COURSE TITLE	**ROBOTICS ENGINEERINGS**
COURSE CODE	**01CA1222**
COURSE CREDITS	**3**

Objective:

1 To understand the various approaches to write position as well as motion equations for open and closed loop configurations

2 To apply the concept of DH convention for forward and inverse kinematics

3 To know the role of friction models and control strategies for various tasks performed by robots.

Course Outcomes: After completion of this course, student will be able to:

1 Apply knowledge of joint types (prismatic, revolute, cylindrical, spherical) to synthesize and design feasible kinematic configurations for robotic manipulators with required degrees of freedom.

2 Apply homogeneous transformations, RPY, and Euler angle representations to formulate position and motion equations for open and closed loop robotic configurations.

3 Apply D-H convention to solve forward and inverse kinematics problems, and analyze workspace, singularities, and performance indices of robotic manipulators.

4 Analyze dynamic behavior of robotic manipulators using Newtonian, Lagrangian, and Hamiltonian formulations, and evaluate friction models and control strategies for trajectory generation and motion control

Pre-requisite of course: Kinematics, Control Engineering

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	0	50	30	20	0	0

Contents : Unit	Topics	Contact Hours
1	**General considerations of Robotic Manipulator** Robot anatomy; Feasible configurations of kinematic chains with prismatic, revolute, cylindrical and spherical joints. Degree of freedoms, Homogeneous transformation; Generalized rotations,, Description of robotic pose, Orientation with RPY and Euler angles (Forward and inverse formulations)	5
2	**Kinematics of Robotic Manipulators** Direct Kinematics, Inverse Kinematics for open and closed architectures;, D-H representation; Work space analysis, Singularity analysis, Performance measurement indices	10

Contents : Unit	Topics	Contact Hours
3	**Dynamic Analysis of Robotic Manipulators** Considerations of forces, moments and torques for robotic configurations, Dynamics formulations using Newtonian, Lagrangian and Hamiltonian principle, Properties of dynamic equations	9
4	**Trajectory Generation** Path and Trajectory, Joint space versus Cartesian space trajectories, Higher order polynomials; Linear function with parabolic blends, numerical based on different motion trajectories.	6
5	**Introduction to grippers, sensors and actuators** Types of grippers, Properties of grippers, Types of sensors along with working principle, sensor properties, , Translational and rotary actuators and their selection	4
6	**Motion Control of Robotic manipulators** Robotic open and closed loop control systems, , Second order systems, Non – linear closed loop equation of motion, Different friction models, Control	10
Total Hours		**44**

Textbook :

1 Robotics control, sensing, vision and intelligence, K S Fu, R C Gonzalez, Tata McGraw Hill Edition, 2008

2 Introduction to robotics, John J Craig, Pearson, Prentice Hall, 2005

References:

1 Introduction to Robotics: Analysis, Control, Applications , Introduction to Robotics: Analysis, Control, Applications , Saeed Niku, Wiley & Sons, 2019

2 Introduction to Robotics, Introduction to Robotics, S K Saha, Tata McGraw-Hill, 2008

3 5. Robotics and control, 5. Robotics and control, R K Mittal, I J Nagrath, Tata McGraw Hill , 2003

4 A Robot Engineering Textbook , A Robot Engineering Textbook , Mohsen Shahinpoor, Harper and Row, Publisher, New York, 1987

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
10.00	20.00	20.00	20.00	20.00	10.00

Instructional Method:

1 Presentation, case study

Supplementary Resources:

1 https://swayam.gov.in/