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 carrying a concentrated load not at mid span. **05**

(b) Draw a Mohr's circle diagram for two mutually perpendicular direct stresses. **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 10 mm steel rod passes centrally through a copper tube of 25mm external diameter and 15 mm internal diameter and 2.5 m long. Tube is closed at each end by 25 mm thick steel plates secured by nuts. The nuts are tightened until the copper tube is reduced in length by 0.8 mm. The complete assembly then raised in temperature by 30 degree centigrade. Determine the stresses in steel and copper tubes before and after the rise in temperature. **12**

Take, $E_s = 2x10^5$ N/mm^2 , $E_c = 1x10^5$ N/mm^2,

Coefficient of thermal expansion of steel = $12x\ 10^{-6}/^0$ C

Coefficient of thermal expansion of copper = $18 \times 10^{-6}/^0$ C.

(b) A 5 m long cast iron hollow column with both ends firmly fixed supports an axial load of 500 KN. The inside diameter of the column is 0.6 times the external diameter. Determine the section of the column. Assume factor of safety to be 5. **08**

Take σ_c=550 N/mm^2 and α=1/1600.

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. **12**

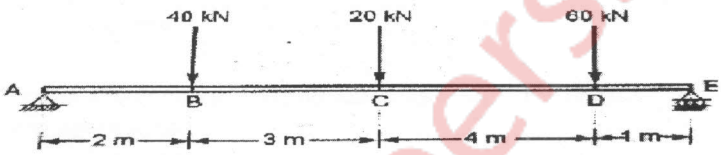
(b) An unknown weight falls though 8 mm on to a collar rigidly connected to the lower end of the vertical bar 4 m long and 800 mm^2 in section. If the maximum **08**

instantaneous extension is known to be 3 mm, what is the corresponding stress and the value of the unknown weight? Take E = 2 x 10^5 N/mm^2.

Q4. **(a)** A hollow circular shaft of 4 m long is to transmit 150 kW power at 150 rpm. If the total angle of twist in this length and the allowable shear stress are not to exceed 2.5 degrees and 60 N/mm^2 respectively, determine the inside and outside diameters. Take G = 8 x 10^4 N/mm^2. **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**

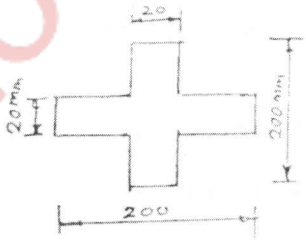
Q5. **(a)** Find the deflections of points B and C for the beam shown in figure. Assume EI =constant. Point A is a fixed support and point E is a roller support in the figure. **12**



(b) State the assumptions made in the theory of pure bending and prove: **08**

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

6. **(a)** Determine the maximum shear force the beam can withstand if the shear stress should not exceed 37 MPa. Draw the shear stress distribution diagram for the cross-section. The cross-section of the beam is plus shaped as shown below. **10**



(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**