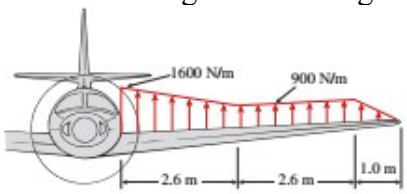
Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2022

Course: Strength of Materials **Semester: IV**
Program: B. Tech ASE **Time : 03 hrs.**
Course Code: MECH 2012 **Max. Marks: 100**

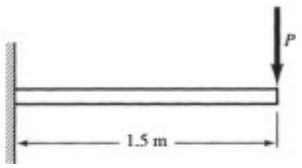
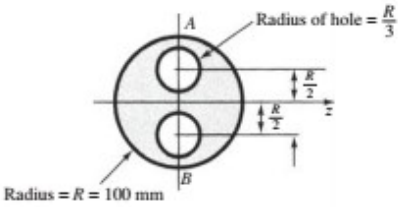
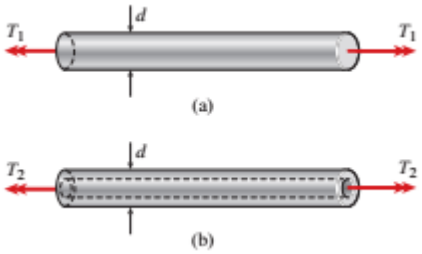
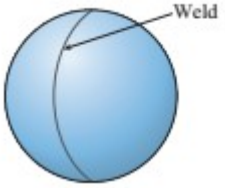
Instructions: i) Assume any suitable value for missing data
ii) Q1-Q3 are True/False

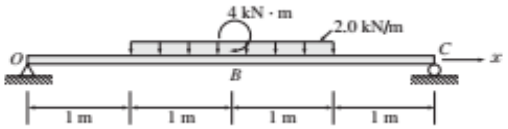
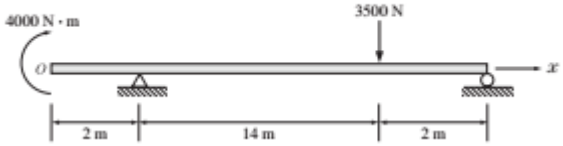
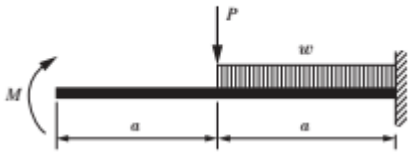
SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	a) Shear stress is zero at neutral axis (2 M) b) Strain is material property while stress is not (2 M)	**4**	**CO1**
Q2.	a) If bar is subjected to only axial loads, then shear stress is zero for any planes passing through a point. (2M) b) Stiffness of material is independent of its geometric properties. (2M)	**4**	**CO1**
Q3.	a) Point of contra-flexure is the position where shear force changes the sign. (2M) b) An isotropic material has same properties at all points in a materials. (2M)	**4**	**CO1**
Q4.	Draw the shear force and bending moment diagram for the beam below. 	**4**	**CO2**
Q5.	An aluminum bar of E = 70 GPa, diameter 20 mm is stretched by axial forces P, causing its diameter to decrease by 0.022 mm. The load P is approximately:	**4**	**CO2**

SECTION B
(4Qx10M= 40 Marks)

Q 6.	Steel railroad rails 10 m long are laid with end-to-end clearance of 3 mm at a temperature of 15C. (a) At what temperature will the rails just come in contact? (b) What stress would be induced in the rails at that temperature if there were no initial clearance? Use alpha= 11.7 x 10^{-6} / °C and E = 200 GPa.	**10**	**CO3**
Q7.	A cantilever beam is of length 1.5 m, loaded by a concentrated force *P* at its tip as shown in Fig. below and is of circular cross section (*R* = 100 mm), having two symmetrically placed longitudinal holes as indicated. The material is titanium alloy, having an allowable working stress in bending of 600 MPa. Determine the maximum allowable value of the vertical force *P*	**10**	**CO2**

	 		
Q8.	A solid brass bar of diameter *d* 30 mm is subjected to torques T_1, as shown in part a of the figure. The allowable shear stress in the brass is 80 MPa. (a) What is the maximum permissible value of the torques *T*1? (4M) (b) If a hole of diameter 15 mm is drilled longitudinally through the bar, as shown in part b of the figure, what is the maximum permissible value of the torques T_2? (3M) (c) What is the percent decrease in torque and the percent decrease in weight due to the hole? (3M) 	**10**	**CO2**
Q9.	A steel spherical tank of diameter 1.2 m and wall thickness 50 mm contains compressed air at a pressure of 17 MPa. The tank is constructed of two hemispheres joined by a welded seam (see figure). (a) Estimate the the tensile load *f* (N per mm of length of weld) carried by the weld? (4M) (b) determine the maximum shear stress τ_{max} in the wall of the tank? (3M) (c) Calculate the maximum normal strain ε in the wall? (3M) (For steel, assume E = 200 GPA, Poisson ratio =0 .3 .) 	**10**	**CO5**
SECTION-C **(2Qx20M=40 Marks)**			
Q10.			

	Draw the shear force and bending moment diagram of the beam shown below. If the beam is of square cross-section of side a= 10 mm E= 110 GPa. a) Determine the magnitude of maximum shear force and bending moment. (6M) b) Determine the maximum and minimum bending stress in beam. (7M) c) Determine the maximum shear stress in the beam. (7M)  **OR** Draw the shear force and bending moment diagram of the beam shown below. If the beam is of square cross-section of side a= 10 mm, E= 110 GPa. a) Determine the magnitude of maximum shear force and bending moment. (6M) b) Determine the maximum and minimum bending stress in beam. (7M) c) Determine the maximum shear stress in the beam. (7M)  	**20**	**CO3**
Q11.	Apply the Macaulay's method, determine the deflection equation of the beam, if M = 100 kNm , a = 10 m, P = 50 kN, w= 10kN/m. Determine the deflection and slope of the beam at the tip of the beam in terms of flexural rigidity (EI)  	**20**	**CO4**