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: Industrial Engineering and Management **Duration: 3 hrs.**

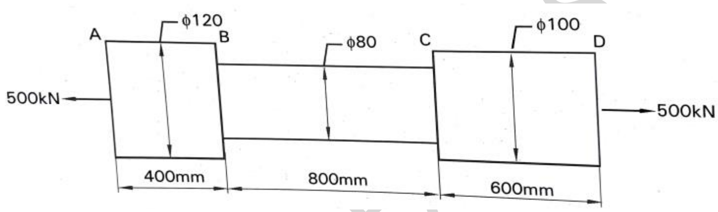
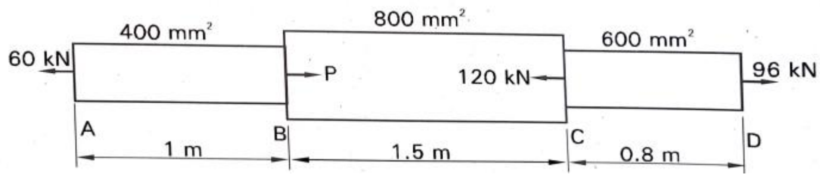
Course Code: 23IM3PCEMM / 22IM3PCMAM **Max Marks: 100**

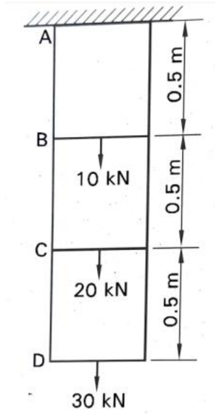
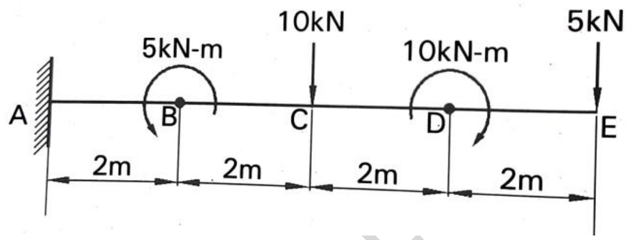
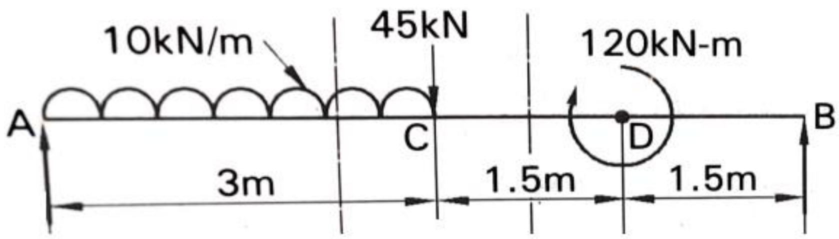
Course: Engineering Materials and Mechanics / Materials and Mechanics

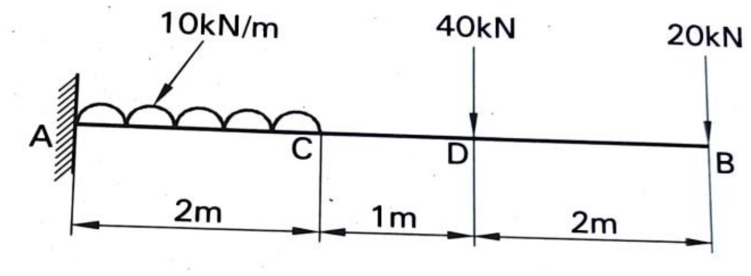
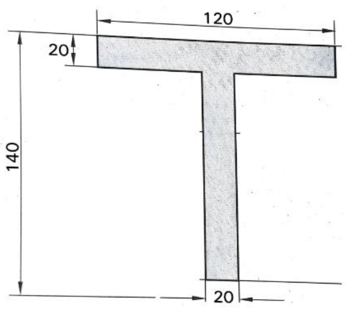
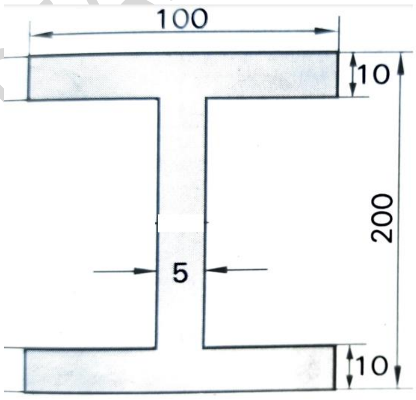
Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

