12043

21112

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

Instructions : (1) All Questions are *compulsory*.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data, if necessary.
(5) Use of Non-Programmable Electronic Pocket Calculator is permissible.
(6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. Attempt any TEN : **10 × 2 = 20**

(a) Define elasticity and elastic limit.
(b) State the relation between Young's modulus and bulk modulus.
(c) Define shear force and bending moment.
(d) In case of simply supported beam, state the point at which B.M. is maximum, when it is carrying full span U.D.L.
(e) Define radius of gyration, state its SI unit.
(f) Define the term 'Polar moment of Inertia'.
(g) State any four assumptions made in the theory of simple (pure) bending.
(h) Write the flexural formula. State the meaning of symbols used in it.
(i) Define the term limit of eccentricity.
(j) Define the term direct load with formula.
(k) Define torque or twisting moment. State its SI unit.
(l) Compare solid shaft and hollow shaft.

2. Solve any FOUR : **4 × 4 = 16**

(a) Define : (i) Factor of safety (ii) Limit of proportionality.
(b) The following observations were made during a tensile test on a mild steel specimen 40 mm in dia. and 200 mm long (elongation with 40 kN load (within limit of proportionality) $\delta\ell$ = 0.0304 mm; yield load = 161 kN. Max. load = 242 kN; length of specimen at fracture = 249 mm. Determine : (i) Young's Modulus (ii) Yield Stress (iii) Ultimate Stress (iv) Percentage Elongation.
(c) State Hooke's law and define Poisson's ratio.

(d) 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.

(e) A hollow cylinder has external dia. 100 mm and thickness of metal 10 mm. The length of cylinder is 800 mm, it carries an axial thrust of 240 kN. If E = 2×10^5 MPa & Poisson's ratio is 0.25 find (i) Change in length (ii) Change in diameter.

(f) Find the elongation of a rod tapering uniformly from 105 mm to 55 mm under the action of axial force of 40 kN. Length of the rod is 2 m & E = 2×10^8 kN/m^2.

3. Solve any FOUR : 4 × 4 = 16

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

(b) Draw S.F. & B.M. Diagram for a simply supported beam of span L carrying a central point load 'W'. State the max. SF & BM values.

(c) Draw SFD & BMD for a simply supported beam of span L carrying U.D.L. w/unit length over the entire span.

(d) A simply supported beam of span 7 m carries a udl of 2 kN/m over 4 m length from left support and a point load of 5 kN at 2 m from right support. Draw SF & BM diagrams.

(e) Draw SFD & BMD for the beam as shown in the Fig. 1.

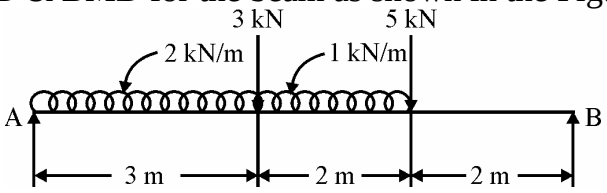

Fig. 1

(f) An overhanging beam is as shown in Fig. 2. Find the value of M_{max} & locate the point of contraflexure.

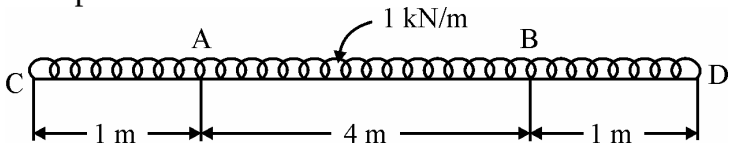

Fig. 2

4. Solve any FOUR : 4 × 4 = 16

(a) A steel rod 4.5 m long is at a temp. of 28 °C. Find the free expansion of the rod when the temp. is raised to 78 °C. If this expansion is completely prevented, find the magnitude and nature of temp. stress and strain developed.

(b) State parallel axis theorem and perpendicular axis theorem of moment of inertia.

(c) A hollow square has inner dimensions a × a and outer dimensions 2a × 2a find the moment of inertia about the outer side.

(d) A symmetrical 'T' section of overall depth of 300 mm has its flanges 150 mm × 10 mm and web 10 mm thick. Find the MI about its centroidal axis parallel to the flanges.

(e) Calculate the moment of inertia about centroidal axis for an angle section 200 × 200 × 20 mm size.

