Time - 03 Hours **Total marks – 80**

N.B.: 1. Question No **1** is **compulsory**
2. Attempt any **Three** questions from the remaining five questions.
3. Assume any **suitable data** if necessary with justification.
4. Figures to the right indicate full marks.

Q1. Attempt any **four** of the following questions.

(a) Draw the shear force and bending moment diagram for a simply supported beam of span L carrying a concentrated load W at the centre. **05**

(b) Draw stress-strain diagram for a ductile material and explain. **05**

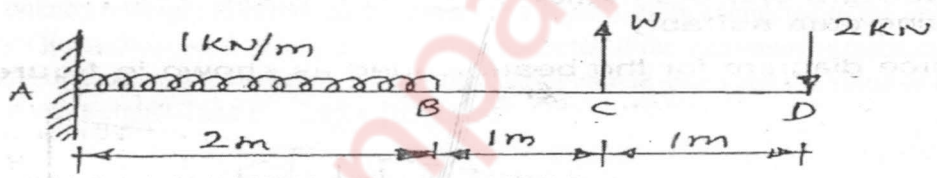
(c) Obtain the core of section for Rectangular Section. **05**

(d) What is pure Torsion? State the assumption made in the theory of pure torsion. **05**

(e) Define the following terms: **05**
a) Stress, b) Strain, c) Modulus elasticity, d) Modulus of rigidity, e) Poisson's ratio.

Q2. **(a)** A tube of aluminum 40 mm external diameter and 20 mm internal diameter is fitted on a solid steel rod of 20 mm diameter. The composite bar is loaded in compression by an axial load P. Find the stress in aluminum, when the load is such that the stresses in steel is 70 N/mm^2. Also find the value of P. **10**
Take $E_S=2 \times 10^5$ N/ mm^2; $E_{Al}= 7 \times 10^4$ N/ mm^2

(b) For the beam loaded as shown in figure, find the value of W such that Bending Moment at the support is zero. Draw S.F. and S.M. diagrams with the value of W. **10**



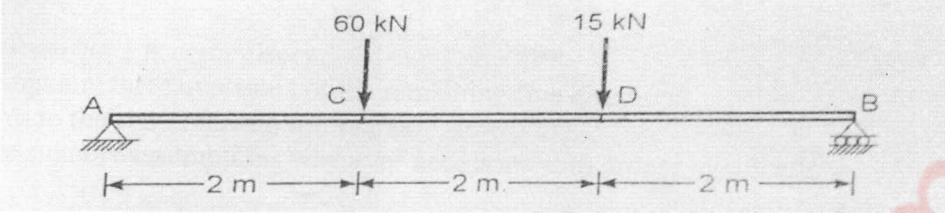
Q3. **(a)** A cantilever beam has a length of 2 m. It is of 'T' section with the flange of 100 mm x 15 mm, web 200 x 10 mm. Determine the maximum load per m run that can be applied if the maximum tensile stress is not to exceed 25 N/mm^2. **10**

(b) A 4 m long cast iron hollow column with both ends firmly fixed supports an axial load of 250 KN. The inside diameter of the column is 0.8 times the external diameter. Determine the section of the column by Rankine's formula. Assume factor of safety to be 5. Take σ_c=550 N/mm^2 and α=1/1600. **10**

Q4. **(a)** A hollow shaft of diameter ratio 3/5 is to transmit 250 kW at 70 rpm. The maximum torque being 20% greater than mean. The shear stress is not to exceed 60 N/mm2 and twist in a length of 4 m is not to exceed 3 degrees. Calculate the external and internal diameters which would satisfy both the above conditions. Take G = 8 x 104 N/mm2. **10**

(b) At a point in a strained body there are normal stresses of 120 MPa and 80 MPa both tensile together with a shear stress of 40MPa, acting on two mutually perpendicular planes. Locate the principal planes and principal stresses. Also find maximum shear stress. **10**

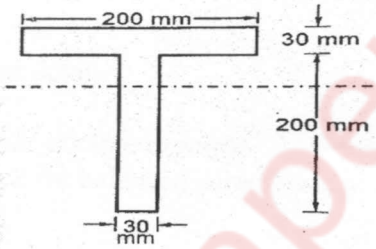
Q5. **(a)** Find the position and magnitude of maximum deflection for the beam loaded as shown in figure. Take E = 200 GPa and moment of inertia of cross section I=4 x 10^7 mm^4. **10**



(b) State the assumptions made in the theory of pure bending and prove: **10**

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

6. **(a)** A Tee beam section is as shown in figure, is subjected to a vertical shear force of 100 KN. Calculate shear stresses at all critical sections and draw shear stress distribution diagram. **10**



(b) An unknown weight falls though 10 mm on to a collar rigidly connected to the lower end of the vertical bar 4 m long and 30 mm in diameter. If the maximum instantaneous extension is known to be 4 mm, what is the corresponding stress and the value of the unknown weight? Take E = 2.05 x 10^5 N/mm^2. **10**