Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, July 2020

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

Read the Instruction carefully before attempting

a) Assume any a suitable value for missing data

b) For Theory-based: Type the Answers in word file

c) For Figures, if any: Draw a freehand sketch and insert as an image in the same word file .

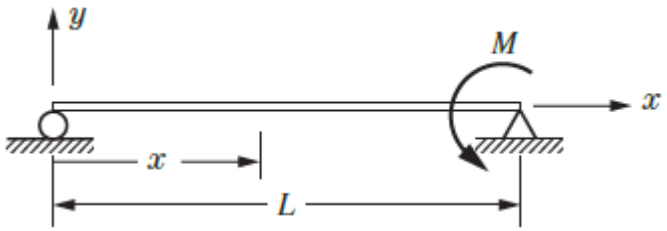
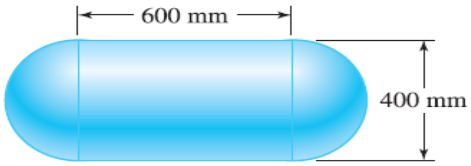
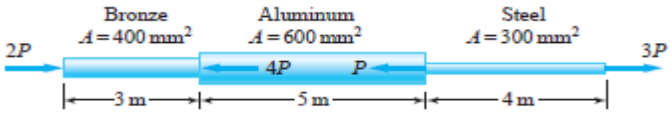
d) For Numerical: Solve it in a paper and insert as the image in the same word file

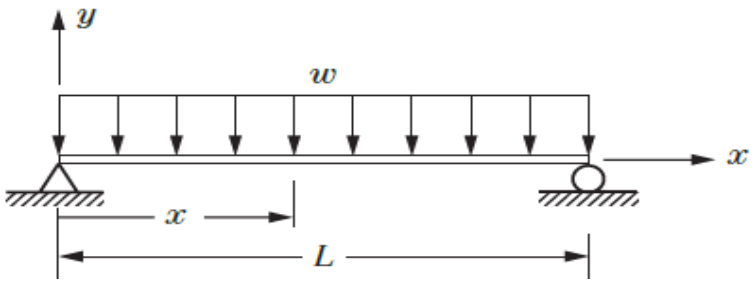
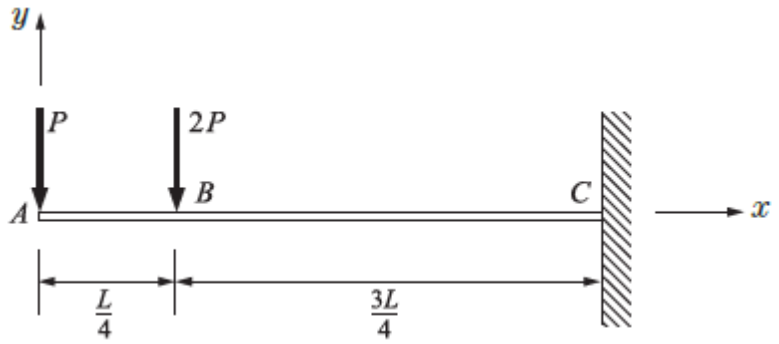
Note : upload your answer script as a single word or PDF file in BlackBoard. No other mode of submission is acceptable

SECTION A

S. No.		Marks	CO
Q 1	Define shear and normal stress. Show all the stress component at a point in a general 3D body.	**4**	**CO1**
Q2.	Justify following questions in brief, not more than two sentence: a) Railway tracks are of I-section (2 Marks) b) For same weight, material and length hollow shaft is more stronger than solid shaft in torsion.. (2 Marks)	**4**	**CO2**
Q3.	Define the complementary shear stress with diagram. How many independent stress components are there in a general 3D body, list all.	**4**	**CO2**
Q4.	A rod of 3m is at temperature 10^0 C. If the temperature of the rod is increased by 30 ^{0}C. Determine the change in the length of the bar due to increase in temperature. If the bar is prevented from the expansion determine the stress produce in the bar, given E =50 GPa, $\alpha = 3.48 * 10^{-6}$ /^{0}C	**4**	**CO1**
Q5.	Show that hollow shaft is stronger and stiffer than solid shaft of same diameter, length and weight	**4**	**CO2**

SECTION B

Q6.	Consider a composite shaft fabricated from a 6-cm-diameter solid aluminum alloy, G =28 GPa, surrounded by a hollow steel circular shaft of outside diameter 7 cm and inside diameter 6 cm, with G = 84 GPa. The two metals are rigidly connected at their juncture. If the composite shaft is loaded by a twisting moment of 154 KNm, calculate the maximum shearing stress in the steel and also in the aluminum.	**10**	**CO4**
Q7.	A simply supported beam is loaded by a couple M as shown in Fig. below. The beam is 2 m long and of square cross section 50 mm on a side. If the maximum permissible deflection in the beam is 5 mm, and the allowable bending stress is 150 MPa, find the maximum allowable load M. Use E =200 GPa. 	**10**	**CO5**
Q8.	The cylindrical pressure vessel with hemispherical end-caps is made of steel. The vessel has a uniform thickness of 18 mm and an outer diameter of 400 mm. When the vessel is pressurized to 3.6 MPa, determine the change in the overall length of the vessel. Use E = 200 GPa and $\vartheta = 0.3$ for steel. Neglect localized bending. 	**10**	**CO4**
Q9.	Axial loads are applied to the compound rod that is composed of an aluminum segment rigidly connected between steel and bronze segments. What is the stress in each material given that P = 10 kN? 	**10**	**CO2**
SECTION-C			
Q10.	A simply supported beam of length L subjected to UDL of intensity w is shown in Fig. below, The young modulus of beam is E. The cross-section of beam is square of side 'a'. Find (*a*) the maximum bending stress in the beam, (*b*) the maximum shearing stress in the beam, and	**20**	**CO3**

	(*c*) If length of beam is 10 cm and side a= 10mm, then determine the bending and shear stress at a point 5cm from hinged end and 2 mm below the top section of beam.  		
Q11.	A cantilever beam made up of steel subjected to the load as shown in fig. below. Determine the equation of slope and defection if cross-section of beam is square of side a = 5mm, Also, a) find the magnitude of maximum slope and deflection of the beam, if length of the beam = 100mm, P = 100 N, and E = 200 GPa b) Using above values, draw the shear force and bending moment diagram of the beam  	**20**	**CO4**