ACHARYA INSTITUTE OF TECHNOLOGY
Bangalore - 560090
CBCS Scheme

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

15MN34

Third Semester B.E. Degree Examination, June/July 2017
Mechanics of Material

Time: 3 hrs. Max. Marks: 80

Note: ***Answer FIVE full questions, choosing one full question from each module.***

Module-1

1 a. Define : (i) Hook's law (ii) Factor of safety (iii) Principle of superposition (iv) Malleability. **(04 Marks)**

b. Neatly draw the stress-strain diagram for mild steel indicating all salient points and zones on it. **(04 Marks)**

c. The following data refers to a mild steel specimen tested in a laboratory :
(i) Diameter of specimen = 25 mm (ii) Gauge length = 200 mm
(iii) Extension under a load of 20 kN = 0.04 mm (iv) Load at yield point = 150 kN
(v) Maximum load = 225 kN (vi) Length of specimen after failure = 275 mm
(vi) Neck diameter = 18.25 mm **(08 Marks)**

OR

2 a. Derive an expression for the extension of uniformly tapering rectangular bar subjected to axial load P. **(08 Marks)**

b. Determine the stresses in various segments of the circular bar shown in Fig. Q2 (b) and also find out its total elongation assuming Young's modulus of steel to be 200 GPa. **(08 Marks)**

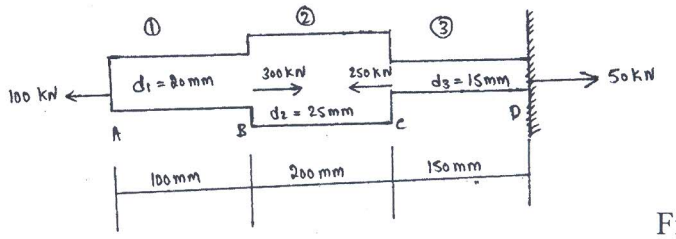

Fig. Q2 (b)

Module-2

3 a. Derive the relationship between modulus of elasticity and modulus of rigidity. **(08 Marks)**

b. The state of stress in two dimensionally stressed body is shown in Fig Q3 (b). Determine the principle stresses. Principal planes, maximum shear stress and their planes. **(08 Marks)**

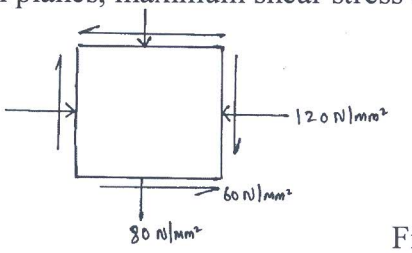

Fig.Q3 (b)

OR

4 a. Define thin cylinder. Also derive an expression for longitudinal stress of a thin cylinder. **(04 Marks)**

b. A thin cylinder of internal diameter 2000 mm contains a fluid at an internal pressure of 3 N/mm^2. Determine the maximum thickness of the cylinder, if (i) longitudinal stress is not to exceed 30 N/mm^2 and (ii) Circumferential stress is not exceed 40 N/mm^2. **(04 Marks)**

c. A thin cylindrical shell 1 m in diameter and 3000 mm long has a metal thickness of 10 mm. It is subjected to an internal fluid pressure of 3 MPa. Determine (i) Circumferential and longitudinal stress (ii) Circumferential, longitudinal & volumetric strain (iii) Change in length, diameter and volume. Also find maximum shearing stress in the shell. Assume Poisson's ratio = 0.3 and E = 210 GPa. **(08 Marks)**

Module-3

5 A cantilever beam carries UDL and point loads as shown in Fig. Q5. Draw shear force and bending moment diagram. **(16 Marks)**

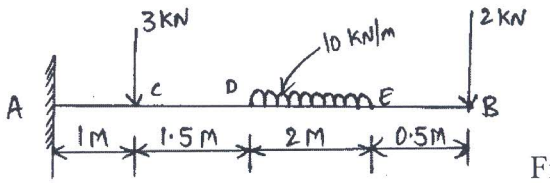

Fig. Q5

OR

6 Draw the shear force and bending moment diagram. For a beam AB of 6 m span is loaded as shown in Fig. Q6. **(16 Marks)**

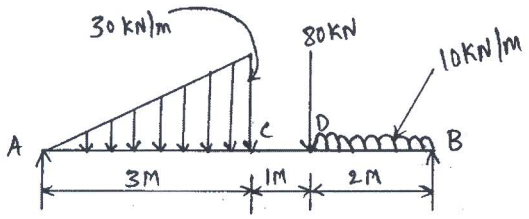

Fig. Q6

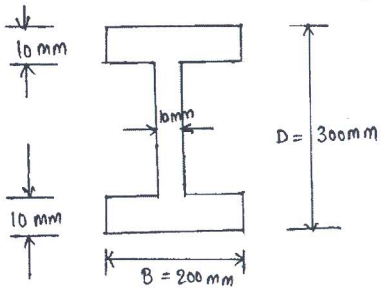

Fig. Q7 (b)

Module-4

7 a. State the assumptions made in theory of simply bending and derive an expression for relationship between bending stress and radius of curvature. **(08 Marks)**

b. The cross section of a beam which is subjected to a shear force of 10 kN is shown in Fig. Q7 (b). Sketch the shear stress distribution across the sections. **(08 Marks)**

OR

8 a. Derive an expression $EI\frac{d^2y}{dx^2} = M$ with usual notations. **(08 Marks)**

b. A cantilever beam 2 m long is carrying a load of 20 kN at its free end and 30 kN at a distance of 1 m from the free end. Find the slope and deflection at the free end. Take $E = 2\times10^5$ N/mm^2, $I = 15\times10^7$ mm^4. **(08 Marks)**

Module-5

9 a. Derive torsion equation with usual notations. State the assumption in the theory of pure torsion. **(08 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. **(08 Marks)**

OR

10 a. Derive an expression for the critical load in a column subjected to compressive load, when both ends are fixed. **(08 Marks)**

b. Find the Euler's crippling load for a hollow cylindrical steel column of 40 mm external diameter and 4 mm thick. The length of the column is 2.5 m and is hinged at both ends. Also compute the Rankine's crippling load using constants 335 MPa and $\frac{1}{7500}$. Take E = 205 GPa. **(08 Marks)**

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