Reg. No. : | | | | | | | | | | | |

Question Paper Code : 24535

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2010.

Fourth Semester

Mechanical Engineering

CE 251 — STRENGTH OF MATERIALS

(Common to Second Semester Mechatronics Engineering)

(Regulation 2001)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Tensile and compressive stresses are called normal stresses. Why?

2. What do you understand by 'An element in a state of simple shear"?

3. What are the different types of loads acting on a beam?

4. What do you mean by contraflexure? Is the point of contraflexure and point of inflexion different?

5. What do you mean by shear stresses in beams?

6. What is meant by the stiffness of a spring?

7. Define torsional rigidity of a shaft.

8. Write a note on Mohr's circle of stresses.

9. Define the term modulus of resilience.

10. State Castigliano's first theorem.

PART B — (5 × 16 = 80 marks)

11. (a) A bar of 30mm diameter is subjected to a pull of 60 kN. The measured extension on gauge length of 200 mm is 0.1 mm and change in diameter is 0.004 mm. Calculate Young's modulus, Shear modulus, Bulk modulus and Poisson's ratio. (16)

Or

(b) A steel rod of 30 mm diameter and 5m long is connected to two grips and the rod is maintained at a temperature of 95°C. Determine the stress and pull exerted when the temperature falls to 30°C, if

(i) The ends do not yield

(ii) The ends yield by 0.1 2cm

Take $E = 2 \times 10^5$ MN/m^2 and $\alpha = 12 \times 10^{-6}$/°C. (16)

12. (a) (i) Draw the shear force and bending moment diagrams for a simply supported beam of length 'L' carrying point load 'W' at a distance 'a' from the left end. (8)

(ii) Draw the shear force and bending moment diagrams for a simply supported beam of length 9m and carrying a uniformly distributed load of 10kN/m for a distance of 6m from the left end. Also calculate the maximum bending moment of the section. (8)

Or

(b) (i) What you understand by neutral axis and moment of resistance? (8)

(ii) A square beam 20mm × 20mm in section and 2m long is supported at the ends. The beam fails when a point load of 400N is applied at the center of the beam. What uniformly distributed load per meter length will break a cantilever of the same material 40mm wide, 60mm deep and 3m long? (8)

13. (a) (i) Derive an expression for the shear stress produced in a circular shaft which is subjected to torsion. What are the assumptions made in the derivation? (8)

(ii) A simply supported wooden beam of span 1.3m having a cross section 150mm wide by 250mm deep carries a point load W at the centre. The permissible stress is 7 N/mm^2 in bending and 1 N/mm^2 in shearing. Calculate the safe load W. (8)

Or

(b) A close-coiled helical spring has a stiffness of 10 N/mm. Its length when fully compressed, with adjacent coils touching each other is 40cm. The modulus of rigidity of the material of the spring is 0.8×10^5 N/mm^2.

(i) Determine the Wire diameter and mean coil diameter if the ratio is 1/10.

(ii) If the gap between any two adjacent coil is 0.2 cm, what maximum load can be applied before the spring becomes solid.

(iii) What is the corresponding maximum shear stress in the spring? (16)

14. (a) The principal stresses at a point in a bar are 160N/mm^2 (tensile) 80 N/mm^2 (compressive). Determine the resultant stress in magnitude and direction on a plane at 60° to the axis of major principal stress. Also determine the maximum intensity of shear stress in the material at the point. (16)

Or

(b) A thin cylinder tube 80mm internal diameter and 5mm thick, is closed at the ends and is subjected to an internal pressure of 6N/mm^2. A torque of 2.0096 kNm is also applied to the tube. Find the hoop stress, longitudinal stress, maximum and minimum principal stresses and the maximum shear stress. (16)

15. (a) A beam length 5m and a uniform rectangular section is simply supported at its ends. It carries a uniformly distributed load of 9kN/m run over the entire span length. Calculate the width and depth of the beam if permissible bending stress is 7N/mm^2 and central deflection is not exceeding 1cm. Take E for the material = 1×10^4N/mm^2. (16)

Or

(b) A solid circular shaft of 10 cm diameter of length 4m is transmitting 112.5kW power at 150 r.p.m.

Determine :

(i) The maximum shear stress induced in the shaft and

(ii) Strain energy stored in the shaft. Take C = 8×10^4 N/mm^2. (16)