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**

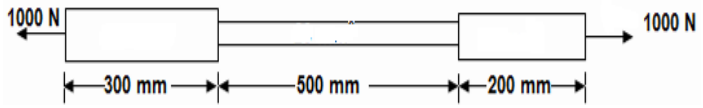
Branch: Mechanical Engineering **Duration: 3 hrs.**

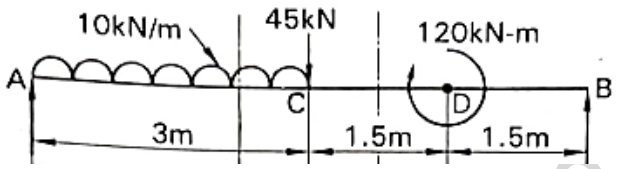
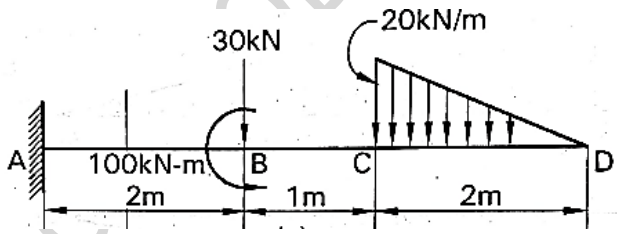
Course Code: 19ME3DCSOM / 15ME3DCSOM **Max Marks: 100**

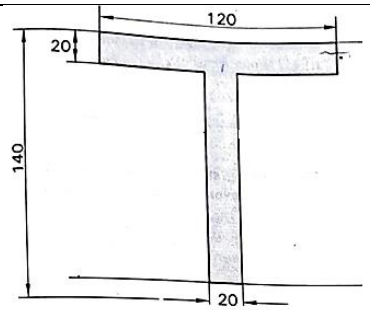
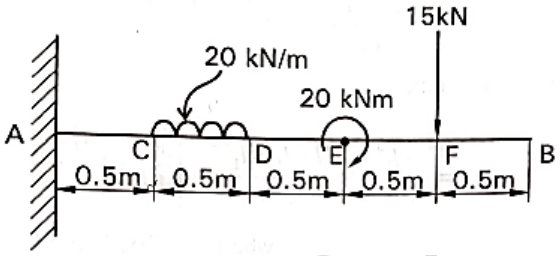
Course: Strength of Materials

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)	With a neat sketch indicating salient points, discuss the stress-strain behavior of a mild steel specimen during tensile test.	*CO1*	*PO1*	**06**
	b)	With suitable illustration, derive relation between Modulus of Elasticity (E) and Modulus of rigidity (G).	*CO2*	*PO1*	**08**
	c)	A composite rod loaded as shown in fig. 1 has its two ends 40 mm^2 and 30 mm^2 in area and the middle portion of the rod is 20 mm^2 in area. If the rod is subjected to an axial tensile load of 1000 N, find its total elongation. Take E = 200 GPa.  Fig.1	*CO2*	*PO1*	**06**
		OR			
2	a)	A steel rail is laid so that there is no stress in rails at 10°C. The maximum temperature expected is 45°C. Find (i) Minimum gap between the rails to be left so that temperature stresses do not develop if the length of each rail is 30 m. (ii) stress developed in the rails at the maximum temperature if there is no allowance for expansion (iii) stress developed in the rails at the maximum temperature if expansion allowance is 7.5 mm per rail. (iv) The maximum temperature to have no stress in rails if expansion allowance is 15 mm per rail (v) If stress developed is 20 N/mm^2, what is the gap between the rails at maximum temperature. Take E = 2 x 10^5 N/mm^2 and α = 12 x 10^{-6} /°C.	*CO2*	*PO2*	**10**

		b)	The stresses on two perpendicular planes through a point in a body are 400 MPa and 150 MPa both tensile along with a shear stress of 100 MPa. Find using analytical / graphical method (i) Magnitude and direction of principal stresses (ii) Magnitude and direction of maximum shear stress.	*CO2*	*PO2*	**10**
			UNIT - II			
	3	a)	Define shear force and bending moment at a section in a beam. Discuss their sign conventions.	*CO2*	*PO1*	**06**
		b)	Draw SFD and BMD for the beam shown in Fig 3b. Find the point of contraflexure, if any.  Fig. 3b	*CO2*	*PO2*	**15**
			OR			
	4	a)	Classify beams based on supports. Give examples. With suitable illustrations, discuss the different types of loads acting on beams.	*CO2*	*PO1*	**10**
		b)	Draw SFD and BMD for the beam shown in Fig 4b. Find the point of contraflexure, if any.  Fig. 4b	*CO2*	*PO2*	**10**
			UNIT - III			
	5	a)	Stating the assumptions made in the theory of simple bending, derive the bending equation.	*CO2*	*PO1*	**10**
		b)	The T-section shown in fig. 5b is used as simply supported beam over a span of 4 m. It carries a uniformly distributed load of 8 kN/m over its entire span. Calculate the maximum tensile and compressive stresses occurring in the section.	*CO2*	*PO2*	**10**

			 Fig. 5b			
			OR			
	6	a)	Obtain the expression for Euler-Bernoulli equation for deflection.	*CO2*	*PO1*	**10**
		b)	Determine slope and deflection at free end of the cantilever shown in fig. 6b. Take I = 200 x 10^{-6} m^4; E = 2 x 10^8 kN/m^2  Fig. 6b	*CO2*	*PO2*	**10**
			UNIT - IV			
	7	a)	State the assumptions in theory of pure torsion. Deduce the Torsion equation.	*CO3*	*PO1*	**10**
		b)	A solid shaft rotating at 1000 rpm transmits 50 kW. Maximum torque is 20% more than the mean torque. Material of the shaft has the allowable shear stress of 50 MPa and modulus of rigidity 80 GPa. Angle of twist in the shaft should not exceed 1^o in one-meter length. Determine the diameter of the shaft.	*CO3*	*PO2*	**10**
			OR			
	8	a)	Determine the ratio of power transmitted by the hollow shaft and a solid shaft when both have the same weight, length, material and speed. The diameter of the solid shaft is 150 mm and external diameter of hollow shaft is 250 mm.	*CO3*	*PO2*	**10**
		b)	Prove that a hollow shaft is stronger and stiffer than a solid shaft of the same material, length and weight.	*CO3*	*PO2*	**10**
			UNIT - V			
	9	a)	Discuss Lame's theory and hence deduce the expression for hoop stress and radial pressure in a thick cylindrical shell.	*CO4*	*PO1*	**10**

		b)	A thin cylindrical shell 1 m in diameter and 3 m long has a metal thickness of 10 mm. It is subjected to an internal fluid pressure of 3 MPa. Determine (i) circumferential and longitudinal stress (ii) circumferential, longitudinal and volumetric strain (iii) Change in length, diameter and volume. Also find the maximum shear stress in the shell. Assume Poisson's ratio as 0.3 and E= 210 GPa.	*CO4*	*PO2*	**10**
			OR			
	10	a)	Discuss the limitations of Euler's theory.	*CO4*	*PO1*	**06**
		b)	Obtain an expression for crippling load by Rankine's formula.	*CO4*	*PO1*	**06**
		c)	A solid round bar of 60 mm diameter and 2.5 m length is used as a strut. Find safe compressive load for the strut if (i) Both ends are hinged (ii) Both ends are fixed. Take E = 2 x 10^5 N/mm^2 and factor of safety = 3.	*CO4*	*PO2*	**08**

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