CBCS SCHEME

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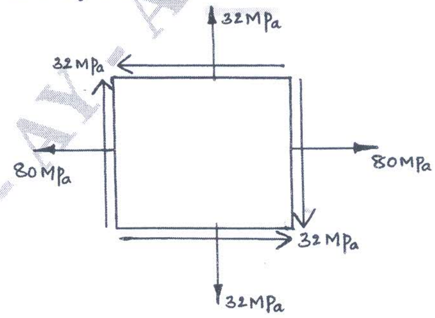
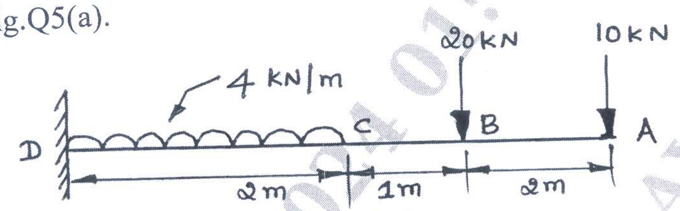
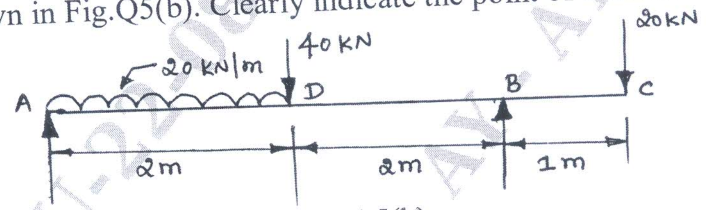
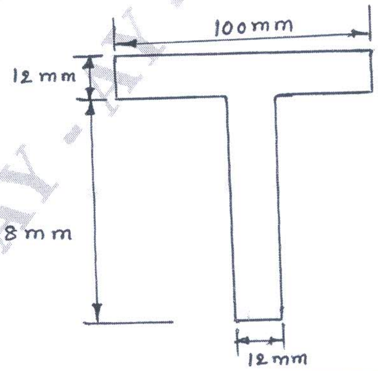
BME301

Third Semester B.E./B.Tech. Degree Examination, June/July 2024
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Define the following with necessary equations: (i) Normal stress (ii) Shear stress (iii) Poisson's ratio (iv) Young's modulus (v) Thermal stress	10	L1	CO1
	b.	The tensile test was conducted on a mild steel bar. The following was obtained from the test: Diameter of steel bar = 16 mm ; Gauge length of the bar = 80 mm ; Load at proportionality limit = 72 kN ; Extension at a load of 60 kN = 0.115 mm ; Load at failure = 80 kN ; Final gauge length of bar = 104 mm ; Diameter of the bar at failure = 12 mm Determine: (i) Young's modulus (ii) Proportionality limit (iii) True breaking stress (iv) Percentage elongation (v) Percentage decrease in area	10	L3	CO1
		OR			
Q.2	a.	Write the relation between the following with usual notations and meaning: (i) Modulus of elasticity and bulk modulus (ii) Modulus of elasticity and modulus of rigidity (iii) Modulus of elasticity, modulus of rigidity and bulk modulus	06	L1	CO1
	b.	Define the following: (i) Gradual load (ii) Sudden load (iii) Impact load (iv) Shock load	04	L1	CO1
	c.	Rails laid such that there is no stress in them at 24°C. If the rails are 32 m long, determine: (i) The stress in the rails at 80°C, when there is no allowance for expansion. (ii) The stress in the rails at 80°C, when there is an expansion allowance of 8 mm per rail (iii) The expansion allowance for no stress in the rails at 80°C. Take $\alpha = 11 \times 10^{-6}$/°C, E = 205 GPa.	10	L3	CO1
		Module – 2			
Q.3	a.	Derive the expression for normal stress and shear stress on a plane inclined at 'θ' angle to the vertical axis in a biaxial stress system with shear stress.	10	L2	CO2
	b.	For the two-dimensional stressed element, shown in Fig.Q3(b), determine the value of: (i) Maximum and minimum principal stress (ii) Principal planes (iii) Maximum shear stress and its plane Verify the answer's by Mohr's circle method  Fig.Q3(b)	10	L3	CO2

		OR			
Q.4	**a.**	Derive an expression for circumferential stress and longitudinal stress for a thin cylinder subjected to an internal pressure 'P'.	10	L2	CO2
	b.	A thick cylinder of internal diameter 160 mm is subjected to an internal fluid pressure of 40 N/mm^2. If the allowable stress in the material is 120 N/mm^2, find the required wall thickness of the cylinder.	10	L3	CO2
		Module – 3			
Q.5	**a.**	Draw the shear force and bending moment diagrams for the cantilever shown in Fig.Q5(a).  Fig.Q5(a)	10	L4	CO3
	b.	Draw the bending moment and shear force diagram for the overhanging beam shown in Fig.Q5(b). Clearly indicate the point of contraflexure.  Fig.Q5(b)	10	L4	CO3
		OR			
Q.6		A simply supported beam of 7m span with overhangs rests on supports which are 4m apart. The left end overhang is 2 m. The beam carries loads of 30 kN and 20 kN on the left and the right ends respectively apart from a uniformly distributed load of 25 kN/m between the supporting points. Draw the shear force and bending moment diagrams. Locate point of contraflexure if any.	20	L4	CO3
		Module – 4			
Q.7	**a.**	Derive the bending equation in the form of $\frac{M}{I}=\frac{\sigma}{Y}=\frac{E}{R}$.	10	L2	CO4
	b.	A square beam 20 mm × 20 mm in section and 2 m long is supported at the ends. The beam fails when a point load of 400 N is applied at the centre of the beam. What uniformly distributed load per metre length will break a cantilever of the same material 40 mm wide, 60 mm deep and 3 m long?	10	L3	CO4
		OR			
Q.8	**a.**	Derive an expression for section modulus of solid rectangular and circular sections.	10	L2	CO4
	b.	Fig.Q8(b) shows the cross-section of a beam which is subjected to a shear force of 20 kN. Draw the shear stress distribution across the depth making values at salient points.  Fig.Q8(b)	10	L3	CO4

		Module – 5			
Q.9	**a.**	Define the following with necessary equations: (i) Torque (ii) Polar modulus (iii) Torsional rigidity	**06**	**L1**	**CO5**
	b.	State the assumptions made in theory of torsion.	**04**	**L1**	**CO5**
	c.	Derive torsion equation in the form of $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{L}$.	**10**	**L2**	**CO5**
		OR			
Q.10	**a.**	Define the following: (i) Column (ii) Buckling load (iii) Slenderness ratio (iv) Long column (v) Short column	**10**	**L1**	**CO5**
	b.	Derive an expression for Euler buckling load when both ends of the column are fixed.	**10**	**L2**	**CO5**

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