Reg. No. :

Question Paper Code : 80351

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024.

Third/Fourth Semester

Aeronautical Engineering

CE 8395 – STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS

(Common to Aerospace Engineering/Automobile Engineering/ Industrial Engineering/Industrial Engineering and Management/ Manufacturing Engineering/Marine Engineering/Material Science and Engineering/ Mechanical Engineering/Mechanical Engineering (Sandwich)/Mechanical and Automation Engineering/ Mechatronics Engineering/Production Engineering/Robotics and Automation/ Safety and Fire Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define bulk modulus and how it relates to Young's modulus of the material.

2. Determine the expression for elongation of a prismatic bar under its own weight.

3. Draw the shear force diagram for a cantilever beam carrying a point load W at the free end.

4. Explain the point of contraflexure.

5. Define the polar moment of inertia.

6. Define the terms torsion and torsional rigidity.

7. What is the use of conjugate method over other methods?

8. A cantilever beam carries a point load at the free end. Determine the deflection of the beam at the free end.

9. Define thin and thick cylinders.

10. What do you mean by Lame's equations?

PART B — (5 × 13 = 65 marks)

11. (a) A prismatic bar of circular cross-section is loaded by a tensile force of 85 kN. The length and diameter of the bar is 3.0 m and 30 mm, respectively. It is made of aluminium with modulus of elasticity 70 GPa and Poisson's ratio of 1/3. Calculate the elongation, decrease in diameter and increase in volume of the bar.

Or

(b) A steel circular bar has three segments, as shown in Figure 1. Determine

(i) the total elongation of the bar (4)

(ii) the length of the middle segment (4)

(iii) the diameter of the last segment to have zero elongation of the bar. Take E = 205 GPa. (5)

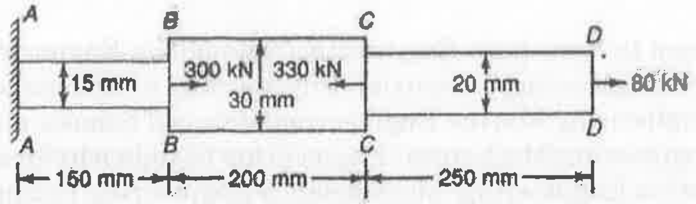

Figure 1

12. (a) Draw the shear force and bending moment diagram of the given beam, as shown in Figure 2.

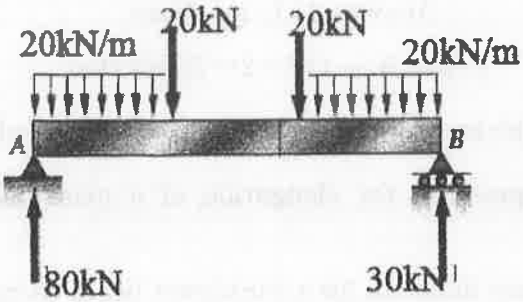

Figure 2

Or

(b) A 250 mm (depth) × 150 mm (width) rectangular beam is subjected to a maximum bending moment of 750 kNm. Determine

(i) The maximum stress in the beam. (4)

(ii) If the value of E for the beam materials is 200 GPa, find out the radius of curvature for that portion of the beam where the bending is maximum. (4)

(iii) The value of longitudinal stress at a distance of 65 mm from the top surface of the beam. (5)

13. (a) Shaft BC is hollow with inner and outer diameters of 90 mm and 120 mm, respectively. Shafts AB and CD are solid and of diameter d. For the loading shown in Figure. 3, determine

(i) the maximum and minimum shearing stress in shaft BC, (7)

(ii) the required diameter d of shafts AB and CD if the allowable shearing stress in these shafts is 65 MPa. (6)

