Question Paper Code : 10220

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2012.

Fourth Semester

Civil Engineering

CE 2252/101402/CE 43/10111 CE 403/080100019 — STRENGTH OF MATERIALS

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define the terms: Resilience and Modulus of Resilience.

2. State Castigliano's first and second theorem for strain energy.

3. What is the value of prop reaction in a propped cantilever of span 'L', when it subjected to a u.d.l over the entire length?

4. What are the advantages and limitations of the theorem of three moments?

5. Define "core" of a column section.

6. How many types of stresses are developed in thick cylinders? Name them.

7. State distortion energy theory for failure.

8. What are the various stress invariants for three dimensional state of stress?

9. What are the reasons for unsymmetrical bending of a beam section?

10. Enumerate the assumptions made in Winkler – Bach theory for the determination of stresses in curved beams.

PART B — (5 × 16 = 80 marks)

11. (a) A simply supported beam of span 3 m is carrying a point load of 20 kN at 1 m from the left support in addition to a u.d.l of 10 kN/m spread over the right half span. Using Castigliano's theorem, determine the deflection under the point load. Take EI is constant throughout.

Or

(b) Determine the vertical deflection at the free end of the cantilever truss shown in Fig. Q. 11 (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.

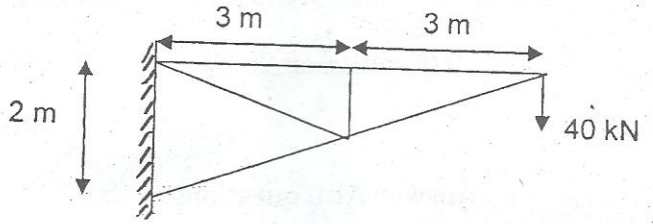

Fig. Q. 11 (b)

12. (a) A propped cantilever of span 6 m is subjected to a u.d.l 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) (i) What are the assumptions made in Euler's column theory? (6)

(ii) Derive the Euler's crippling load for a column with one end fixed and the other end free. (10)

Or

(b) A hollow cylindrical cast iron column whose external diameter is 200 mm and has a thickness of 20 mm is 4.5 m long and is fixed at both ends. Calculate the safe load by Rankine's formula using a factor of safety of 2.5. Take the crushing strength of material as 550 N/mm^2 and Rankine's constant as 1/1600. Find also the ratio of Euler's to Rankine's load. Take $E = 150$ GPa.

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14. (a) The state of stress (Cartesian components of stress) at a point are : $\sigma_{xx} = 7$ Mpa, $\sigma_{yy} = 6$ Mpa, $\sigma_{zz} = 5$ Mpa, $\zeta_{xy} = 2$ Mpa, $\zeta_{yz} = -2$ Mpa, $\zeta_{xz} = 0$ Mpa. Determine the values of principal stresses.

Or

(b) A cylindrical shaft made of steel of yield strength 350 MPa is subjected to static load consisting of bending moment of 10 kN-m and a torsional moment of 30 kN-m. Determine the diameter of the shaft using (i) maximum principal stress theory, (ii) maximum shear stress theory (iii) maximum strain energy theory and (iv) maximum distortion energy theory. Take E =210 GPa, Poisson's ratio = 0.25 and factor of safety = 2.

15. (a) A beam of rectangular section, 80 mm wide and 120 mm deep is subjected to a bending moment of 20 kN-m. The trace of the plane of loading is inclined at 45° to the YY axis of the section. Locate the neutral axis of the section and calculate the bending stress induced at each corner of the beam section.

Or

(b) A curved beam of rectangular cross section is subjected to pure bending with a moment of 400 N-m. The beam has width of 20 mm, depth of 40 mm and is curved in plane parallel to the depth. The mean radius of curvature is 50 mm. Determine the position of neutral axis and the ratio of maximum to the minimum stress.