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)	Describe the concept of cooling curves in phase transformations. How are they used in the construction of phase diagrams?	CO1	PO1	**08**
	b)	Two metals A and B have their melting points at 900°C and 800 °C respectively. The alloy pair forms a eutectic at 600 °C of composition 60% B and 40% A. A and B have unlimited mutual liquid solubility. Their solid solubility is as below: 10% B in A at 600°C and 5% B at 0°C. 8% A in B at 600°C and 4% A in B at 0°C. Assume the liquidus, solidus and solvus lines to be straight. No solid state reactions or any intermediate phase changes occur in the series. i) Draw the phase diagram for the series and label all salient temperatures, compositions and regions. ii) Find the room temperature structure of an alloy of composition 60% A and 40% B, with respect to the number, type, extent and composition of phases.	CO1	PO1	**12**
		OR			
2	a)	Explain the different types of solid solutions that can exist in metallic alloys. Discuss how different factors influence the formation of solid solutions in metallic systems.	CO1	PO1	**10**
	b)	Define a solid solution and differentiate between them with suitable examples.	CO1	PO1	**05**
	c)	What are the Hume-Rothery rules, and how do they govern the formation of substitutional solid solutions?	CO1	PO1	**05**
		UNIT - II			
3	a)	Explain the heat treatment processes of annealing, normalizing, and hardening. Discuss the key differences among these processes	CO2	PO2	**08**
	b)	Distinguish between the 'Top-Down' and 'Bottom-Up'	CO2	PO2	**06**

			approaches for manufacturing nanomaterials. How do these methods influence the final properties of nanomaterials?			
		c)	Describe the pultrusion process as a production method for fiber-reinforced composites. Analyze the advantages and limitations of pultrusion.	*CO2*	*PO2*	**06**
			OR			
	4	a)	Describe the carburizing and flame hardening methods for surface heat treatment. How do these processes improve the surface hardness and wear resistance of steel?	*CO2*	*PO2*	**08**
		b)	Define composite materials and give their classifications. Enumerate the general properties of these composites and provide examples of their applications in various industries.	*CO2*	*PO2*	**06**
		c)	Describe the steps involved in Sol-Gel process for manufacturing nanomaterials. State its advantages, limitations and applications.	*CO2*	*PO2*	**06**
			UNIT - III			
	5	a)	A bar shown in the figure below is subjected to a tensile load of 500 kN. Find the total elongation of the bar and the maximum stress in the material. $E=2x10^5$ MPa. 	*CO3*	*PO3*	**10**
		b)	A steel specimen of 12.5mm diameter and 150mm gauge length is subjected to tensile test. It is observed that load at yield point is 43kN and maximum load is 60 kN. A load of 16.4 kN is required to cause an elastic extension of 0.1mm. Final length of specimen is 190 mm and the diameter of neck after the fracture is 8mm. Determine (i) yield stress (ii) ultimate stress (iii) Young's modulus (iv) percentage increase in length and (v) percentage reduction in area.	*CO3*	*PO3*	**10**
			OR			
	6	a)	A steel bar ABCD of varying sections is subjected to the axial forces as shown in figure below. Compute the value of P necessary for equilibrium. If $E=210kN/mm^2$, determine (i) Stress in various segments (ii) Total elongation of bar (iii) Total strain in the bar. 	*CO3*	*PO3*	**10**
		b)	A steel bar of 1.5m length and uniform section of $500mm^2$ is suspended vertically and loaded as shown in the figure below.	*CO3*	*PO3*	**06**

			Taking $E=2 \times 10^5$ N/mm^2 determine the total elongation of the bar neglecting the self-weight of the bar.  			
		c)	Describe with a neat sketch the characteristic stages observed in the stress-strain curve of mild steel during a uniaxial tension test.	*CO3*	*PO3*	**04**
			UNIT - IV			
	7	a)	Find the reactions at the fixed end and draw SFD and BMD for the cantilever beam shown in the figure below.  	*CO3*	*PO3*	**10**
		b)	What is a beam? How are beams classified? Explain with neat sketches.	*CO3*	*PO3*	**05**
		c)	What are the main types of supports? Distinguish between roller and hinged supports.	*CO3*	*PO3*	**05**
			OR			
	8	a)	A simply supported beam AB of 6m span is loaded as shown in the figure below. Draw the SFD and BMD. Also indicate the point of contraflexure.  	*CO3*	*PO3*	**12**
		b)	Find the reactions at the fixed end and draw the shear force and bending moment diagrams for the cantilever beam shown in the figure below.	*CO3*	*PO3*	**08**

						
			UNIT - V			
	9	a)	Define pure bending. State the assumptions in pure bending.	*CO4*	*PO4*	**05**
		b)	How is the modulus of rigidity related to the material properties, and how does it affect the angular deformation of a shaft under torque?	*CO4*	*PO4*	**05**
		c)	The T-section shown in figure below is used as a simply supported beam over a span of 4m. It carries an uniformly distributed load of 8kN/m over its entire span. Calculate the maximum tensile and compressive stresses occurring in the section. 	*CO4*	*PO4*	**10**
			OR			
	10	a)	A cast iron bracket of I-section with equal flanges is as shown in the figure below. The beam carries an *udl* of 10 kN/m on a span of 10m length. Determine the positon of neutral axis, Moment of Inertia about the neutral axis and the maximum stress distribution. 	*CO4*	*PO4*	**10**
		b)	A beam of ‘I’ section 200mm x 300 mm has web thickness of 10mm and flange thickness 10mm. It carries a shearing force of 10 kN at a section. Sketch the shear stress distribution across the section.	*CO4*	*PO4*	**10**

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