Degree: B.E. DEGREE EXAMINATION.

Branch: Mechanical Engineering

Semester: IV

Subject Code No. / Subject Title: CE 295 — STRENGTH OF MATERIALS

Time : Three hours Maximum : 100 marks

Answer ALL questions.

Assume any additional data required and indicate it clearly.

PART A — (10 × 2 = 20 marks)

1. A bar of varying cross–section consists of two sections of lengths l_1 and l_2 with cross–sections A_1 and A_2. It is subjected to an axial pull F. Find the total elongation.
2. The Young's modulus of a material is 200 kN/mm^2 and poisson's ratio 0.3. Determine the rigidity modulus.
3. What is the bending moment at the fixed end of a cantilever of length 4m, carrying a concentrated load of 12kN at 3m from the fixed end?
4. Derive the relation between the intensity of load and shear force, in bending theory.
5. Draw the shear stress distribution diagram for an I –section.
6. Derive an expression for the power transmitted by a circular shaft in S.I. units, which is subjected to a torque T in Nm.
7. Distinguish between close coil and open coil helical springs.
8. State the condition for the use of Macaulay's method
9. State Castigliano's theorems with the example of a cantilever with span L and point load P at free end.
10. State the principle of virtual work for deformable body.

PART B — (5 × 16 = 80 marks)

11. Draw the shear force and bending moment diagrams for the 9m long beam as shown in Fig.Q.No.11. The beam is loaded with uniformly distributed load 10kN/m and concentrated load of 50kN as shown in Fig.Q.No.11. Find out the point of contraflexure also.

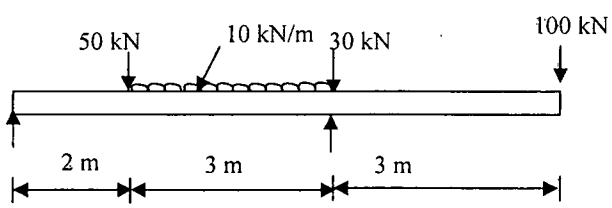

Fig.Q.No.11

12.

(a) A bar 20 mm in diameter and 10 m long was subjected to an axial pull of 60 kN. The extension of the bar was found to be 0.15 mm, while decrease in the diameter was found to be 0.15 mm. Find the Young's modulus, Poisson's ratio, rigidity modulus and bulk modulus of the material of the bar.

OR

(b) An aluminium rod 22 mm diameter passes through a steel tube of 25 mm internal diameter and 3 mm thick. The rod and tube are fixed together at the ends at a temperature of 30°C. Find the stresses in the rod and tube when the temperature is raised to 150°C. $E_S = 200\ \text{kN/mm}^2$, $E_{al} = 70\ \text{kN/mm}^2$, $\alpha_S = 12 \times 10^{-6}/°\text{C}$, $\alpha_{al} = 23 \times 10^{-6}/°\text{C}$.

13.

(a) A timber beam 240 mm wide and 360 mm deep is simply supported. It carries a udl of 20 kN/m over the entire span. Find the span length if the allowable bending stress is not to exceed 8 N/mm^2.

Or

(b) A hollow shaft is to transmit 300 kW at 80 rpm. The internal diameter is 0.6 of the external diameter. The maximum torque is 40% more than the mean torque. If the shear stress is not to exceed 60 N/mm^2, find the external and internal diameters of the shaft.

14.

(a) Using Virtual Work Principle, find the vertical and horizontal deflections of the free end of the lamppost shown in Fig. Q.No.14 (a).

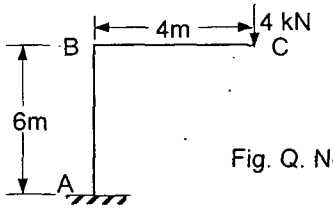

Fig. Q. No.14(a)

OR

(b) At a point in a strained material the horizontal tensile stress is 80 N/mm^2 and the vertical compressive stress is 140 N/mm^2. The shear stress is 40 N/mm^2. Find the principal stresses and the principal planes. Find also the maximum shear stress and its planes.

15.

(a) A simply supported beam of uniform flexural rigidity EI and span *l*, carries two symmetrically placed loads *P* at one–third of the span from each end. Find the slope at the supports and the deflection at mid–span. Use moment area theorems.

OR

(b) A simply supported beam of uniform flexural rigidity EI and span l, carries two symmetrically placed loads P at a distance of "a" from each end. Find the deflection under each load and the deflection at the centre.