17304

11718

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) Write the equation for M.I. of Hollow shaft section.

(iv) Define direct load and eccentric load.

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

(vi) Draw a stress - strain diagram for ductile material in tension.

(vii) State relation between Hoop stress and Longitudinal stress, for thin cylinder.

(viii) Define core of section. Write its value for a circular section.

Marks

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

(i) For a round bar of 50 mm diameter and 2.5 m long of certain material has Young's modulus of 1.1×10^5 N/mm^2 and Modulus of Rigidity of 0.45×10^5 N/mm^2. Find the Bulk Modulus and the lateral contraction of the bar when stretched by 3 mm.

(ii) A simply supported beam 6 m long is carrying a udl of 20 kN/m over a length of 3 m from the right end. Draw the SFD and BMD for the beam and also calculate the maximum bending moment in the section.

(iii) A cantilever beam of span 6.5 m is having cross section of 400 mm wide and 700 mm deep. If the bending stress is not allowed to exceed 280 N/mm^2, calculate the magnitude of point load which can be applied at the free end of the cantilever beam.

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

a) A metal rod, 500 mm long and 20 mm in diameter, is subjected to an axial pull of 40 kN. Under this load, elongation of rod is 0.5 mm and decrease in diameter of rod is 0.006 mm. Calculate modulus of elasticity and Poisson's ratio.

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 steel tube 40 mm external diameter and 4 mm thick encloses centrally a solid copper bar of 30 mm diameter. The bar and the tube are rigidly connected together at the ends at a temperature of 40°C. Find the stress and its nature in each metal when heated to 180°C. Take $\alpha_s = 1.08 \times 10^{-5}$/°C, $\alpha_c = 1.7 \times 10^{-5}$/°C, $E_s = 2.1 \times 10^5$ N/mm^2 and $E_c = 1.1 \times 10^5$ N/mm^2.

Marks

d) A steel tube of 40 mm inside diameter and 4 mm metal thickness is filled with concrete. Determine the stress in each material due to an axial thrust of 60 kN. Take E steel = 2.1×10^5 N/mm^2 and E con = 0.14×10^5 N/mm^2.

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 cylindrical compressed air drum is 2 m in diameter with plate thickness of 12 mm. If the tensile stress is not to exceed 100 N/mm^2. Find the maximum safe air pressure.

3. Attempt any <u>FOUR</u> of the following: **16**

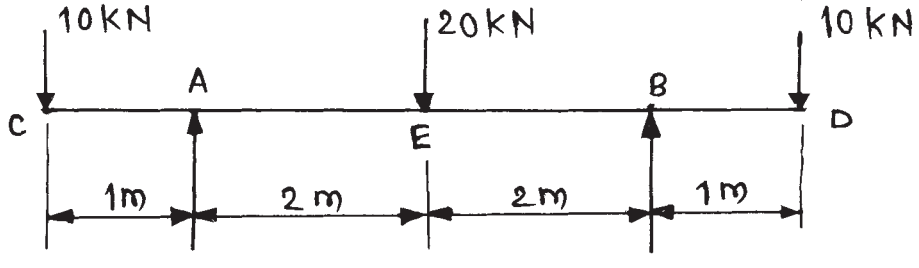
a) Define shear force and bending moment.

b) Draw shear force and bending moment diagram for a simply supported beam of span 'L' carrying a central point load 'W'. State the maximum SF and BM values.

c) A cantilever beam of span 4 m carrying two point loads of 10 kN and 30 kN at 1 m and 2.5 m from free end respectively. Draw SFD and BMD.

d) A simply supported beam of 8 m span carries three point loads of 100 N, 200 N and 400 N at 2 m, 4 m and 6 m from left hand support. Draw SF and BM diagrams.

e) A simply supported beam having equal overhangs on both sides and carrying point loads is shown in Fig. No. 1. Draw SF and BM diagrams.



<u>Fig. No. 1</u>

Marks

f) Calculate M.I. for a triangle of height 100 mm about axis passing through vertex and parallel to base If M.I. about the base of same triangle is 10^7 mm^4.

