U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: III**

Branch: Civil Engineering **Duration: 3 hrs.**

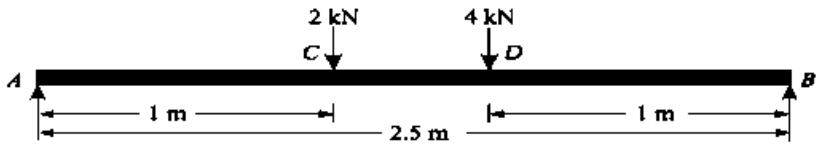
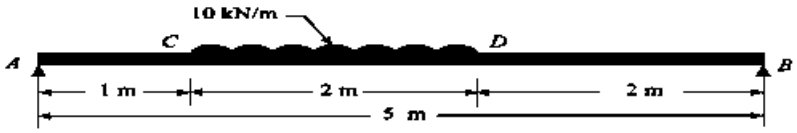
Course Code: 23CV3PCSOM / 22CV3PCSOM **Max Marks: 100**

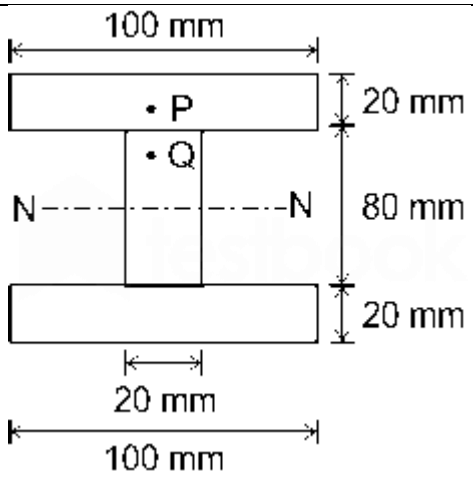
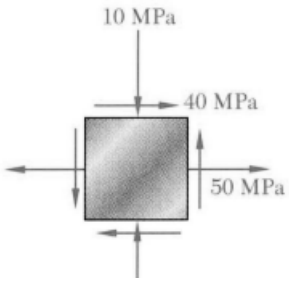
Course: Strength of Materials

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	A steel cylinder of diameter 80 mm and 400 mm long is placed inside a hollow aluminium cylinder of internal diameter 100 mm and external diameter 140 mm. The aluminium cylinder is 0.24 mm longer than steel cylinder. The total assembly is subjected to an axial load of 500 kN through rigid cover plates. Find the stresses developed in steel and aluminium. Take Es = $2x10^5$ MPa and Eal = $0.7x10^5$ MPa	*CO2*	*PO 1,2*	**10**
	b)	A steel tube of 80mm outer diameter and 10 mm thick is filled into a copper tube of 30 mm inner diameter and 10mm thick. They are connected rigidly at the ends and subjected to an axial compression of 300kN load. If the length of each bar is 600mm, find the stresses in each material. Consider E_s = 200GPa and E_{cu} = 120GPa.	*CO2*	*PO1, 2*	**10**
		OR			
2	a)	Explain the following (i) Stress (ii) Strain (iii) Young's Modulus	*CO1*	*PO1*	**6**
	b)	Derive the expression for extension of rectangular tapering bar of length 'L' thickness 't' and with varying width b1 at one end and b2 at the other end subjected to an axial load 'P'.	*CO1*	*PO1*	**8**
	c)	A steel rod of 3cm diameter and 5m long is connected to two grips and the rod is maintained at temperature of 95°C. Determine the stresses and pull exerted when the temperature falls below 30°C if (i) The ends are not yielding (ii) The ends yield by 0.12cm. Consider E = 2 x 10^5 MN/m^2 and α = 12 x 10^{-6}/°C.	*CO2*	*PO2*	**6**

			UNIT - II			
	3	a)	Draw the SFD and BMD for the beam shown in fig. 2  Fig. 2	***CO2***	***PO2***	**10**
		b)	Derive the expression for maximum bending moment of a simply supported beam subjected to uniformly distributed load and draw SFD and BMD. Indicate the salient points.	***CO1***	***PO1***	**10**
			OR			
	4	a)	A simply supported beam 5m long is loaded with a UDL of 10kN/m over a length of 2m as shown in fig. 3. Draw SFD and BMD. Indicate the salient points.  Fig. 3	***CO2***	***PO2***	**10**
		b)	Derive the expression for maximum bending moment of a simply supported beam subjected to two equal concentrated loads at $1/3^{rd}$ distance of the span 'L' and draw SFD and BMD. Indicate the salient points.	***CO1***	***PO2***	**10**
			UNIT - III			
	5	a)	A simply supported beam has a span of 4 m and rectangular in cross section 100 mm x 200 mm. Find the uniformly distributed load it can carry, if the maximum bending stress and the maximum shear stress are not to exceed 10 N/mm2 and 0.6 N/mm2 respectively.	***CO1***	***PO1***	**10**
		b)	An I-section of a beam is shown in fig. 4. If the shear stress at point P which is very close to the bottom of the flange is 12MPa, evaluate the shear stress at point Q close to the flange.	***CO2***	***PO2***	**10**

			 Fig. 4			
			OR			
	6	a)	Define (i) Modulus of Rupture (ii) Section Modulus (iii) Flexural Rigidity (iv) Shear Stress (v) Bending Stress	***CO1***	***PO2***	**10**
		b)	Derive the Bending Equation.	***CO1***	***PO2***	**10**
			UNIT - IV			
	7	a)	For state of plane stress shown in fig.5, find (a) principal planes, (b) principal stresses, (c) maximum shearing stress and corresponding normal stress.  Fig. 5	***CO2***	***PO2***	**14**
		b)	Define (i) Plane Stress, (ii) Plane Strain and (iii) Mohr's Circle	***CO1***	***PO1***	**6**
			OR			
	8	a)	Derive the expression for Plane Strain using Mohr's Circle.	***CO1***	***PO2***	**10**
		b)	Discuss (i) Rankine's Theory of Failure and (ii) Maximum Shear Stress Theory with neat diagrams	***CO2***	***PO2***	**10**
			UNIT - V			
	9	a)	Derive the expressions for Euler's crippling load for (i) Both ends hinged and (ii) both ends fixed	***CO1***	***PO1***	**14**

		b)	A solid circular shaft transmits 75kW power at 200rpm. Calculate the shaft diameter, if the twist in the shaft is not to exceed 1° in 2 meters length of the shaft, and shear stress is limited to 50MN/m^2. Take C=100GN/m^2	***CO2***	***PO2***	**6**
			OR			
	10	a)	Discuss following briefly: (i) Torsional stiffness (ii) Torsional rigidity (iii) Polar Moment of Inertia (iv) Torsion equation (v) Angle of Twist	***CO1***	***PO1***	**10**
		b)	Find Euler's crushing load for a hollow cylindrical cast iron column 120mm external diameter and 20mm thick, if it is 4.2m long and is hinged at both ends. Take E = 80kN/mm^2. Compare this load with the crushing load as given by Rankine's formula using constants fc=550N/mm^2 and a = 1/1600. For what length of strut does the Euler's formula cease to apply?	***CO2***	***PO2***	**10**

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