U.S.N.										

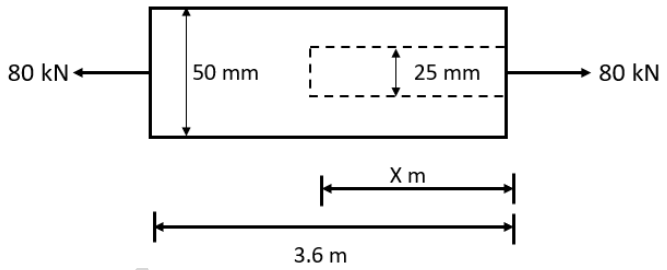
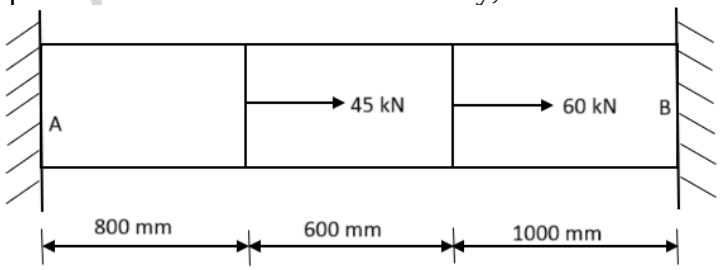
B.M.S. College of Engineering, Bengaluru-560019

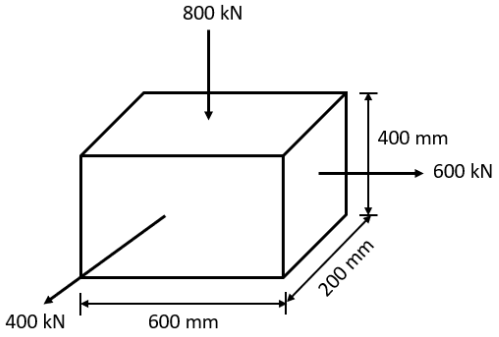
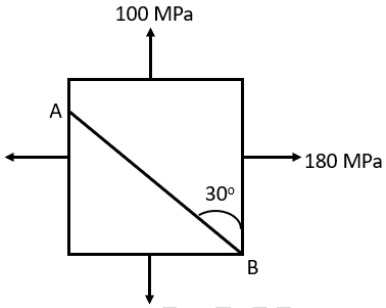
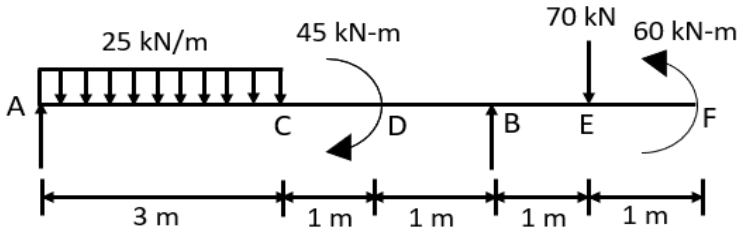
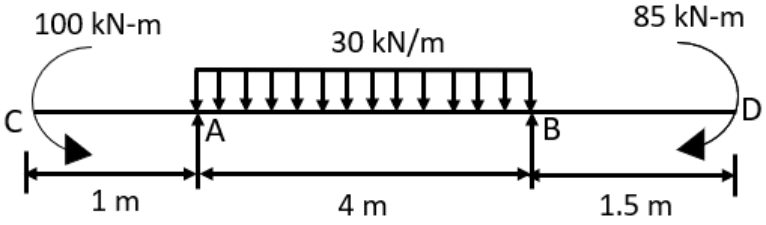
Autonomous Institute Affiliated to VTU

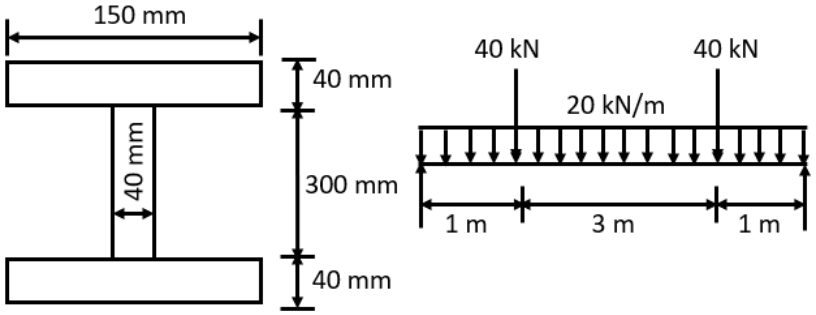
January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: Civil Engineering **Duration: 3 hrs.**
Course Code: 19CV3PCSOM **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)	Explain briefly St. Venant's Principle with a neat sketch.	CO 1	PO1	05
	b)	A circular bar of 50 mm diameter and 3.6 m length is subjected to an axial load of 80 kN as shown in the Fig.Q1(b). The bar is centrally bored with a bore diameter of 25 mm to a distance x meters such that the elongation of the bar increases by 40%. Find the value of 'x'. Take modulus of elasticity as $E = 2x10^5$ MPa.  **Fig Q1(b)**	CO 2	PO1, PO2	07
	c)	A circular bar of diameter 50 mm is rigidly held at the edges and subjected to axial forces as shown in the Fig Q1(c) below. Determine the reaction forces at the supports A and B necessary for equilibrium. Take modulus of elasticity, $E = 2x10^5$ MPa.  **Fig Q1(c)**	CO 2	PO1, PO2	08
		OR			
2	a)	A steel tube of 50 mm external diameter and 30 mm internal diameter encloses a copper rod of 25 mm diameter such that both the materials are rigidly connected at each end. If no thermal stress is induced at room temperature, determine the stress in steel and copper if the temperature is raised by 150 ^oC. Take Es = 2 x 10^5 MPa, Ecu = 1 x 10^5 MPa. Coefficient of thermal expansion of steel is $12x10^{-6}/^oC$ and copper $18x10^{-6}/^oC$.	CO 2	PO1, PO2	07

