1T01433 - S.E.(Mechanical) Engineering)(SEM-III)(Choice Base Credit Grading System) ((R- 19) (C Scheme) / 51622 - Strength of Materials QP CODE: 10037426 DATE: 23/11/2023

3 Hours ***Total Marks: 80***

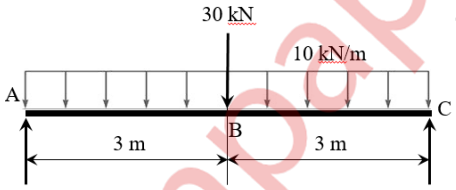
N.B.

1. Question no. 1 is compulsory**.**
2. Attempt any **THREE** from **remaining questions.**
3. Figures to the right indicates maximum marks.
4. Assume suitable data if needed and state it clearly.

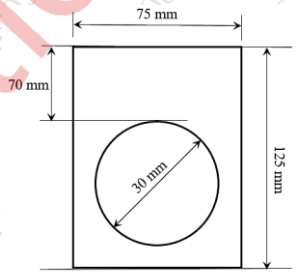
Q1 Attempt any **FOUR** of the following. **(20M)**

a) A bar of 30 mm diameter and 300 mm length is subjected to a tensile load of 54×10^3 N. The change in length is 0.112 mm and the change in diameter is 0.00366 mm. Calculate poisons ratio and modulus of elasticity.

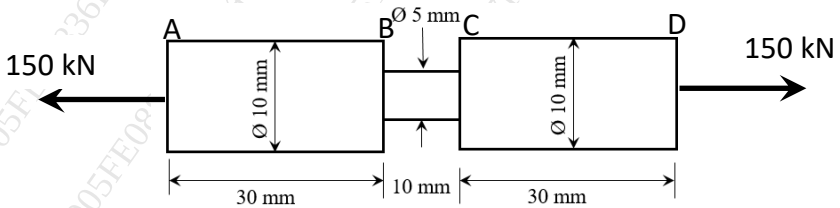
b) A simply supported beam AB is acted upon by UDL of 10 kN/m intensity over the entire length of 6 m and a point load of 30 kN exactly at the middle. Draw shear force diagram for the beam.



c) Calculate the section modulus about horizontal neutral axis for the section of the beam shown below.

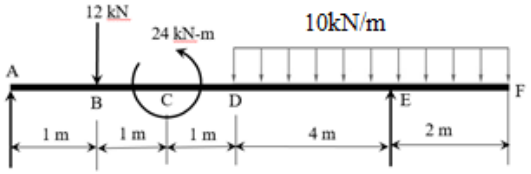


d) A circular shaped machine member shown in figure is acted upon by the load of 150 kN. Calculate the strain energy of the member.
Take E = 200×10^3 N/mm^2.

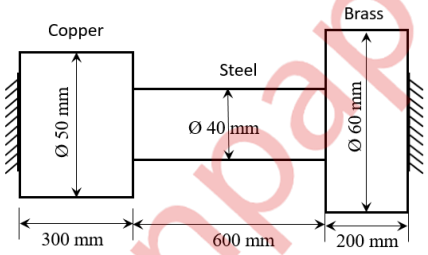


e) State assumption in the theory of pure torsion.

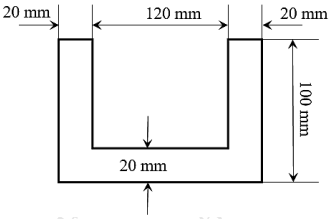
Q2a) An overhanging beam with supports at points A and E is loaded as shown in figure. Draw shear force and bending moment diagram for the beam. **(10M)**



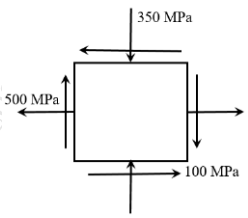
Q2b) A composite bar of circular section made up of copper, steel and brass is rigidly attached at the ends. Determine the stresses in the three portions of the bar, if the temperature of the bar is raised by 70°C. Take E for copper, steel and brass as 100 GPa, 205 GPa and 95 GPa, respectively and coefficient for linear expansion as 18×10^{-6} per °C, 11×10^{-6} per °C and 19×10^{-6} per °C, respectively. **(10M)**



