(3 Hours) **[Total Marks: 80]**

N.B.: 1. Question number 1 is compulsory.
2. Attempt any THREE questions from Q2 to Q6.
3. Figures to the right indicates maximum marks.

Q1 Attempt **any FOUR** of the following: **20**

(a) Define:
1. Strain energy
2. Resilience
3. Proof resilience
4. Proof stress
5. Modulus of resilience

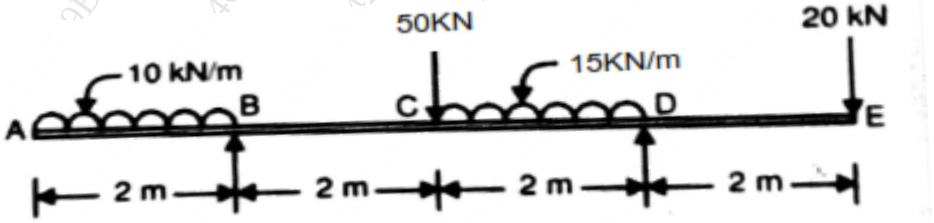
(b) State assumptions made in Euler's theory of column

(c) A rod of 40 mm diameter and 2 m length is stretched by 2.5 mm. Young's modulus for material is 120 GPa and modulus of rigidity is 40 MPa. Take poisons ratio as 0.25. Find out lateral contraction of rod and bulk modulus.

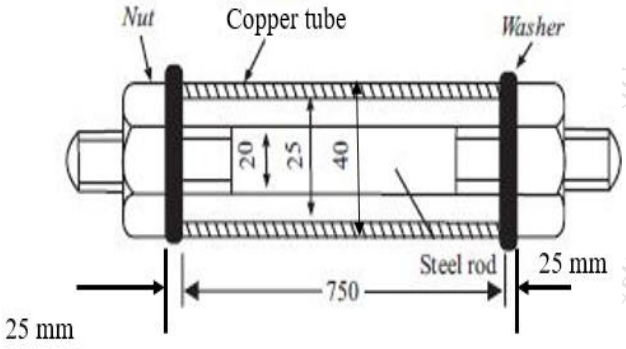
(d) Calculate slope at the support of a simply supported beam of 10 m length acted upon by a point load of 25 kN at centre of beam.

(e) Draw SFD for a cantilever beam of 5 m length loaded with UDL of 100 kN/m for entire length of beam and a point load of 50 kN at free end.

Q2 **(a)** Draw shear force and bending moment diagrams for the beams loaded as shown in figure. **10**



(b) A 20 mm steel rod passes centrally through a copper tube of 40 mm external diameter and 25 mm internal diameter and 750 mm 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. Calculate the stresses in the tube and rod due to tightening. Take, $E_s = 2 \times 10^5 N/mm^2$, $E_c = 1 \times 10^5 N/mm^2$. **10**



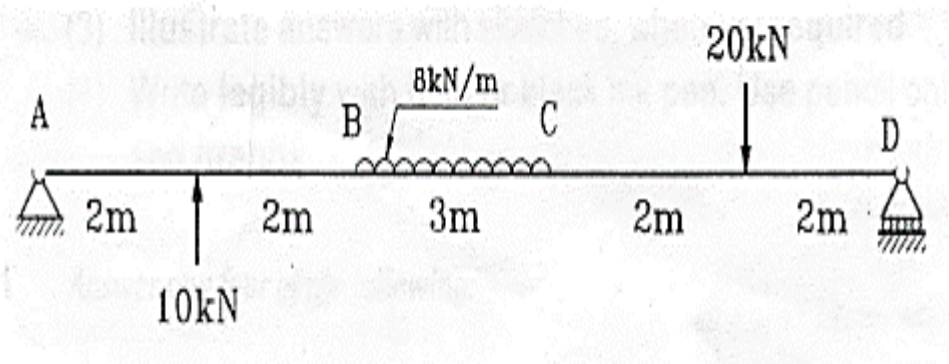
Q3 **(a)** Two mutually perpendicular planes of an element of material are subjected to tensile stress of 105 MPa, compressive stress of 35 MPa and shear stress of 70 MPa. Find graphically or otherwise, **10**

i. Magnitude and the direction of principal stresses

ii. Magnitude of the normal and the shear stresses on a plane, on which the shear stress is maximum.

(b) An unknown weight falls through 8 mm on a collar rigidly attached to the lower end of a vertical bar, 4 m long and 400 mm^2 in section. If maximum instantaneous extension is known to be 3 mm, what is the corresponding stress and the value of unknown weight? Take E= $2X10^5$ N/mm^2. **10**

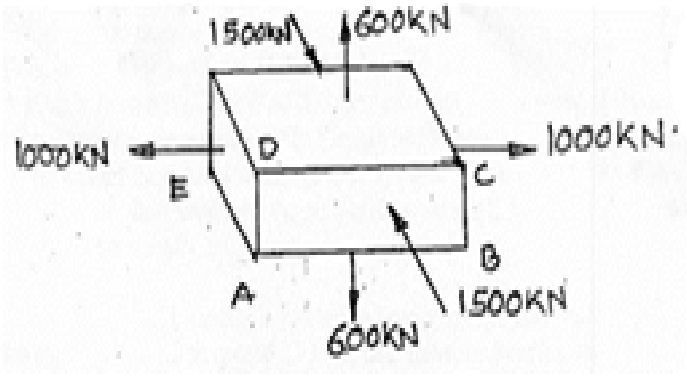
Q4 **(a)** Find slope at point D, Deflections at point B for a beam shown in Fig. Also find the maximum deflection. Take E = 2 X 10^5 N/mm^2 and I = 300 X 10^8 mm^4. **10**



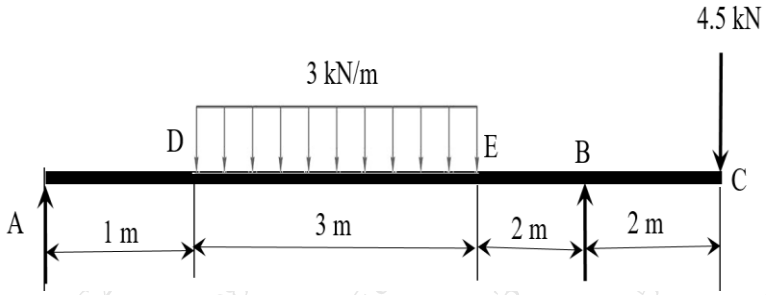
(b) A hollow cast iron column has outside diameter 200 mm, it is 4.5 m long and is fixed at both ends. Determine the safe load the column can carry using Rankine's formula. Take metal thickness = 20 mm, σ_C = 550 MPa, $1/\alpha = 1600$ and E = 90GPa, FOS = 4 **10**

Q5 **(a)** A closed cylindrical vessel, 4 mm thick carries fluid under a pressure of 3 N/mm^2. The diameter of the cylinder is 250 mm and length is 750 mm. Calculate the longitudinal and hoop stresses in the cylinder wall of the cylinder. Also calculate maximum shear stress and change in dimensions. Take E = $2X10^5$ N/mm^2, 1/m = 0.3. **10**

(b) A rectangular block is loaded as shown in figure. Find the change in dimensions and also change in its volume. Take Poisson's ratio = 0.3, E=210 GPa, AB=400 mm, BC=120 mm, AE=250 mm. **10**



Q6 **(a)** For the beam loaded as shown in figure determine deflection at point C and slope at point A. **10**



(b) For the beam loaded as shown in figure draw the Shear force and bending moment diagram. **10**