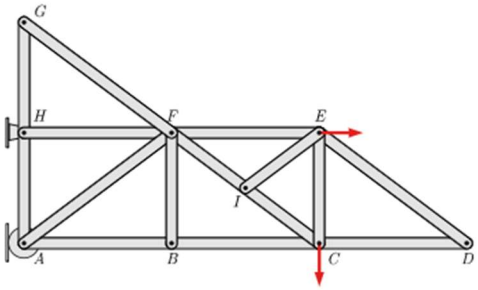
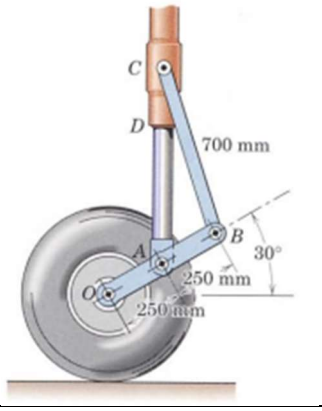
Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

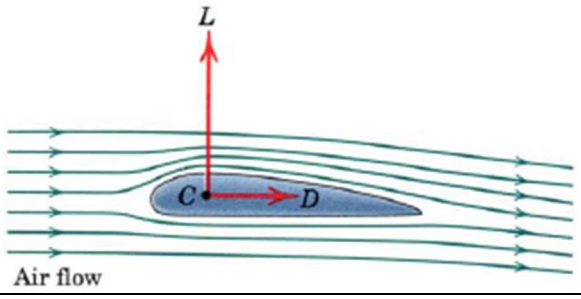
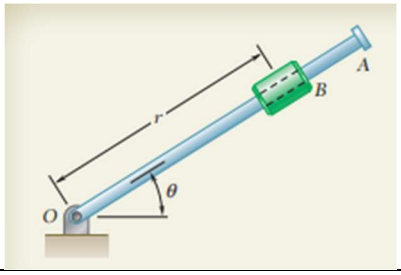
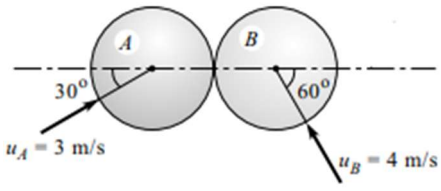
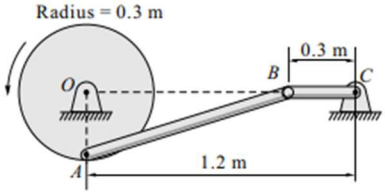
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2023

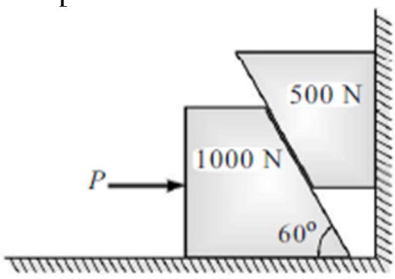
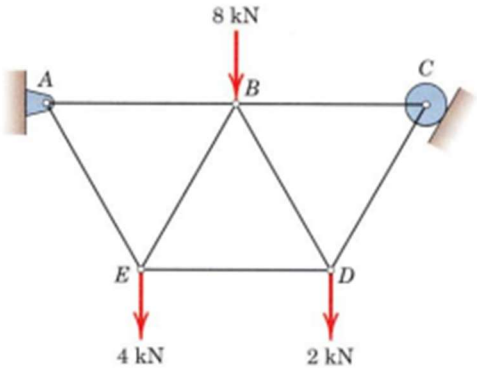
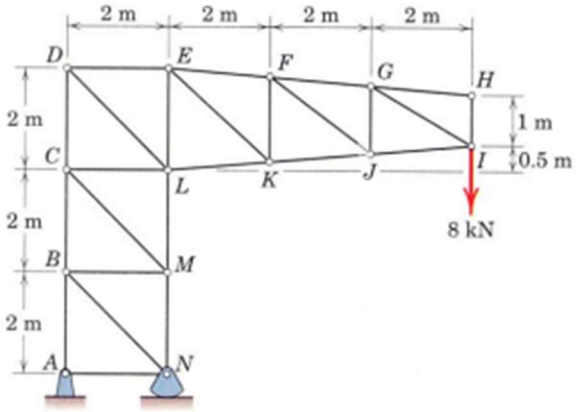
Course: Engineering Mechanics — **Semester: II**
Program: B.Tech. Aerospace — **Time: 03 hrs.**
Course Code: MECH 1002 — **Max. Marks: 100**

Instructions: 1. Assume suitable right-handed coordinate system if it is not mentioned in problem.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Explain perfect and redundant truss.	**4**	**CO1**
Q 2	Define Centre of Gravity and Centroid.	**4**	**CO1**
Q 3	What is the condition of self-locking in wedge and screw jack friction applications.	**4**	**CO1**
Q 4	Determine the zero-force member in the loaded truss as shown below. 	**4**	**CO1**
Q 5	The aircraft landing gear consists of a hydraulic piston-cylinder *D*, the two pivoted links *OAB* and *BC*. Draw the free body diagram of links *OAB* and *BC*. 	**4**	**CO1**

SECTION B (4Qx10M= 40 Marks)			
Q 6	The ratio of lift force L to drag force D for the simple airfoil is $L/D = 10$. If the lift force on the short section of airfoil is 50 N, determine the resultant force **R** and angle θ which it makes with the horizontal.  	**10**	**CO2**
Q 7	The angular displacement of a rotating rigid body is defined by the relation $\theta = 3t^3 + t - 2$, here θ is expressed in radians, determine the angular displacement, angular velocity, and angular acceleration of the rigid body when t = 3 seconds.	**10**	**CO2**
Q 8	The rotation of the 0.9 m arm OA about O is defined by the relation θ=$0.15t^2$, where θ is expressed in radians and t in seconds. Collar B slides along the arm in such a way that its distance from O is $r = 0.9 - 0.12t^2$, where r is expressed in meters and t in seconds. After the arm OA has rotated through 30°, determine (a) the total velocity of the collar, (b) the total acceleration of the collar, (c) the relative acceleration of the collar with respect to the arm.  	**10**	**CO2**
Q 9	The magnitude and direction of the velocities of two identical frictionless balls before they strike each other, is shown in **Fig. 9(a)**. Assume e = 0.9, determine the magnitude and direction of the velocity of each ball after the impact.  **Fig. 9(a)** **Or,**  **Fig. 9(b)** In the device shown in **Fig. 9(b)**. Find the velocity of point B and angular velocity of both the rods. The wheel is rotating at 2 rad/s anticlockwise.	**10**	**CO2**

SECTION-C (2Qx20M=40 Marks)			
Q 10	Referring to figure below, the coefficients of friction are as follows: 0.25 at the floor, 0.3 at the wall and 0.2 between the blocks. Determine the minimum values of a horizontal force P, applied to the lower block that will hold the system in equilibrium.  	**20**	**CO3**
Q 11	Calculate the force in each member of the loaded truss. All triangles are equilateral, and length of each member is *L*.  **Or,** Calculate the forces in members *DE*, *DL* and *DC* of the plane truss as shown in figure below.  	**20** **20**	**CO3** **CO3**