PART C — (1 × 15 = 15 marks)

16. (a) Calculate the principal stress and principal planes. The stress components at a point are given by the following array.

$$\begin{bmatrix} 10 & 5 & 6 \\ 5 & 8 & 10 \\ 6 & 10 & 6 \end{bmatrix} MPa$$

Or

(b) Determine the deflection at the centre of a simply supported beam over a span of 3 m carrying uniformly distributed load of 20 kN/m over the entire span. Use Castigliano's theorem. Take EI = 2.25 MN/m².

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Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 90324

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Fourth Semester

Civil Engineering

CE 8402 — STRENGTH OF MATERIALS II

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Strain energy density.

2. State Castigliano's second theorem.

3. Tell the advantages of continuous beams over simply supported beams.

4. State the theorem of three moments.

5. List out the assumptions made in Euler's Column theory.

6. Calculate the bursting pressure for cold drawn seamless steel tubing of 50 mm inside diameter with 3 mm wall thickness. The ultimate strength of steel is 450 MN/m².

7. Define Principal stress and Principal plane.

8. Name the theory of failure that is suitable for ductile and brittle materials? Why?

9. Define Stress concentration.

10. Distinguish between symmetrical and unsymmetrical beam sections.

PART B — (5 × 13 = 65 marks)

11. (a) A beam of span 5m is simply supported at the ends and carries an UDL of 6kN/m length over the entire length. Determine the strain energy stored in the beam. Take E = 200GN/m² and I = 144 × 10^5 mm⁴.

Or

(b) Determine the deflection at C of the beam shown in fig. Q. 11b. Use principle of virtual work.

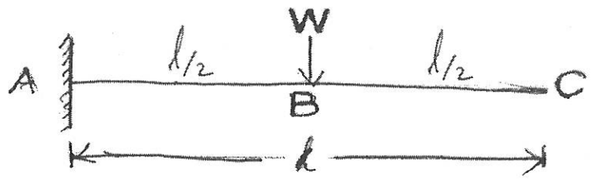
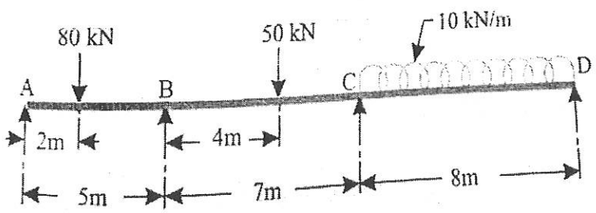


Fig. Q11b

12. (a) A fixed beam AB of length 8m carries a uniformly distributed load of 20 kN/m run over 4 m length starting from left support and a concentrated load of 40 kN at a distance of 6m from the left end A. Find the fixed end moments and the reactions at the supports. Draw Bending Moment and Shear Force diagrams.

Or

(b) Draw Bending Moment Diagram and Shear Force Diagram for a continuous beam ABCD, 20m long which is loaded as shown in fig. If the support B sinks by 10 mm below A and C, find the support moments. Take E = 2.1 × 10^8 kN/m², I = 85 × 10^6 mm⁴.



13. (a) Compare the crippling loads given by Euler's and Rankine's formulae for a tubular steel strut 2.5 m long, having outer and inner diameters 4 cm and 3 cm respectively through pin joints at each end. Take the yield stress as 330 MN/m², the Rankine's constant = 1/7500, and E = 200 GN/m².

Or

(b) Calculate the thickness of the metal necessary for a steel cylindrical shell of internal diameter 0.15 m to withstand an internal pressure of 50 MN/m², the maximum permissible tensile stress is not to exceed 150 MN/m².

14. (a) Determine the diameter of the shaft according to the maximum shear stress theory for a shaft subjected to a maximum torque of 10KN-m and a maximum bending moment of 8kN-m at perpendicular section, if the allowable equivalent stress in simple is 160MN/m².

Or

(b) Calculate, (i) total strain energy per unit volume, (ii) Shear strain energy per unit volume, (iii) Volumetric strain energy per unit volume (iv) Factor of Safety based on total strain energy criteria for a material whose principal stresses are 60 MN/m², 48 MN/m² and –36 MN/m². Take yield strength of the material = 120 MN/m². Young's modulus E = 200 GN/m². Poisson's ratio μ = 0.3.

15. (a) Determine the location of shear centre of channel section with b = 100 mm, h = 150 mm, t = 4 mm

Or

(b) Determine (i) location of neutral axis (ii) maximum and minimum stress and (iii) ratio of maximum and minimum stress, when a curved beam of rectangular cross section of width 20 mm and of depth 40 mm is subjected to pure bending moment of 600 Nm. The beam is curved in a plane parallel to depth. The mean radius of curvature is 50 mm. Also plot the variation of stresses across the section.