17304

15116

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 : **6 × 2 = 12**

(a) Define linear and lateral strain.
(b) State any two mechanical properties of materials with suitable example.
(c) Draw bending stress and shear stress distribution diagram for a rectangular section.
(d) Draw core-section for a rectangular section.
(e) Define 'Fatigue' with suitable example.
(f) Define Poisson's Ratio.
(g) In what direction, circumferential and longitudinal stresses are developed ? What are their effects on dimensions of cylinder ?
(h) Write expression for stresses developed on a oblique section of a body subjected to direct and shear stress on one plane.

(B) Attempt any TWO : **2 × 4 = 8**

(a) A circular hole of 20 mm diameter is to be punched in a mild steel plate of 3 mm thickness. If shearing stress developed in the metal is 180 MPa, find required force to punch the hole.
(b) Find M.I. of a square section @ its diagonal resting on one of its corner having diagonal = 400 mm in length.
(c) A cylinder has internal diameter of 100 mm and it carries a liquid at 10 N/mm^2. Find required thickness if hoop stress is not to exceed 120 N/mm^2.

P.T.O.

2. Attempt any FOUR : **4 × 4 = 16**

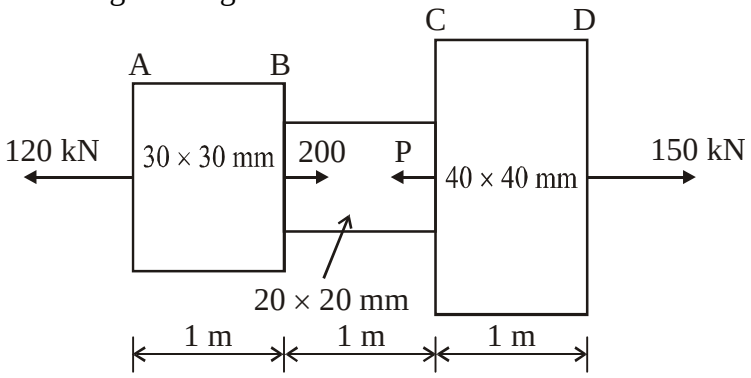
(a) Write four assumptions of Euler's theory.

(b) A reinforced concrete column 400 × 400 mm is reinforced with 4 bars of 20 mm diameter. Determine the stresses induced in each material if it has to carry a load of 500 kN. Use E_s = 200 GPa and E_c = 100 GPa.

(c) A hollow metal cylinder has external diameter 100 mm and thickness of metal = 10 mm, length of cylinder = 800 mm. It carries an axial tensile load of 250 kN. If E = 2×10^5 MPa, Poisson's Ratio = 0.25, find change in length and change in diameter.

(d) A steel bar of 30 mm diameter is heated to 70 °C and then clamped at ends. It is then allowed to cool down to 20 °C. Calculate temperature stresses developed and reactions at the clamps, length of bar = 10 m, $\alpha = 12 \times 10^{-6}$/°C; E = 2×10^5 N/mm^2.

(e) A member ABCD of a machine is subjected to loads as shown. Find force 'P' and Net change in length. E = 2×10^5 N/mm^2.



(f) The principal tensile stresses at a point across two perpendicular planes are 60 N/mm^2 and 30 N/mm^2. Find normal and tangential stress and its obliquity on a plane at 20° with major parallel plane.

3. Attempt any FOUR : **4 × 4 = 16**

(a) A cantilever beam of span 'L' m is subjected to a U.D.L. of W kN/m over entire span. Draw S.F.D. and B.M.D.

(b) A simply supported beam of span 6 m carries two point loads of 30 kN each at 2 m and 4 m from left support. The beam also carries a U.D.L. of 20 kN/m between two point loads. Draw S.F.D. and B.M.D.

(c) Draw S.F.D. and B.M.D. for a beam whose left support is hinge and right support is roller. The beam has following details :

(i) Span = 8 m

(ii) U.D.L. of 20 kN/m at 4 m from left support.

(iii) A point load of 120 kN at a distance of 6 m from LHS.

(d) A cantilever beam of span 6 m carries point loads of 8 kN, 6 kN and 4 kN at free end and 2 m, 4 m from free ends respectively. Draw SFD & BMD.

(e) A simply supported beam of span 5 m carries point loads of 15 kN and 30 kN at 1 m from left and right support respectively. Draw SFD & BMD.

