PART C — (1 × 15 = 15 marks)

16. (a) To measure the longitudinal and circumferential strains, strain gauges were fixed on the outer surface of a closed thick cylinder of diameter ratio 2.5. At an internal pressure of 230 MN/m² these strains were recorded as 9.18×10^{-5} and 36.9×10^{-5} respectively. Determine the values of:

(i) Poisson's ratio;

(ii) Young's modulus;

(iii) Modulus of rigidity.

Or

(b) Three long parallel wires equal in length are supporting a rigid bar connected at their bottoms as shown in Fig.4. If the cross sectional area of each is 100 mm². Calculate the stresses in each wire.

Take E of brass = 100GPa and E of steel = 200GPa.

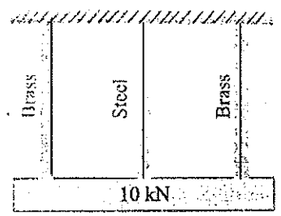

Fig.4

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Question Paper Code : 30103

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

Third/Fourth Semester

Industrial Engineering

CE 3491 — STRENGTH OF MATERIALS

(Common to Industrial Engineering and Management/Mechanical Engineering/Mechanical Engineering(Sandwich)/Safety and Fire Engineering)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Mention the relationship between the three elastic constants.
2. Outline the application of Mohr's circle of stress.
3. List any four assumptions made in the theory of simple bending.
4. Classify beams.
5. Compare shafts in series and shafts in parallel connection.
6. Differentiate closed and open coiled helical springs.
7. What is the maximum deflection in a simply supported beam carrying udl on full span?
8. What are determinate beams?
9. Where do circumferential and longitudinal stresses occur in a cylinder?
10. Enlist the type of stresses in a spherical shell.

PART B — (5 × 13 = 65 marks)

11. (a) A round bar 40mm diameter is subjected to an axial pull of 80kN and reduction in diameter was found to be 0.00775 mm. Find the Poisson's ratio and Young's modulus for the material of the bar. Take value of shear modulus as 40GPa.

Or

(b) An element in a strained body is subjected to a tensile stress of 150MPa and a shear stress of 50MPa tending to rotate the element in an anticlockwise direction. Using Mohr's circle determine:

(i) The magnitude of the normal and shear stresses on a section inclined at 40 degree with the tensile stress. (6)

(ii) The magnitude and direction of maximum shear stress that can exist on the element. (7)

12. (a) Analyse the beam shown in Fig. 1. Draw the shear force and bending moment diagrams.

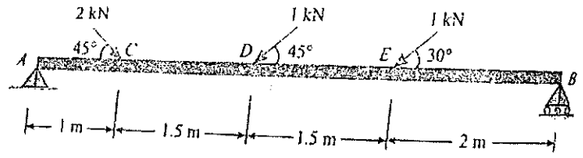

Fig.1

Or

(b) A T-section beam with 100mm × 15mm flange and 150mm × 15mm web is subjected to a shear force of 10kN at a section. Draw the variation of shear stress across the depth of the beam and obtain the value of maximum shear stress at the section.

13. (a) A solid shaft of 200 mm diameter has the same cross-sectional area as a hollow shaft of the same material with an inside diameter of 150 mm. Find the ratio of

(i) Power transmitted by both the shafts at the same angular velocity,

(ii) Angles of twist in equal lengths of the shafts, when stressed to the same intensity.

Or

(b) A closely coiled helical spring is made of 6mm wire. The maximum shear stress and deflection under a 200N load is not to exceed 80MPa and 11 mm respectively. Determine the number of coils and their mean diameter. Take C=84MPa.

14. (a) A beam AB of 4m span is simply supported at the ends and is loaded as shown in Fig.2. Determine:

(i) Deflection at C:

(ii) Maximum deflection; and

(iii) Slope at the end A using Macaulay's method

Given : $E = 200 \times 10^6$ kN/m^2 and $I = 20 \times 10^{-6}$m^4

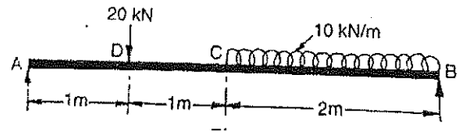

Fig.2

Or

(b) For the beam shown in the Fig.3, determine the following using Conjugate beam method:

(i) Slope at end A;

(ii) Deflection at the mid span;

(iii) Maximum deflection.

Given: $I = 8 \times 10^{-5}$m^4 and $E = 200 \times 10^6$kN/m^2

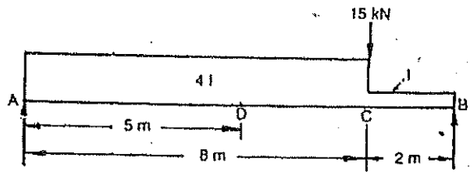

Fig.3

15. (a) A boiler drum consists of a cylindrical portion 4m long, 1.5m in diameter and 2.25cm thick. It is closed by hemispherical ends. In a hydraulic test to 6MN/m^2, how much additional water will be pumped in after initial filling at atmospheric pressure. The circumferential strain at the junction of the cylinder and hemisphere may be assumed to be the same for both. E = 200 GN/m^2, K (for water) = 2.13GN/m^2 and l/m = 0.3.

Or

(b) A thick cylinder of 150mm outside radius and 100mm inside radius is subjected to an external pressure of 30 MN/m^2. Calculate the maximum shear stress in the material of the cylinder at the inner radius.