RAI 913 Robotic Manipulation (3-0)

Text Book: Mechanics of Robotic Manipulation by Matthew T. Mason, The MIT Press, 2001.

ISBN-10: 0-262-13396-2, ISBN-13: 978-0-262-13396-8

Reference Books:

- Dextrous Robot Hands, by Matthew T. Mason and J. Kenneth Salisbury, The MIT Press, 1985.
  ISBN-10: 0-262-13210-9, ISBN-13: 978-0-262-13210-7

- Robot Hands and the Mechanics of Manipulation, by Matthew T. Mason and J. Kenneth Salisbury, The MIT Press, 1985.
  ISBN-10: 0-262-13205-2, ISBN-13: 978-0-262-13205-3

Objective:

This course targets the use of robots for the purpose of moving objects, and the various processes involved—grasping, carrying, pushing, dropping, throwing, and so on. Unlike the Introduction to Robotics course, it focuses on manipulation itself rather than manipulators. This attention to processes rather than devices allows a more fundamental approach, leading to results that apply to a broad range of devices, not just robotic arms.

Pre-Requisite:

EM 800 Robotics – I   (or equivalent)

Course Outcome:

This course will impart the students with a thorough study of mechanics associated with various complex robotic manipulation tasks with a focus on the process of manipulation itself. This will enable the students to undertake research projects and theses for design of end effectors keeping in view the mechanics involved in the targeted manipulation tasks.

Course Outline:

This course shall cover various factors that come into play during the processes involved in manipulation of objects by robots. These include quasistatic as well as dynamic phenomena, contact models, effects of friction, impact etc.

Topics	Allocated Periods
Human Manipulation vs Automated Robotic Assembly System Taxonomy of manipulation techniques Planar Kinematics, Spherical Kinematics, Spatial Kinematics Kinematic Mechanisms and Constraints Spatial Rotations and Displacements Holonomic Path Planning Path Planning for Non-Holonomic systems Kinematic Models of Contact Forces Acting on Rigid Bodies	45
Polyhederal Convex Cones Contact Wrenches and Wrench Cones Cones in Velocity Twist Space Instantaneous Centers and Reuleaux's Method Line of Force and Moment Labelling Single DOF Friction Problems Planar Single Contact Friction Cones Planar Sliding Grasping and Fixturing Pushing Parts Orienting Assembly	

Dynamics: Angular Inertia Matrices Planar Single and Multiple Contact Problems Rigid Body Impact Quasidynamic Manipulation Continuous Dynamic Manipulation	