17304

21819

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

(i) Define brittleness. Name two brittle materials.

(ii) Define principal plane and principle stress.

(iii) Define radius of gyration. State its S.I. units.

(iv) Define the term direct stress with formula.

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

(vi) Define factor of safety.

(vii) Write the equation of circumferential stress in thin cylinder and explain each term.

(viii) Define the term core of a section.

Marks

b) **Attempt any <u>TWO</u> of the following:** **8**

(i) A steel rod 800 mm long and 60 mm x 20 mm in cross–section is subjected to an axial push of 89 kN. If the modulus of elasticity is 2.1×10^5 N/mm^2. Calculate the stress strain and reduction in the length of the rod.

(ii) A simply supported beam of span 7 m carries a uniformly distributed load 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 SF & BM diagram.

(iii) Determine the maximum bending stress developed in a beam of rectangular cross section 50 mm × 150 mm when a bending moment of 600 Nm is applied about x-x axis.

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

a) (i) Draw a stress-strain diagram of M.S and show silent point on it.

(ii) State Euler's formula and write the meaning of symbols used.

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 determine Euler's crippling load. $E = 2 \times 10^5$ N/mm^2. Also calculate the safe load if factor of safety is 3.

c) A steel rod 10 mm diameter and 2 m in length is at 25°C. Find the new length of rod if the temperature is raised to 70°C, Find the magnitude and nature of the force required to prevent this expansion. $E_s = 2 \times 10^5$ N/mm^2 and $\alpha_s = 12 \times 10^{-6}$/°C.

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

Marks

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 shell 3 m long and 1 m in diameter is subjected to an internal pressure of 1 MPa. If the thickness of the cylindrical shell is 12 mm, find the change in volume of cylindrical shell. Take E = 2 $\times 10^5$ N/mm^2 and Poisson's ratio = 0.3.

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

a) Draw S.F and B.M diagrams for a simply supported beam of span L carrying a central point load W. Find the maximum S.F and maximum B.M.

b) (i) Enlist various types of beam. Draw neat sketches.

(ii) Define point of contraflexture with a neat sketch.

c) A simply supported beam of span 5 m carries two point loads of 5 kN and 7 kN at 1.5 m and 3.5 m from the left hand support respectively. Draw S.F.D and B.M.D showing the important values.

d) A cantilever beam of span 2.5 m carries three point loads of 1 kN, 2 kN and 3 kN at 1 m, 1.5 m and 2.5 m from the fixed end. Draw S.F.D and B.M.D.

e) Draw bending moment and shear force diagram of a cantilever beam AB 4 m long having its fixed end at A and loaded with a uniformly distributed load of 1 kN/m up to 2 m from B and with a concentrated load of 2 kN at 1 m from A.

f) Find the moment of inertia of a rectangle 60 mm × 200 mm about its 200 mm edge.

Marks

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

a) State parallel axis theorem and perpendicular axis theorem of MI along with sketches.

b) Calculate MI of a T-section about the centroidal axis XX. Top Flange is 1200 × 200 mm and web is 1800 × 200 mm. Total height is 2000 mm.

c) A symmetrical I-section of overall depth of 300 mm has its flanges 150 mm x 10 mm and web 10 mm thick. Find the moment of inertia about its centroidal axis, parallel to the flanges.

d) A base 'b' of an equilateral triangle is horizontal show that the centroidal moment of inertia with respect to horizontal and vertical axis are equal. State the value of moment of inertia in terms of 'b'.

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

f) Draw shear stress distribution diagram for a circular section and locate the position of maximum shear stress.

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

a) 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.

b) A shaft column 200 mm × 200 mm is subjected to an eccentric load of 95 kN at an eccentricity of 65 mm in the plane bisecting the two opposite faces. Find the maximum and minimum intensities of stress of the base section.

c) A masonary wall 6 m high, 2 m thick and 1 m wide is subjected to a horizontal wind pressure of 5 kN/m^2 on 1 m face. Find the values of resultant stresses at base of the wall masonary weights 20 kN/m^3.

d) A rectangular rod of size 50 mm × 100 mm is bent into C-shape and a load of 40 kN is applied at a distance of 40 mm from the centre of vertical side (eccentricity). Calculate the resultant stresses developed at centroidal section.

Marks

e) Calculate the limit of eccentricity for a circular section having diameter 50 mm.

f) Calculate the power transmitted by a shaft of 300 mm, with a speed of 200 rpm. If permissible shear stress is 120 N/mm^2. Take maximum torque as 30% more than average torque.

6. Attempt any FOUR of the following: 16

a) State the assumption (any four) made is theory of pure torsion.

b) A solid circular shaft of 120 mm diameter is transmitting power of 100 kN at 150 rpm. Find the intensity of the shear stress induced in the shaft. Take $T_{max} = 1.4\ T_{avg}$.

c) A hollow circular shaft has internal diameter $3/4^{th}$ of the external diameter and transmits 500 kN at 120 rpm. If the shear stress is limited to 80 N/mm^2 and the angle of twist is not to exceed 1.4 in 3 m length. Calculate the external and internal diameter take C = 84 kN/mm^2.

d) Find the power that can be transmitted by a shaft 40 mm diameter rotating at 200 rpm, if the maximum permissible shear stress is 85 MPa.

e) A hollow shaft is required to transmit a torque of 24 kNm. The inside diameter is 0.6 times the external diameter. Calculate both the diameters if the allowable shear stress is 80 MPa.

f) (i) Define neutral axis.

(ii) Define the term ‘torsional rigidity‘.