Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, May 2024

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

Program: B. Tech. Aerospace Engineering — **Time : 03 hrs.**

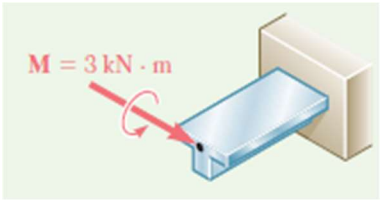
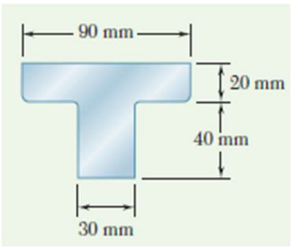
Course Code: MECH 2042 — **Max. Marks: 100**

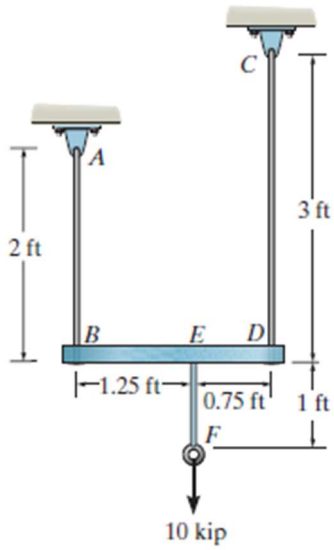
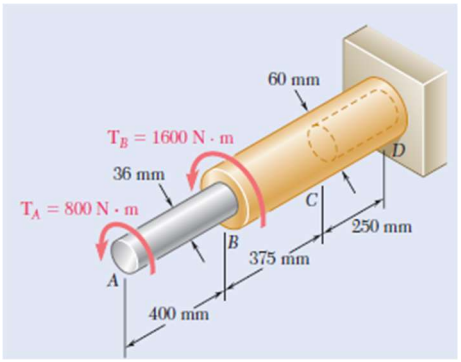
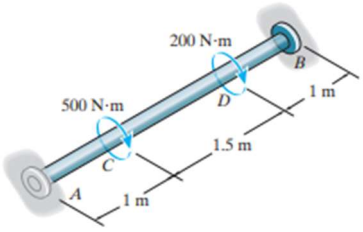
Instructions: Assume suitable right-handed coordinate system if it is not mentioned in problem.

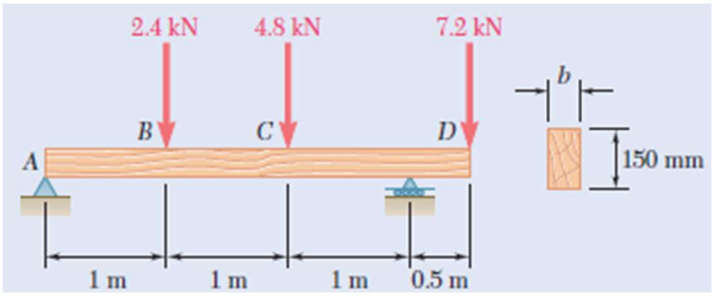
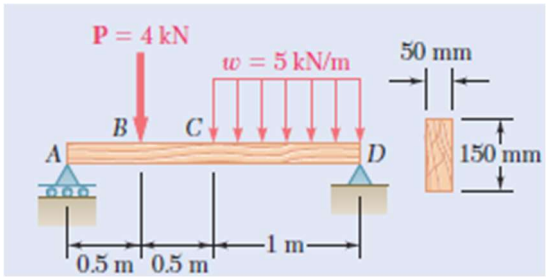
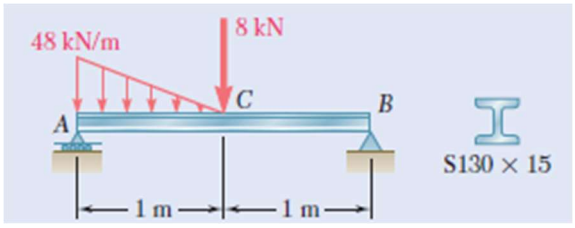
SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Define the section modulus of any beam cross-section and its significance.	**4**	**CO1**
Q 2	Describe with the help of sketch of the state of stress in any thin walled cylindrical and spherical pressure vessel.	**4**	**CO1**
Q 3	Explain the flexural rigidity and the torsional rigidity of any circular shaft.	**4**	**CO1**
Q 4	Derive the relation between the shear strain and angle of twist for the slender circular shaft subjected to twisting moment applied on its end.	**4**	**CO1**
Q 5	Define the state of stress and state of strain on infinitesimal element from any stressed body.	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

Q 6	A cast-iron machine part is acted upon by 3 kN.m couple as shown in figure about the lateral axis of member. Knowing that Young's elastic Modulus = 165 GPa and neglecting the effect of fillets, determine (a) the maximum tensile and compressive stresses in the casting and (b) the radius of curvature of the casting.  	**10**	**CO2**
Q 7	The assembly consists of two steel rods and a rigid bar BD. Each rod has a diameter of 0.75 in. If a force of 10 kip is applied to the bar, determine the vertical displacement of the load and angle of tilt of the bar. Take Young's modulus of steel rod $E = 29 \times 10^3$ ksi. and 1 ft = 12 in.	**10**	**CO3**

			
Q 8	Wall thickness of cylindrical shell of 500 mm internal diameter and 2 m long is 8 mm. If the shell is subjected to internal pressure of 1.5 MPa, determine (**a)** circumferential stress (**b)** longitudinal stress (**c)** maximum shear stress and, (**d)** change in length, diameter, and volume of the shell. Take Young's modulus of elasticity $E = 200$ GPa and $\nu = 0.3$.	**10**	**CO3**
Q 9	The aluminium rod *AB* (G = 27 GPa) is bonded to the brass rod *BD* (G =39 GPa) as shown in **Fig. 9(a)**. Knowing that portion C*D* of the brass rod is hollow and has an inner diameter of 40 mm, determine the angle of twist at *A*.  **Fig. 9(a)** **Or**  **Fig. 9(b)** The steel shaft has a diameter of 60 mm and is fixed at its ends A and B as shown in **Fig. 9(b).** If it is subjected to the torques shown in above figure, determine the absolute maximum shear stress in the shaft. Take Modulus of rigidity G = 80 GPa.	**10**	**CO2**

SECTION-C (2Qx20M=40 Marks)			
Q 10	For the beam and loading shown, determine the minimum required width ***b***, knowing that for the grade of timber used, σ_{all} = 12 MPa and τ_{all} = 825 kPa.  	**20**	**CO2**
Q 11	For the timber beam and loading shown in figure below, determine (*a*) the equation of the elastic curve *(b)* the slope at end *A* and (c) the deflection at the midpoint *C*. Take *E*=12 GPa.  **Or** For the beam and loading shown, determine (a) the equation of the elastic curve (b) the slope at end *A* and, (c) the deflection at the midpoint *C*. Beam is having I-cross-section with top & bottom flange of 130 mm × 15 mm and web of 130 mm × 15 mm. Take *E* = 200 GPa.  	**20**	**CO4**