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

Question Paper Code : 20324

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 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 (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. A circular steel wire is subjected to a pull of 5 kN. If the ultimate tensile stress is 250 MPa, find the minimum diameter of the wire. Adopt a factor of safety of 2.5

2. A point in a stressed material is subjected to pure shear stress of 40 MPa. Find the major and minor principal stresses.

3. A cantilever of length 'l' is subjected to a point load of 'W' at its free end. Draw the bending moment diagram.

4. A mild steel strap 60 mm wide and 10 mm thick is bent into a circular arc of radius 20 m. Find the maximum bending stress induced if Young's Modulus is 200 GPa.

5. Draw the diagram showing the shear stress distribution along the thickness of a hollow shaft subjected to torsion.

6. Why is a hollow shaft preferred over a solid shaft for transmitting power?

7. What is the advantage of Macaulay's method over double integration method?

8. Find by Moment-area method the maximum slope and deflection in a prismatic cantilever of length 'l' subjected to a point load 'W' at the free end. Take flexural rigidity as EI.

9. Find the shear stress in a thin cylinder in terms of hoop stress and longitudinal stress.

10. A seamless pipe of diameter 1 m is to carry a fluid under a pressure of 2.5 MPa. Calculate the minimum thickness of the metal if the maximum stress is not to exceed 80 MPa.

PART B — (5 × 13 = 65 marks)

11. (a) A metallic rod of diameter 10 mm, when tested under an axial pull of 10 kN was found to reduce its diameter by 0.003 mm. The modulus of rigidity for the material of the rod is 51 GPa. Find the Poisson's ratio, modulus of elasticity and bulk modulus.

Or

(b) (i) Draw typical stress-strain curve for a mild steel bar subjected to tension test marking the salient points. (3)

(ii) A reinforced concrete column is 300 mm × 300 mm in section. It carries a load of 100 kN and is reinforced with steel bars of total area 2500 mm². Calculate the stresses in concrete and steel. If the stress in concrete is not to exceed 4 MPa, find the area of steel required so that the column may support a load of 500 kN. Take modular ratio as 18. (10)

12. (a) A simply supported beam of span 5 m carries a uniformly distributed load of 10 kN/m over the entire span and also a point load of 10 kN at 2 m from the left support. If the permissible bending stress is 8 MPa, design a suitable rectangular section taking the depth twice the width.

Or

(b) (i) State the assumptions made in theory of simple bending. (5)

(ii) Derive Bending formula. (8)

13. (a) A hollow shaft of diameter ratio 3/5 is required to transmit 400 kW at 120 rpm, the maximum torque being 30% greater than the mean. The shear stress is not to exceed 50 MPa and the twist in a length of 4 m is not to exceed 1.6°. Calculate the minimum external diameter satisfying these conditions. Take shear modulus as 80 GPa.

Or

(b) A carriage spring 1 m long is made up with steel plates with width equal to six times, the thickness. Design the spring for a load of 15 kN such that the bending stress does not exceed 160 MPa and the deflection does not exceed 16 mm. Take modulus of elasticity as 200 GPa.

14. (a) A simply supported beam of span 4 m supported at A and B has C as the middle point. It is subjected to uniformly distributed load of 10 kN/m on the portion AC. Find the maximum deflection in terms of EI.

Or

(b) A simply supported Reinforced concrete beam of length 3.5 m is carrying a uniformly distributed load of 10 kN/m over the entire span. If the bending stress is limited to 7 MPa and deflection is not to be more than 10 mm, find the required width and depth of the beam. Assume the depth to be twice the width.

15. (a) A cylindrical shell 3.25 m long, 1 m in diameter is subjected to an internal pressure of 1 MPa. If the thickness of the shell is 10 mm, find the circumferential and longitudinal stresses. Also, find the maximum shear stress and changes in the dimensions of the shell. Take modulus of elasticity and Poisson's ratio as 200 and 0.3 respectively.

Or

(b) Compare the maximum tensile stress and volumetric strain of a thin cylinder and a thin spherical shell having the same internal pressure and the diameter/thickness ratio. Take Poisson's ratio as 0.3.

PART C — (1 × 15 = 15 marks)

16. (a) At a point in a stressed material, in a particular direction, there is a tensile stress of 20 MPa and a shear stress of 5 MPa. In the perpendicular direction, there is a normal tensile stress of 12 MPa. Locate the principal planes and find the principal stresses. Also, find the maximum shear stress and the resultant stress on a plane inclined at 15° to the major principal plane.

Or

(b) Draw the shear force and bending moment diagrams for the beam shown in figure given Fig. Q 16(b) indicating the values at salient points. Also locate the points of contraflexure.

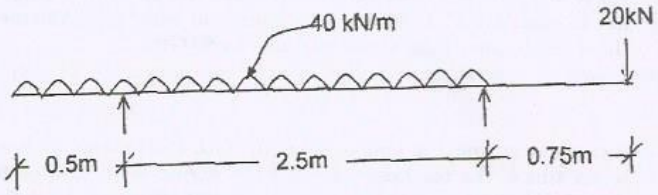

Fig. Q 16(b)