6. (a) A beam of length 8 m is simply supported at its ends and carries two-point loads of 36 kN and 46 kN at a distance of 1.5 m and 4 m from the left support.
Find :
(i) Deflection under each load.
(ii) Maximum deflection
(iii) The point at which maximum deflection occurs.
Given $E = 2 \times 10^5$ N/mm^2 and $I = 85 \times 10^6$ mm^4. Use Macaulay's method. **10**

(b) A parabolic three-hinged arch has a span of 20 m and a rise of 5 m. If a point load of 30 kN is applied at mid-span, determine the reactions at the supports. **5**

7. A composite shaft consists of steel rod 60 mm diameter surrounded by a closely fitting tube of brass. Find the outside diameter of the tube so that when a torque of 1000N-m is applied to the composite shaft, it will be shared equally by the two materials. Take shear modulus for steel 84 GPa and for brass 42 GPa. Find also the maximum shear stress in each material and common angle of twist in length of 4 m. **15**

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002402

May 2025

B. Tech. (Civil) (Fourth Semester)

Strength of Materials (PCC-CED205)

Time : 3 Hours] [*Maximum Marks : 75*

Note : It is compulsory to answer all the questions (1.5 marks each) of Part A in short. Answer any *four* questions from Part B in detail. Different sub-parts of a question are to be attempted adjacent to each other. Use of non-programmable scientific calculator is allowed.

Part A

1. (a) What is stress and how is it different from pressure ? **1.5**
(b) What are principal stresses, and how are they determined ? **1.5**
(c) Define strain energy and resilience. **1.5**
(d) What are the various theories of failure ? **1.5**
(e) What is point of contraflexure ? **1.5**
(f) Write the Simple Bending equation. **1.5**
(g) What is buckling, and how does it differ from bending ? **1.5**

(h) What is Euler's formula for column buckling ? 1.5

(i) Define hoop stress and longitudinal stresses. 1.5

(j) What is Castigliano's first theorem ? 1.5

Part B

2. (a) A bar of 30 mm diameter is subjected to a pull of 60 kN. The measured extension on gauge length of 200 mm is 0.1 mm and change in diameter is 0.004 mm. Calculate :

(i) Young's modulus

(ii) Poisson's ratio

(iii) Bulk modulus. 10

(b) A material is subjected to two perpendicular tensile stresses of 80 MPa and 50 MPa. Find the magnitude and direction of principal stresses and maximum shear stress. 5

3. (a) A steel rod of 3 cm diameter is enclosed centrally in a hollow copper tube of external diameter 5 cm and internal diameter of 4 cm. The composite bar is then subjected to an axial pull of 45000 N. If the length of each bar is equal to 15 cm, determine : 5

(i) The stresses in the rod and tube

(ii) Load carried by each bar

(b) A 6-meter beam with overhangs on both ends, carries a uniform load of 30 kN/m over its entire length. Determine the required overhang length so that the maximum positive bending moment equals the maximum negative bending moment in magnitude. Also, sketch the shear force diagram (SFD) and bending moment diagram (BMD) for this beam. 10

4. Write the assumptions of theory of simple bending and derive the simple bending equation. 15

5. (a) A thin cylindrical shell 1 m in diameter and 3 m long is subjected to an internal pressure of 2 MPa. Determine the hoop and longitudinal stresses. 5

(b) A simply supported beam carries a uniformly distributed load of intensity 30 N/mm over the entire span of 2 m. The cross-section of beam is a T-section having flange 125 × 25 mm and web 175 × 25 mm. Calculate the maximum shear stress for the section subjected to maximum shear force. Also draw the shear stress distribution. 10