Name: **Enrolment No:**	

UPES

End Semester Examination, May 2023

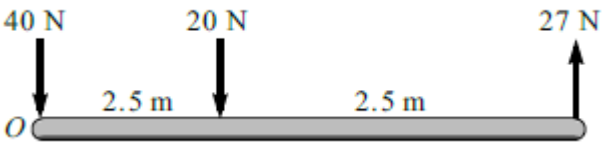
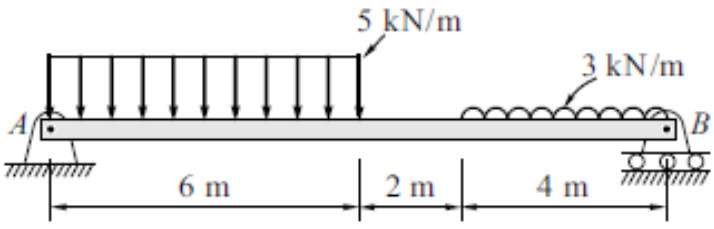
Course: Mechanics of Materials — **Semester: IV**

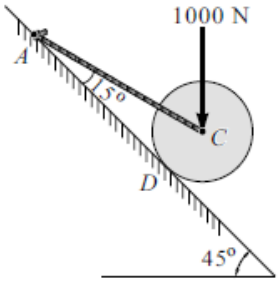
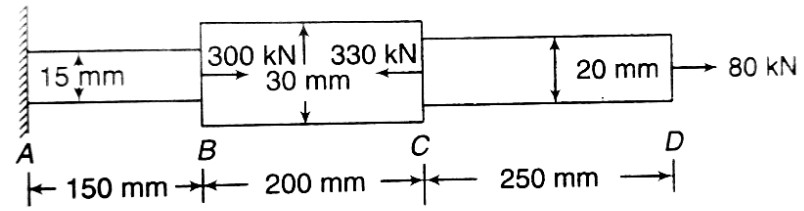
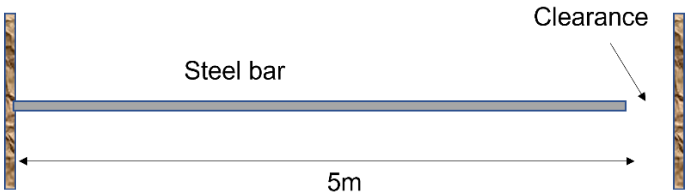
Program: B.Tech (Mechatronics) — **Time : 03 hrs.**

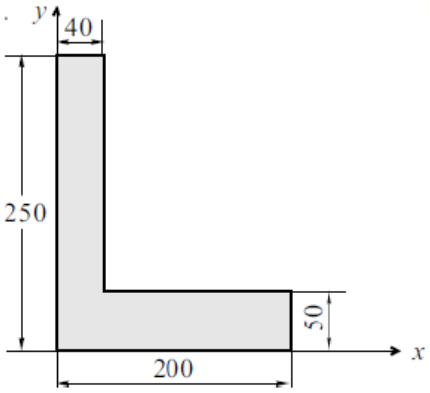
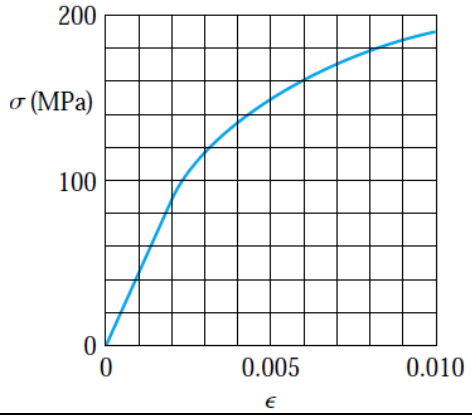
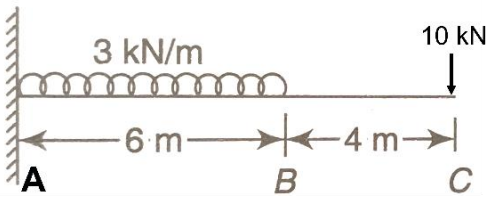
Course Code: MECH 2042 — **Max. Marks: 100**

