Con. 6901–13. **LJ–10313**

(3 Hours) **[Total Marks : 100**

N.B. • *Q1 is compulsory. Answer any FOUR from the remaining six questions.*
- *Assume suitable data, wherever required. State the assumptions and justify the same.*
- *Illustrate answers with sketches, wherever required.*
- *Write legibly with blue or black ink pen. Use pencil only to draw diagrams and graphs.*

1. Answer any four :–

a) For a given material, Young's Modulus is 110 GN/m^2 and Shear Modulus is 42 GN/m^2. Find the bulk modulus and lateral contraction of a round bar of 37.5 mm diameter and 2.4 m length, when stretched to 2.5 mm. **[05]**

b) A beam of 15 m long simply supported at 1.25 m from each end carries a concentrated load of 4 kN at each extreme end. Sketch the shear force and bending moment diagrams. **[05]**

c) Derive the torsion formula, $T/J = G\theta/l = \tau/R$. **[05]**

d) A steel specimen 1.5 cm^3 in cross section stretches 0.5 cm gauge length under an axial load of 30 kN. Calculate the strain energy stored in the specimen at this point. If the load at the elastic limit for the specimen is 50 kN, calculate elongation at the elastic limit. **[05]**

e) What do you mean by core of a section? Give the limit of eccentricity for (i) a rectangular section (ii) circular section. **[05]**

f) A symmetrical section 200 mm deep has a moment of inertia 2.26 x 10^{-5} m^4 about the neutral axis. Determine the longest span, over which when simply supported, the beam would carry a uniformly distributed load of 4 kN/m for the entire span, if the stress due to bending does not exceed 125 MN/m^2. **[05]**

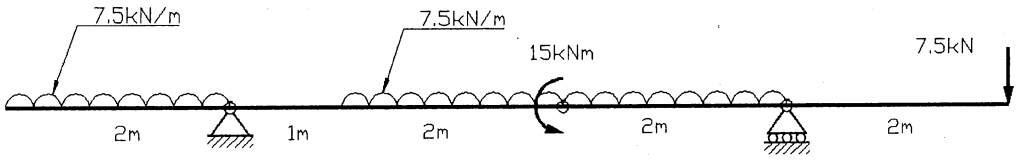
2.a) A concrete column of cross section 400 mm x 400 mm is reinforced with four steel bars of 50 mm diameter placed at each corner. If the column carries a load of 300 kN, determine **[10]**

(i) Load carried by concrete and steel bars

(ii) Compressive stress produced in concrete and steel bars

b) Direct stress of 120 MN/m^2 in tension and 90 MN/m^2 in compression are applied to an elastic material at a certain point on planes right angles to another. If the maximum principal stress is not to exceed 150 MN/m^2 in tension, to what shear stress can the material be subjected? What is then the maximum shear stress in the material? Also, find the other principal stress and its inclination with 120 MN/m^2. **[10]**

3.a) Construct the shear force and bending moment diagram for the beam shown in the figure. **[10]**



b) A simply supported beam of 100 mm wide and 150 mm deep carries a uniformly distributed load over a span of 2 m. If the permissible stress in bending is 28 N/mm^2 and in shear is 2 N/mm^2, calculate maximum load per metre run, which can safely be carried. **[10]**

4.a) A symmetrical I-section has flanges 50 mm x 5(mm and web 109 mm x 3.5 mm. It is subjected to a shearing force of 10 kN. Draw the shear force distribution diagram. **[10]**

b) A beam 4 m long is freely supported at the ends. It carries concentrated loads of 20 kN each at points 1 m from the ends. Calculate the maximum slope and deflection of the beam and slope and deflection under each load. **[10]**

$EI = 13000\ kNm^2$.

5. a) A copper cylinder 900 mm long 40 mm external diameter and 6 mm wall thickness has both ends closed by rigid blank flanges. It is initially full of oil at atmospheric pressure. Calculate the additional volume of the oil, which must be pumped into it, in order to raise the oil pressure 5 N/mm^2 above atmospheric pressure. For copper, E= 100 GN/m^2 and Poisson ratio= 1/3. Bulk modulus of oil= 2.6 GN/m^2. **[10]**

b) A flitched timber beam consists of two joists 100 mm wide and 300 mm deep with a steel plate 200 mm deep and 15 mm thick placed symmetrically in between and clamped to them. Calculate the total moment of resistance of the section, the allowable stress in the timber is 9 N/mm^2. **[10]**

6. a) While transmitting power of a steam engine, the angle of twist of a rotating shaft was measured as 1.2° over a length of 6 m. The external and internal diameters of the shaft are 250 mm and 170 mm respectively. The rotational speed of the shaft is 250 RPM and shear modulus is 80 GPa. Determine the power transmitted and maximum shear stress developed in it. **[10]**

b) A column 2.5 m long is pin-connected at both ends. It has 50 mm x 100 mm rectangular cross section. Young's Modulus of material is 2 x 10^5 MPa. Determine, **[10]**

(i) Slenderness Ratio

(ii) Euler buckling load

(iii) Safe load, if factor of safety is 2.5

7. a) A rectangular strut 200 mm wide and 150 mm thick carries a load of 60 kN at an eccentricity of 20 mm in a plane bisecting the thickness. Find the maximum and minimum intensities of stress in the section. **[10]**

b) An unknown weight fall through a height of 10 mm on a collar rigidly attached to the lower end of a vertical bar 5 m long and 600 mm^2 in section. If the maximum extension of the rod is to be 2 mm, what is the corresponding stress and magnitude of the unknown weight? E= 200 GN/m^2. **[10]**