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Question Paper Code : 23249

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Fourth Semester

Civil Engineering

CE 2252 — STRENGTH OF MATERIALS

(Regulations 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State Maxwell's reciprocal theorem.
2. Derive the relation for strain energy due to shear.
3. Explain briefly about fixed end moments.
4. Define theorem of three moments.
5. Show the failure of short and long columns.
6. What is meant by core of a section?
7. State distortion energy theory for failure.
8. What are the various stress invariants for three dimensional state of stress?
9. Give the reasons for unsymmetrical bending.
10. Write Winkler Bach formula.

PART B — (5 × 16 = 80 marks)

11. (a) A bar of uniform cross section A and length L hangs vertically, subjected to its own weight. Prove that the strain energy stored within the bar is given by $u = \frac{Ax\rho^2 xL^3}{6E}$.

Or

(b) Determine the deflection of the beam at its midpoint and also the position of maximum deflection and maximum deflection for the beam given in Fig. Q. 11 (b) Take $E=2\times10^5$ N/mm^2 and $I = 4.3 \times 10^8$ mm^4.

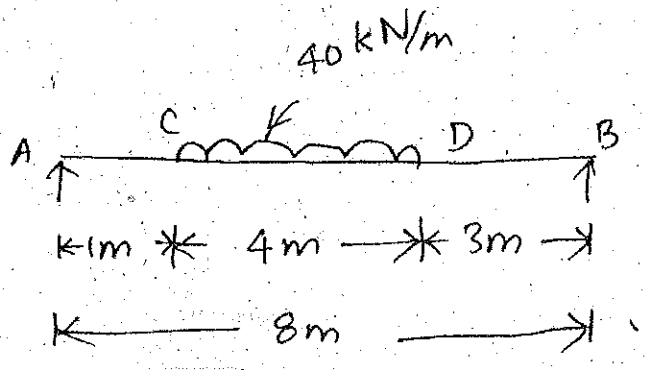

Figure 11(b)

12. (a) A propped cantilever of span 6 m is subjected to a UDL of 2 kN/m over a length of 4 m from the fixed end. Determine the prop reaction and draw the shear force and bending moment diagrams.

Or

(b) A continuous beam ABCD, 20 m long is fixed at A, simply supported at D and carried on the supports B and C at 5 m and 12 m from the left end A. It carries two concentrated loads of 80 kN and 40 kN at 3 m and 8 m respectively from A and uniformly distributed load of 12 kN/m over the span CD. Analyse the beam by theorem of three moments and draw the shear force and bending moment diagrams.

13. (a) A bar of length 4 m when used as a simply supported beam and subjected to a u.d.l. of 30 kN/m over the whole span, deflects 15 mm at the centre. Find the EI value for the above beam and hence determine the crippling loads when it is used as a column with the following end conditions :

(i) Both ends pin-jointed; (6)

(ii) One end fixed and the other end hinged; (5)

(iii) Both ends fixed. (5)

Or

(b) A cylinder of 200 mm internal diameter and 50 mm thickness carries a fluid at a pressure of 10 MN/m^2. Calculate the maximum and minimum intensities of circumferential stresses across the section. Also sketch the radial stress distribution and circumferential stress distribution across the section. (16)

14. (a) A cylindrical shell made of mild steel plate and 12 m in diameter subjected to an internal pressure of 1.5 MN/m². If the material fails at 200 MN/m², calculate the thickness of the plate on the basis of the following three theories, assuming factor of safety 2 in each case.

(i) maximum principal stress theory (6)

(ii) maximum shear stress theory (5)

(iii) maximum shear strain energy theory. (5)

Or

(b) At a section of a mild steel shaft the maximum torque is 8437.5 Nm and maximum bending moment is 5062.5 Nm. The diameter of shaft is 90 mm and the stress at the elastic limit in simple tension for the material of the shaft is 220 N/mm². Determine whether the failure of the material will occur or not according to maximum shear-stress theory. If not, then find the factor of safety.

15. (a) (i) Define Fatigue. (4)

(ii) What is the polar moment of inertia? (4)

(iii) What is unsymmetrical bending? (4)

(iv) What are the reasons for unsymmetrical bending occurring in the beams? (4)

Or

(b) A beam of T-section having flange of 100 mm × 20 mm and web of 150 mm × 10 mm and 4 m long is simply supported at its ends. It carries 5 kN at 40° to vertical and passing through the centroid of the section. Calculate the maximum tensile stresses and maximum compressive stresses, $E = 200$ kN/mm². (16)