S.E. / Civil / Sem-III / 'C' Scheme / Sub:- MS / Date:- 14/11/2025
S.H. 2025

(3 Hours) [Total Marks: 80]

SP. Code:- 10097265

Notes :

1. Question No **ONE** is **Compulsory**.
2. Answer any **THREE** from the remaining.
3. Draw **FIGURES** wherever necessary. The figures to the right indicate full marks.
4. **WRITE** proper question / sub-question numbers on the left margin allotted in answer sheet.
5. Each Question carries **EQUAL** marks.
6. **ASSUME** any additional data if necessary and state it clearly.

1. Answer the following (any 4) **20**

a) State Torsional Equation and the assumptions in the theory of Torsion

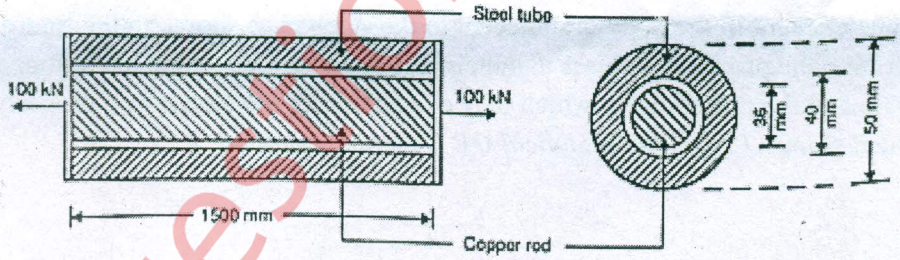
b) State the relationship between the modulus of elasticity, modulus of rigidity, and bulk modulus.

c) What do you mean by " Pure Bending "

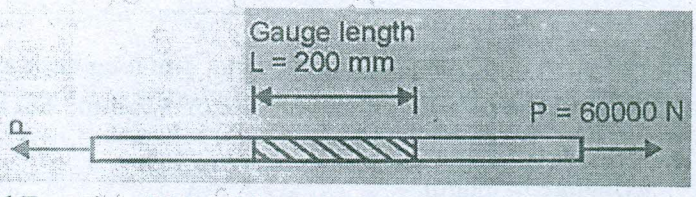
d) Derive Volumetric Strain in Thin cylindrical shell: $e_V = e_L + 2e_C$

e) Derive the relation between Loading intensity, Shear Force, and Bending Moment

2. a) A copper rod 36 mm in diameter is encased and rigidly attached at the end of a steel tube which is 50 mm external diameter, the thickness of the metal being 5 mm. The composite section is then subjected to an axial pull of 100 kN. Find the stresses induced in each metal and extension on the length of 1.5m.Take Es = $2x10^5$ N/mm^2 and Ec = $1.1x10^5$ N/mm^2. **8**

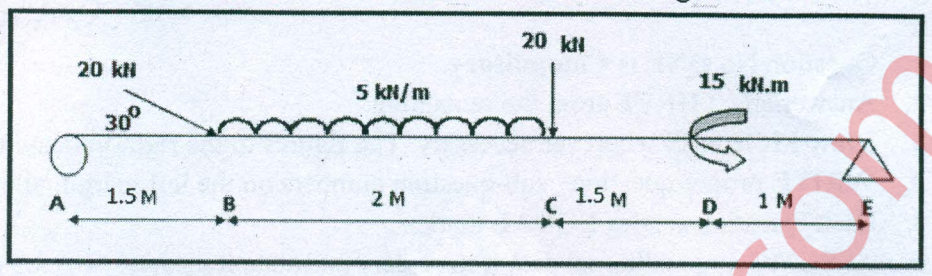


b) In an experiment, a bar of 30 mm diameter is subjected to a pull of 60 kN. The measured extension of the gauge length is 200 mm and is 0.09 mm and the change in diameter is 0.0039 mm. Calculate the poission's ratio and the values of the 3 modules. **6**

