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Question Paper Code : 10358

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2025.

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 — ($10 \times 2 = 20$ marks)

1. Calculate the elongation of mild steel rod 25 mm in diameter and 2 m long when subjected to an pull of 80 kN. E for steel is 200 kN/mm^2 .
2. What is meant by principal plane and principal stress?
3. Write the maximum bending moment for the simply supported beam of span '1' with a point load of W at the mid span of the beam.
4. Draw qualitative shear stress distribution of I-section.
5. Compute the torsional rigidity of a 100 mm diameter, 6 m length shaft modulus of rigidity $G = 110 \text{ kN/m}^2$.
6. Give any two practical applications of helical springs.
7. State the two theorems of conjugate beam method.
8. Write the equation giving maximum deflection in case of a simply supported beam subjected to a point load at mid span.

9. A cylindrical pipe of diameter 1.5 m and thickness 15 mm is subjected to an internal fluid pressure of 1.2 N/mm^2 . Determine the longitudinal stress developed in the pipe.
10. What are the stresses acting on a thin cylinder, when it is subjected to internal pressure?

PART B — ($5 \times 13 = 65$ marks)

11. (a) A steel rod 18 mm in diameter passes through a steel tube 30 mm in external diameter and 2.5 mm thickness. The tube is 0.75 m long and is closed by rigid washers of negligible thickness which are fastened by nuts threaded on the rod. The nuts are tightened until the compressive load on the tube is 20 kN. Calculate the stresses in the tube and the rod.

Or

- (b) The Normal stresses in two mutually perpendicular directions are 100 N/mm^2 and 47 N/mm^2 both tensile. The Complementary shear stresses in these directions are of intensity 63 N/mm^2 . Determine the magnitude and directions of principal stresses.
12. (a) A cantilever beam of 2 m long carries a UDL of 1.5 kN/m over a length of 1.6 m from the free end. It also carries a point load of 2kN at the free end. Draw shear force and bending moment diagrams.

Or

- (b) A timber of rectangular section is to support a total load of 20 kN uniformly distributed over a span of 3.6 m when the beam is simply supported. If the depth is twice the width of the section and the stress in timber is not to exceed 3.5 N/mm^2 find the dimensions of the cross section?
13. (a) A solid steel shaft is subjected to a torque of 45 kNm. If the angle of twist is 0.5° per metre length of the shaft and the shear stress is not to be allowed to exceed 90 MN/m^2 find:
 - (i) Suitable diameter for the shaft, (5)
 - (ii) Final maximum shear stress and angle of twist Take modulus of rigidity as 80 GN/m^2 . (8)

Or

- (b) A closed coil helical spring is to have a stiffness of 1.5 N/mm of compression under a maximum load of 60 N. The maximum shearing stress produced in the wire of the spring is 125 N/mm^2 . The solid length of the spring is 50 mm. find the diameter of coil, diameter of wire and number of coils $C = 4.5 \times 10^4 \text{ N/mm}^2$.

14. (a) A beam AB of length 8 m is simply supported at its ends and carries two point loads of 50 kN and 40 kN at a distance of 2 m and 5 m respectively from left support A. Determine, deflection under each load, maximum deflection and position under each load, maximum deflection and position at which maximum deflection occurs. Take $E = 2 \times 10^5 \text{ N/mm}^2$, and $I = 8.5 \times 10^6 \text{ mm}^4$.

Or

- (b) A cantilever of length 6 metres carries a uniformly distributed load of 10 kN/m over the whole length. If $E = 200 \times 10^6 \text{ kN/m}^2$ and $I = 30 \times 10^{-5} \text{ m}^4$. Determine the following using conjugate beam method.
- (i) Slope at the free end, (6)
- (ii) Deflection at the free end. (7)

15. (a) A cylindrical vessel whose ends are closed by means of rigid flange plate, is made of steel plate 3mm thick. The length and the internal diameter of the vessel are 500 cm and 250 cm respectively. Determine the longitudinal and hoop stresses in the cylindrical shell due to an internal fluid pressure of 3 N/mm². Also calculate the increase in length, diameter and volume of the vessel. Take $E = 2 \times 10^5 \text{ N/mm}^2$ and $\mu = 0.3$.

Or

- (b) A compound cylinder, formed by shrinking one tube to another is subjected to an internal pressure of 90 MN/m². Before the fluid is admitted, the internal and external diameters of the compound cylinder are 180 mm and 300 mm respectively and the diameter at the junction is 240 mm. If after shrinking on, the radial pressure at the common surface is 12 MN/m², determine the final stresses developed in the compound cylinder.

PART C — (1 × 15 = 15 marks)

16. (a) A bar of variable cross-section is 550mm long and is subjected to an axial pull of 30 kN. The bar has a diameter of 30 mm over a length of 200 mm, 20 mm over a another length of 200 mm and 10 mm over the remaining length of 150 mm. If E for the material is 100 kN/m², determine:
- (i) elongation of the bar,
- (ii) maximum stress set up in the bar and
- (iii) minimum stress set in the bar. (5+5+5)

Or

- (b) A simply supported beam of 16m effective span carries the concentrated loads of 4 kN, 5kN and 3kN at distance 3 m, 7 m, 11 m respectively from the left support. Calculate maximum shearing force and bending moment. Draw S.F. and B.M. diagrams.

