Name:

Enrolment No:

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

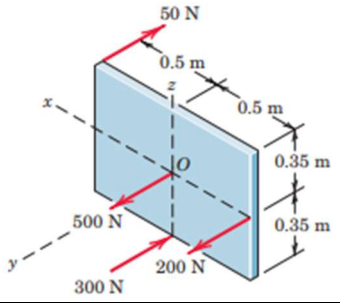
Course: Mechanics and Mechanism **Semester: I**
Program: M Tech (Advance Vehicles) **Time: 03 hrs.**
Course Code: MECH 7002 **Max. Marks: 100**

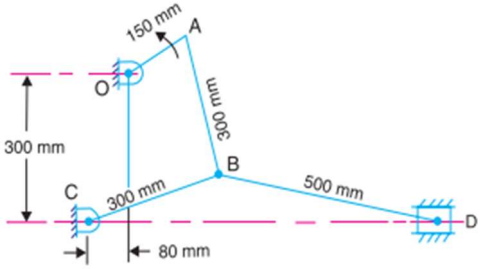
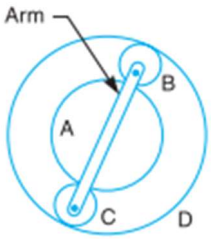
Instructions: All questions of one section should be answered collectively at one place.

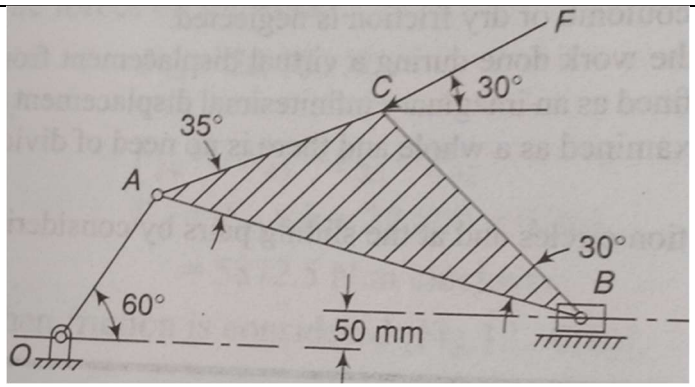
SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	What are the conditions of equilibrium for concurrent and general force systems in a space?	**4**	**CO1**
Q 2	Explain with the help of sketches **a.** reverted gear train **b.** compound gear train	**4**	**CO3**
Q 3	Explain type synthesis and number synthesis of the mechanism.	**4**	**CO3**
Q 4	Determine the mobility (degrees of freedom) of the mechanism. Explain Grubler's criterion for determining degree of freedom for mechanisms.	**4**	**CO2**
Q 5	Explain the terms 'static balancing' and 'dynamic balancing'. State the necessary conditions to achieve them.	**4**	**CO4**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Determine the resultant of the system of parallel forces which act on the plate shown in figure. 	**10**	**CO1**
Q 7	Figure shows a toggle mechanism in which link *D* is constrained to move in horizontal direction. For the given configuration, find out: **a.** absolute velocity of point *D*; and **b.** angular velocities of links *AB*, *BC*, and *BD*. The crank *OA* rotates at 60 r.p.m. in anticlockwise direction.	**10**	**CO2**

			
Q 8	Determine the Chebyshev spacing for a four-bar linkage generating the function $y = e^x$, in the range of $0 \leq x \leq 4$, where three precession points are to be prescribed. The range in the input and output link rotations $\Delta\phi = 80^\circ$ and $\Delta\psi = 110^\circ$, Find ϕ_2, ϕ_3, ψ_2, and ψ_3 by using these precession points.	**10**	**CO3**
Q 9	Derive an expression for displacement, velocity and acceleration for follower motion when it moves with simple harmonic motion (SHM), also draw y-θ, v-θ and f-θ diagrams. Where θ, y, v and f are constant cam rotation, displacement, velocity, and acceleration of follower respectively. Or, An epicyclic train of gears is arranged as shown in figure. How many revolutions does the arm, to which the pinions *B* and *C* are attached, make: **a.** when *A* makes one revolution clockwise and *D* makes half a revolution anticlockwise, and **b.** when *A* makes one revolution clockwise and *D* is stationary? The number of teeth on the gears *A* and *D* are 40 and 90 respectively. 	**10**	**CO3**
SECTION-C (2Qx20M=40 Marks)			
Q 10	What is the meant by the primary and secondary unbalanced forces in reciprocating engine mechanism. Explain why only a part of the unbalanced force due to reciprocating masses is balanced by revolving mass. Derive the following expressions, for an uncoupled two-cylinder locomotive engine: (a) Variation of tractive force; (b) Swaying couple; and (c) Hammer blow.	**20**	**CO4**
Q 11	For the mechanism shown in figure. Determine the required input torque for the static equilibrium. The length *OA* and *AB* are 250 mm and 650 mm respectively. Where *F*= 500 N.	**20**	**CO5**



Or,

In four-link mechanism shown in figure, torque T_3 and T_4 have magnitudes of 30 Nm and 20 Nm respectively. The link lengths are *AD* = 800 mm, *AB* =300 mm, *BC* = 700mm and *CD* = 400 mm. for the static equilibrium of the mechanism, determine the required input torque T_2.