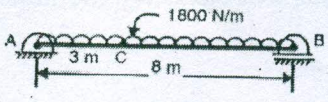


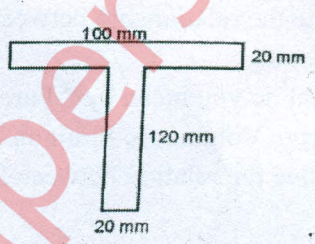
c) Derive Flexural Equation. **M/I = 6 / y = E / R** **6**

3. a) Draw SFD and BMD for the beam loaded as shown in the figure below. 8



b) A cast iron beam is of T section as shown in the figure and loaded as shown. Draw shear stress distribution across the cross section for maximum shear force in the beam. 6

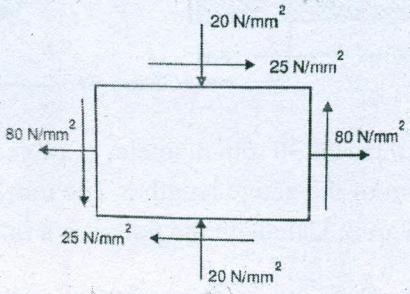




c) A uniform steel bar having E = 200 GPa, of 3.0 m in length and 15 mm in diameter is subjected to a pull of 80 kN. Determine stress, change in length, strain energy stored, and the resilience in the bar when 6

i. The pull is gradually applied.
ii. The pull is suddenly applied.

4. a) A plane element in the body is subjected to the stresses as shown in the figure. Determine the principle stresses and their directions as well as the maximum shear stresses and the directions in which they occur. Sketch the stresses on properly oriented planes. (Solve *by Analytical* ***OR*** *Graphical Method.*) 8

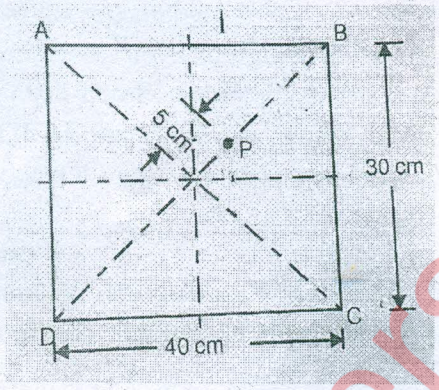


b) A cylindrical shell one meter in diameter and 4 m long has a metal thickness of 15 mm. If it is subjected to an initial pressure of $4N/mm^2$. Take E = 210 kN/mm^2 and 1/m = 0.3. Determine 6

i) Change in length.
ii) Change in diameter.
iii) Change in Volume.

c) Draw a shear stress distribution diagram for the above problem 3b 6

5. a) A short vertical column is of rectangular section 40 cm x 30 cm. It carries a load of 80 kN at a point 5 cm away from the center of the section along one of the diagonals. Calculate the intensity of the stress at the corners of the column in the plan. 8

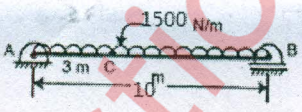


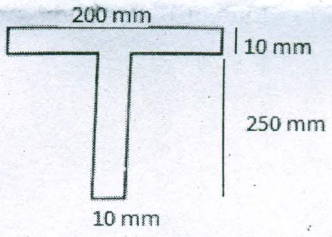
b) Define 8

i) Slenderness Ratio.
ii) The radius of Gyration.
iii) The effective length of the Column(one side fixed, the other free)
iv) The effective length of the Column(one side fixed, the other hinged)

c) State Torsional Equation in brief along with its assumptions. 4

6. a) A cast iron beam is of T section as shown in the figure. Sketch the bending distribution diagram at point C. 8





b) An R.C.C column 40 cm x 60 cm in cross-section is reinforced with 8 bars of steel 20 mm in diameter. If the permissible stress in steel and concrete is not to exceed 13 kN/cm^2 and 700 N/cm^2, find the safe maximum load the column can carry. If the length of the column is 4.5 m, what will be the change in its length? Take Es = 2 x 10^5 N/mm^2 and Ec= 1 x 10^4 N/mm^2. 8

c) 350 kW Power has to be transmitted at 200 rpm. Find 4

i. The necessary diameter of a solid circular shaft
ii. The necessary diameters of a hollow circular section have an inside diameter being ¾ of the external diameter. Allowable shear stress = 85 N/mm^2