		b)	A metallic block of 600 mm x 400 mm x 200 mm is subjected to the axial forces as shown in the Fig.Q2(b) below. Determine the change in volume of the block. Take E = $2x10^5$ MPa and Poisson's ratio as 0.25.  **Fig. Q2(b)**	***CO*** 1	***PO1, PO2***	**07**
		c)	Stress at a point in a strained material is as shown in the Fig.Q2(c) below. Determine the normal and tangential stresses on the inclined plane AB.  **Fig. Q2(c)**	***CO*** 1	***PO1, PO2***	**06**
			UNIT - II			
	3	a)	Discuss the relationship between loading, shear force and bending moment.	**CO** 2	**PO1, PO2**	**06**
		b)	For the beam as shown in the Fig. Q3(b) below, Draw SFD and BMD indicating the values of salient points.  **Fig. Q3(b)**	***CO*** 2	***PO1, PO2***	**14**
			OR			
	4	a)	For the beam as shown in the Fig. Q4(a) below, Draw SFD and BMD indicating the values of salient points.  **Fig. Q 4(a)**	***CO*** 2	***PO1, PO2***	**12**

		b)	Draw SFD and BMD for a cantilever beam of span 'L' meters carrying uniformly distributed load of 'W' kN/m over half of the span (L/2) from free end.	***CO*** 2	***PO1, PO2***	**08**
			UNIT - III			
	5	a)	A T-section with flange dimensions 250 mm x 25 mm and web of 25 mm x 350 mm is used for a simply supported beam of span 6 m. If the beam carries a u.d.l of 30 kN/m over the entire span, plot the shear stress distribution across the depth of the beam.	***CO*** 2	***PO1, PO2***	**10**
		b)	Derive the bending stress (Bernoulli's) equation from the principles of simple bending theory.	***CO*** 2	***PO1, PO2***	**10**
			OR			
	6	a)	Prove that maximum shear stress is 1.5 times of average shear stress for a rectangular cross section.	***CO*** 2	***PO1, PO2***	**06**
		b)	A symmetrical I section 150 mm x 380 mm (outer dimensions) is used for a simply supported beam as shown in the Fig.Q6(b) below. Plot the shear stress and bending stress distribution across the depth of the beam.  **Fig.Q6(b)**	***CO*** 2	***PO1, PO2***	**14**
			UNIT - IV			
	7	a)	Derive an expression for Euler's buckling load for a column with both ends are hinged.	***CO*** 2	***PO1, PO2***	**10**
		b)	A hollow rectangular cross section is used for a column with its external dimensions of 300 mm x 500 mm having a uniform thickness of 20 mm all around. The column is 3.5 m long with supports fixed at both the ends. Determine the crippling load using Euler's equation. Assume Young's modulus of the material = 130 GPa.	***CO*** 2	***PO1, PO2***	**10**
			OR			
	8	a)	Discuss the limitations of Euler's and Rankine's equations in the assessment of crippling load.	***CO*** 2	***PO1, PO2***	**06**
		b)	Explain the terms: Slenderness ratio, radius of gyration and effective length.	***CO*** 2	***PO1, PO2***	**06**
		c)	A symmetrical I section of flanges 150 mm x 20 mm and web 20 mm x 200 mm is used for a column of length 4 m fixed at both ends. Determine the crippling load using Rankine's equation. Take the crushing strength = 450 MPa and Rankine's constant, a = 1/1600.	***CO*** 2	***PO1, PO2***	**08**
			UNIT - V			
	9	a)	With usual notations, derive the torsional equation for circular shafts.	***CO*** 2	***PO1, PO2***	**10**

		b)	A hollow circular shaft has to transmit 250 kW power at 120 rpm such that the shear stress does not exceed 60 MPa. If the ratio of internal to external diameter of the shaft is 3/4 and the value of modulus of rigidity is 85 GPa, find the dimensions of the shaft and angle of twist in a length of 3 m.	***CO*** 2	***PO1, PO2***	**10**
			OR			
	10	a)	Derive an expression for longitudinal stress and hoop stress for thin cylinders.	***CO*** 2	***PO1, PO2***	**10**
		b)	A Closed cylindrical vessel made of steel plates of 5 mm thick carries a fluid under a pressure of 4 MPa. The diameter of the cylinder is 250 mm and length is 900 mm. Calculate the longitudinal and hoop stress in the cylinder wall and also determine the changes in the diameter, length and volume of the cylinder. Take E = 2x105 MPa and Poisson's ratio as 0.24.	***CO*** 2	***PO1, PO2***	**10**

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