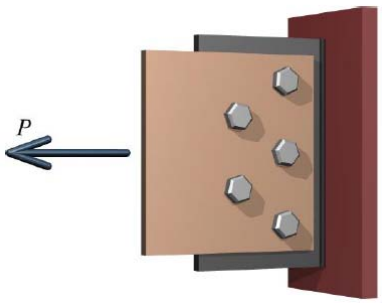
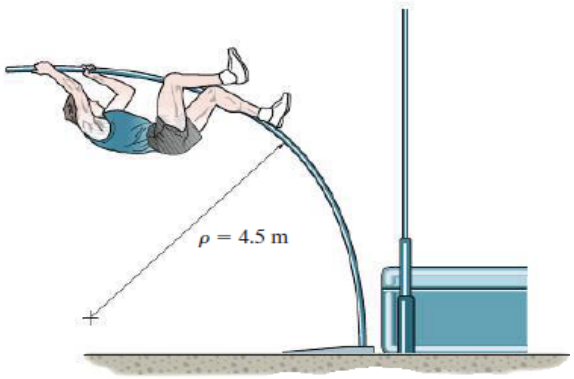
Name: **Enrolment No:**	UPES

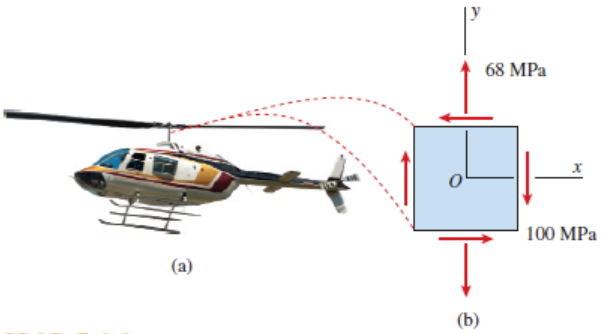
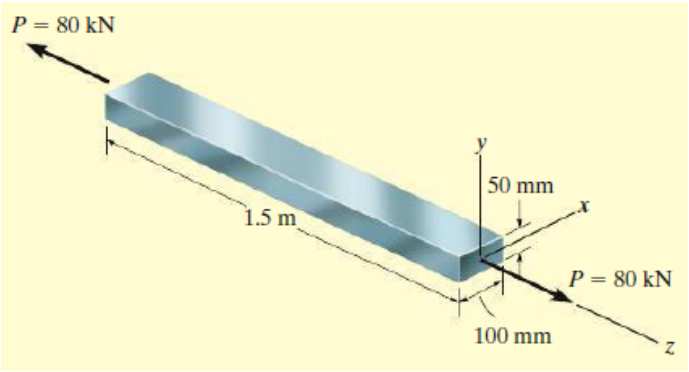
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, April/May 2018

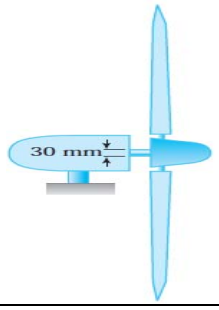
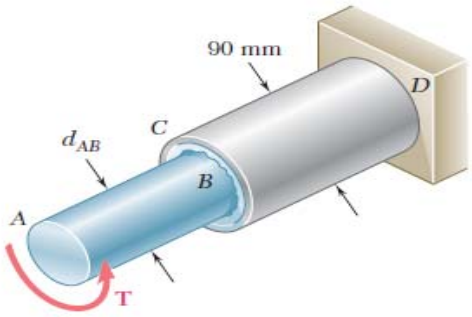
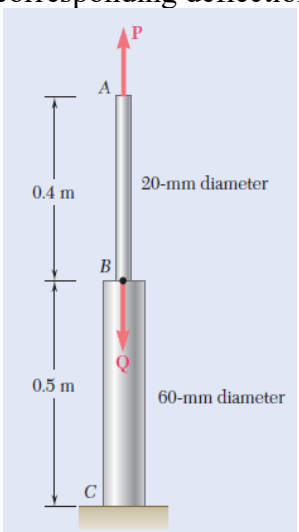
Course: Mechanics of Solids (GNEG 215) **Semester: IV**
Program: B. Tech – Mechatronics
Time: 03 hrs. **Max. Marks: 100**

