Hall Ticket No | | | | | | | | | | | Course Code: ACEC02

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

B.Tech III SEMESTER END EXAMINATIONS (REGULAR / SUPPLEMENTARY) - FEBRUARY 2023

Regulation: UG20

STRENGTH OF MATERIALS

Time: 3 Hours **(CIVIL ENGINEERING)** **Max Marks: 70**

Answer ALL questions in Module I and II
Answer ONE out of two questions in Modules III, IV and V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Summarize the terms modulus of rigidity, modulus of elasticity and bulk modulus. Build the relationship between bulk modulus and Young's modulus. [BL: Understand| CO: 1|Marks: 7]

   (b) A bar of 25 mm diameter is tested in tension. It is observed that when a load of 60 kN is applied, the extension measured over a gauge length of 200 mm is 0.12 mm and contraction in diameter is 0.0045 mm. Analyze the bar and determine the Poisson's ratio and elastic constants E, G, K [BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) Draw the S.F. and B.M. diagrams for a simply supported beam of length L which is subjected to a clockwise moment 'M' at the center of the beam [BL: Understand| CO: 2|Marks: 7]

   (b) A beam of length 6 m is simply supported at its ends. It is loaded with a gradually varying load of 800 N/m from left hand support to 1500 N/m to the right-hand support. Analyze the beam and construct the S.F. and B.M. diagrams and find the amount and position of the maximum B.M. over the beam. [BL: Apply| CO: 2|Marks: 7]

MODULE – III

3. (a) Write a note on pure bending. Find an expression for bending equation. State the assumptions made in deriving bending equation [BL: Understand| CO: 3|Marks: 7]

   (b) A square beam 20mm x 20mm in section and 2m long is simply 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. [BL: Apply| CO: 3|Marks: 7]

4. (a) Explain the concept of complimentary shear in longitudinal section of a beam which is transversely loaded. [BL: Understand| CO: 4|Marks: 7]

   (b) Analyze the T- beam given in Figure 1 and calculate the shear stresses at top of flange and web-flange junction. It has shear force of 30 KN. G is the centroid of the beam. Draw the shear stress distribution diagram for the section. [BL: Apply| CO: 4|Marks: 7]

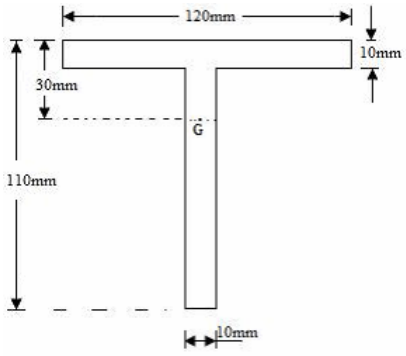

Figure 1

MODULE – IV

5. (a) Draw the torsional shear stress distribution in a solid and in a hollow shaft. Differentiate between bending moment and twisting moment [BL: Understand| CO: 5|Marks: 7]

   (b) A hollow steel shaft transmits 300 kW of power at 250 rpm. The total angle of twist in a length of 6 m of the shaft is 4^o. Find the inner and outer diameters of the shaft if the permissible shear stress is 70 MPa. G = 90 GPa. [BL: Apply| CO: 5|Marks: 7]

6. (a) Explain in detail various types of springs with neat sketches. Derive the expression for maximum shear stress in the wire in close coiled helical spring [BL: Understand| CO: 5|Marks: 7]

   (b) The stiffness of a closely coiled helical spring is 1.5 N/mm of compression under a maximum load of 100N. The maximum shearing stress produced in the wire of the spring is $130N/mm^2$. The solid length of the spring (when the coils are touching) is given as 5cm. Find i) Diameter of the wire ii) Mean diameter of the coils iii) Number of coils required. Take $C = 4.5 \times 10^4 N/mm^2$. [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) Determine the expression for distortion energy per unit volume when a body is subjected to principal stresses $\sigma 1$, $\sigma 2$ and $\sigma 3$. [BL: Understand| CO: 6|Marks: 7]

   (b) A material subjected to a simple tension test shows an elastic limit of 250 MN/m^2. Calculate the factor of safety provided if the principal stresses set up in a complex two- dimensional stress system are limited to 160 MN/m^2 tensile and 50 MN/m^2 compressive. The appropriate theories of failure on which your answer should be based are: i) The maximum shear stress theory. ii) The maximum shear strain energy theory. [BL: Apply| CO: 6|Marks: 7]

8. (a) Explain about maximum principal stress theory, maximum principal strain theory and shear strain energy theory. [BL: Understand| CO: 6|Marks: 7]

   (b) State of stress at a point in a material is as shown in the Figure 2. Determine i) Principal stresses ii) Maximum shear stress iii) Plane of maximum shear stress iv) The resultant stress on the plane of maximum shear stress. [BL: Apply| CO: 6|Marks: 7]

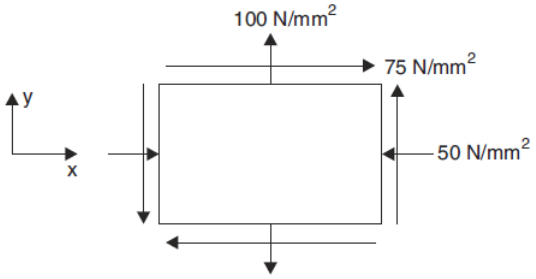

Figure 2