(03 Hours) **Total Marks: 80**

Instructions:

1. Question No. 1 is **compulsory**
2. Answer **any three** from the remaining.
3. Each full question carries **20 marks.**
4. **Assume** suitable data, if needed and state it clearly.

Q. 1 Attempt any **four** Marks

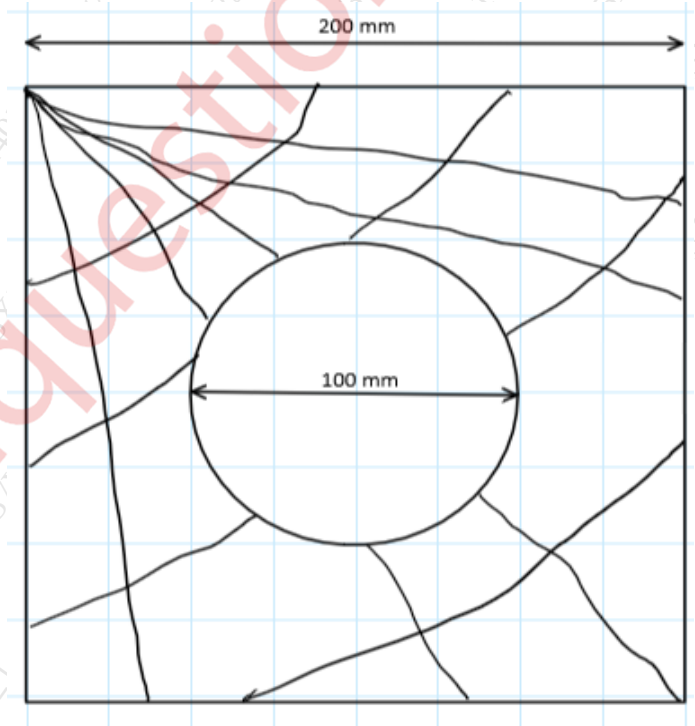
a Establish relationship between Young's Modulus, Bulk Modulus and Shear Modulus. **5**

b Draw Shear force diagram and Bending moment diagram for a simply supported beam carrying a UVL of intensity zero and 20 kN/m at left support and right support respectively. **5**

c Define core or kernel of a section, Locate the Core of the solid rectangular section having a width of 300 mm and a depth of 400 mm. **5**

d Define strain energy. Derive the expression for strain energy due to suddenly applied axial load. **5**

e A timber beam has a square cross section (200 mm x 200 mm). A 100 mm diameter hole is punched at the centre of the beam. Calculate Moment of inertia along both the axes. **5**



f Discuss virtual work theorem and Castigliano's theorems. **5**

Q. 2

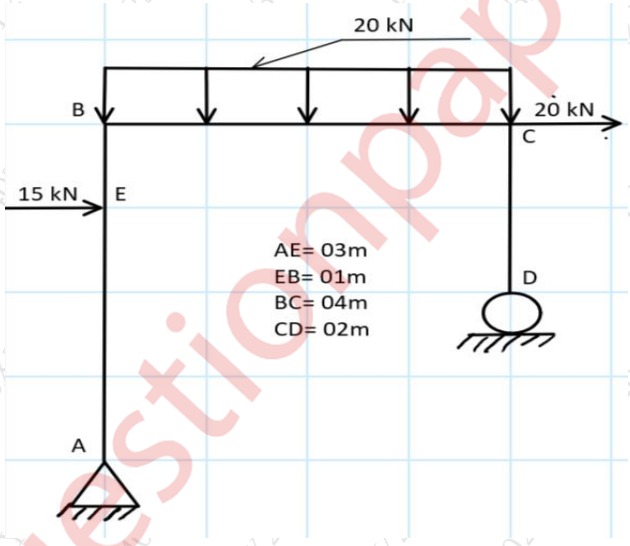
a A T-beam of span 5 m is simply supported. Flange is (200 mm X 20 mm) and web is **10**

(20 mm X 180 mm). Maximum permissible bending stress is 200 MPa. Determine the maximum UDL which the beam can carry safely.

