

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION-2022

B.Tech-VII Semester (ECE)

COURSE CODE (CREDITS): 18B1WEC737 (3)

MAX. MARKS: 35

COURSE NAME: ROBOTIC SYSTEMS AND CONTROL

COURSE INSTRUCTORS: Dr. Emjee Puthooran/ Mr. Mukund Mitra

MAX. TIME: 2 Hours

Note: All questions are compulsory. Marks are indicated against each question in square brackets.

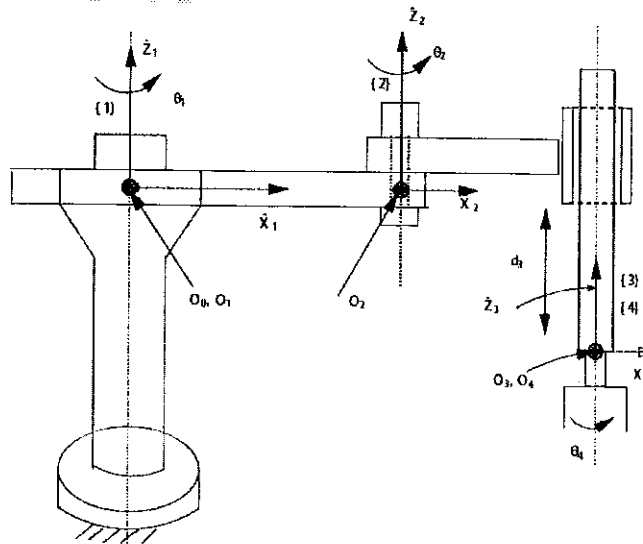
Q1. Explain the 4 Denavit Hartenberg (DH) parameters ($\alpha_{i-1}, a_{i-1}, d_i, \theta_i$, where $i = \text{links}$) with a schematic diagram. [CO3, 5M]

Q2. Find a trajectory ($\theta_1(t)$) with C^2 for a robotic manipulator using joint space scheme given the following conditions:

$$\theta_1(0) = 10^\circ; \theta_1(3) = 40^\circ; \dot{\theta}_1(0) = -20 \text{ deg/sec}; \dot{\theta}_1(3) = 30 \text{ deg/sec}$$

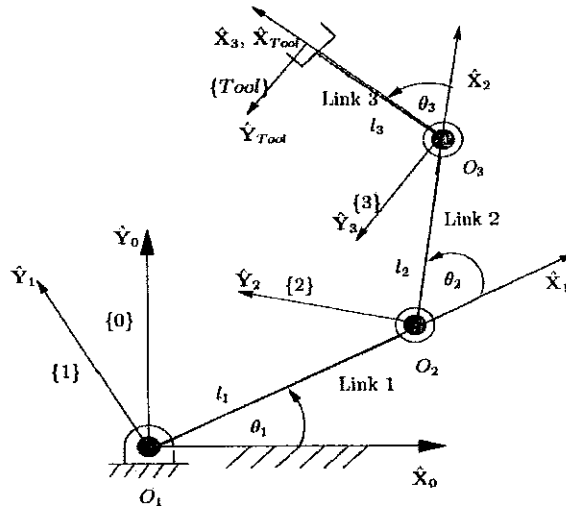
Draw the position, velocity and acceleration profiles for the trajectory obtained. [CO4, 5M]

Q3. Calculate the Denavit Hartenberg (DH) parameters for the SCARA manipulator shown below. Write the 4 parameters ($\alpha_{i-1}, a_{i-1}, d_i, \theta_i$, where $i = 1,2,3,4$) in tabular form. Briefly write the steps involved to obtain each parameter. [CO5, 5M]



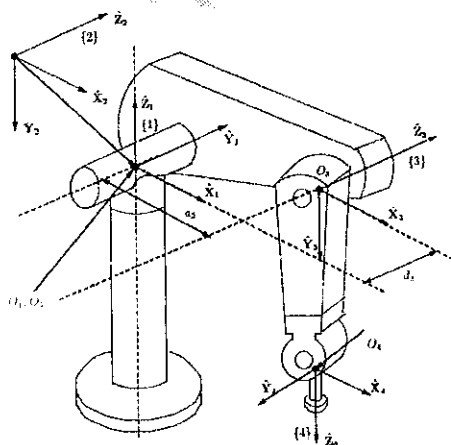
[P.T.O]

Q4. Find the Inverse Kinematic solution for a 3R robotic manipulator as shown below. Comment on the uniqueness of Inverse Kinematic solution along with reason. [CO3, 7M]

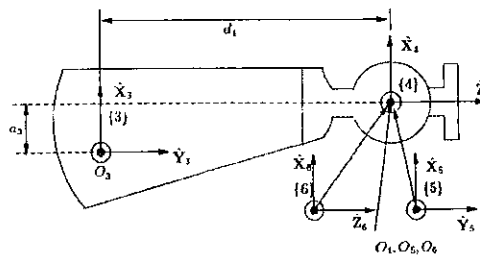


Q5. Define motion planning. What are the various types of schemes used for motion planning of a robotic system? Define each scheme along with its importance. What is C^2 continuity? Mention its importance in motion planning. [CO4, 6M]

Q6. Find the DH parameters for the PUMA 560 robot shown below. Then calculate the 4×4 Homogenous transformation matrix of the {link - 3} with respect to the inertial link or fixed link {link- 0} for the PUMA 560 robot using the DH parameters. [CO5, 7M]



(a) The PUMA 560 manipulator



(b) PUMA 560 - forearm and wrist