Name: **Enrolment No:**	

UPES

End Semester Examination, May 2025

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

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

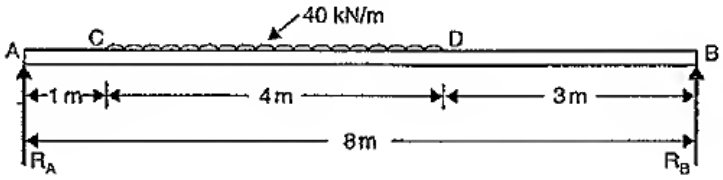
Course Code: MECH 2042 **Max. Marks: 100**

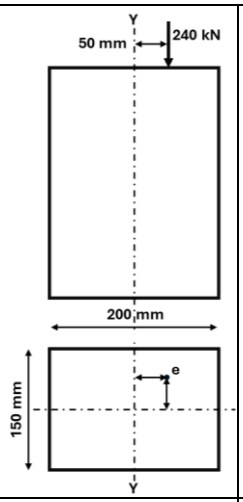
Instructions: Answer all questions from Section A. Sections B and C have an internal choice.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Draw SFD and BMD for a cantilever beam with a point load at the free end.	**4M**	**CO2**
Q 2	Derive the torsion formula for a solid circular shaft.	**4M**	**CO2**
Q 3	Define bending stress. State the assumptions of the theory of simple bending.	**4M**	**CO1**
Q 4	Define the polar moment of inertia and its importance in torsion.	**4M**	**CO1**
Q 5	Differentiate between elastic limit, yield point, and ultimate stress using a typical stress-strain diagram.	**4M**	**CO2**

SECTION B
(4Qx10M= 40 Marks)

Q 6	A beam of length 8m is simply supported at its ends. It carries a UDL of 40kN/m as shown in the Figure. Determine the deflection of the beam at its mid-point, the position of maximum deflection, and the maximum deflection. Take E= 2×10^5 N/mm^2 and I = 4.3×10^8 mm^4**. Apply Macaulay's method.** 	**10M**	**CO3**

Q 7	A rectangular column of width 200 mm and of thickness 150 mm carries a point load of 240 kN at an eccentricity of 50 mm, as shown in Fig. Determine the maximum and minimum stress on the section. Plot these stresses along the width of the section. 	**10M**	**CO4**
Q 8	Determine the diameter of a solid shaft that will transmit 300 kW at 250 r.p.m. The maximum shear stress should not exceed 30 N/mm^2 and twist should not be more than 1^o in a shaft length of 2 m. Take modulus of rigidity = 1×10^5 N/mm^2	**10M**	**CO4**
Q 9	Derive the expression for longitudinal stress and hoop stress in a thin cylinder with ends closed by rigid flanges and subjected to an internal fluid pressure '***p***'. Take the internal diameter and thickness of the cylinder to be '***d***' and '***t***' respectively. **Or** Explain the types of riveted joints with the help of a neat sketch. Also, describe different types of failure of a riveted joint.	**10M**	**CO2**
SECTION-C (2Qx20M=40 Marks)			
Q 10	(a) Prove the relation, $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ (b) A spherical shell of internal diameter 0.9 m and thickness 10 mm is subjected to an internal pressure of 1.4 N/mm^2. Determine the increase in diameter and increase in volume. Take E=2×10^5 N/mm^2 and μ = 1/3.	**20M**	**CO3**
Q 11	A cast-iron bracket of I-section has its top flange as 200 mm x 40 mm, bottom flange as 120 mm x 40 mm, and the web as 300 mm x 40 mm. The overall depth of the section is 380 mm. The bracket is subjected to bending. If the maximum tensile stress in the top flange is not to exceed 15 MPa, determine the bending moment the section can take. If the beam is subjected to a shear force of 150 kN, sketch the stress distribution over the depth of the section. Consider Fig. A	**20M**	**CO5**

OR

(a) A 430 mm x 160 mm I-beam is to be used as a simply supported beam of span 8 m. The web thickness is 10 mm, and the flanges are of 15-mm thick. The beam carries a uniformly distributed load of 60 kN/m over the whole span. Find whether the maximum bending stress is within the permissible limits of 180 MPa or not. If not, find the width of 12-mm thick cover plates to be welded to each flange for the section to be safe. Also, find the length over which the plates should extend. Consider Fig. B (**15 M**)

(b) Prove that the variation in shear stress is parabolic for a rectangular section. (**5 M**)

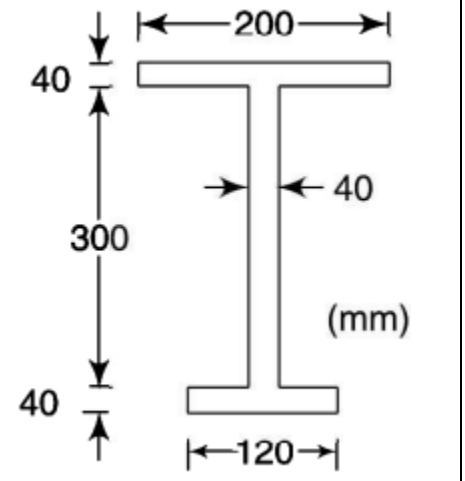


Fig. A

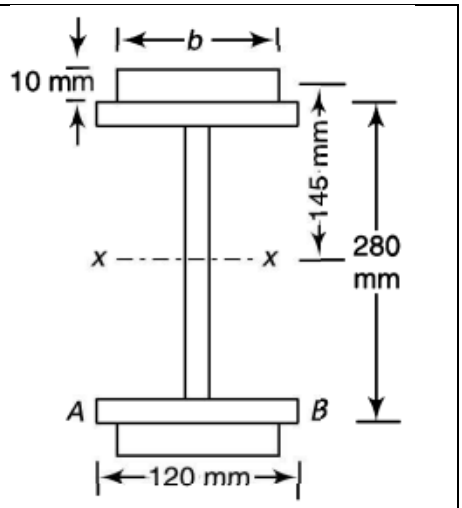


Fig. B