Mechanical Engineering Dept. Department

Syllabus
ME 443: Mech of Robotic Manipulators (3-0-3)

Course Catalog Description:

Basic configurations of robots and their industrial applications, Kinematics of robotic manipulators; coordinate transformations and workspace calculations, Robotic forces, moments, torques and compliant motions, Introduction to robot motion dynamics and control.

Course Pre-requisites:

- ME 309: Mechanics of Machines

Course Objectives:

1. To teach students the basic configurations of robots and their industrial applications.
2. To train students to identify degrees-of-freedom, joints, kinematic mobility, and constraints.
3. To teach students displacement and velocity kinematics of robotic manipulators.
4. To teach students robot motion dynamics and their control systems.
5. To train students to analyze the performance of robotic manipulators.

Course Learning Outcomes:

CLO1. Demonstrate a basic understanding of robots configurations and their industrial applications.

CLO2. Demonstrate a basic understanding of objects degrees-of-freedom, joints, kinematic mobility, bilateral and unilateral constraints.

CLO3. Demonstrate a basic knowledge of displacement and velocity kinematics of robotic manipulators.

CLO4. Use kinematics and kinetics to calculate robotic forces, moments, torques and compliant motions.

CLO5. To train students to analyze the performance of robotic manipulators.

CLO6. Evaluate the performance of robotic manipulators through the calculation of their forces, moments, torques and its effects on their motions.

CLO7. Demonstrate the ability to present short written reports on robotic manipulators for different industrial applications.

Learning Resources:

- Introduction to Robotics: Mechanics and Control (4th Edition), John J. Craig: 4th Edition, 2017.
- Power Point Presentations.

Lecture Assessment Plan:

Assessment Task	Week Due	Weight
Final Exam	End of Semester	30.0%
Group Term Project	Week 14	30.0%
Project Presentation	Week 15	20.0%
Midterm Exams	Week 6	20.0%

Lecture Weekly Schedule:

Week#	Topics
1	Robot applications: industrial manipulators, robotic hands, mobile robots, and wheeled vehicles.
2	Freedom and Constraints: object degrees-of-freedom, joints, kinematic mobility, bilateral and unilateral constraints.
3	Freedom and Constraints: object degrees-of-freedom, joints, kinematic mobility, bilateral and unilateral constraints. (Continue)
4	Freedom and Constraints: object degrees-of-freedom, joints, kinematic mobility, bilateral and unilateral constraints. (Continue)
	Displacement Kinematics: forward and reverse displacement for serial and parallel robots.
5	Displacement Kinematics: forward and reverse displacement for serial and parallel robots. (Continue)
6	Displacement Kinematics: forward and reverse displacement for serial and parallel robots. (Continue)
7	Static Analysis: end-effector and joint loading for serial and parallel robots, general singularities.
8	Static Analysis: end-effector and joint loading for serial and parallel robots, general singularities. (Continue)
9	Velocity Kinematics: forward and reverse displacement for serial robots, parallel robots, and mobile vehicles, Jacobians, general singularities.
10	Velocity Kinematics: forward and reverse displacement for serial robots, parallel robots, and mobile vehicles, Jacobians, general singularities. (Continue)
11	Task Planning: trajectory planning, path planning and task sequencing.
12	Task Planning: trajectory planning, path planning and task sequencing. (Continue)
13	Sensing: general robot sensors, perception, accuracy, repeatability.
14	Actuation: Motor types, specifications, limitations,
15	Control: Control of robotic manipulators. PID control strategy.