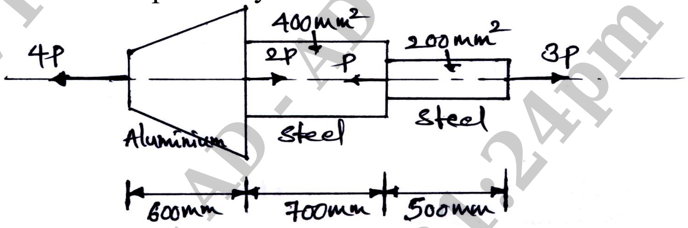
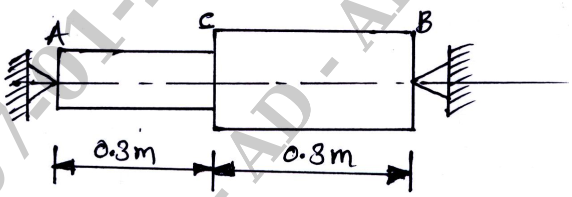
CBCS SCHEME

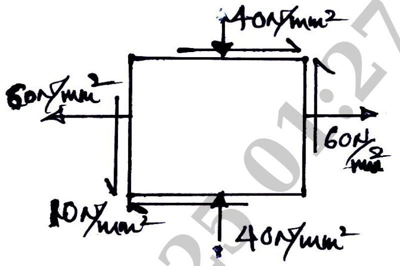
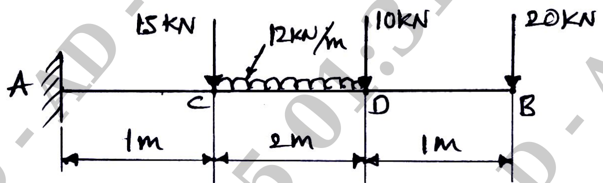
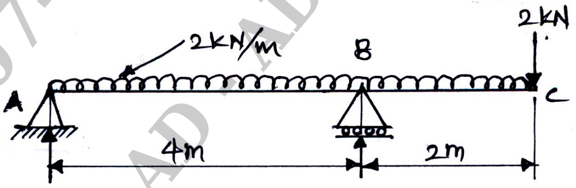
USN | | | | | | | | | | | **BME301**

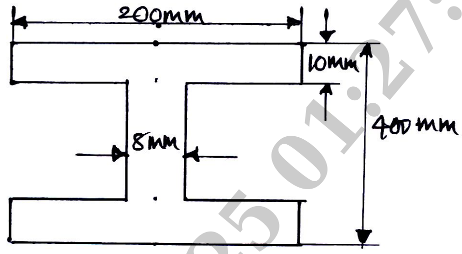
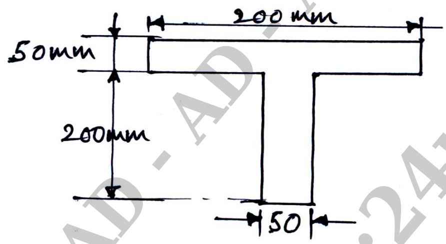
Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Mechanics of Materials

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 terms: (i) Poisson's ratio (ii) Factor of safety	04	L1	CO1
	b.	Show that the expression for the extension of uniformly tapering circular bar subjected to an axial load 'P' is given by, $\delta = 4PL/\pi d_1 d_2 E$	06	L1	CO1
	c.	A bar with stepped portion is subjected to the forces shown in Fig.Q1(c). Solve for the magnitude of force 'P' such that net deformation in the bar does not exceed 1 mm. E for steel is 200 GPa and that of aluminium is 70 GPa. Big end diameter and small end diameter of the tapering bar are 40mm and 12.5mm respectively.  Fig.Q1(c)	10	L3	CO1
		OR			
Q.2	a.	How do you relate Modulus of Elasticity and Bulk modulus?	10	L1	CO1
	b.	Solve for the values of stress and strain in portion AC and CB of the steel bar shown in Fig.Q2(b). A close fit exists at both the rigid supports at room temperature and the temperature is raised by 75°C. Take E = 200 GPa and $\alpha = 12\times10^{-6}/°C$ for steel. Area of cross-section of AC is 400 mm^2 and of BC is 800 mm^2.  Fig.Q2(b)	10	L3	CO1
		Module – 2			
Q.3	a.	A rectangular bar is subjected to two direct stresses 'σ_x' and 'σ_y' in two mutually perpendicular directions. Show that the normal stress 'σ_n' and shear stress 'τ' on an oblique plane which is inclined at an angle 'θ' with the axis of minor stress are given by $\sigma_n = \frac{\sigma_x+\sigma_y}{2} + \frac{\sigma_x-\sigma_y}{2}\cos 2\theta$ and $\tau = -\left(\frac{\sigma_x-\sigma_y}{2}\right)\sin 2\theta$	10	L1	CO2

