CBCS SCHEME

USN | | | | | | | | | | |

21MR53

Fifth Semester B.E. Degree Examination, June/July 2024
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. Define following properties of material: i) Elasticity ii) Plasticity iii) Ductility iv) Brittleness v) Toughness vi) Hardness **(06 Marks)**

b. Derive the expression of change in length for uniformly tapering circular bar. **(06 Marks)**

c. The tensile test was conducted on a mild steel bar the following data was obtained from the test diameter of steel bar = 16mm, Gauge length = 80mm, Load at proportionality limit = 72kN, load at failure = 80kN, Extension of at a load of 60kN = 0.115mm, Final gauge length = 104mm, Diameter of load at failure is 12mm. Determine:
i) Young's modulus ii) Proportionality limit iii) True breaking stress iv) Percentage elongation. **(08 Marks)**

OR

2 a. Draw a stress-strain curve for ductile material and explain the salient points. **(06 Marks)**

b. Derive a relation between modulus of elasticity and modulus of rigidity. **(06 Marks)**

c. A member ABCD is subjected to point loads as shown in Fig.Q.2(c). Calculate: i) Force 'P' necessary for the equilibrium ii) Total elongation of the bar. Take E = 210GN/m^2. **(08 Marks)**

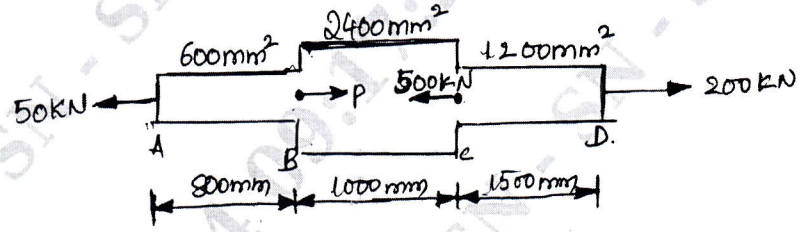

Fig.Q.2(c)

Module-2

3 a. Derive expressions for normal stress and tangential stress in member subjected to direct stress on two mutually perpendicular directions. **(10 Marks)**

b. The state of stress at a point in a strained material as shown in Fig.Q.3(b). Determine:
i) Maximum and minimum normal stresses (principal stresses) and their planes.
ii) Maximum shear stress and its direction.
iii) Indicate all the above in sketch. **(10 Marks)**

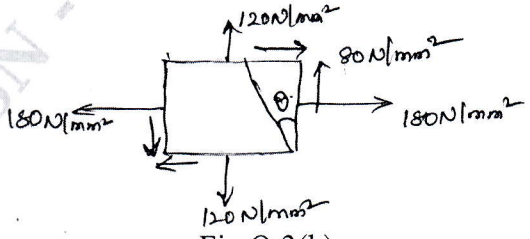

Fig.Q.3(b)

OR

4 a. Show that the sum of the normal stresses on any two planes at right angles in a general two dimensional stress system is constant. **(10 Marks)**

b. A machine components to subjected to the stress as shown in Fig.Q.4(b). Find the normal and shearing stresses on the section 'AB' inclined at an angle of 60° with X-X axis. Also find the resultant stress on section and its direction. **(10 Marks)**

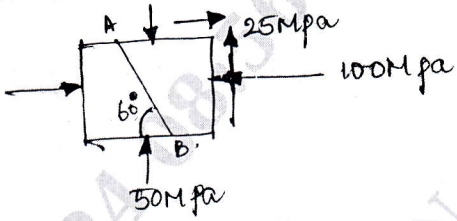

Fig.Q.4(b)

Module-3

5 a. Explain with neat sketches of different kinds of beams and loads. **(08 Marks)**

b. A cantilever beam carries UDL and point loads as shown in Fig.Q.5(b). Draw SFD and BMD. **(12 Marks)**

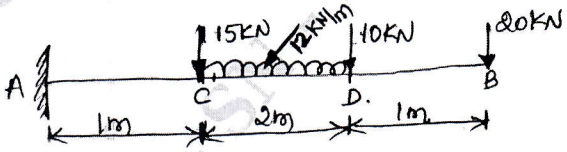

Fig.Q.5(b)

OR

6 a. Establish a relationship between radius of curvature and bending stress. Also state the assumption in simple bending. **(08 Marks)**

b. Determine the shearforce, bending moment at points shown in Fig.Q.6(b). Also draw the shear force diagram and bending moment diagram for simply supported beam. **(12 Marks)**

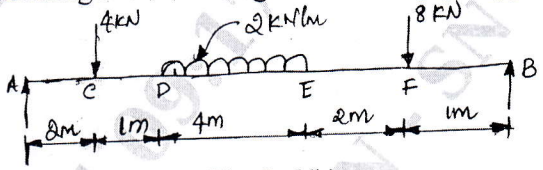

Fig.Q.6(b)

Module-4

7 a. Derive an Euler Bernoulli equation for deflection which establish relation between slope, deflection and radius of curvature. **(10 Marks)**

b. Find the slope and deflection at the free end of the cantilever beam as shown in Fig.Q.7(b). Take the Youngs modulus $E = 200kN/mm^2$, $I = 40 \times 10^6 mm^4$. **(10 Marks)**

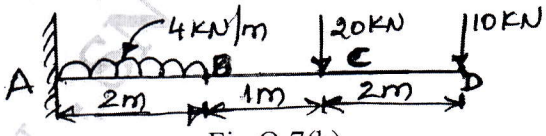

Fig.Q.7(b)

OR

8 a. State the assumptions of pure torsion and derive torsion equations. **(10 Marks)**

b. A solid shaft is subjected to a maximum torque of 25kN-m. Find a suitable diameter of a solid shaft, if allowable shear stress and the twist are limited to $80N/mm^2$ and 1° respectively for a length of 20 times the diameter of the shaft. **(10 Marks)**

Module-5

9 a. What is thick cylinder? Derive the Lame's equation for thick cylinder. (10 Marks)

b. A pipe of 400mm internal diameter and 100mm thickness contains a fluid at a pressure $80 N/mm^2$. Find the maximum and minimum hoop stresses across the section. Also sketch the radial and hoop stress distributed across the section. (10 Marks)

OR

10 a. Derive an expression for Euler's crippling load for a column when both of its ends are hinged or pinned. (10 Marks)

b. A solid round bar of 60mm diameter and 2.5m long is used as a strut. Find the safe compressive load for the strut if i) Both ends are hinged ii) Both ends are fixed. Take $E = 2 \times 10^5 N/mm^2$ and factor of safety = 3. (10 Marks)

* * * * *