(f) Find the MI of the section shown in the fig. 3 about the vertical and horizontal axis passing through centre of gravity also find polar moment of inertia.

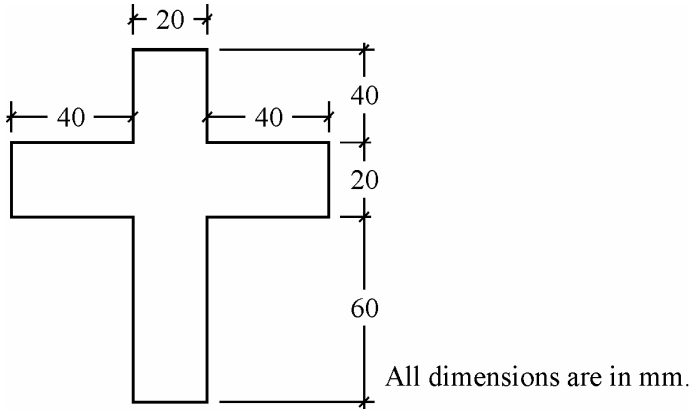

Fig. 3

5. Solve any FOUR : **4 × 4 = 16**

(a) A circular beam of 120 mm dia. is simply supported over a span of 10 m and carries a UDL of 1000 N/m find the max. bending stress produced.

(b) 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 σ_{max} & σ_{min}.

(c) A short mild steel column of external dia. of 200 mm and internal dia. 150 mm carries an eccentric load. Find the greatest eccentricity which the load can have without producing tension in the section of column.

(d) A 30 mm dia. rod is bent upto form an offset link as shown in Fig. 4 if permissible tensile stress is 80 MPa. Determine the max. value of P.

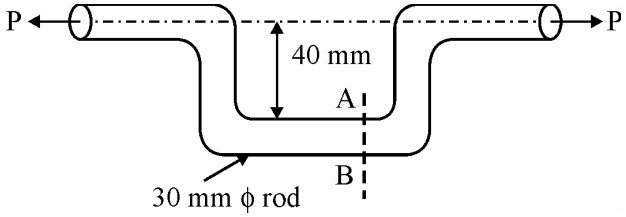

Fig. 4

(e) A rectangular rod of size 50 mm × 10 mm is bent into 'C' shaped as shown in Fig. 5 and applied load of 40 kN at point A. Calculate the resultant stresses developed at section X – X.

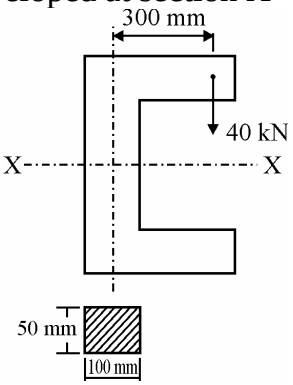

Fig. 5

(f) A 'C' clamp made up of rectangular cross-section 30 × 10 mm as shown in Fig. 6 is subjected to a force of 2.5 kN. Find the stresses induced at section AB.

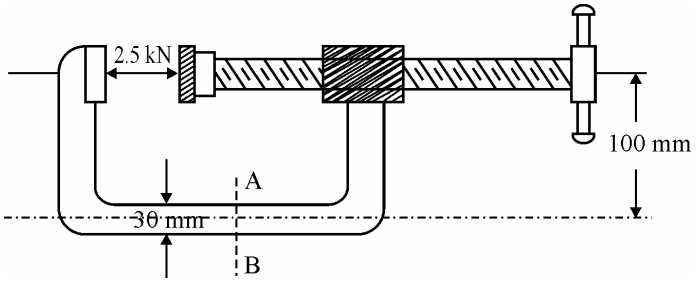

Fig. 6

6. Solve any FOUR : **4 × 4 = 16**

(a) 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 free end of this cantilever beam.

(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. E = 2 × 10^5 MPa.

(c) State any four assumptions in the theory of torsion in solid circular shaft.

(d) How the power of shaft can be calculated ? A circular shaft is rotating at 200 rpm calculate the power developed if torque is 40000 Nmm.

(e) Find the power transmitted by a solid shaft of dia. 60 mm running at 220 rpm if the permissible shear stress is 68 MPa. The max. torque is likely to exceed the mean torque by 25%.

(f) A hollow shaft is required to transit a torque of 24 kNm, the inside dia. is 0.6 time the outer dia. Calculate both diameter if allowable shear stress is 80 MPa.

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