Gautam Buddha University, Greater Noida

School of Engineering (Mechanical Engineering)

Degree	Course Name	Course Code	Marks:100
M. Tech. in Design Engg.	Robotic Engineering	MED 607	SM+MT+ET 25+25+50
Semester	**Credits**	**L-T-P**	**Exam.**
III	3	3-0-0	3 Hours

Unit – I

Introduction: Automation and Robotics; Historical development; Definitions; Basic structure of robots; Robot anatomy; Complete classification of robots; Fundamentals about robot technology; Factors related to use robot performance; Basic robot configurations and their relative merits and demerits; Types of drive systems and their relative merits; The wrist & gripper subassemblies; Concepts and model about basic control system; Transformation and block diagram of spring mass system; Control loops of robotic systems; PTP and CP trajectory planning; Different types of controllers; Control approaches of robots. **(07 Hours)**

Unit – II

Kinematics of Robot Manipulator: Introduction; General description of robot manipulator; Mathematical preliminaries on vectors & matrices; Homogenous representation of objects; Robotic manipulator joint coordinate system; Euler angle & Euler transformations; Roll-pitch-yaw (RPY) transformation; Relative transformation; Direct & inverse kinematics solution; D H representation & displacement matrices for standard configurations; Geometrical approach to inverse kinematics; Homogeneous robotic differential transformation; Introduction; Jacobian transformation in robotic manipulation. **(06 Hours)**

Unit – III

Robotic Workspace & Motion Trajectory: Introduction; General structures of robotic workspaces; Manipulations with n revolute joints; Robotic workspace performance index; Extreme reaches of robotic hands; Robotic task description. Robotic motion trajectory. Design - Introduction; Trajectory interpolators; Basic structure of trajectory interpolators; Cubic joint trajectories. General design consideration on trajectories- 4-3-4 & 3-5-3 trajectories; Admissible motion trajectories. **(08 Hours)**

Unit – IV

Dynamics of Robotic Manipulators: Introduction; bone; Graph modeling of robotic manipulators; Examples of bond graph dynamic modeling of robotic manipulator. Brief

discussion on Lagrange-Euler (LE) dynamic modeling of robotic manipulators-preliminary definitions; Generalized robotic coordinates; Dynamic constraints; Velocity & acceleration of moving frames; Robotic mass distribution & inertia tensors; Newton's equation; Euler equations; The Lagrangian & Lagrange's equations. **(07 Hours)**

Unit – V

Robot Teaching: Introduction; Various teaching methods; Task programming; Survey of robot level programming languages; A robot program as a path in space; Motion interpolation; Wait; Signal & delay commands; Branching; Robot language structure; Various textual robot languages such as val ii; Rail; AML and their features; Typical programming examples such as palletizing; Loading a machine etc. **(09 Hours)**

Unit – VI

Inventory Management: Inventory robot sensing & vision: Various sensors and their classification; Use of sensors and sensor based system in robotics; Machine vision system; Description; sensing; Digitizing; Image processing and analysis and application of machine vision system; Robotic assembly sensors and intelligent sensors. Industrial applications: Objectives; Automation in manufacturing; Robot application in industry; Task programming; Goals of AI research; AI techniques; Robot intelligence and task planning; Modern robots; Future application and challenges and case studies.

(08 Hours)

Recommended Books:

1. A Robot Engineering Textbook; Mohsen Shahinpoor; Harper & Row Publishers; New York.
2. Robotics; Control Vision and Intelligence; Fu; Lee and Gonzalez; McGraw Hill International.
3. Introduction to Robotics; John J. Craig; Addison Wesley Publishing.
4. Robotics for Engineers; Yoram Koren; McGraw Hill International.
5. Industrial Robotics; Groover; Weiss; Nagel; McGraw Hill International.
6. Robotics and Control; Nagrath - Mittal; Tata McGraw Hills.
7. Robot Technology Fundamentals; Keramas; Thomson; Vikas Publication House.
8. Company Fundamentals of Robotics Analysis and Control; Schilling; Prentice Hall.
9. Introduction to Robotics; Niku; Pearson Education; Asia.
10. Foundation of Robotics; Yoshikawa; Prentice Hall (EEE).
11. Robotic Engineering - An Integrated approach by Klafter; Chmielewski and Negin; Prentice Hall.
12. Robot Vision and Sensor Controls Vol-3 by Rooks B; North Holland.