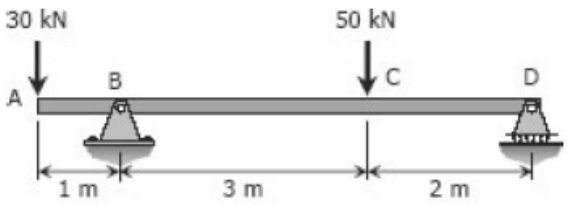
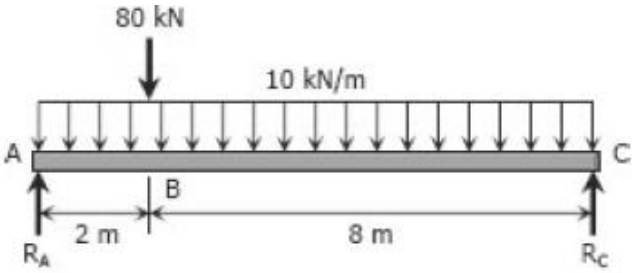
Instructions: Use Graph Sheets for drawing SFD and BMD

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Write parallel axis theorem and perpendicular axis theorem for moment of inertia.	**4**	**CO1**
Q 2	With the help of sketch discuss the difference between simple stress, shear stress and bending stress.	**4**	**CO3**
Q 3	What is lateral strain and the Poisson's ratio?	**4**	**CO3**
Q 4	For the bar shown in figure, calculate the resultant force and moment at point O. 	**4**	**CO1**
Q 5	Calculate the reaction forces for the beam shown in figure. 	**4**	**CO2**

SECTION B (4Qx10M= 40 Marks)			
Q 6	A roller weight W = 1000 N rests on a smooth inclined plane. It is kept from rolling down the plane by string AC as shown in Figure. Find the tension in the string and reaction at the point of contact D.  	**10**	**CO2**
Q 7	A steel circular bar has three segments (as shown in figure). Calculate the stress in each segment and total elongation in the bar. Which segment of the bar may fail first? Comment based on stress analysis. Take E = 205 GPa.  OR A cantilever steel bar (length 5 m) is fixed into a rigid wall at one end (as shown in figure). The bar is heated from 20°C to 120°C. There is a rigid wall at the right end of the bar with a clearance between the bar and the wall. The coefficient of thermal expansion of steel is 10^{-5}/°C. Calculate the value of thermal stress induced in the bar if, a) The clearance between the wall and the right end of the bar is 6 mm b) The clearance between the wall and the right end of the bar is 2 mm  	**10**	**CO3**

Q 8	Obtain the centroid of the area and moment of inertia of the area about its base (x-axis), shown in figure. [4+ 6 marks]  	**10**	**CO1**
Q 9	A circular bar of magnesium alloy is 800 mm long. The stress-strain diagram for the material is shown in the figure. The diameter of the bar is 10mm. The bar is subjected to 1000N. Calculate a) the stress induced in the bar, b) the elongation in the bar, c) decrease in diameter of the bar. The Poisson's ratio of the material is 0.3.  	**10**	**CO4**
	SECTION C **(2Qx20M= 40 Marks)**		
Q10	Draw shear force diagram (SFD) and bending moment diagram (BMD) for the following beams (use graph sheets). Also calculate the maximum value of bending moment in the beam. [2Q ×10 Marks] a)  	**20**	**CO3**

	b)  		
Q11	A beam of rectangular cross-section (10 mm width and 20mm thickness) is loaded as shown in figure. The value of young's modulus for the beam is 200GPa. [8+8+4 marks] a) Calculate the values of shear force and bending moment at the mid span of the beam. b) Calculate the value of maximum bending stress induced in the beam. c) At which location the beam is likely to fail due to bending and at which section (along the span) the beam may fail due to shear.  OR a) What do you understand by pure bending? Write the assumptions for theory of pure (or simple) bending. b) Derive the flexural formula (Relation between Moment-Curvature - bending stress) for the beam in pure bending. c) What is neutral axis of a beam? Show that the neutral axis of beam (in pure bending) passes through the centroid of the cross-section of the beam. [4+10+6 Marks]	**20**	**CO4**