Name: **Enrolment No:**	

UPES

End Semester Examination, May 2025

Course: Strength of Materials **Semester: IV**

Program: BTech **(**Civil Engineering) **Time :** 03 hrs**.**

Course Code: MECH2018 **Max. Marks:** 100

Instructions:

- Attempt all questions.
- Use neat diagrams wherever necessary.
- Assume suitable data if required.

SECTION A

(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Fill in the blank: a) The unit of stress is _____. b) Torque produces _____ stress in a shaft.	**2** **2**	CO1
Q 2	Prove that the hoop stress in thin-walled pressure vessel is exactly twice the longitudinal stress.	**4**	CO2
Q 3	What are your key observations and learnings from the ongoing civil work at Block 11, where you have been attending Strength of Materials (SOM) classes on the ground floor?	**4**	CO1
Q 4	A steel column 4 m high and fixed at both ends has a diameter of 150 mm. Find the critical buckling load. Use E=200 GPa.	**4**	CO2
Q 5	A steel rod of cross-sectional area 300 mm² is subjected to a tensile force of 12 kN. Find the stress and strain in the rod. Assume Young's Modulus E=200 GPa.	**4**	CO1

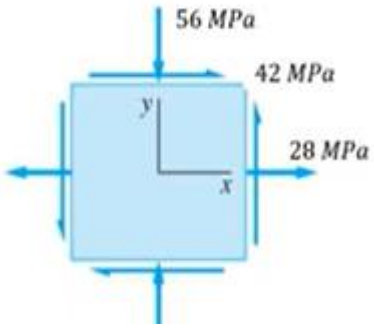
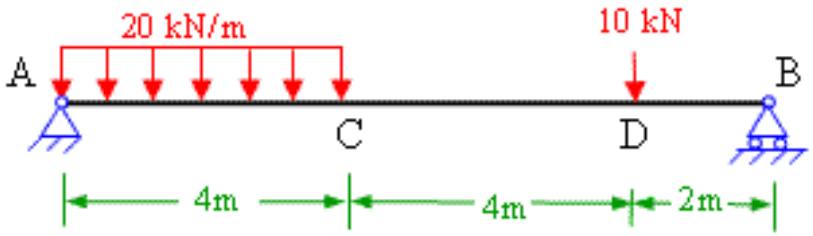
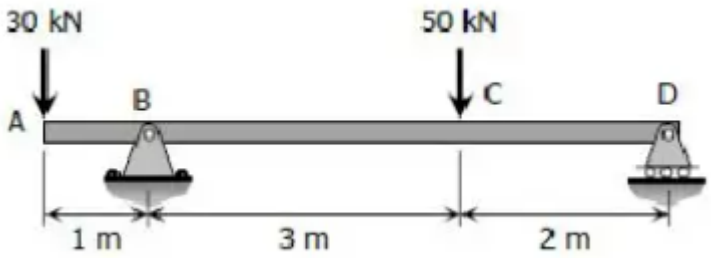
SECTION B

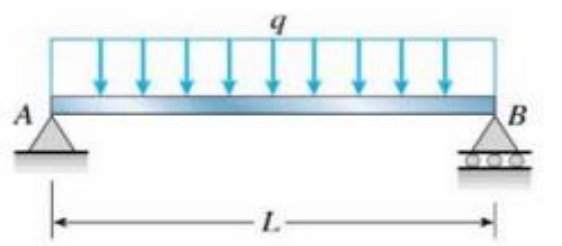
(4Qx10M= 40 Marks)

Attempt any four questions

Q 6	A cylindrical pressure vessel having an outer radius 100 mm, wall thickness 4 mm, is subjected to internal pressure of 100 bar. Determine: i. The hoop stress and longitudinal stress. ii. Is the design safe if the material yield strength is 50 MPa? iii. Also calculate hoop stress and longitudinal stress for the spherical pressure vessel having the same outside radius.	**4+2+4**	CO2

Q 7	i. A steel cable of length 10 m and diameter 30 mm is subjected to a tensile force of 200 kN. If the modulus of elasticity of steel is 200 GPa, calculate the strain energy stored in the cable ii. Briefly explain the physical significance of the equivalent length of a Column in civil engineering applications.	**5** **5**	**CO4**
Q 8	A steel pipe carrying water as shown in the below figure. Hope all of you have seen it on our UPES campus. Supports are four meters apart.  Given: • Pipe outer diameter: 100 mm • Pipe wall thickness: 4 mm • Density of water: 1000 kg/m³ • Steel density (for pipe weight): 7850 kg/m³ Calculate: i. Weight per meter of the pipe (water + pipe) ii. Reactions at each support	**5** **5**	**CO1**
Q 9	A solid steel shaft used in a fire hose reel is subjected to torsional force while unwinding the hose during a fire emergency. The shaft must be strong enough to withstand the applied torque without failure. **Given:** ➢ Length of the shaft (L): 0.8 m ➢ Diameter of the shaft (d): 30 mm ➢ Torque applied (T): 150 Nm ➢ Modulus of rigidity (G): 80 GPa ➢ Allowable shear stress for steel: 60 MPa **Calculate:** i.Maximum shear stress developed in the shaft ii.Angle of twist over the shaft length iii.Check if the shaft is safe under the applied torque	**4** **4** **2**	**CO2**

Q10	At a point in the structural member, the stresses are represented as shown in the figure –  Use Mohr's Circle method to find out the following: a. Mohr's circle diagram and label critical points. b. Amount of minimum and maximum principal stress. ❖ Please clearly mention the scale assumed.	**5+5**	**CO1**
	SECTION-C **(2Qx20M=40 Marks)**		
Q 11	 i. Calculate support reactions at point A and B ii. Draw shear force diagram (SFD) iii. Draw bending moments diagram (BMD) **Note:** show all the calculation steps **OR**  	**4+4** **6** **6**	**CO3**

	iv. Calculate support reactions at point B and D v. Draw shear force diagram (SFD) vi. Draw bending moments diagram (BMD) **Note:** show all the calculation steps	**4+4 6 6**	
Q12	Derive the deflection curve and slop equations using double integration method of beam AB supporting a uniformly distibuted load of intensity q , as shown in below figure:  Also determine max defelection at center of beam and slop at point A. Flexural rigidity of the beam is EI. **Note:** show all the calculation steps	**10+5 +5**	**CO 4**