

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Mechanics of Materials

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. List the mechanical properties of materials. Explain any 5 mechanical properties. (12 Marks)
- b. Draw stress strain diagram for ductile material, name the salient points and briefly explain (08 Marks)

OR

- 2 a. A steel plate of thickness 16 mm tapers uniformly from 80 mm at one end to 50 mm at the other end in a length of 800 mm. If the plate is subjected to a load of 120 kN, find the extension of the plate. $E = 2 \times 10^5$ MPa. Also calculate the percentage error if average area is used for calculating its extension. (10 Marks)
- b. Derive a relation between Young's modulus of rigidity and bulk modulus. (10 Marks)

Module-2

- 3 a. Derive expressions for normal stress and tangential stress in a member subjected to direct stresses on two mutually perpendicular directions. (10 Marks)
- b. The principle stresses at a point in a bar are 200 N/mm^2 (tensile) and 100 N/mm^2 (compressive). Determine the resultant stresses in magnitude and direction on a plane inclined at 60° to the axis of major principal stress. Also determine the maximum intensity of shear stress in the material at the point. (10 Marks)

OR

- 4 A point in a machine member is subjected to the stresses as shown in Fig Q4. Determine :
 - i) Stresses on a plane which is at an angle of 60° with respect to 80 MPa stress.
 - ii) Magnitude of principle stresses and their locations
 - iii) Maximum shear stresses and their location by Mohr's circle of stresses method. And compare with analytically

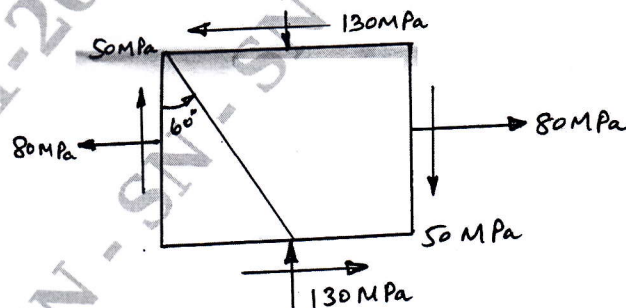


Fig Q4

(20 Marks)

Module-3

- 5 a. Derive a relation between loads, shear force and bending moments with relevant sketch. (10 Marks)

- b. A cantilever beam carries UDL and point loads as show in Fig Q5(b). Find the reactions at the fixed end and draw SFD and BMD.

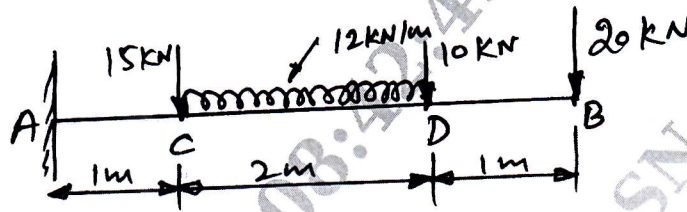


Fig Q5(b)

(10 Marks)

OR

- 6 a. Draw SFD and BMD for a simply supported beam with an eccentric point load. (10 Marks)
 b. Prove that maximum shear stress in a rectangular beam is equal to 1.5 times average shear stress. (10 Marks)

Module-4

- 7 a. Derive Euler beamoulli equation for deflection. (10 Marks)
 b. Calculate maximum deflection of a cantilever beam with an uniformly distributed load. (10 Marks)

OR

- 8 a. Derive torsional equation for solid shaft and list the assumptions made in theory of pure torsion. (10 Marks)
 b. A solid shaft rotating at 1000 rpm transmits 50 kW maximum torque is 20% more than the mean torque. Material of the shaft has the allowable shear stress of 50 MPa and modulus of rigidity 80 GPa. Angle of twist in the shaft should not exceed 1° in one meter length. Determine the diameter of the shaft. (10 Marks)

Module-5

- 9 a. A boiler shell is to be made of 20 mm thick plates having a limiting tensile stress of 125 N/mm^2 . If the efficiencies of the longitudinal and circumferential joints are 80% and 30% respectively, determine
 i) Maximum permissible diameter of the shell for an internal pressure of 2.5 N/mm^2
 ii) Permissible intensity of internal pressure when the shell diameter is 1.6 m. (10 Marks)
 b. Derive Lamé's equation is thick cylinders. (10 Marks)

OR

- 10 a. Derive Euler's crippling load for a column when both ends are fixed. (10 Marks)
 b. Determine the internal strain energy stored within an elastic bar subjected to an axial tensile force P. (10 Marks)
