20MD005 ROBOTICS AND AUTOMATION

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Course Description and Objective:

The purpose of this course is to introduce at senior level graduate students on the design considerations of automation lines and robotic configurations for automation applications in manufacturing industry.

Course Outcomes: Students will be able to

- Understand the basics of automation and mechatronic system components
- Estimate the factors in Flexible Manufacturing System layouts
- Evaluate parameters in automated assembly lines
- Demonstrate the control system configurations in automated systems
- Analyze joint and link parameters in robot systems

Unit-1 **L - 12**

Introduction to Automation: Definition of automation, Reasons for automation, Types.
Mechatronic Systems: Overview of mechatronic systems and devices in manufacturing, sensors, transducers, and control systems in manufacturing, PLCs, and Microprocessors.

Unit-2 **L - 12**

Flexible Manufacturing Systems (FMS): Introduction to FMS, Components of FMS, Types of flexibilities, Applications and benefits, Layout Configurations, Implementation, Quantitative analysis of FMS, Simple problems. Automated material handling systems, Automated guided vehicles, Automated storage and retrieval systems, Carousel storage system and automated data capturing systems.

Unit-3 **L - 12**

Automated assembly lines: Fundamentals, System configuration, Part delivery at workstation and its applications, Design for automated assembly, Quantitative analysis of assembly systems, Line balancing algorithm, Largest candidate rule - simple problems; Kilbridge and Wester method - simple problems; Ranked positional weights method, Computerized techniques – simple problems.

Unit-4 **L - 12**

Control System: Introduction to control system, types of control system, block diagrams, lag in response, transfer function, overall transfer function, transfer function with viscous damped output, open and closed transfer function

Unit-5 **L - 12**

Robotics in Automation: Robot classification and anatomy, forward and inverse kinematics, DH matrix transformation, Jacobian and differential motion, Trajectory planning, Static and dynamic analysis, applications in manufacturing.

Lab Component:

- Design and optimize spot-welding processes in a 3D-graphics environment using Robcad Software.
- Robcad Arc of automotive, heavy industry and shipyard for exceptionally fast generation of new arc welding programs.
- Robcad Paint to design, test and optimize coverage programs in the office environment without interrupting production.
- Off-line programming and optimization of Material handling robots.
- Assembly Studies to define, analyse and verify product assembly and disassembly sequences
- Near-realistic Simulation of Human operations

Textbooks

1. Deb, S. R., Robotics technology and flexible automation, Tata McGraw-Hill, 2nd Ed., 2009.
2. M P. Groover, Industrial Robotics: Technology, Programming and Applications, McGraw-Hill, 2nd Ed., 2012, ISBN: 9780070265097.
3. Craig J.J., “Introduction to Robotics: Mechanics and Control ", Prentice Hall, 3rdEdn, 2004, ISBN: 978-0201543612.