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

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, May 2022

Programme Name: B.Tech. Mechatronics Engineering **Semester : VI**
Course Name : Advanced Robotics **Time : 03 hrs**
Course Code : MEPD3009P **Max. Marks : 100**
No. of page(s) : 1
Instructions: Assume any missing data.

SECTION A (20 marks)

S. No.		Marks	CO
Q 1	Explain why homogeneous coordinates are required in modeling of robotic manipulators.	**4**	**CO1**
Q 2	Discuss the procedure of assignment of X-axis in DH representation.	**4**	**CO1**
Q 3	Explain why DH convention does not give unique frame assignment for a given manipulator.	**4**	**CO2**
Q 4	Discuss the significance of studying the manipulator differential motion.	**4**	**CO3**
Q 5	Discuss the singularities of a manipulator. Explain briefly.	**4**	**CO2**
	SECTION B (40 marks)		
Q 6	Find out the DH parameters for a 3 DoF articulated robot.	**10**	**CO2**
Q 7	Explain the manipulator control problem for manipulators	**10**	**CO3**
Q 8	Show that the overall differential transformation due to three differential rotations of $\delta x, \delta y, \wedge \delta z$ about $x-, y-, \wedge z-¿$ axes, respectively, is independent of the order in which rotations are made.	**10**	**CO3**
Q 9	Explain the significance of Jacobian in for manipulators. OR Differentiate between the following (i) Forward and inverse kinematics (ii) Forward and inverse dynamics	**10**	**CO1**
	SECTION-C (20 marks)		
Q 10	Derive the Jacobian matrix for a 3 DoF articulated robot.	**20**	**CO5**

Q 11	Formulate the equations of motion for a two-link articulated planar manipulator using the approach of Lagrangian dynamics. OR Derive the expression for Lagrangian for an *n*-DoF manipulator using Euler-Lagrange approach.	**20**	**CO4**