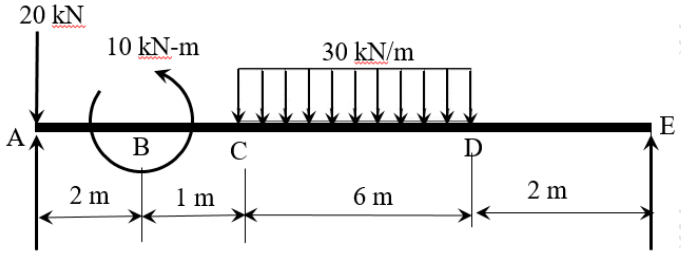
Q3a) The section of a beam as shown in figure is acted upon by the maximum sagging bending moment of 4 kNm. Calculate the maximum bending stress intensity induced in the beam. Also, draw the bending stress distribution diagram. **(10M)**



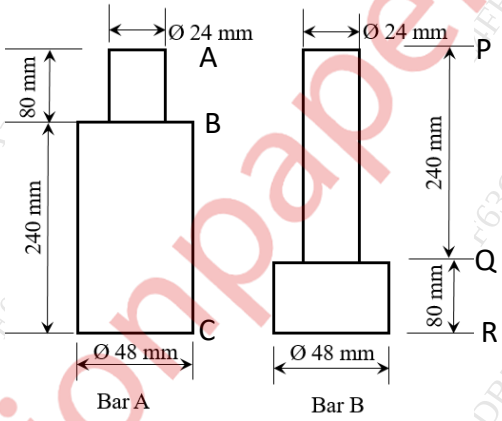
Q.3b) An element in a stressed material has tensile stress intensity of 500 MPa and compressive stress intensity of 350 MPa acting on two mutually perpendicular planes. A shear stress of 100 MPa accompany theses stresses as shown in figure. Find the principal stresses, maximum shear stress and position of principal planes. Verify the answer graphically using Mohr's circle method. **(10M)**



Q4a) For the beam loaded as shown in figure, determine the deflections at point C and D and slope at point A. **(10M)**



Q.4b) The two bars shown in figure are made up of same material and each of 320 mm in length. An axial blow to bar A produces maximum stress of 160 N/mm^2. Determine, for same axial blow, the maximum stresses produced in the bar B. Take E = 200×10^3 N/mm^2. **(10M)**



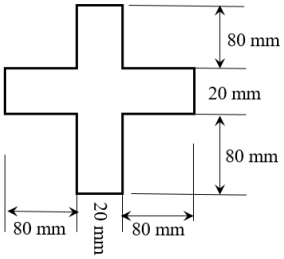
Q5a) A hollow shaft of diameter ratio 3/8 is required to transmit 600 kW at 110 RPM. The maximum torque being 20% greater than the mean torque. The shear stress is not to exceed 63 N/mm^2 and the angle of twist in a length of 3 m not to exceed 1.4°. Calculate maximum estimated external diameter of the shaft for these conditions. Take Modulus of rigidity as 84×10^3 N/mm^2. **(10M)**

Q.5b) A thin cylindrical tube of 200 mm internal diameter and 600 mm in length is 6 mm thick. The tube is filled with water at 8 N/mm^2. **(10M)**

Assuming E = 210×10^3 N/mm^2 and poisons ratio of 0.25, determine:

1. Circumferential and longitudinal stresses
2. Change in length
3. Change in diameter
4. Change in volume

Q6a) A 4 m long simply supported beam is in the form of cross bar as shown in figure. It carries a UDL of 40 kN/m over the entire length. Calculate the maximum shear stress and draw shear stress distribution diagram for the given section. **(10M)**



Q.6b) A column of I-section with both ends fixed has cross sectional dimensions as shown in figure. The length of the column is 12 m. Determine the safest load it can carry using Eulers column theory. **(10M)**

Take E = 205 GPa and factor of safety as 5.