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

N.B. 1. Question No.1 is compulsory.
2. Answer any three questions from remaining questions.
3. Assume suitable data if required.
4. Figure to the right indicates full marks.

Q.1 Answer any four of the following. **20**

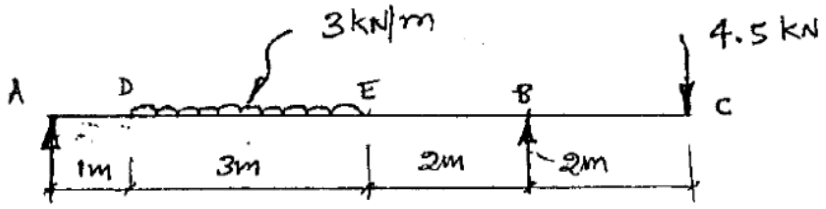
a. What are different types of column end conditions? Explain with giving relation for equivalent lengths of columns for various end conditions.
b. Write the assumptions made in theory of pure torsion and derive torsional formula.
c. Draw the stress strain curve for ductile materials and explain the salient points on it.
d. A simply supported beam of span 4 m is carrying a uniformly distributed load of 2 kN/m over the entire span. Find the maximum slope and deflection of the beam. Take EI for the beam as 80×10^9 N-mm^2.
e. State Assumptions in theory of simple bending. Also derive Bending equation.

Q.2 a. Find the Euler's crippling load for a hollow cylindrical steel column of 38 mm external diameter and 2.5 mm thick. Take length of the column as 2.3 m and hinged at its both ends. Take E = 205 GPa. Also determine crippling load by Rankine's formula using constants as 335 MPa and 1/7500. **10**

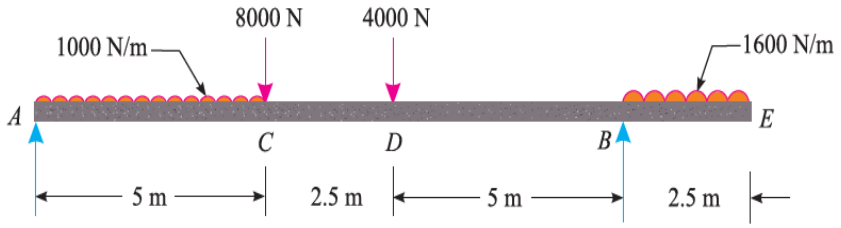
b. A hollow shaft of diameter ratio 3/5 is to transmit 250 KW at 70 rpm. The maximum torque is 20 % greater than mean torque. The shear stress is not to exceed 60 MPa and twist in length of 4m is not to exceed 3^0. Calculate the external and internal diameters which would satisfy both the above conditions. Take modulus of rigidity G= 80 GPa. **10**

Q.3 a. An unknown weight falls through 8 mm on a collar rigidly attached to the lower end of a vertical bar, 4000 mm long and 40mm * 10 mm in section. If maximum instantaneous extension is 3 mm what is the corresponding stress and value of unknown weight? Take E = 2 x 10^5 N/mm^2. **10**

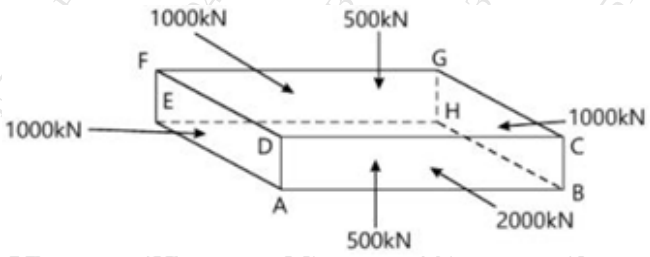
b. Determine the deflection at free end C for the overhanging beam ABC supported and loaded as shown in fig. Take E= 200GPa, I= 13.5 * 10^{-6} m^4. **10**



Q.4 a. Draw shear force and bending moment diagrams for the beam. Indicate the values at all important sections. **10**



b. Compute change in dimensions, change in volume, stress and strain induced in all directions for Figure. Take μ=0.3, E=210Gpa, AB=500mm, BC=200mm and AE= 400mm. **10**



Q.5 a. The stresses at a point of a machine component are 150 MPa and 50 MPa both tensile. Find the intensities of normal, shear and resultant stresses on a plane inclined at an angle of 55° with the axis of major tensile stress. Also find the magnitude of the maximum shear stresses in the component. **10**

b. Two wooden planks 150 mm × 50 mm each are connected to form a T section of a beam. If a moment of 6.4 kN-m is applied around the horizontal neutral axis, inducing tension below the neutral axis, find the bending stresses at both the extreme fibers of the cross- section. **10**

Q.6 a. A cylindrical thin drum 800 mm in diameter and 4 m long is made of 10 mm thick plates. If the drum is subjected to an internal pressure of 2.5 MPa, determine its changes in diameter and length. Take E as 200 GPa and Poisson's ratio as 0.25. **10**

b. An aluminium rod of 20 mm diameter is completely enclosed in a steel tube of 30 mm external diameter and both the ends of the assembly are rigidly connected. If the composite bar is heated through 50°C, find the stresses developed in the aluminium rod and steel tube. Take: **10**
Modulus of elasticity for steel = 200 GPa
Modulus of elasticity for aluminum = 80 GPa
Coefficient of expansion for steel $= 12 \times 10^{-6}$/ °C
Coefficient of expansion for aluminium = 18×10^{-6}/°C
