Reg. No. : | E | N | G | G | T | R | E | E | . | C | O | M |

Question Paper Code : 30098

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Fourth Semester

Civil Engineering

CE 3402 – STRENGTH OF MATERIALS

(Regulations 2021)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State Hooke's Law.
2. What are the assumptions involved in analysis of thin cylindrical Shells?
3. Write the relationship between the rate of loading, shear force and bending moment.
4. State the condition for no tension in section of a beam.
5. State the two theorems in moment area method.
6. Distinguish between actual beam and conjugate beam.
7. Write down the general form of Clapeyron's three moment equations for the continuous beam.
8. What are the advantages and disadvantages of the fixed beam?
9. Write the failure criteria of materials according to maximum principal strain theory.
10. List out the reasons for unsymmetrical bending.

PART B — (5 × 13 = 65 marks)

11. (a) A compound bar of length 1000 mm consists of a strip of aluminum 50mm wide and 30 mm thick and a strip of steel 60 mm wide × 10 mm thick rigidly joined at the ends subjected to axial tensile force of 60 kN. If elastic modulus of steel and aluminum are 2×10^5 N/mm^2 and 1×10^5 N/mm^2, determine the stresses developed in each material and the extension of the compound bar.

Or

(b) A load of 100N falls through a height of 20 cm on to a collar rigidly attached to the lower end of a vertical bar 1.5m long and of 1.5cm² cross-sectional area. The upper end of the vertical bar is fixed. Determine,

(i) Maximum instantaneous stress induced in the vertical bar.

(ii) Maximum instantaneous elongation.

(iii) Strain energy stored in the vertical rod.

12. (a) A simply supported beam of span 4m carries audl of 6kN/m over the entire span. The maximum allowable stress due to bending is restricted to 150 N/mm². Evaluate the cross sectional dimensions, if the section is

(i) Rectangular with depth twice the breadth

(ii) Solid circular section

Or

(b) A 6m long cantilever beam carries loads of 5kN, 8kN and 15kN at 1m, 2.5m and 5m respectively from the free end and a uniformly distributed load of 12kN/m over a length of 4m from the fixed end. Draw shear force and bending moment diagrams.

13. (a) Using the moment area method, determine the slope and deflection at free end of the cantileverbeam when it is subjected to uniformly distributed load over entire length and point load at the free end.

Or

(b) A cantilever beam of 3.5m length and of uniform rectangular cross section of 200mm wide and 400mm deep is loaded with a point load of 25kN at its free end subjected to an uniformly distributed load of 15kN/m run over its entire length. Assume Young's modulus E = 210GN/m². Calculate the slope and maximum deflection of the beam by using double integration method.

14. (a) A fixed beam of 9 m span subjected to two point loads of intensity 200 kN and 300 kN at a distance of 3 m and 6 m from right end, respectively. Take modulus of elasticity $E = 2 \times 10^8$ kN/m² and moment of inertia $I = 10 \times 10^8$ m². Find maximum deflection in the beam.

Or

(b) A continuous beam ABCD has three spans AB, BC and CD, each of length 3 m, 6 m and 5 m respectively. The beam is loaded with uniformly distributed load of intensity 4 kN/m, 8 kN/m and 4kN/m over the spans AB, BC and CD respectively. Draw the bending moment diagram and shear force diagram for the beam. Take flexural rigidity $EI = 2 \times 10^8$ kNm².

15. (a) A thick walled closed-end cylinder is made up of an aluminum alloy has a Young's modulus of 70 GPa and Poisson's ratio as 0.3. It has an internal diameter of 150 mm and outside diameter of 500 mm. The fluid is subjected to an internal fluid pressure of 150 MPa. Determine the principal stresses and maximum shear stress at a point on the inside surface of the cylinder. Also, determine the increase in inside diameter due to fluid pressure.

Or

(b) The principal stress in the wall of a container are 40 MN/m^2 and 80MN/m^2. Determine the normal, shear and resultant stresses in magnitude and direction in a plane, the normal of which makes an angle of 30° with the direction of maximum principal stress.

PART C — (1 × 15 = 15 marks)

16. (a) A solid circular shaft transmits 75KW power at 200rpm. If the twist in the shaft is not to exceed one degree in 2m length of shaft and shear stress is not exceed 50 N/mm^2, determine the values of shaft diameter. Assume the modulus of rigidity of the material of the shaft as 100 kN/mm^2.

Or

(b) A beam of uniform section, 10m long is simply supported at the ends. It carries point loads of 100kN and 60kN at distances of 2m and 5m respectively from the left end. Take, $E = 200 \times 10^6 N/m^2$; $I = 118 \times 10^{-4}\ m^4$. Using Macaulay's method, calculate

(i) The deflection under each load

(ii) The maximum deflection