(f) (i) State relation between shear force, bending moment and rate of loading.

(ii) Explain 'Point of Contraflexure' with suitable example.

4. Attempt any FOUR : 4 × 4 = 16

(a) A circular section of 100 mm diameter is subjected to a shear force of 5 kN, when used as a beam. Determine maximum and minimum shear stress induced. Sketch shear stress distribution diagram.

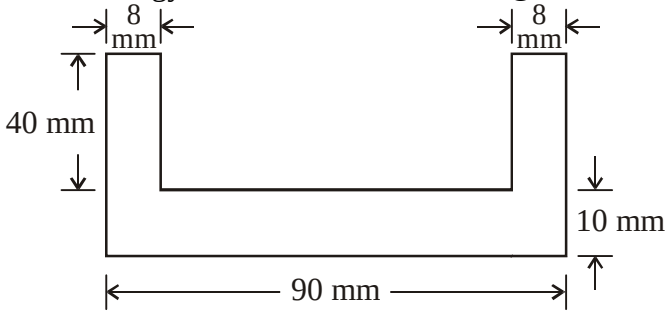
(b) A T-Section is used as a beam simply supported beam over a span 5 m. Calculate sate U.D.L., the beam can carry without exceeding bending stress of 160 MPa. For T-Section.

$I_{xx} = 45 \times 10^6$ mm^4. C_{xx} = 47.5 mm from Top of flange

Overall depth = 150 mm.

(c) Calculate I_{xx} of an inverted T-Section with flange 200 × 12 mm and web 350 × 10 mm.

(d) Calculate radius of gyration of channel section @ centroidal axis X-X.



(e) A mild steel I-Section is 400 mm overall deep with top and bottom flange 100 × 20 mm and web thickness is 10 mm. Find I_{yy} only.

(f) (i) State values of M.I. of triangle @ its base and centroidal axis.

(ii) State parallel axis and perpendicular axis theorem.

5. Attempt any FOUR : 4 × 4 = 16

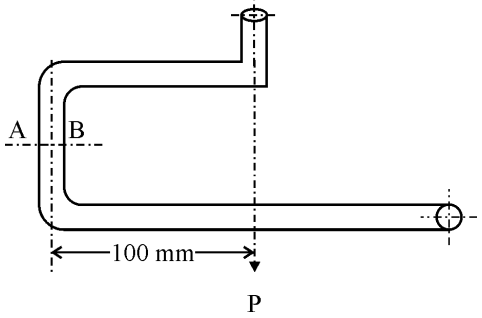
(a) A short mild steel column of external diameter 300 mm and 50 mm thickness carries an eccentric load of 200 kN. Find the greatest (maximum) eccentricity which the load can have without producing tension in column section.

(b) A rectangular beam 50 mm wide and 140 mm deep is simply supported over a span of 6 m carrying a U.D.L. of 5 kN/m. Find maximum bending stress.

(c) Calculate limit of eccentricity for a circular section having diameter = 40 mm.

(d) A rectangular column 100 mm thick and 200 mm wide is subjected to a load of 200 kN at an eccentricity of 80 mm in the plane bisecting thickness. Draw combined stress and stress distribution diagram.

(e) A mild steel tube 50 mm external diameter and 10 mm thick is bent in the form of a hook. What maximum load 'P' the hook can lift, if the stresses on c/s. AB should not exceed 100 MPa in tension and 25 MPa in compression ?



(f) Draw shear stress distribution diagram for T-Section and channel section showing position of maximum stress.

6. Attempt any FOUR : 4 × 4 = 16

(a) A solid circular shaft of diameter 100 mm and length 2.7 m is subjected to a torque of 30 kN.m. Assume, G = 75 GPa. Find maximum stress induced.

(b) State four assumptions made while analysis of 'Circular Shaft' subjected to Pure torsion.

(c) 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.

(d) A shaft transmitting 100 kW at 180 rpm. If the allowable stress in the material is 60 N/mm^2. Determine suitable diameter for the shaft. Provided the shaft do not twist more than 1° in 3 m length. Take C = 80 kN/mm^2.

(e) (i) Write torsion equation for shaft. State meaning of each term.

(ii) Define polar modulus. State its expression.

(f) If permissible shear stress in a hollow shaft of 100 mm diameter (external) and 60 mm internal diameter is subjected to a 2 kN.m twisting moment and if shaft rotates at 300 rpm. Find power transmitted by the shaft.

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