U.S.N.										

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

Autonomous Institute Affiliated to VTU

June 2025 Semester End Main Examinations

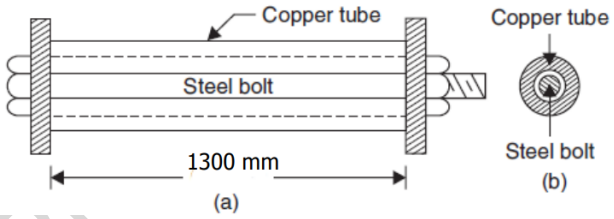
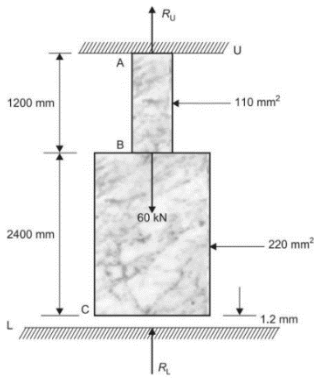
Programme: B.E. **Semester: III**

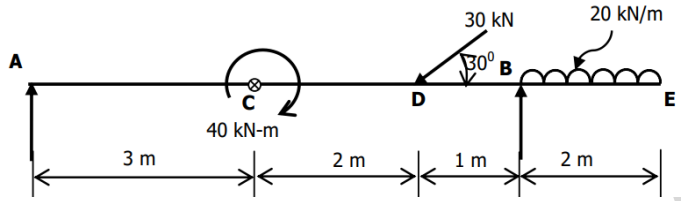
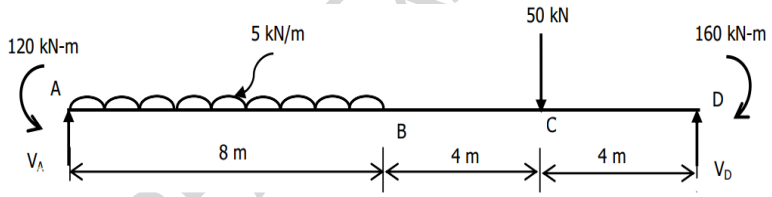
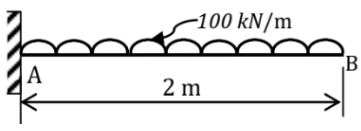
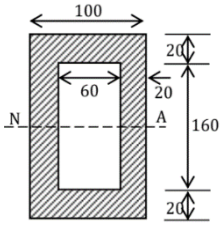
Branch: Civil Engineering **Duration: 3 hrs.**

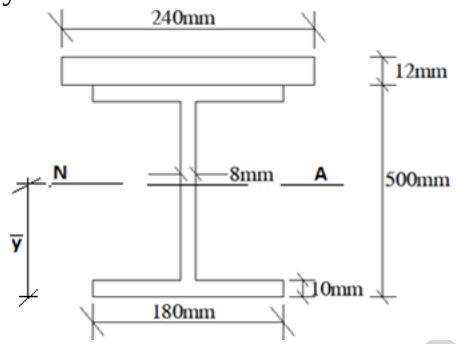
Course Code: 23CV3PCSOM / 22CV3PCSOM **Max Marks: 100**

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.

			UNIT - I	CO	PO	Marks
1	a)		Prove that Volumetric strain is equal to the sum of strains in three mutually perpendicular directions.	*CO1*	*PO 1*	**8**
	b)		A steel rod 25 mm in diameter passes through a copper tube of 63 mm external diameter and 40 mm internal diameter. The tube is 1300 mm long and closed by rigid washers and nuts. If one nut is tightened by half a turn relative to the other. What are the stresses developed in steel rod and copper tube? There are 4 threads per 10 mm. Take E_{CU} = 100 GPa, E_S = 200 GPa.  **Figure.1**	*CO1, CO2*	*PO2*	**12**
			OR			
2	a)		For the bar shown in the figure calculate the reactions produced by the lower support on the bar. Assume E = 2 x 10^5 N/mm^2. Find also the stresses in the bars.  **Figure. 2**	*CO1, CO2*	*PO2*	**10**
	b)		Briefly explain the Saint Venant's Principle with a neat sketch.	*CO1,*	*PO1*	**5**

