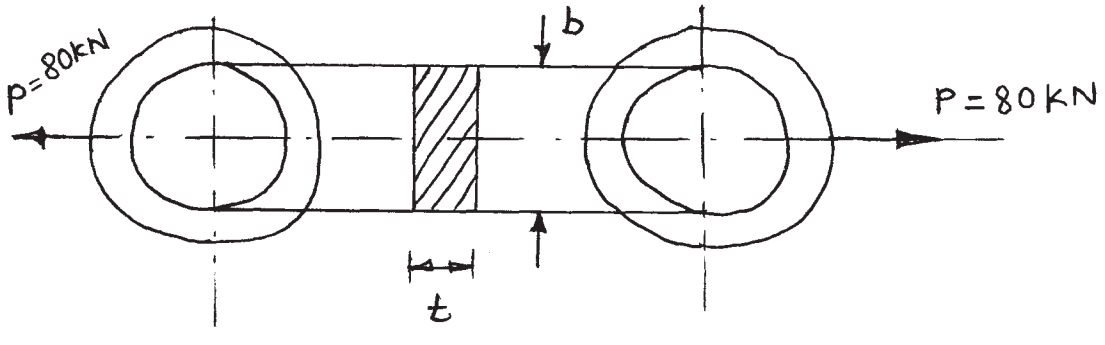


**Fig. No. 2**

**Marks**

e) A clamp made up of rectangular cross-section 30 × 10 mm as shown in Figure No. 3 is subjected to a force of 2.5 kN. Find the stresses induced at section A-A.

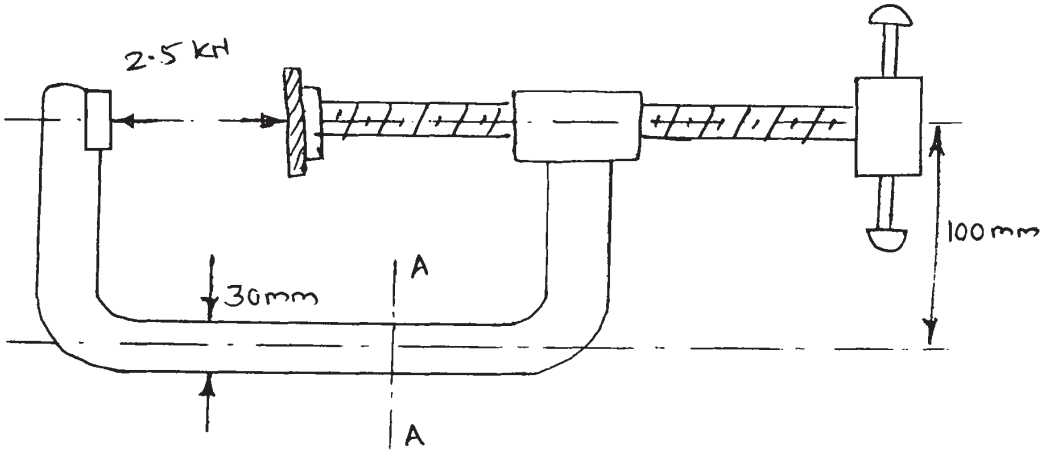


**Fig. No. 3**

f) A mild steel flat 50 mm wide and 5 mm thick is subjected to load 'P' acting in the plane bisecting the thickness at a point 10 mm away from the centroid of the section. If the tensile stress is not to exceed 150 MPa, calculate the magnitude of 'P'.

**6. Attempt any FOUR of the following :** **16**

a) State assumption in theory of pure torsion.

b) Find the torque that can be applied to a shaft of 100 mm in diameter, if the permissible angle of twist is 2.75° in a length of 6 m. Take C = 80 kN/mm$^2$.

c) Calculate the suitable diameter of a solid shaft to transmit 220 KW at 150 rpm if the permissible shear stress is 68 MPa.

d) A shaft is required to transmit 20 KW at 150 rpm. The maximum torque may exceed average torque by 40%. Determine the diameter. of shaft, if the shear stress is not to exceed 50 MPa.

e) Find the torsional moment of resistance for a hollow circular shaft of 225 mm external diameter and 220 mm internal diameter. If the permissible shear stress is 60 MPa.

f) (i) Define - section modulus

(ii) Define torque and state its S.I. units.