SASTRA

|  |  |  |  |
| --- | --- | --- | --- |
| **L** | **T** | **P** | **C** |
| **3** | **0** | **0** | **3** |

# Course Code: MCT 309 Semester: IV

**INDUSTRIAL MANIPULATORS**

# Course Objective:

The subject aims to ensure that students

1. Apply rigid body transformations to determine position and orientation of a robot.
2. Develop basic kinematic model and trajectory planning of a serial manipulator
3. Implement the knowledge gained in design, fabrication and control of a serial manipulator

# UNIT – I 11 Periods

**INTRODUCTION TO ROBOTICS**

Classification of Industrial Robots - Components of a Robot – Technical specifications of robot - Spatial descriptions and Transformations - Operations and Mapping

# UNIT – II 13 Periods

**MANIPULATOR KINEMATICS**

Forward and Inverse Kinematics – Examples of 3-DoF, 5-DoF and 6 DoF manipulators with Denavit – Hartenberg representation – Simple problems

# UNIT – III 11 Periods

**SIMULATION, DYNAMICS AND TRAJECTORY PLANNING**

Modeling and simulation of a 2-DOF planar robot, Robot dynamics (Basic concepts only), Trajectory planning – Joint Space and Task Space Schemes – Simple problems; Velocity Jacobian and Jacobian in statics (Introduction only)

# UNIT – IV 10 Periods

**ADVANCED ROBOT CONCEPTS**

Leadthrough, pendant and textual programming – Robot cell design - Collaborative Robots: overview of components, Digital Twins: Introduction, Levels of twin modelling; **mini project**

**TEXT BOOK**

1. R.K.Mittal and I.J.Nagrath, *Robotics and Control*, Tata McGraw Hill Publishing CompanyLtd, 2007.
2. Fei Tao, Meng Zhang, A.Y. C. Nee, Digital Twin Driven Smart Manufacturing, Academic Press, 2019

**REFERENCES**

1. John J. Craig*, Introduction to Robotics: Mechanics and Control*, Pearson Education (Singapore) Pvt. Ltd., 2009
2. Saeed B. Niku, *Introduction to Robotics: Analysis, Control, Applications,* Prentice – Hal lof India Pvt Ltd, 2010
3. Fu, Gonzalez and Lee, *Robotics: Control, Sensing, Vision and Intelligenc*e, McGraw Hill International edition, 2008
4. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, *Industrial Robotics: Technology Programming and Applications*, McGraw Hill International Edition, 2008.
5. Carl Anthony Moore, Design, construction and Control of a 3-revolute arm COBOT, Northwestern University, 2001

# Assessment

CIA component of 50 marks is split into 30 marks from 2 CIAs and 20 marks from one miniproject.

# ONLINE MATERIALS

1. <http://nptel.ac.in/courses/112101099/>
2. <http://nptel.ac.in/courses/112108093/>

# LEARNING OUTCOMES

Upon successful completion of the course, students will be able to

|  |  |
| --- | --- |
| Unit I | Mathematically transform any object to various positions, orientations and scales using programming |
| Unit II | Develop kinematic model of robots based on Denavit-Hartenberg convention and simulate a 2 DOF serial robot. |
| Unit III | Perform trajectory planning of a robotic manipulator |
| Unit IV | Program prototype robots for joint space operation, Select application-based robotic work cell, Identify level of Digital Twin and components of Cobot |

**Overall course learning outcome** is that a student will be able to model, design, fabricate and control a serial manipulator and also verify the kinematics characteristics of the manipulator.