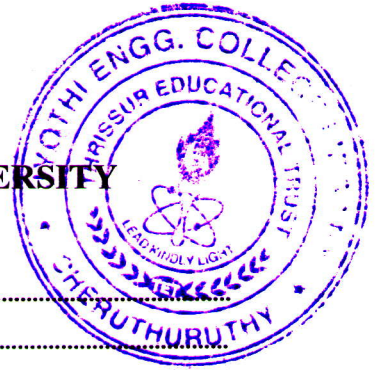


APJ ABDULKALAM TECHNOLOGICAL UNIVERSITY  
08 PALAKKAD CLUSTER



Q. P. Code : IAR0820121-I

(Pages: 2)

Name: .....

Reg. No: .....

FIRST SEMESTER M.TECH. DEGREE EXAMINATION MARCH 2021

Branch: Mechanical Engineering

Specialization: Industrial Automation and Robotics

08ME6321 ROBOT KINEMATICS AND DYNAMICS

Time: 2 hour 15 minutes

Max. Marks: 60

Answer all six questions.

Modules 1 to 6: Part 'a' of each question is compulsory and answer either part 'b' or part 'c' of each question.

Q. No.	Module 1	Marks
1.a	Compare the performance of hydraulic, pneumatic and electric drives in robots.	3
	<b>Answer b or c</b>	
b	Define four Denavit – Hartenberg (DH) parameters and write the general form of a D-H matrix.	6
c	Define work envelope and sketch the work envelope for different coordinate systems.	6

Q. No.	Module 2	Marks
2.a	Distinguish between forward and inverse kinematics.	3
	<b>Answer b or c</b>	
b	The Fig. 1 shows a two-link planar arm with rotary joints. For this arm, the second link is half as long as the first ( $L_1 = 2L_2$ ). The joint range limits in degrees are $0 < \theta_1 < 180$ and $-90 < \theta_2 < 180$ . Find the approximate workspace of the tip of the link-2.	6

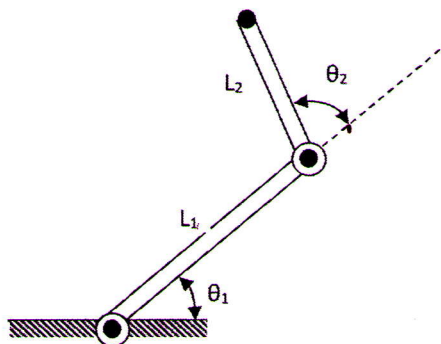


Fig. 1

- c Determine the Homogeneous transformation matrix to represent the following sequence of Operations: 6
- (i) Rotation  $60^\circ$  about the OX axis
  - (ii) Then translate 5 units along X- axis

Q. No.	Module 3	Marks
3.a	Distinguish between arm and wrist singularities.	3
<b>Answer b or c</b>		
b	Discuss the Jacobian matrix of a planar two link revolute jointed manipulator.	6
c	Using schematic diagram, explain knowledge based and sensor based path planning methods.	6

Q. No.	Module 4	Marks
4.a	State DoF and explain any one Degree DoF manipulator.	3
<b>Answer b or c</b>		
b	Write the general format of Euler-Lagrange's equation and state space model/representation.	6
c	Illustrate the smooth trajectory polynomial for the second joint of SCARA serial manipulator with initial velocity 5 deg/sec and final velocity 3 deg/sec.	6

Q. No.	Module 5	Marks
5.a	Explain robot singularity.	4
<b>Answer b or c</b>		
b	Analyze the singularity conditions of a 2 DOF serial manipulator. Classify reachable workspace (RWS) and dexterous workspace (DWS). Evaluate the RWS and DWS of a 2 DOF arm.	8
c	The second joint of SCARA serial manipulator is required to move from $\theta = 20$ degree to 100 degree in 6 seconds. Estimate the cubic polynomial to generate the smooth trajectory for the joint. Show the maximum acceleration for this trajectory.	8

Q. No.	Module 6	Marks
6.a	Write short note on different types of end effectors.	4
<b>Answer b or c</b>		
b	Using suitable example explain the application of robots in inspection.	8
c	Explain different tools used as end effectors.	8