APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

08 PALAKKAD CLUSTER

Q. P. Code : IRA0819321-1 (Pages: 2) Name: .....

Reg. No: .....

FIRST SEMESTER M.TECH. DEGREE EXAMINATION December 2019

Branch: Mechanical Engineering **Specialization: Industrial Automation and Robotics**

08ME6321 ROBOT KINEMATICS AND DYNAMICS

Time: 3 Hours **Max. Marks: 60**

Answer all six questions.

Q. No.	Module 1	Marks
1. a	What is meant by a work envelope?	3
	Answer b or c	
b	Using neat diagram explain the structure of a cylindrical coordinate robot. Indicate the various movements of the joints and sketch work volume the robot.	6
c	Draw the kinematic diagram of a spherical wrist and describe its functioning. What are the DOF of the Spherical wrist?	6

Q. No.	Module 2	Marks
2. a	Write general D-H transformation matrix from the frame {i} to frame {i-1}. List the Link parameters associated with this transformation.	3
	Answer b or c	
b	Sketch a 3 link planar robot with link lengths L_1, L_2, L_3 and joint angles θ_1, θ_2 and θ_3. Assign link frames using DH-convention, make link parameter table and obtain its forward kinematic equation.	6
c	The forward kinematic equation of two link planar robot is given by $${}^{0}_{2}T = \begin{bmatrix} c_{12} & -s_{12} & 0 & c_1L_1 \\ s_{12} & c_{12} & 0 & s_1L_1 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$ Obtain the inverse kinematic equations of the robot.	6

Q. No.	Module 3	Marks
3. a	Explain any 3-industrial applications of Pick and Place robots.	3
	Answer b or c	

b	What you meant by dexterous workspace and reachable workspace. Using the sketches of a two link planar robot list the dexterous workspace and reachable workspace when (i) $L_1 = L_2$ and (ii) when $L_1 > L_2$.	6
c	With a neat sketch describe triangulation technique used in robotics for contour mapping or range detection.	6

Q. No.	Module 4	Marks
5. a	What is a holonomic constraint? Give an example.	3
	Answer b or c	
b	Develop Dynamics of a simple 2 DOF planar robotic arm using Newton-Euler equation.	6
c	Write the Lagrange's equation of motion. Develop the dynamics of a single link robot using Lagrange's equation of motion.	6

Q. No.	Module 5	Marks
4. a	Define redundancy in robotic manipulators. What are advantageous of redundant manipulators? Give the minimum DOF of a special redundant manipulator	4
	Answer b or c	
b	What is a Stewart - Gough platform? Using neat sketch explain the working of Stewart - Gough platform.	8
c	Using a neat sketch describe the functioning of a 3 × RPR planar parallel mechanism.	8

Q. No.	Module 6	Marks
6. a	How Robotic End effectors are different from a manipulating tool? Give examples.	4
	Answer b or c	
b	With a neat sketch describe the working of two fingered robotic gripper. How will you determine the gripper force for lifting a object weighing 1 N using a 2 fingered robotic gripper?	8
c	Describe the salient features a robot performing assembly operations in an industry.	8