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Question Paper Code : 21249

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Fourth Semester

Civil Engineering

CE 2252/CE 43/080100019/10111 CE 403 — STRENGTH OF MATERIALS

(Regulations 2008/2010)

(Common to 10111 CE 403 — Strength of Materials for B.E. (Part-Time) Second Semester Civil Engineering – Regulations 2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Determine the strain energy stored in a cantilever beam when it is subjected to a uniformly distributed load 'w' over the entire span 'l'. Assume that the beam has uniform flexural rigidity throughout.

2. State: Principle of virtual work.

3. Draw the shearing force diagram for a fixed beam of length 'l' when one of its supports sinks.

4. How do you analyze a fixed beam using theorem of three moment equations?

5. Define effective length of a column.

6. What are the assumptions made in Lame's thick cylinder theory?

7. What are principal planes?

8. Name the theories of failures suitable for brittle materials.

9. What are the causes for unsymmetrical bending of beams?

10. What is meant by fatigue failure?

PART B — (5 × 16 = 80 marks)

11. (a) A horizontal beam of uniform section and 6 m long is simply supported at its ends and subjected to a uniformly distributed load of 8 kN/m over the left half span. Determine the slope and deflection at mid span of the beam using strain energy method.

Or

(b) Determine the vertical deflection at the free end of the cantilever truss shown in Fig.Q11(b). Take cross sectional area of compression members as 850 mm^2 and tension members as 1000 mm^2. Modulus of elasticity, E = 210 GPa for all the members.

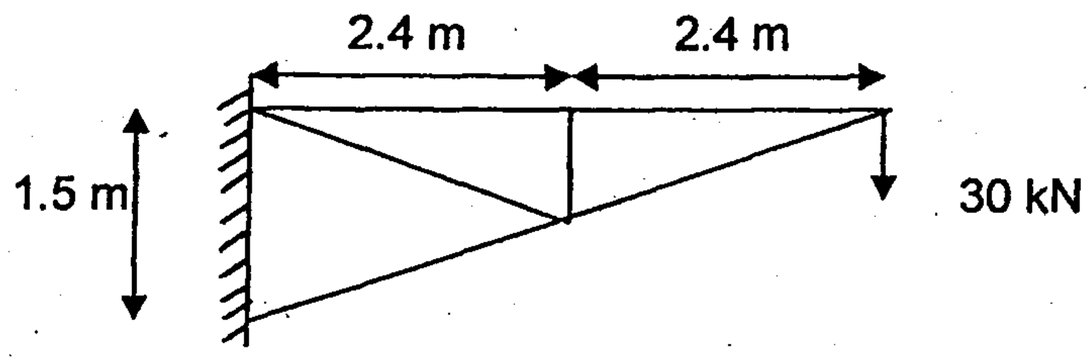

Fig.Q.11(b)

12. (a) A propped cantilever of span 6 m is subjected to a uniformly distributed load of 10 kN/m over a span 3 m from the fixed end and a point load of 20 kN at 4.5 m from the fixed end. Draw the shearing force and bending moment diagrams.

Or

(b) A continuous beam ABC is fixed at A and simply supported at B and C. Length of the spans are, AB = 7 m and BC = 5 m. The beam carries a uniformly distributed load of 4 kN/m over the span AB and a central concentrated load of 16 kN on the span BC. Draw the shearing force and bending moment diagrams.

13. (a) (i) What are the assumptions made in Euler's column theory? (6)

(ii) Derive expression for Euler's crippling load of a column with both ends hinged from first principles. (10)

Or

(b) A 4 m long hollow circular cast iron column with both ends fixed has 200 mm external diameter and 20 mm thickness. The column carries a load of 200 kN at an eccentricity of 30 mm from the axis of the column. Determine (i) the extreme stresses on the cross-section and (ii) the maximum eccentricity when there is no tension anywhere on the cross-section. The elastic modulus of the material of the column is 80 GPa.

14. (a) Determine the principal stresses and principal planes for the state of stress at a point characterized by the components shown below as stress tensor.

$$\begin{matrix} 20 & 8 & 12 \\ 8 & 12 & 4 \\ 12 & 4 & 10 \end{matrix} \quad N/mm^2$$

Or

(b) A metal sheet is to be used to fabricate a closed cylindrical vessel of 800 mm internal diameter which is to be subjected to an internal pressure of 2 MPa. The stipulated factor of safety, elastic limit stress under pure tension and the Poisson's ratio of the metal are: 3,240 MPa and 0.3 respectively. Determine the necessary thickness of the sheet based on: (i) Maximum principal stress theory (ii) Maximum shear stress theory and (iii) Maximum strain energy theory.

15. (a) A rectangular beam, 120 mm wide and 200 mm deep is used as a simply supported beam over a span of 8 m. Two loads of 6 kN each are applied to the beam symmetrically, each load being 2 m from the support. The plane of the loads makes an angle 30° with the vertical plane of symmetry. Find the direction of neutral axis and calculate the bending stress induced at each corner of the beam section.

Or

(b) A curved bar of rectangular section of 30 mm width, 40 mm depth and mean radius of curvature of 60 mm is initially unstressed. If a bending moment of 400 Nm is applied to the bar which tends to straighten it, determine the stresses at the inner and outer surfaces and sketch a diagram to show the variation of stress across the section.
