S 9064

B./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2006.

Third Semester

Civil Engineering

CE 231 — MECHANICS OF SOLIDS

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define :
   (a) Hooke's law and
   (b) Poisson's ratio.

2. The young's modulus of a material is 200 kN/mm² and its rigidity modulus is 80 kN/mm². Determine the bulk modulus.

3. Derive the relation between the intensity of load and shear force, in bending theory.

4. Draw the shear force and bending moment diagrams for a cantilever beam of span 'l' carrying a point load 'W' at a distance 'a' from the free end.

5. Sketch the shear stress distribution diagram for an I-section.

6. Find the power that can be transmitted by a solid shaft rotating at 200 rpm under a torque of 300 Nm.

7. The stiffness of a close coil helical spring is 10 N/mm. What is the axial deformation (deflection) in the spring when a load of 50 N is acting on the spring?

8. Find the maximum shear stress in a thin walled circular cylinder.

9. Write the expressions for principal stresses σ_1, σ_2 when a material is subjected to normal stresses σ_x, σ_y and shear stress τ.

10. A cantilever is subjected to a clockwise moment at the free end. Find the deflection at the free end, using moment area method.

PART B — (5 × 16 = 80 marks)

11. (a) Draw the SF and BM diagrams for the beam shown in Fig. Q. 11. Find the maximum values and their position. Give the values at important points in the diagram.

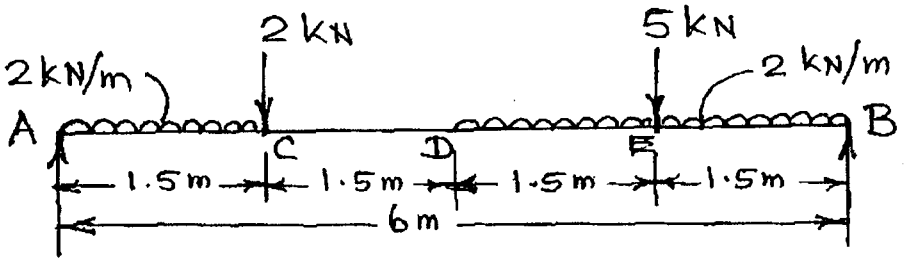

Fig. Q. 11(a)

Or

(b) A rectangular wooden beam of size 120 mm × 200 mm is strengthened by two steel plates of size 150 mm × 10 mm placed symmetrical one on each side. Determine the moment of resistance of the composite beam if the maximum bending stress in wood is limited to 8 μ mm^2. Take the modular ratio between steel and wood as 20.

12. (a) A copper rod of 30 mm diameter is enclosed centrally in a hollow steel tube of external diameter 50 mm and internal diameter 40 mm. The composite bar is then subjected to an axial pull of 45 kN. Length of each bar is 150 mm. Determine (i) the stresses in the rod and tube (ii) load carried by each bar.

E_s = 210 kN/mm^2, E_c = 110 kN/mm^2

Or

(b) Determine the forces in all the members of the truss shown in Fig. Q. 12(b)

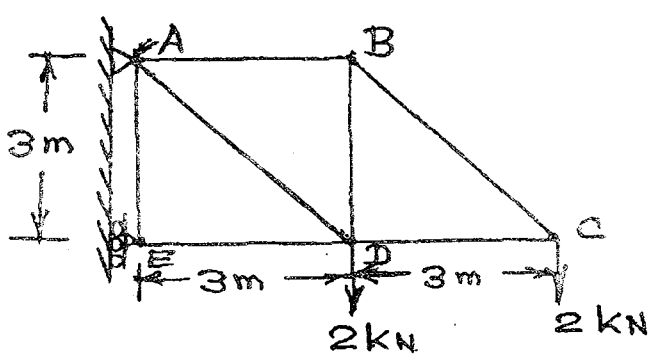

Fig. Q. 12(b)

13. (a) A steel carriage spring is 800 mm long and carries a central load of 6 kN. The plates are 70 mm wide and 5 mm thick. Determine the number of plates in the spring to sustain a maximum bending stress of 200 N/mm^2. What is the deflection in the spring? To what radius should each plate be curved so that it becomes straight under the given load? E = 200 kN/mm^2.

Or

(b) A rectangular block of material is subjected to a tensile stress of 90 N/mm^2 along the X-axis and a compressive stress of 45 N/mm^2 along the Y-axis, with a shear stress of 80 N/mm^2. Find the principal stresses, principal planes and the maximum shear stress and its planes.

14. (a) A solid circular shaft has to transmit 105 kW at 160 rpm. If the shear stress is not to exceed 65 N/mm^2 and the angle of twist is not to exceed 1° in a length of 3.5 m, find a suitable diameter for the shaft. G = 80 kN/mm^2.

Or

(b) A close coil helical spring of 100 mm mean diameter is made of 10 mm diameter write and has 20 turns. The spring carries an axial load of 200 N. Determine (i) the shear stress in the spring, (ii) deflection of the spring and (iii) stiffness of the spring. G = 85 kN/mm^2.

15. (a) A horizontal beam of uniform section and 6 m long is simply supported at its ends. Two vertical concentrated loads of 48 kN and 40 kN act at 1 m and 3 m, respectively from the left hand support. Determine the deflection under the two loads. E = 200 G N/m^2 and I = 85 × 10^{-6} m^4. Use Macaulay's method.

Or

(b) A simply supported beam of span 5 m carries a point load of 5 kN at a distance of 3 m from the left support. Determine the slope at the left support and the deflection under the load, using conjugate beam method. E = 200 kN/mm^2, I = 1 × 10^8 mm^4.
