

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note: Attempt five questions in all, selecting one question each from section A, B, C and D. Section-E is compulsory.

Section - A

- 1 a) Define free-body diagram, moment of inertia, centre of gravity and centroid. Write down the formulas in detail. (6)
- b) Draw a stress-strain curve for mild steel and explain the curve in detail. (6)
2. a) Define the terms: creep, proof stress, toughness and Fatigue of materials. (6)
- b) Define the perpendicular axis theorem. Derive the perpendicular axis theorem relating to moment of inertia in detail. (6)

Section - B

3. a) Derive an expression between modulus of elasticity and modulus of rigidity in detail. (4)
- b) At a point in a strained material, the principal stresses are 100 N/mm² tensile and 40 N/mm² compressive. Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of the major principal stress.

What is the maximum intensity of shear stress in the material at the point? (8)

4. a) Define Mohr's circle and explain the properties of Mohr's circle in brief. (6)
- b) Determine the Poisson's ratio and bulk modulus of a material, for which Young's modulus is 1.2×10^5 N/mm² and modulus of rigidity is 4.8×10^4 N/mm². (6)

Section - C

5. a) A cantilever of length 4 m carries a uniformly distributed load of 1 kN/m run over the whole length and a point load of 2 kN at distance of 1m from the free end. Draw the S.P. and B.M. diagrams for the cantilever. (8)
- b) What do you mean by point of contraflexure? How many points of contraflexure you will have for simply supported beam overhanging at one end only? (4)
- 6 A beam of 1-section is having overall depth as 500 mm and overall width as 190 mm. The thickness of flanges is 25 mm whereas the thickness of the web is 15 mm. The moment of inertia about N.A. is given as 6.45×10^8 mm⁴. If the section carries a shear force of 40 kN, calculate the maximum shear stress. Also sketch the shear stress distribution across the section in detail. (12)

Section - D

7. a) Define the term of Polar modulus. Find the expression for polar modulus for a solid circular shaft in detail. (5)
- b) A solid shaft of 150 mm diameter is used to transmit torque. Find the maximum torque transmitted by the shaft if the maximum shear stress induced to the shaft is 45 N/mm². (7)

[P.T.O.]

8. a) What do you mean by end conditions of a column? What are the important end conditions for a column? Explain different end conditions for columns in detail. (8)
- b) Define slenderness ratio. State the limitations of Euler's formula in detail. (4)

Section - E

9. a) What are the two primary equilibrium equations used to determine the reactions at the supports of a simply supported beam subjected to point loads and distributed loads?
- b) Define shear force and bending moment.
- c) What is limiting friction? State any two applications of Limiting Friction.
- d) What are the sign conventions for shear force and bending moment in general?
- e) Define the torsional rigidity and polar modulus.
- f) Write down the principal stresses and Elastic constants formulas in details. (6×2=12)