Reg. No. :

Question Paper Code : 50335

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

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. Determine the Poisson's ratio and bulk modulus of a material for which Young's modulus is 110 GN/m^2 and modulus of rigidity is 45 GN/m^2.

2. Define principal planes and principal stresses.

3. Draw the SFD and BMD for a 6m cantilever beam carrying a clockwise moment of 6 kNm at free end.

4. Calculate the moment of resistance of a beam subjected to a bending stress of 6 N/mm^2 and section modulus is 2000 mm^3.

5. List the assumptions made in the theory of torsion.

6. A solid circular shaft of 60 mm diameter transmits a torque of 1600 N.m. Determine the value of maximum shear stress developed.

7. List the important methods used to find slope and deflection.

8. Define Mohr's first theorem.

9. List out the few assumptions made in the Lame's theory for thick cylinders.

10. How many types of stresses are developed in thick cylinders?

PART B — (5 × 13 = 65 marks)

11. (a) A compound tube consists of a steel tube 140 mm internal diameter and 160 mm 10 external diameter and an outer brass tube 160 mm internal diameter and 180 mm external diameter. The two tubes are of same length. The compound tube carries an axial compression load of 900 kN. Find the stresses and the load carried by each tube and the amount of its shortens. Length of each tube is 1500 mm. Take E for Steel as 2×10^5 N/mm^2 and for brass 1×10^5 N/mm^2.

Or

(b) (i) Derive a relation for change in length of a uniformly varying circular bar subjected to axial load. (8)

(ii) Derive the relationship between modulus of elasticity and modulus of rigidity. (5)

12. (a) Draw SFD and BMD and find the maximum bending moment for the given beam. (Figure 12(a))

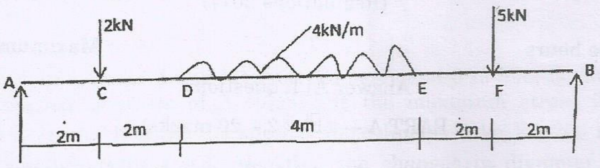

Figure 12(a)

Or

(b) A 250 mm × 150 mm rectangular beam is subjected to maximum bending moment of 700 kNm. Determine the following:

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

(ii) If the value of E for the beam material is 200 GN/m², find out the radius of the curvature for the 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) A solid steel shaft is subjected to a torque of 50 kNm. If the angle of twist is 0.5° per metre length of the shaft and the shear stress is not to be allowed to exceed 90 MN/m². Take $C = 80\ GN/m^2$. Find the following œ

    (i) Suitable diameter for the shaft (3)

    (ii) Final maximum shear stress (3)

    (iii) Angle of twist (4)

    (iv) Maximum shear strain in the shaft (3)

Or

(b) For the close - coiled helical spring subjected to an axial load of 350 N having 12 coils of wire diameter of 16 mm and made with coil diameter of 250 mm. Take $C = 80\ GN/m^2$ find the following :

    (i) Axial Deflection (4)

    (ii) Strain energy (3)

    (iii) Maximum torsional shear stress in the wire (3)

    (iv) Maximum shear stress using Wahls correction factor. (3)

14. (a) A beam AB of length 8 m is simply supported at its ends and carries two-point loads of 60 kN and 40 kN at a distance of 3 m and 5 m respectively from left support A. Determine deflection under each load and maximum deflection by using Macaulay's method. Take $E = 2 \times 10^5$ N/mm² and $I = 8.5 \times 10^6$ mm⁴.

Or

(b) Determine the following by using conjugate beam method. Take $I = 8 \times 10^{-5}\ m^4$, $E = 200 \times 10^6\ kN/m^2$. Find the following (Figure 14. (b)).

    (i) Slope at end A (4)

    (ii) Deflection at C (5)

    (iii) Maximum Deflection (4)

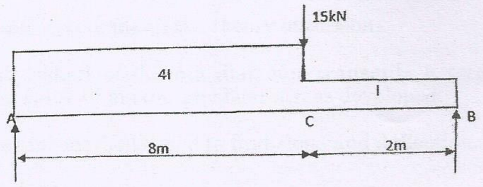

Figure 14(b)

15. (a) A thin cylindrical shell 3 m long has 1m internal diameter and 15 mm metal thickness. Calculate the circumferential and longitudinal stresses induced and also the change in the dimensions of the shell, if it is subjected to an internal pressure of 2 N/mm². Take E = 2 × 10^5 N/mm² and Poisson's ratio = 0.3. Also calculate change in volume.

Or

(b) A thick walled closed-end cylinder is made of an Al-alloy $\left(E = 72 GPa \frac{1}{m} = 0.33\right)$ has inside diameter of 200 mm and outside diameter of 800 mm. The cylinder is subjected to internal fluid pressure of 150 MPa. Determine the principal stresses and maximum shear stress at a point on the inside surface of the cylinder. Also determine the increase in inside diameter due to fluid pressure.

PART C — (1 × 15 = 15 marks)

16. (a) A hollow shaft with diameter ratio 3/5 is required to transmit 450 kW at 120 rpm. The shearing stress in the shaft must not exceed 50 N/mm² and the twist in a length of 2.5 m is not to exceed 1°. Calculate the maximum external diameter of the shaft. Take C = 80 kN/mm².

Or

(b) A thin cylinder 1.5 m internal diameter and 5 m long is subjected to an internal pressure of 3 N/mm². If the maximum stress is limited to 160 N/mm² find the thickness of the cylinder. Take E = 200 kN/mm² and Poisson's ratio = 0.3. Also find the changes in diameter, length and volume of the cylinder.

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