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

Question Paper Code : 90322

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2022.

Third/Fourth Semester

Aeronautical Engineering

CE 8395 – STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS

(Common to : Aerospace Engineering / Automobile Engineering / Industrial Engineering / Industrial Engineering and Management / Manufacturing Engineering / Marine Engineering / Material Science and Engineering / Mechanical Engineering / Mechanical Engineering (Sandwich) / Mechanical and Automation Engineering / Mechatronics Engineering / Production Engineering / Robotics and Automation / Safety and Fire Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Differentiate between tensile stress and shear stress.

2. Explain thermal stresses.

3. Define the Point of Contraflexure.

4. Explain the term Neutral axis.

5. Define torsional rigidity.

6. Explain the types of helical springs.

7. State the expression for maximum deflection of a simply supported beam carrying a udl of 'w' per unit length over entire length 'l' of beam.

8. State and explain Maxwell's reciprocal theorem.

9. Differentiate thin cylinder and thick cylinder.

10. State Lame's Equations.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Derive the relationship between Young's modulus and bulk modulus. (8)

(ii) Explain principal planes and principal stresses. (5)

Or

(b) (i) For a member subjected to two axial stresses in mutually perpendicular directions and a shear stress, derive an expression for normal stress and shear stress in an oblique plane inclined at an angle θ to y- axis. (7)

(ii) Explain the stress-strain diagram for a ductile material. (6)

12. (a) A beam of length 12 m simply supported at its ends carries three concentrated loads of 6 kN, 5 kN and 7 kN at the distances of 4 m, 7 m and 10 m respectively from the left support. Also an uniformly distributed load of 2 kN/m acts for 2 metre length from left support and 3 kN/m uniformly distributed load acts for 3 metre length from right support. Draw the shear force and bending moment diagrams.

Or

(b) A uniform T section of a beam is as follows : (flange width 100 mm, flange depth 125 mm, web depth 125 mm, web thickness 12 mm). If the limiting bending stress is 150 MPa in tension, find the maximum uniformly distributed load that the beam can carry over a simply supported span of 5 m.

13. (a) A solid cylindrical shaft is to transmit 300 kW power at 100 rpm. If the shear stress is not to exceed 60 N/mm^2, find its diameter. What percent saving in weight would be obtained if this shaft is replaced by a hollow one whose internal diameter equals to 0.6 times the external diameter, when the length, material and maximum shear stress being the same?

Or

(b) Determine the maximum shear stress and elongation in a helical steel spring composed of 15 turns of 16 mm diameter wire on a mean radius of 80 mm, when the spring is supporting a load of 1.4 kN. Take rigidity modulus as 80 GPa.

14. (a) A simply supported beam of span 6 m and uniform rectangular cross section 150 mm wide and 300 mm deep is subjected to an UDL of 2 kN/m over the entire span and a point load of 3 kN at 4 m from the left support. Find the maximum slope and deflection of the beam. $E = 210$ kN/mm^2.

Or

(b) A steel cantilever 7 m long carries the point loads of 12 kN at the free end and 20 kN at a distance 3 m from the free end. Also a UDL of 3 kN/m acts over the entire span. Find (i) slope at the free end (ii) Deflection at the free end. Take $I = 1.3 \times 10^8$ mm^4 and $E = 2 \times 10^5$ N/mm^2.

15. (a) Derive expressions for change in length, change in diameter and change in volume of a thin cylindrical shell subjected to an internal pressure.

Or

(b) Derive expressions for stress, change in diameter and change in volume of a thin spherical shell subjected to an internal pressure.

PART C — ($1 \times 15 = 15$ marks)

16. (a) A compound tube consists of a steel tube with 120 mm internal diameter and 140 mm external diameter and outer brass tube with 140 mm internal diameter and 160 mm external diameter. The two tubes are of same length. The compound tube carries an axial load of 800 kN. Find the stresses and load carried by each tube. Length of each tube is 200 mm. Take E for steel as 2.1×10^5 N/mm^2 and for brass as 1.2×10^5 N/mm^2.

Or

(b) At a certain point in a strained material, the intensities of stresses on two planes at right angles to each other are 20 N/mm^2 and 10 N/mm^2 both tensile. They are accompanied by a shear stress of magnitude 10 N/mm^2. Find the location of principal planes and evaluate principal stresses.

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