Name:

Enrolment No:

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

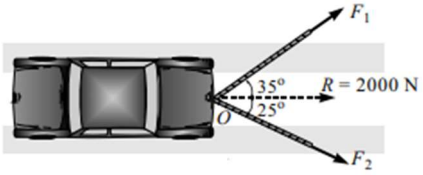
Course: Engineering Mechanics — **Semester: III**
Program: B.Tech. Aerospace — **Time: 03 hrs.**
Course Code: MECH 2031 — **Max. Marks: 100**

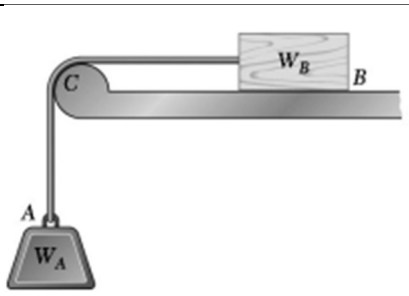
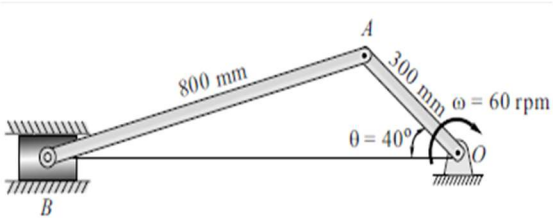
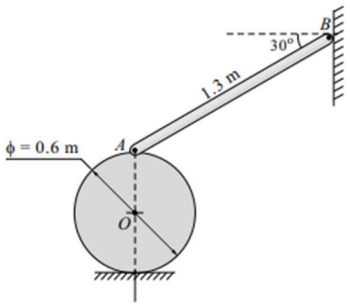
Instructions: 1. All questions of the particular section should be answered collectively at one place.
2. Assume suitable right-handed coordinate system if it is not mentioned in problem.

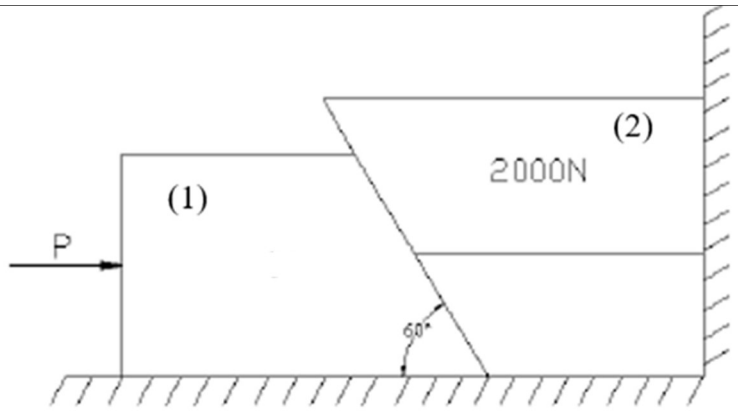
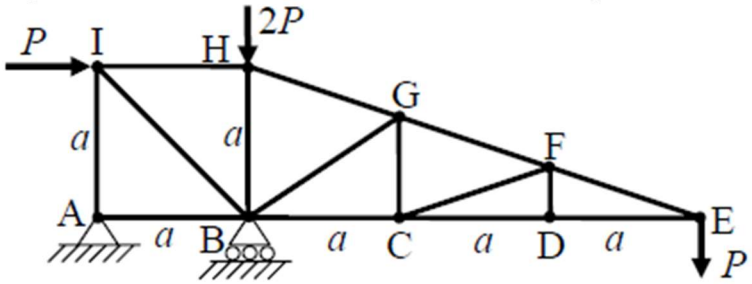
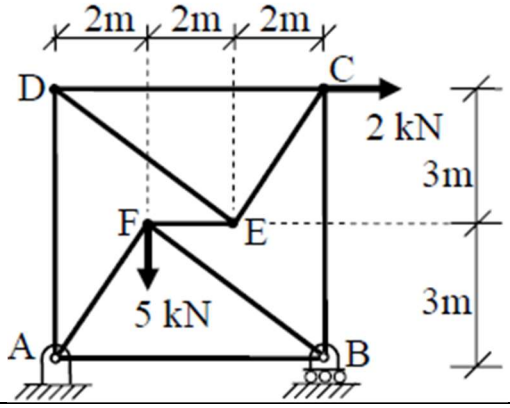
SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Explain two-force member and three-force member principle.	**4**	**CO1**
Q 2	State & derive the expression for parallel axis theorem.	**4**	**CO1**
Q 3	What is the condition of self-locking in wedge and screw jack friction applications.	**4**	**CO1**
Q 4	Explain instantaneous centre of rotation.	**4**	**CO1**
Q 5	State D'Alembert's principle.	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

Q 6	A car is made to move by applying resultant force R = 2000 N along the x-axis. This resultant is developed due to two pulling forces F_1 and F_2 on two ropes, as shown in figure. Determine the tension in individual ropes. 	**10**	**CO2**
Q 7	Drive the relation $T_1/T_2 = e^{\mu\theta}$ of the belt friction for the flat belt, where T_1 and T_2 are the tension in tight and slack side respectively. μ is the coefficient of static friction between the belt and pulley surface. The coefficient of static friction between block B and the horizontal surface and between the rope and support C is 0.40. Knowing that W_A= 30 lb. Determine the smallest weight of block B for which equilibrium is maintained.	**10**	**CO2**

			
Q 8	The motion of a flywheel around its geometrical axis is described by the equation: $\omega = 15t^2 + 3t + 2$ rad/s and angular displacement is 160 radians at t =3 sec. Find the angular acceleration, velocity and displacement at t = 1 sec.	**10**	**CO2**
Q 9	Crank OA rotates at 60 rpm in clockwise sense. In the position shown $\theta = 40^{\circ}$ determine angular velocity of AB and velocity of B which is constrained to move in a horizontal cylinder.   Or, A uniform cylinder to which a rod *AB* is pinned at *A* and the other end of the rod *B* is moving along a vertical wall as shown below. If the end *B* of the rod is moving upward along the wall at a speed of 3.3 m/s, find the angular velocity of the cylinder assuming that the cylinder is rolling without slipping.	**10**	**CO2**
SECTION-C (2Qx20M=40 Marks)			
Q 10	The co-efficient of friction are as follows: 0.25 at the floor, 0.30 at the wall, and 0.20 between blocks **1** and **2**. The weight of block **2** is 2000 N. Find the minimum value of force P applied to the lower block that will hold the system in equilibrium. If the weight of block **1** is 4000 N, then what will be the minimum force P applied to hold the system will be in equilibrium.	**20**	**CO3**

			
Q 11	Calculate the load carried by member BH of the plane truss with loads as shown in figure. Neglect weight of the members. Variable *P* indicates a magnitude of force and variable *a* indicates lengths of certain members.  Or, Calculate the forces in members AB, BC, CD and AD of the plane truss schematically shown in figure. The truss is loaded by a horizontal force of 2 kN and a vertical force of 5 kN. 	**20**	**CO3**