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

a) A rectangular beam section has width 200 mm and depth of 300 mm. Using parallel axis theorem. Calculate M.I. about its base.

b) State parallel axis theorem and perpendicular axis theorem of moment of inertia with neat sketches.

c) 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.

d) Find the M.I. of an I-section having equal flanges 120 mm × 40 mm and web 120 mm × 40 mm about XX-axis overall depth 200 mm.

e) Explain the meaning of moment of resistance and neutral axis in the theory of simple bending.

f) The cross section of beam is symmetrical I-section having flange width 100 mm, overall depth 180 mm and thickness 10 mm. If the permissible bending stress is 120 N/mm^2, find the moment of resistance of the beam section.

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

a) A rectangular strut is 120 mm × 80 mm thick. It carries a load of 100 kN at an eccentricity of 10 mm in a plane bisecting the thickness. Find the maximum and minimum intensities of stress in the strut 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.

Marks

c) Fig. No. 2 shows the frame of a screw damp carrying a load of 4 kN. The cross section of frame is rectangular having width 60 mm and thickness 20 mm. Determine to resultant stresses for the frame material.

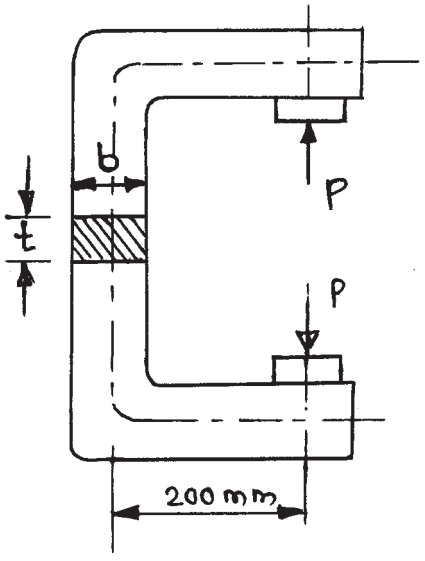


Fig. No. 2

d) A M.S. link as shown in Fig. No. 3, transmits a pull of 80 kN. Find the cross sectional dimensions (band f) if b = 3t. Assume the permissible tensile stress as 70 MPa.

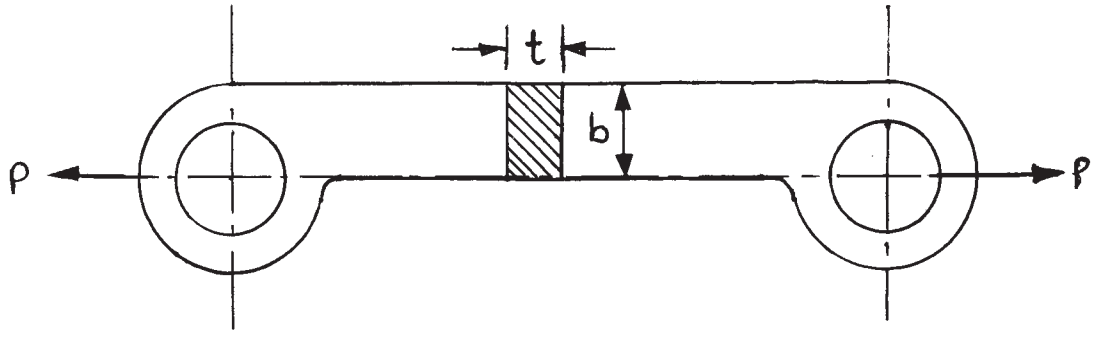


Fig. No. 3

e) A circular section of diameter 'd' is subjected to load 'P' eccentric to the axis-YY. The eccentricity of load is 'e'. Obtain the limit of eccentricity such that no tension is induced at the section.

Marks

f) A short MS column of external diameter 200 mm and internal diameter 150 mm carries an eccentric load. Find to greatest eccentricity which the load can have without producing tension in the section of a column.

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

a) State assumptions 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) Find the power transmitted by a solid shaft of diameter 60 mm running at 220 rpm; if the permissible shear stress is 68 MPa. The maximum torque is likely to exceed the mean torque by 25%.

d) Calculate the suitable diameter of the solid shaft to transmit 220 KW power at 150 rpm; if the permissible shear stress is 68 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 - Torsional stiffness.

———