17304

16172

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

Instructions – (1) All Questions are *Compulsory.*

(2) Figures to the right indicate full marks.

(3) Assume suitable data, if necessary.

(4) Use of Non-programmable Electronic Pocket Calculator is permissible.

(5) 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 elasticity and modulus of elasticity.

(ii) Define 'angle of obliquity'.

(iii) State the parallel axis theorem.

(iv) What do you mean by eccentric load? Show by simple sketch eccentrically applied load.

(v) State any four assumptions made in the theory of pure torsion.

(vi) Define bulk modulus.

(vii) Define hoop stress. State the formula.

(viii) State middle third rule.

Marks

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

(i) A metal rod 24 mm diameter and 2 meter 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 9.75 m is carrying full span u.d.l. of 10 kN/m. What is the magnitude and position of maximum bending moment developed?

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

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

a) (i) What is meant by modular ratio?

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

b) A circular steel bar of 10 mm diameter and 1.2 m long is subjected to a compressive load in a testing machine. Assuming both ends hinged, calculate Euler's crippling load. Also calculate safe load by considering factor of safety as 3. Take $E=2\times10^5$ N/mm^2.

c) A steel cube block of 50 mm side is subjected to a force of 6 kN (tensile) along X-direction; 8 kN (compressive) along Y-direction and 4 kN (tensile) along Z-direction. Determine change in volume of the block. Take E=200 GPa and $m = \frac{10}{3}$

d) A concrete column 300 mm × 300 mm is reinforced with 4 bars of 20 mm diameter and carries a compressive load of 400 kN. The modular ratio is 15. Calculate the stresses in steel and concrete. Also calculate the load shared by each material.

e) A cantilever beam of length 10 m carries two point loads of magnitude 20 kN and 30 kN at 4 m and free end respectively. Draw the S.F.D. and B.M.D.

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) Draw S.F. and B.M. diagram for a simply supported beam of span 'L' carrying a central point load 'W'. State the value of maximum shear force and maximum bending moment.

b) Define point of contraflexure. How is the point of contraflexure located for a beam?

c) A simply supported beam of 3 m span carries two point loads of 5 kN each at 1 m and 2 m from the left end A. Draw the shear force and bending moment diagram.

d) A beam 6 m long rests on two supports 5 m apart. The right end is overhang by 1 m. The beam carries a u.d.l. of 5 kN/m over the entire length of the beam. Draw S.F. and B.M. diagram.

e) A point in a strained material is subjected to two mutually perpendicular tensile stresses of 200 MPa and 100 MPa. Determine the intensities of normal, shear and resultant stresses on a plane inclined at 30° with the axis of minor tensile stress.

f) Find the M.I. of a 'T' section having top flange 200 mm × 20 mm and web 200 mm × 20 mm about the centroidal axis X-X and Y-Y.

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

a) Find the moment of inertia of a square of side 'a' about its outer edge.

b) A channel section 100 cm × 100 cm × 30 cm thick. Find the moment of inertia about centroidal axis X-X and Y-Y.

c) An isosceles triangular section ABC has base width 80 mm and height 60 mm. Determine the M.I. of the section about the C.G. of the section and the base BC.

d) A hole of 100 mm diameter is cut from a rectangular plate 600 mm wide and 400 mm deep. The centre of hole is at 160 mm from the edge on an axis bisecting shorter side. Find M.I. of remaining plate about X-X and Y-Y axis.

Marks

e) State any four assumptions 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 u.d.l. 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) A circular section of diameter 'd' is subjected to load 'P' eccentric to the axis Y-Y (vertical) The eccentricity of load is 'e'. Obtain the limit of eccentricity such that no tension is induced at the section.

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. Also draw stress distribution diagram.

d) A square column 300 mm × 300 mm carries an axial load of 200 kN. Find the position of 30 kN load acting along the axis bisecting the width of the cross-section so that the stress developed at the other extreme of the column will be zero.

e) A square pillar is 600 mm × 600 mm in section. At what eccentricity a point load of 6000 kN be placed on one of the centroidal axis of the section so as to produce no tension in the section.

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'.

Marks

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

a) A hollow shaft is of the same external diameter as that of the solid shaft. The inside diameter of the hollow shaft being half the external diameter. Both the shafts have the same material and length. Then show that the ratio of torque transmitted by hollow shaft to the torque transmitted by solid shaft is 0.9375.

b) A shaft is transmitting 150 kW at 200 RPM. If allowable shear stress is 80 N/mm^2 and allowable twist is 1.5° per 4 m, find the diameter of shaft. Take $C = 0.8 \times 10^5$ N/mm^2.

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

d) Select a suitable diameter for a solid shaft to transmit 200 hp. at 180 rpm. The allowable shear stress is 80 N/mm^2.

e) A hollow shaft is of external diameter and internal diameter 400 mm and 200 mm respectively. Find the maximum torque it can transmit, if the angle of twist is not to exceed 1.5° in a length of 10 m. Take $C = 0.8 \times 10^5$ N/mm^2.

f) (i) Differentiate between pure bending and ordinary bending.

(ii) Write the equation of torque transmitted by the O.C. shaft giving meaning and unit of each term.
