

III B. Tech I Semester Regular/ Supplementary Examinations, December – 2023
INDUSTRIAL ROBOTICS
(Mechanical Engineering)

Time: 3 hours

Max. Marks: 70

Answer any **FIVE** Questions **ONE** Question from **Each unit**
All Questions Carry Equal Marks

UNIT-I

1. a) Write a short note on the following: [7M]
 - (i) Work volume and work envelope of robot.
 - (ii) Speed of control of motion
- b) Discuss about the factors to be considered in the selection of end-effectors in robots. [7M]

(OR)

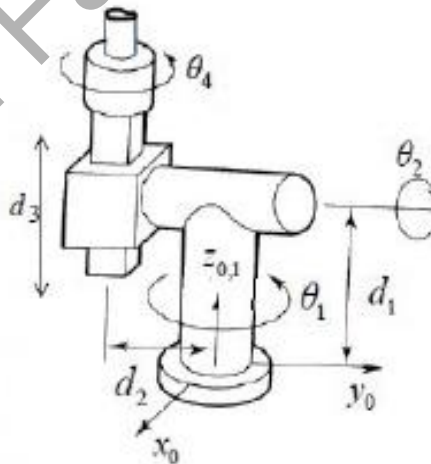
2. a) Enumerate the differences between open loop control system and closed loop control system. [7M]
- b) Write a short note on hydraulic and electric actuation drive systems. [7M]

UNIT-II

3. a) Compute the homogeneous transformation representing a translation of 4 units along the Z-axis and followed by rotation of 60° about the current Y-axis followed by a translation of -5 unit along the fixed X-axis. [7M]
- b) Write a short note on forward kinematics and inverse kinematics analysis with an example. [7M]

(OR)

4. For the robot depicted in figure: [14M]



- i) Assign appropriate frames for D-H representation.
- ii) Fill out the parameter table containing $\theta, d, a,$ and α
- iii) Write an equation in terms of A matrices that show how can be calculated

UNIT-III

5. a) Differentiate between Lagrangian and Newtonian mechanics. [7M]
b) Apply a suitable technique for the three degrees of freedom for both Rotational and linear system and derive the equation of motion. [7M]
(OR)
6. Derive the equations of motion of RRR manipulator by using Newton – Euler formulations. [14M]

UNIT-IV

7. a) Explain various types of Robot programming languages. [7M]
b) A jointed - arm robot of configuration RRR is to move all three axes so that the first joint is rotated through 60° , the second joint is rotated through 45° and the third joint is rotated through 90° . Maximum speed of any of these rotational joints is 15° mm/s. Ignore effects of acceleration and deceleration. [7M]
(i) Determine the time required to move each joint if skew motion is used.
(ii) Determine the time required to move the arm to the desired position and
(iii) The rotational velocity of each joint, if joint - interpolation motion is used.
(OR)
8. a) Explain in detail about General considerations in path description and generation with an example. [7M]
b) Discuss the following: [7M]
(i) Joint interpolation motion
(ii) Skew motion

UNIT-V

9. a) Explain the various electrical and pneumatic actuation system used with an industrial robot and compare their features, merits and demerits. [7M]
b) Write the important features of the robots used in the area of inspection? [7M]
(OR)
10. a) Explain about various types of velocity sensors with neat sketch. [7M]
b) Discuss the requirements of robots used in assembly operations in detail. [7M]