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Total Number of Pages: 02

Course: B.Tech/IDD
Sub_Code: MEPC2001

3rd Semester Regular/Back Examination: 2025-26

SUBJECT: Mechanics of Solids

BRANCH(S): AERO, AUTO, C&EE, CIVIL, ENV, MANUTECH, MECH, MMEAM

Time: 3 Hours

Max Marks: 100

Q.Code: U565

Answer Q1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.
The figures in the right-hand margin indicate marks.

Part-I

Q1 Answer the following questions:

(2 x 10)

- What is the use of Mohr's circle?
- What do you mean by thermal stresses?
- A steel bar of 2 m long and 150 mm² in cross-section is subjected to an axial pull of 15 kN. Find the elongation of the bar ($E = 200$ GPa).
- State the relationship between shear force and bending moment at a section.
- What is point of contraflexure?
- A simply supported beam AB of span l and stiffness EI carries a concentrated load P at its centre. Find the expression for deflection of the beam at its centre.
- What is the difference between beam and column?
- Two closely coiled helical springs 'A' and 'B' are equal in all respects but the diameter of wire of spring 'A' is double that of spring 'B'. Find the stiffness ratio of spring 'B' to that of spring 'A'.
- What is a spring? State any two of its uses.
- State the assumptions in the Euler's Column Theory.

Part-II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)

(6 x 8)

- Derive the relation between the elastic constants (Young's modulus, modulus of rigidity, and bulk modulus).
- A delta strain rosette is mounted on the surface of a structural member. The measured strains along directions making angles of 0°, 60°, and 120° with the x-axis are 4.5×10^{-4} , -6×10^{-4} and 1.5×10^{-4} , respectively. Determine the principal stresses. Take, Young's modulus, $E = 200$ GPa, and Poisson's ratio, $\nu = 0.3$.
- Derive the relation between load rate, shear force, and bending moment in the SFD and BMD.
- Demonstrate Moment area method with an example.
- Using the theory of simple bending, derive the governing differential equation of a beam.

- f) For the beam shown in Fig.1, draw the shear force and bending moment diagrams.

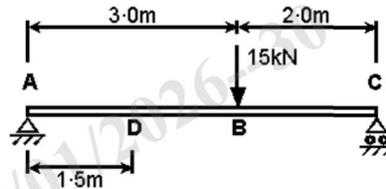


Fig. 1

- g) State the fundamental assumptions of the theory of torsion. Using these assumptions, derive the torsion equation for a circular shaft subjected to pure torsion:

$$\frac{T}{J} = \frac{G\theta}{l} = \frac{\tau}{R}$$

- h) A hollow steel shaft transmits 200 kW of power at 180 rpm. The total angle of twist in a length of 5 m of the shaft is 3° . Find the inner and outer diameters of the shaft if the permissible shear stress is 60 MPa. $G = 80$ GPa.
- i) A hollow shaft of external and internal diameter of 80 mm and 50 mm is required to transmit torque from one end to the other. What is the safe torque it can transmit, if the allowable shear stress is 45 MPa?
- j) A close-coiled helical spring having 24 turns is made of 8 mm diameter wire. The mean diameter of the spring is 80 mm and it carries a load of 250 N. Determine the shear stress developed, the deflection and stiffness of the spring. Take, $G = 84$ GPa.
- k) Define springs. Classify the different types of springs.
- l) Derive the Euler's crippling load for a column with one end fixed and another end free.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

- Q3 Draw the stress-strain diagram for the mild steel and cast iron. Explain the stress-strain diagram behaviour of both the curves. Also, explain the significance of different stress points for both the cases and indicate them on the curves. (16)
- Q4 A cantilever beam of length L is subjected to a uniformly varying load (UVL) along its span, as shown in the Fig. 2. Derive expressions for the slope and deflection of the beam at the fixed support. (16)

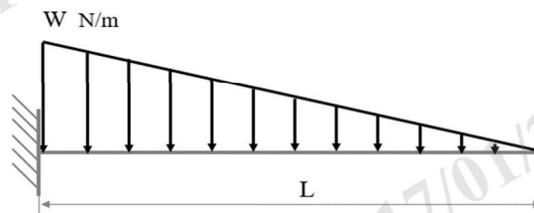


Fig. 2

- Q5 A solid shaft of 200 mm diameter has the same cross-sectional area as a hollow shaft of the same material with inside diameter of 150 mm. Find the ratio of (16)
- powers transmitted by both the shafts at the same angular velocity.
 - angles of twist in equal lengths of these shafts, when stressed to the same intensity.
- Q6 Derive a relation for the Euler's crippling load for a column when (16)
- it has both ends hinged, and
 - both ends fixed.