D 4031

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2007.

Third Semester

Chemical Engineering

CH 1203 — MECHANICS OF SOLIDS

(Common to Textile Technology)

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State Hooke's law.

2. State the relations between elastic constants.

3. What are the relationships between bending moment, shear force and applied distributed load for a beam.

4. Define point of contra-flexure in a beam.

5. State the moment area theorems.

6. What are the advantages of Macaulay' s method for beam deflections.

7. What is the maximum shear stress in a beam with rectangular cross section (b × d) subjected to a shear force V.

8. Discuss the principle of leaf spring.

9. What is the expression for torsion rigidity of a circular shaft?

10. What are the assumptions of Euler's theory of columns.

PART B — (5 × 16 = 80 marks)

11. (a) A steel tube 75 cm long 2.5 cm external diameter and 2 cm internal diameter encloses a copper rod of the same length and 1.5 cm in diameter. The tube is firmly joined to the rod at both ends and the temperature is raised by 120°C. Calculate the stresses in steel and copper. Find the increase in length of the composite system and the external force required to prevent this increase in length. $E_s = 210$ GPa, $E_c = 100$ GPa, $\alpha_s = 10 \times 10^{-6}/^\circ C$, $\alpha_c = 11 \times 10^{-6}/^\circ C$.

Or

(b) A rigid bar is suspended from three rods of length 2 m hung from a ceiling. Rod 1 is of copper and area of cross section 1 cm^2 . Rod 2 is of steel and area of cross section 1.5 cm^2. Rod 3 is of aluminum and area of cross section 2 cm^2. Distance between rods 1 and 2 is 1 m and that between 2 and 3 is 1.25 m. If a load of 60 kN is applied at a distance of 0.5 m from the rod 2 between rods 2 and 3, determine the stresses in the rods and the slope of the rigid bar.

12. (a) Draw the shear force and bending moment diagrams for the following beam and show the points of maximum bending moment. Also find the points of contra-flexure.

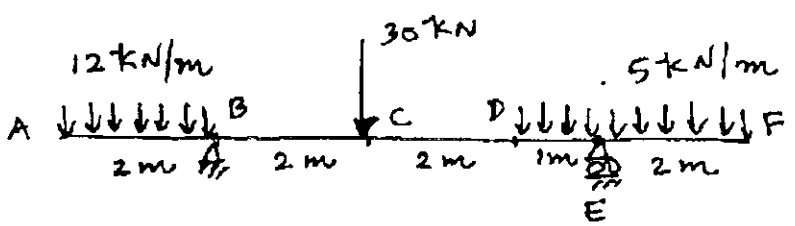

Fig. Q. 12 (a)

Or

(b) Draw the shear force and bending moment diagrams for the following beam and show the points of maximum bending moment. Also find the points of contra-flexure.

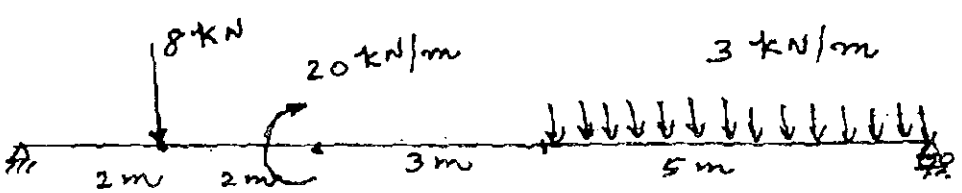

Fig. Q. 12 (b)

13. (a) A simply supported beam of span 5 m is subjected to a u.d.l. of intensity 8 kN/m spread over 2 m starting at 1 m from left support. If flexural EI = 24 MNm^2, find the slope and deflection at mid-span. Also find the maximum deflection.

Or

(b) A simply supported beam of length L and flexural rigidity El is subjected to a concentrated load P at L/3 from the left support. Find the location and magnitude of the maximum deflection.

14. (a) A T-section beam of dimensions 100 mm × 100 mm × 20 mm (flange width × web depth × thickness) is used as a cantilever of span 1 m with flange on top. If it carries a 5 kN load at the free end, what additional u.d.l. can be applied on it, if the bending stress is not to exceed 120 MN/m^2.Neglect self weight of the beam.

Or

(b) The proof load of a semi-elliptic leaf spring is 12 kN and the span is 1 m. If the bending stress is to be limited to 400 MN/m^2 and the central deflection not to exceed 60 mm, determine the values of thickness, width and the number of plates required, if the plate width is to be ten times its thickness. Find also the radius of curvature of the plates. E = 210 GN/m^2.

15. (a) A shaft ABCD ,600 mm long and 100 mm diameter is firmly clamped at the ends. A clockwise torque of 25 kNm is applied at B and an anticlockwise torque of 20 kNm is applied at C. Calculate the maximum shear stress in the shaft. Modulus of rigidity for the shaft may be taken the same in each zone. AB = BC = CD = 200 mm.

Or

(b) Find the Euler buckling load for the following columns :

(i) Hinged-hinged column.

(ii) Fixed-Fixed column.