	b.	The state of stress at a point in a stained material is shown in Fig.Q3(b). Identify (i) Direction of principal planes (ii) Magnitude of principal stresses (iii) Magnitude of maximum shear-stress and its direction.  Fig.Q3(b)	10	L3	CO2
		OR			
Q.4	a.	Show that the change in volume of thin cylindrical shell is given by $\delta_V = \frac{Pd}{4tE}(5-4M)\nu$	10	L1	CO2
	b.	A pipe of 500 mm internal diameter and 75 mm thick is filled with a fluid at a pressure of 6 N/mm^2. Solve for the maximum and minimum hoop stress across the cross-section of the cylinder. Also construct the radial pressure and hoop stress distribution sketch across the section.	10	L3	CO2
		Module – 3			
Q.5	a.	Explain with sketches, the different types of loads acting on a beam.	10	L2	CO3
	b.	A cantilever beam carries UdL and point loads as shown in Fig.Q5(b). Construct SFD and BMD.  Fig.Q5(b)	10	L3	CO3
		OR			
Q.6	a.	Explain SFD and BMD for a cantilever beam with a uniformly varying load.	10	L2	CO3
	b.	An overhanging beam ABC is located as shown in Fig.Q6(b). Develop the SFD and BMD. Also locate point of contraflexure.  Fig.Q6(b)	10	L3	CO3
		Module – 4			
Q.7	a.	Explain the assumptions made in simple bending and show that the maximum transverse shear stress is 1.5 times the average shear stress in a beam of a rectangular section.	10	L2	CO4

	b.	The cross-section of a beam is as shown in Fig.Q7(b). If permissible stress is 150 N/mm^2. Find its moment of resistance and compare it with equivalent section of the same area for a square section.  Fig.Q7(b)	**10**	**L4**	**CO4**
		OR			
Q.8	**a.**	Illustrate an expression for the bending stress and radius of curvature for a straight beam subjected to pure bending.	**10**	**L2**	**CO4**
	b.	A 'T' shaped cross-section of a beam shown in Fig.Q8(b) is subjected to a vertical shear force of 100 KN. Inspect the shear stress at the neutral axis junction and flange. MI about the horizontal neutral axis is 0.0001134 m^4.  Fig.Q8(b)	**10**	**L4**	**CO4**
		Module – 5			
Q.9	**a.**	Explain the assumptions made in pure torsion-theory and show that $\frac{T}{J_p} = \frac{\tau}{R} = \frac{G\theta}{L}$	**10**	**L2**	**CO5**
	b.	A hallow shaft having internal diameter 40% of its external diameter, transmits 562.5 KW power at 100 rpm. List the internal and external diameters of the shaft if the shear stress is not to exceed 60 N/mm^2 and the twist in a length of 2.5m should not exceed 1.3 degrees. The maximum torque being 25% greater than mean. $G = 9\times10^4$ N/mm^2.	**10**	**L4**	**CO5**
		OR			
Q.10	**a.**	Show the variation of Euler's critical load with slenderness ratio. Explain the limitations of Euler's theory and mention for formulae to overcome these limitations.	**10**	**L2**	**CO5**
	b.	A 1.5 m long column has a circular cross-section of 50 mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor of safety as 3, analyze the safe load using (i) Rankine's formula taking yield stress 560 N/mm^2 and $\alpha = 1/1600$. (ii) Euler's formula, taking $E = 1.2\times10^5$ N/mm^2.	**10**	**L4**	**CO5**

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