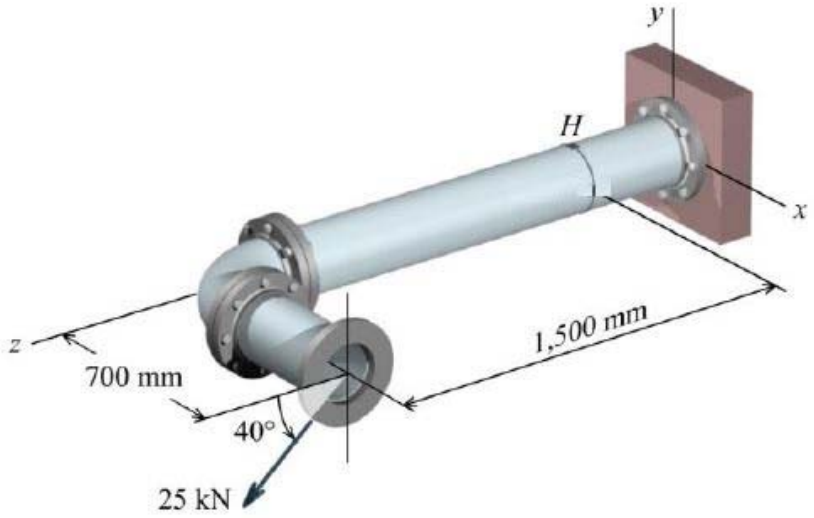
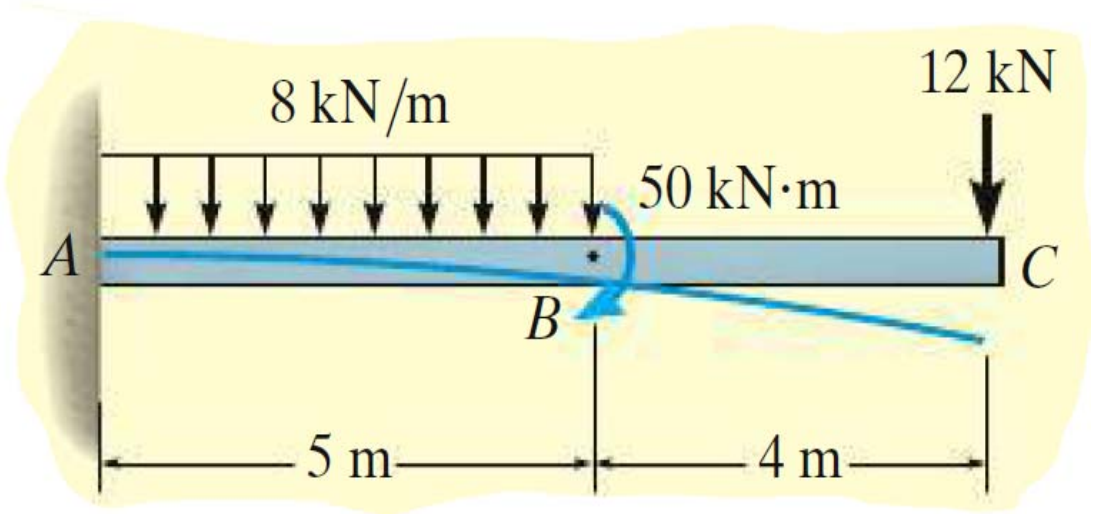
Instructions:
1. **ALL QUESTIONS ARE COMPULSORY**
2. **No. of pages – 05**

SECTION A

S. No.	Statement of question	Marks	CO
Q 1	The five-bolt connection shown in figure below, must support an applied load of P = 300 kN. If the average shear stress in the bolts must be limited to 225 MPa, determine the minimum bolt diameter that may be used in the connection. 	**5**	**CO4**
Q 2	A picture is taken of a man performing a pole vault, and the minimum radius of curvature of the pole is estimated by measurement to be 4.5 m. If the pole is 40 mm in diameter and it is made of a glass-reinforced plastic for which E_g = 131 GPa, determine the maximum bending stress in the pole. 	**5**	**CO2**

Q 3	The rotor shaft of a helicopter (see figure part a) drives the rotor blades that provide the lifting force and is subjected to a combination of torsion and axial loading (see figure part b). Find the normal and shear stress at a plane inclined at an angle of 35° in clockwise direction from x face.  	**5**	**CO3**
Q 4	A bar made of A-36 steel has the dimensions shown in figure below. If an axial force of P = 80 kN is applied to the bar, determine the change in its length and the change in the thickness after applying the load. The material behaves elastically. E = 190 GPa and poisonn's ratio is 0.35.  	**5**	**CO1**
SECTION B			
Q 5	Explain why failure of this garden hose occurred as tear along its length. Assume the water pressure is 0.2 MPa. Assume if any additional data is required.  **OR**	**10**	**CO3**

	The 30-mm-diameter shaft of the wind turbine carries an axial thrust of 50 kN and transmits 2.5 kW of power at 200 rpm. Determine the maximum normal stress in the shaft. 		
Q 6	A 2-m-long pin-ended column of square cross section is to be made of wood. Assuming E = 13 GPa, and allowable stress as 12 MPa, and using Euler's critical load for buckling, determine the size of the cross section if the column is to safely support a 100-kN load.	**10**	**CO4**
Q 7	The solid rod AB has a diameter d_{AB} = 60 mm. the pipe CD has an outer diameter of 90 mm and a wall thickness of 6 mm. Knowing that both the rod and the pipe are made of steel for which the allowable shearing stress is 75 MPa, determine the largest torque T that can be applied at A. 	**10**	**CO2**
Q 8	Both portions of the rod ABC are made of an aluminum for which E = 70 GPa. Knowing that the magnitude of P is 4 kN, determine (a) the value of Q so that the deflection at A is zero, (b) the corresponding deflection of B. 	**10**	**CO1**

SECTION-C			
Q 9	A pipe with an outside diameter of 220 mm and a wall thickness of 5 mm is subjected to the load shown in figure below. The internal pressure in the pipe is 2,000 kPa. A) Determine the normal and shear stresses on the top surface of the pipe at point H. B) Find the factor of safety if yield stress in tension is 300 MPa by using maximum shear stress theory. 	**20**	**CO3**
Q 10	For the beam as shown in the figure below – a) Draw the shear force diagram and bending moment diagram. b) Find the deflection and slope at point B and C using Macaulay's method. (E = 200 GPa, I = $65*10^{-6}$ mm^4)  **OR** For the beam as shown in the figure below – a) Draw the shear force and bending moment diagram	**20**	**CO2**

	b) Find the slope and deflection at point C using moment area method. Consider EI as constant