U.S.N.										

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

Autonomous Institute Affiliated to VTU

February 2025 Semester End Main Examinations

Programme: B.E. **Semester: IV**

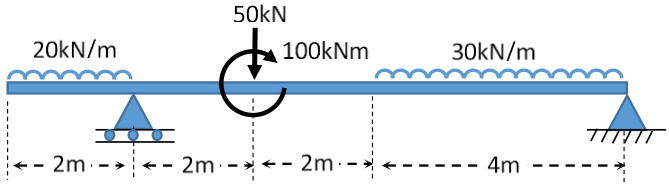
Branch: Aerospace Engineering **Duration: 3 hrs.**

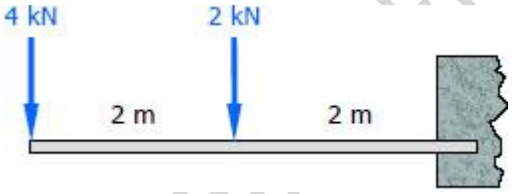
Course Code: 23AS4PCSDM / 22AS4PCSDM **Max Marks: 100**

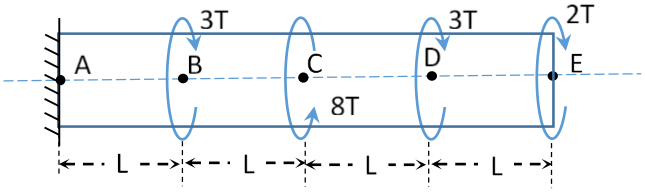
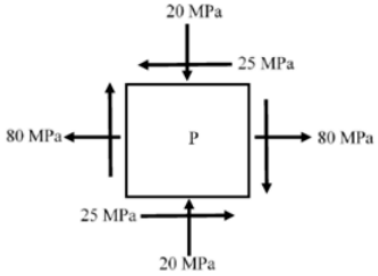
Course: Solid Mechanics

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)	Derive the tip extension expression for a uniformly circular bar under a load its tip and self-weight.	CO2	PO1	**10**
	b)	A material has Youngs modulus E = 200 GPa and Poisson's ratio μ = 0.3. Determine the modulus of rigidity G and bulk modulus K.	CO3	PO1 PO2	**10**
		OR			
2	a)	Derive the relationship between modulus of elasticity, modulus of rigidity and bulk modulus.	CO2	PO1	**10**
	b)	A compound bar is made of a steel plate 50 mm wide and 10 mm thick to which copper plates of size 40 mm wide and 5 mm thick are connected rigidly on each side as shown in the below Figure. The length of the bar at normal temperature L is 1 m. If the temperature is raised by 80°, determine the stresses in each metal and the change in length. Given $\alpha_s = 12\times10^{-6}$/°C, $\alpha_c = 17\times10^{-6}$/°C, $E_s = 2 \times 10^5$ N/mm^2, $E_c = 1 \times 10^5$ N/mm^2.	CO3	PO1 PO2	**10**
		UNIT - II			
3	a)	Derive the relation between distributed load, shear force and bending moment in beam.	CO2	PO1	**8**
	b)	Draw the SFD and BMD for the following beam as shown in Figure 3b Also find the location of contra-flexure and magnitude of maximum bending moment.  Fig. 3b	CO2	PO1 PO2	**12**
		OR			

	4	a)	Derive the flexural formula for beam $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ with usual notation. State the assumptions made.	*CO2*	*PO1*	**10**
		b)	A 2m long SSB with rectangular section (b=50 mm, d=100mm) is subjected to 10kN point load at mid of span. Draw the bending and shear stress distribution along the depth of the section at ½ and ¼ of the span length from a support.	*CO3*	*PO1* *PO2*	**10**
			UNIT - III			
	5	a)	Derive the deflection equation. State the assumptions made.	*CO2*	*PO1*	**8**
		b)	Determine the value of the maximum deflection expression for a simply supported beam with a concentrated load at the mid using: i. Macaulay's ii. Moment area methods.	*CO2*	*PO2*	**12**
			OR			
	6	a)	Discuss the various method for analysis the deflection with stating their applications	*CO2*	*PO1*	**10**
		b)	The cantilever beam shown in Figure 8b has a rectangular cross-section 50 mm wide by h mm high. Find the height h if the maximum deflection is not to exceed 10 mm. Use E = 10 GPa.  Fig 8b	*CO3*	*PO1* *PO2*	**10**
			UNIT - IV			
	7	a)	Derive the torsional formula $\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{L}$ with usual notation for the circular shaft.	*CO2*	*PO1*	**10**
		b)	A hallow circular column is used to carry an automobile of mass 2000 Kg through a height of 3 meters. Material of column has an yield stress of 330 MPa. Outer diameter of the column is 100mm and thickness of wall is 5 mm. One end of the column is fixed and other end is free. Taking E as 200 GPa, determine, i) Factor of safety, ii) Ratio of crushing stress at yields point to buckling stress.	*CO3*	*PO1* *PO2*	**10**
			OR			
	8	a)	Derive Euler's expression for buckling load for with one end fixed and other end free with stating the assumptions.	*CO2*	*PO1*	**10**
		b)	Determine the total twist and ratio of maximum shear stress for shaft shown in Figure 8b. Draw the twist and torque diagram along the shaft length.	*CO3*	*PO1* *PO2*	**10**

			 Fig 8b			
			UNIT - V			
	9	a)	List and briefly explain the various theories of failure with proper equations.	*CO 1*	*PO1*	**10**
		b)	For a plane stress problem, the state of stress at a point P is represented by the stress element as shown in Figure 9b. Determine the principal stress and direction using Mohr's circle method.  Fig 9b	*CO 1*	*PO1*	**10**
			OR			
	10	a)	At a point in a strained material the normal stresses are σ_x. and σ_y which are tensile in nature and shear stress τ_{xy}, derive the expression for normal stress and shear stress in an inclined plane making an angle θ with the vertical plane.	*CO2*	*PO1* *PO2*	**10**
		b)	The cross-section of a bolt is required to resist an axial tension of 15 kN and a transverse shear of 15 kN. Estimate the diameter of the bolt by, (i) Maximum principal stress theory and (ii) Maximum shear stress theory. The elastic limit of the material is 300 N/mm^2, and factor of safety = 3.	*CO5*	*PO1* *PO2*	**10**

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