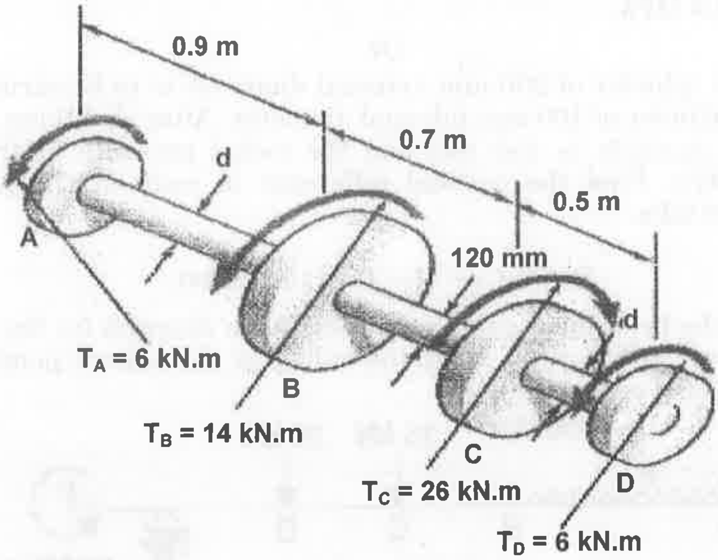

Figure. 3

Or

(b) A closed coiled helical spring of 10 turns is made of 8 mm diameter wire with an outer diameter of 100 mm. Compute the deflection, maximum stress, strain energy and stiffness of the spring when subjected to an axial force of 250 N. Determine the maximum permissible axial load on the spring for an allowable shear stress of 140 MPa. Assume Young's modulus = 210 GPa and Poisson's ratio 0.32.

14. (a) A beam AB of span 8 meters is simply supported at the ends. It carries a uniformly distributed of 30 kN/m over its entire length and a concentrated load of 60 KN at 3 meters from the support A. Draw the loading diagram and find the maximum deflection.

Or

(b) Find the midspan deflection δ for the beam shown in Figure 4, carrying two triangularly distributed loads.

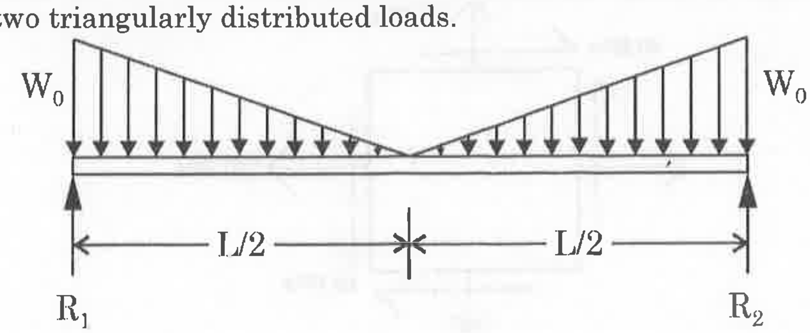

Figure. 4

15. (a) A thin cylindrical shell subjected to internal fluid pressure, the end being closed by

(i) Two water-tight pistons attached to the common piston rod (6)

(ii) Hemispherical end

Find the increase in the internal diameter in each case, given that the internal diameter is 200 mm, thickness 5 mm, Poisson's ratio is 0.3, Young's modulus is 200 GPa, and the internal pressure is 3.5 MPa. (7)

Or

(b) A steel cylinder of 200 mm external diameter is to be shrunk to another steel cylinder of 100 mm internal diameter. After shrinking, the diameter at the junction is 150 mm and the radial pressure at the junction is 12.5 MPa. Find the original difference in radii at the junction. Take E = 200 GPa.

PART C — (1 × 15 = 15 marks)

16. (a) Draw the bending moment and shear force diagram for the beam loaded, as shown in Figure 5. Mark the values at the salient points. Determine the point of contraflexure.

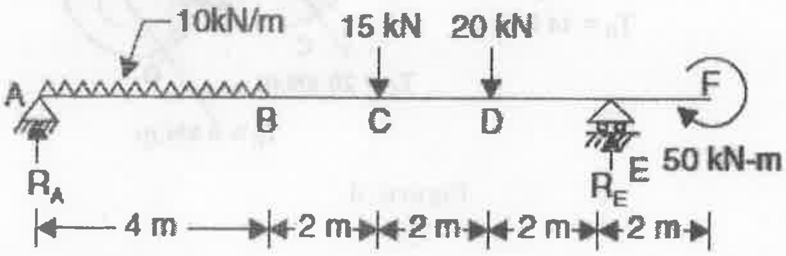

Figure 5

Or

(b) Stress at a point in an externally loaded structural member is 160 MPa and 40 MPa along horizontal and vertical planes respectively along with a shear stress of 60 MPa (Figure 6). Determine

(i) The magnitude and direction of the principal stresses (5)

(ii) Normal stress and shear stress on the plane of maximum shear stress (5)

(iii) Normal and shear stress on a plane inclined 30° with the vertical plane (measured counter clockwise) on which 160 MPa is acting. (Use Graphical method only). (5)

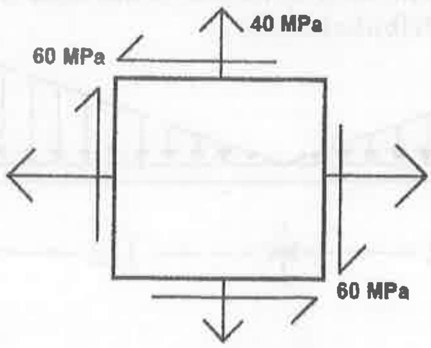

Figure 6