Reg. No.															

Question Paper Code	14026

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

Fifth Semester

Mechanical and Automation

20MUPC502 – MECHANICS AND CONTROL OF ROBOTIC MANIPULATORS

Regulation - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	Which of the following best describes the First Law of Robotics as proposed by Isaac Asimov? a) A robot must obey the orders given by humans at all times b) A robot must protect its own existence above all else c) A robot may not injure a human being or, through inaction, allow a human to come to harm d) A robot must replicate itself to ensure continuity	1	K1	CO1
2.	Which of the following is a valid type of robot joint configuration? a) Linear–Rotary–Oscillatory b) Prismatic–Revolute–Spherical c) Cylindrical–Torsional–Magnetic d) Cartesian–Polar–Elastic	1	K1	CO1
3.	Which of the following methods is commonly used to solve inverse kinematics problems in robotic manipulators? a) Newton-Raphson Method b) Denavit–Hartenberg Convention c) Jacobian Iterative Method d) Euler's Integration Technique	1	K1	CO2
4.	What does the term "degrees of freedom" refer to in robotic systems? a) Number of sensors in a robot b) Number of independent movements a robot can perform c) Number of joints in a robot d) Number of tasks a robot can execute	1	K1	CO2
5.	Which mathematical approach is typically used to solve the inverse kinematics of a 2-DOF planar robot arm? a) Laplace Transform b) Trigonometric Equations c) Fourier Series d) Matrix Inversion	1	K1	CO3
6.	What is a major challenge in solving inverse kinematics for a 6-axis articulated robot? a) Lack of sensors b) Single solution availability c) Multiple valid joint configurations d) Fixed workspace geometry	1	K1	CO3
7.	Which mathematical formulation is commonly used to derive the equations of motion for robotic manipulators? a) Laplace Transform b) Denavit–Hartenberg Parameters c) Lagrangian Mechanics d) Fourier Analysis	1	K1	CO4
8.	In robotics, Hamiltonian vector fields are primarily used to describe which aspect of system behavior? a) Kinematic constraints b) Energy-based dynamic evolution c) Sensor calibration d) Path planning algorithms	1	K1	CO4
9.	Why are stepper motors commonly used as joint actuators in robotic systems? a) They provide continuous rotation without control b) They offer precise position control without feedback c) They consume high power at low torque d) They require complex hydraulic systems	1	K1	CO5
10.	What is the primary function of a robotic vision system in industrial automation? a) To control motor speed b) To detect and interpret visual information c) To regulate battery voltage d) To transmit wireless signals	1	K1	CO5

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11.	Outline the types of joints used in robotics	2	K1	CO1
12.	Explain about work volume and how it could be determined	2	K2	CO1
13.	Distinguish between forward and Inverse kinematics equation	2	K2	CO2
14.	Brief D-H notation used for solving kinematics equation	2	K1	CO2
15.	Outline the issues faced in inverse kinematics	2	K1	CO3
16.	Distinguish between 3 axis and 6 axis robots	2	K2	CO3
17.	Explain about Lagrange's equation in robot dynamics	2	K2	CO4
18.	State inertia tensor.	2	K1	CO4
19.	What are the factors which must be considered while choosing the drive system for robots?	2	K1	CO5
20.	Summarize the advantages and disadvantages of pneumatic actuators.	2	K2	CO5
21.	Summarize some control systems used in robotics	2	K2	CO5
22.	Define machine vision.	2	K1	CO5

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23.	a)	Explain through schematic line sketches construction of any two types of grippers.	11	K2	CO1
		OR			
	b)	Explain various ROBOT arm configuration and draw their work volume representation through line sketches.	11	K2	CO1
24.	a)	Construct the forward kinematics of SCARA robot using DH convention.	11	K2	CO2
		OR			
	b)	Construct and explain the DH convention with suitable algorithms.	11	K2	CO2
25.	a)	Explain solvability and existence of solutions in inverse kinematics.	11	K2	CO3
		OR			
	b)	Derive the inverse kinematics of 3dof 3R robot with steps.	11	K2	CO3
26.	a)	Develop the equations of Motion for a simple 2 dof 2R manipulator using Lagrange dynamic model.	11	K2	CO4
		OR			
	b)	Derive and explain the expression for potential energy of an n-link robotic manipulator using coordinate frames and gravitational effects.	11	K2	CO4
27.	a)	Explain in detail about robotic vison system with suitable sketch.	11	K2	CO5
		OR			
	b)	Model the control equation of a linear system using PID controller.	11	K2	CO5
28.	a)	Explain in detail about working of Servo and stepper motors and compare the same.	11	K2	CO5
		OR			
	b)	Explain in detail about various types of actuators used in robotics.	11	K2	CO5