MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
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Model Question Paper

Seventh Semester BE Degree Examination

Industrial Robotics

Time: 3 Hours (180 Minutes) **Max. Marks: 100**

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: RBT (Revised Bloom's Taxonomy) level, C: Course outcomes.

		Module -1	**M**	**L**	**C**
Q1	a.	Describe the various transduction methods used in tactile sensors.	08	L2	CO1
	b.	Explain the importance and uses of sensors in robotics.	06	L2	CO1
	c.	What are grippers? Explain the general classification of robotic grippers with suitable examples.	06	L2	CO1
		OR			
Q2	a.	Describe the working principle of range sensors with a neat sketch.	08	L2	CO1
	b.	Explain the factors to be considered and the recommendations for selecting an appropriate robotic gripper.	06	L2	CO1
	c.	What is an end effector? Classify the different types of end effectors used in robotics.	06	L2	CO1
		Module- 2			
Q3	a.	A vector v=3i+2j+7k is rotated by 60° about the z axes of the reference frame. It is then rotate by 30° about the x axes of the reference frame. Find the rotation transformation.	08	L3	CO3
	b.	A single link manipulator is to move from an initial angle of 20° to a final angle to 90° in 3 seconds. If the manipulator is at rest at the start and final end position, find the coefficients of a cubic that describes this motion.	06	L3	CO3
	c.	Explain the role of the third degree of freedom in determining the position and orientation of the end effector of a 3-DOF planar robotic manipulator.	06	L2	CO3
		OR			
Q4	a.	For the vector v =25i + 10j +20k, perform a translation by a distance of 8 in the x direction, 5 in the y direction and 0 in the z direction.	08	L3	CO3
	b.	A 2-link planar robot has link lengths L1 = 400 mm and L2 = 300 mm. The joint angles are $\theta 1 = 30°$ and $\theta 2 = 45°$. Calculate (i) The position coordinates (x, y) of the end effector, (ii) If the end effector needs to reach point (500, 250) mm, determine the required joint angles using inverse kinematics.	06	L3	CO3
	c.	Explain the roll, pitch, and yaw and describe how they are used to represent the orientation of a robot wrist mechanism.	06	L2	CO3
		Module - 3			
Q5	a.	A robot arm having one degree of freedom (revolute joint) is stationary at $\Theta=0°$. It is required to more it to $\Theta=60°$ in 5 seconds. Find the coefficient of a cubic that accomplishes this motion and brings the manipulator to rest at the goal point.	08	L3	CO4
	b.	A two-link planar manipulator has link masses of 6 kg and 4 kg with moments of inertia of 1.8 kg·m² and 1.2 kg·m², respectively. The manipulator is carrying a 3 kg payload and moves with angular accelerations of 1.8 rad/s² and 1.2 rad/s². Determine the dynamic torque required at the shoulder and elbow joints.	06	L3	CO4

	c.	Explain the general configuration of a robot controller with the help of a suitable block diagram.	06	L2	CO4
		OR			
Q6	a.	A robotic manipulator moves from 30∘30^\circ30∘ to 120∘120^\circ120∘ in 4 seconds. The initial and final angular velocities are zero. Develop the cubic trajectory equation and determine the joint angle after 2 seconds.	08	L3	CO4
	b.	A robotic arm has a link of length 0.5 m with a mass of 6 kg and carries a 4 kg workpiece at its end. Determine the total static torque required at the base joint to maintain the arm in a horizontal position. Assume the link's center of gravity is at its midpoint and take $g=9.81\ m/s^2$.	06	L3	CO4
	c.	Explain the basic principles and design considerations of material handling systems.	06	L2	CO4
		Module - 4			
Q7	a.	Discuss the different robot cell layouts used in robotic workstations.	08	L2	CO2
	b.	Explain the considerations involved in the design of a robotic work cell.	06	L2	CO2
	c.	Illustrate the role of interlocks in maintaining the correct sequence of operations in an automated work cell.	06	L2	CO2
		OR			
Q8	a.	Describe various Error detection and recovery methods in Robot cell layout.	08	L2	CO2
	b.	Explain the functions of work cell control in a robotic work cell.	06	L2	CO2
	c.	Describe the various elements that contribute to the cycle time of a robot.	06	L2	CO2
		Module - 5			
Q9	a.	A robotic arm performs a pick-and-place operation from a conveyor to an assembly station. Write a robot program that uses wait, signal, and delay commands to synchronize the robot with the conveyor movement and gripping action.	10	L3	CO5
	b.	Using the 8 X 8 square grid of Robot work space with 8 X 8 addressable points taken by Cartesian Coordinate Robot if it's directed to move between the following sets of points in the grid using linear interpolation i. Point (1,1) and point (6,6) ii. Point (2,1) and point (8,2) iii. Point (2,2) and point (7,5)	10	L3	CO5
		OR			
Q10	a.	A robot is programmed to perform continuous welding along a complex path on a metal structure. Write a robot program that uses motion interpolation and delay commands to control the welding path and synchronize the robot motion with the welding operation for maintaining proper weld quality.	10	L3	CO5
	b.	Write a robot program using lead-through programming to perform a pick-and-place operation, where the robot waits for a sensor signal, moves along a programmed path using motion interpolation to pick a part from a conveyor, places it at a workstation, includes wait, signal, and delay commands, and repeats the cycle using branching.	10	L3	CO5

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