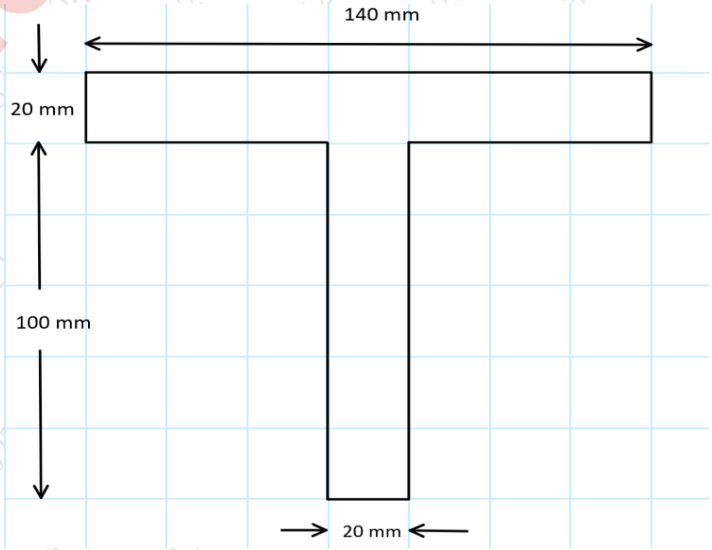
b A cylindrical vessel of 1.6 m diameter and 3.5 m long is closed at ends by a rigid plate. It is subjected to an internal pressure of 2.5 N/mm^2. If maximum circumferential stress is not to exceed 150 N/mm^2, find the thickness of shell. Find change in diameter, length and volume of the shell. Assume: E= 2x10^5 N/mm^2 and Poisson's ratio= 0.25. **10**

Q. 3

a Draw AFD, SFD & BMD for the frame shown below. UDL on beam BC is 20 kN/m. **12**



b A beam cross-section shown below, is subjected to a shear force of 140 kN. Draw shear stress distribution diagram across the c/s. **8**



Q. 4

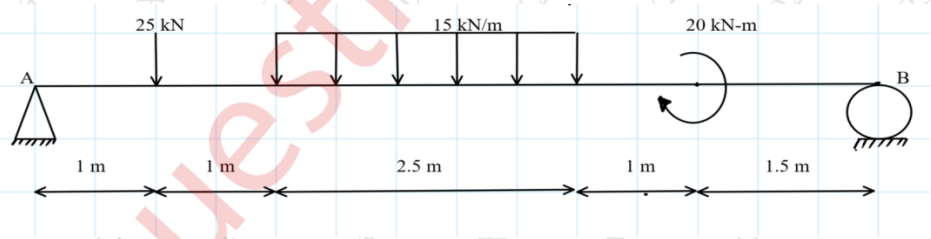
a In an experiment, a bar of 40 mm diameter and 200 mm in length is subjected to a pull of 85 kN. Change in length and diameter is 0.09 mm and 0.0039 mm respectively. Calculate the Poisson's ratio, Modulus of Elasticity, Shear Modulus and Bulk Modulus. **10**

b A hollow circular shaft has external diameter of 200 mm and internal diameter of 160 mm. Find the safe power that can be transmitted if allowable shear stress is 130 MPa and maximum angle of twist is 4^0 for 3.8 m length. Take speed of shaft as 4 revolutions per second. Maximum torque exceeds mean torque by 25 %. Take G= 85 GPa. **10**

Q. 5

a The principal stresses at a point across two perpendicular planes are 135 MPa horizontal (Tensile) and 95 MPa vertical (Tensile). Find the normal stress, tangential stress and resultant stress and its obliquity on a plane at 30 degrees with the major principal plane. **10**

b Calculate slope at supports and maximum deflection by using Macaulay's method. Take EI constant **10**



Q. 6

a A cantilever beam AB of span 4 m is fixed at left end A and is free at right end B. It carries a UDL of 25 kN/m all over the span and a couple of 50 kN.m clockwise at free end B. Draw SFD and BMD. **7**

b A masonry pier (3m x 4m) supports a vertical load of 30 kN at an eccentricity of 0.5 m along y axis and an eccentricity of 1 m along x axis respectively. Width 3 m is parallel to x-axis. Find the stresses developed at each corner of the pier. **8**

c A steel rod 28 mm in diameter is 3.5 m long. Find the maximum instantaneous stress induced and work done at maximum elongation when the load of 80 kN is suddenly applied. Take E= 210 GPa. **5**