		c)	A concrete column is reinforced with steel bars comprising 5% of the gross section of the column. What fraction of the compressive load is sustained by steel bars? The ratio of Young's modulus of steel to that of concrete is 13.	*CO1, CO2*	*PO2*	**5**
			UNIT - II			
	3	a)	Establish the relationship between load intensity, Shear force and bending moment with usual notations.	*CO2*	*PO1*	**6**
		b)	Draw the bending moment and shear force diagram for the beam loaded as shown in figure. Mark all the salient points. Determine the point of contraflexure also.  **Figure. 3**	*CO2*	*PO2*	**14**
			OR			
	4	a)	Draw the shear force and bending moment diagram for a simply supported beam of span L subjected to a load uniformly varying from 0 kN/m at one end to w kN/m at the other end.	*CO2*	*PO2*	**6**
		b)	For the beam shown in figure, obtain SFD and BMD. Locate points of contraflexure, if any.  **Figure. 4**	*CO2*	*PO2*	**14**
			UNIT - III			
	5	a)	List the assumptions made in the simple bending theory.	*CO1*	*PO1*	**5**
		b)	Prove that in case of a beam of a rectangular cross-section, the maximum shear stress developed is 1.5 times the average shear stress.	*CO1*	*PO1*	**5**
		c)	A cantilever shown in figure carries a UDL of 100 kN/m. All dimensions are in mm. Draw the shear stress distribution at the distance 1.5 m from the free end.   **Figure. 5**	*CO1, CO2*	*PO2*	**10**
			OR			

	6	a)	Explain the terms: pure shear and section modulus.	*CO1*	*PO1*	**4**
		b)	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/mm^2 and 0.6 N/mm^2 respectively.	*CO1, CO2*	*PO2*	**6**
		c)	An I section has flanges of size 180 mm x 10 mm and its overall depth is 500 mm. Thickness of the web is 8 mm. It is strengthened with a plate of size 240 mm x 12 mm on tension side as shown in the Figure.6. Find the moment of resistance of the section if permissible stress is 150 N/mm^2. How much uniformly distributed load it can carry if it is used as a cantilever beam of span 3 m?  **Figure. 6**	*CO1, CO2*	*PO2*	**10**
			UNIT - IV			
	7	a)	Prove that in case of a strained element subjected to normal stresses and complimentary shear stress system, the maximum shear stress is half the difference between principal stresses.	*CO1, CO2*	*PO2*	**5**
		b)	An element is subjected to a tensile stress of 800 N/mm^2 and a compressive stress of 500 N/mm^2 on two mutually perpendicular planes. A shear stress of 200 N/mm^2 acts clockwise on plane of 800 N/mm^2 and anticlockwise on the plane of 500 N/mm^2. Find analytically: i. Principal Stresses and their planes ii. Maximum Shear Stresses and their planes iii. Shear stress on a plane inclined at 30^0 measured clockwise from the plane of 800 N/mm^2	*CO1, CO2*	*PO2*	**15**
			OR			
	8	a)	Explain: Principal stresses and Principal planes	*CO1*	*PO1*	**4**
		b)	A 300 mm length rectangular rod of cross section 15 mm x 10 mm carries two tensile loads of 30 kN along X – axis and 450 kN along Y – axis across the two mutually perpendicular planes. Using Mohr's Circle, find the normal, tangential and the resultant stresses on the plane inclined at 60^0 anticlockwise to the axis of minor principal stress. Also calculate the angle of obliquity.	*CO1, CO2*	*PO2*	**16**
			UNIT - V			
	9	a)	Deduce the Euler's buckling equation for a column with both ends fixed.	*CO1, CO2*	*PO2*	**10**

		b)	A power of 2.2 MW has to be transmitted at 60 rpm. If the allowable stress in the material of the shaft is 85 MPa. Find the required diameter of the shaft if it is solid. If instead, a hollow shaft is used with $3d_0 = 4d_i$ ratio, calculate the percentage saving in weight per meter length of the shaft. Density of the material of the shaft is 7800Kg/m^3	*CO1, CO2*	*PO2*	**10**
			OR			
	10	a)	Prove that a hollow shaft is always stronger than a solid shaft of the same material, weight and length, when subjected to pure torque.	*CO1, CO2*	*PO2*	**8**
		b)	Find the Euler's crushing load for a hollow cylinder cast iron column 150 mm, external diameter and 20 mm thick. If column is 7m long, fixed at both ends E = 70 kN/mm^2. Compare this load with the crushing load given by Rankine's formula, taking yield stress =550 N / mm^2 and $\alpha = \frac{1}{1600}$. For what length of the column would these two formulae give the same crushing load.	*CO1, CO2*	*PO2*	**12**

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