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Question Paper Code : 27104

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

Fourth Semester

Civil Engineering

CE 6402 — STRENGTH OF MATERIALS

(Common to Fourth Semester Petrochemical Engineering and Third Semester Plastic Technology and Polymer Technology)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define strain energy.

2. Write the expression for strain energy due to shear.

3. Define degrees of freedom.

4. Define bending moment diagram.

5. What is equivalent length of a column?

6. Define slenderness ratio.

7. Define the term obliquity.

8. Define principal plane.

9. Define shear centre.

10. Distinguish between curved beam and a straight beam.

PART B — (5 × 16 = 80 marks)

11. (a) A tension bar 6 m long is made up of two parts, 3 metre of its length has a cross-sectional area of 100 mm^2 while the remaining 3 metre has a cross-sectional area of 200 mm^2. An axial load of 100 kN is gradually applied. Find the total strain energy produced in the bar and compare this value with that obtained in a uniform bar of the same length and having the same volume when under the same load. Take $E = 2 \times 10^5 \, N/mm^2$.

Or

(b) Determine mid span deflection and end slopes of a simply supported beam of span 'L' carrying a uniformly distributed load 'w' per unit length.

12. (a) A fixed beam AB of length 6 m carries point loads of 150 kN and 120 kN at a distance of 2 m and 4 m 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) A continuous beam ABC covers two consecutive span AB and BC of lengths of 4 m and 6 m, carrying uniformly distributed loads of 6 kN/m and 8 kN/m respectively. If the ends A and C are simply supported find the support moments at A, B and C. Draw also bending moment and shear force diagrams.

13. (a) A hollow cylindrical cast iron column is 4 m long with both ends fixed. Determine the minimum diameter of the column if it has to carry a safe load of 250 kN with a factor of safety of 5. Take the internal diameter as 0.8 times the external diameter. Take $f_c = 550 \, N/mm^2$ and $\alpha = \frac{1}{1600}$ in Rankine's formula.

Or

(b) Determine the maximum and minimum hoop stress across the section of a pipe of 500 mm internal diameter and 100 mm thick, when the pipe contains of fluid, at a pressure of 10 N/mm^2.

14. (a) Direct stresses of 120 N/mm^2 tensile and 80 N/mm^2 compression exist on two perpendicular planes at a certain point in a body. They are also accompanied by shear stress on the planes. The greatest principal stress at the point due to these is 160 N/mm^2.

(i) What must be the magnitude of the shearing stresses on the two planes?

(ii) What will be the maximum shearing stress at the point?

Or

(b) Find the diameter of a shaft according to the distorsion energy theory if the shaft is subjected to a maximum torque of 12 KNm and a maximum bending moment of 10 KNm at a particular section. Take allowable equivalent stress in simple tension as 180 MN/m^2.

15. (a) A beam of rectangular section, 80 mm wide and 120 mm deep is subjected to a bending moment of 10 kN-m. The trace of the plane of loading is inclined at 45° to the Y-Y axis of the section. Locate the neutral axis of the section and calculate the maximum bending stress induced in the section.

Or

(b) A curved beam, rectangular in cross-section is subjected to pure bending with couple of +400 N-m. The beam has width of 20 mm, and depth of 40 mm and is curved in a plane parallel to the depth. The mean radius of curvature is 5 mm. Find the position of the neutral axis, and the ratio of the maximum to the minimum stress. Also, plot the variation of the bending stress across the section.
