ROBOTICS

II Semester

Course Code: 19ME2107 **L P C**

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Course Outcomes: At the end of the course, the student will be able to
CO1: Analyze the manipulator design including selection of gripper.
CO2: Evaluate kinematics and dynamics for serial and parallel robots.
CO3: Classify different control schemes and identify applications of sensors in robotics.
CO4: Explain image processing in robot vision system and types of robot programming languages.
CO5: Design a robot work cell layout and discuss applications of robot systems.

UNIT-I **(10-Lectures)**

Introduction: Automation and robotics, robot anatomy, robot configurations, work volume, robot drive systems, control systems and precision of movement.
Robot end-effectors: Grippers-types, operation, mechanism, force analysis, tools as end-effectors and considerations in gripper selection and design.
Learning outcomes:

1. Identify the difference between automation and robotics. (L1)
2. Explain the robot anatomy, configuration, work volume, drive and control systems. (L2)
3. Design and analyze grippers. (L6)

UNIT-II **(10-Lectures)**

Robot kinematics: Forward and inverse kinematics for RR & RP serial robots and parallel robots (planar four bar mechanism and three DOF parallel manipulator).
Robot dynamics: Dynamics-Lagrangian formulation for RR & RP serial and planar robots, trajectory planning – joint space techniques and Cartesian space techniques.
Learning outcomes:

1. Explain the concepts of manipulator kinematics and dynamics. (L2)
2. Solve forward and inverse kinematics for simple robots. (L3)
3. Solve manipulator dynamic problems using Lagrangian formulation. (L3)

UNIT-III **(10-Lectures)**

Control of Manipulators: Basic control system concepts and models, manipulator control problem, linear control schemes, PD, PID and CTC schemes, force control of robotic manipulators
Robot Sensors and Actuators: Desirable features of tactile, proximity and range sensors, uses of sensors in robotics robot sensors and actuators – position sensors, velocity sensors, actuators and power transmission systems.
Learning outcomes:

1. Explain the basic concepts of robot controlling systems. (L2)
2. Describe PD and PID control schemes. (L2)
3. Select the types of sensors and actuators used in robotics. (L4)

UNIT-IV **(10-Lectures)**

Robotic vision: Process of imaging, architecture of robotic vision system, image acquisition, image representation, image processing.
Robot programming and languages: Lead through programming, robot programming as a path in space, motion interpolation, WAIT, SIGNAL and DELAY commands, branching, capabilities and limitations of

lead through methods, textual robot languages, generations, robot language structure and motion commands.

Learning outcomes:

1. Explain the concept of image enhancement, segmentation and transformation. (L2)
2. Describe the requirements and features of robot programming. (L2)
3. Explain the various methods of robot programming. (L2)

UNIT-V **(10-Lectures)**

Robot cell design and control: Robot cell layouts-robot centered cell, inline robot cell, mobile robot cell, considerations in work design, work cell control, inter locks, errors detection, work cell controller

Robot applications: Industrial applications – material handling, processing applications, assembly and inspection applications, nonindustrial applications.

Learning outcomes:

1. Design a robot cell for simple manufacturing system. (L6)
2. Explain the concepts of work cell control, inter locks and error detection. (L2)
3. Explain various industrial applications of robotics. (L2)

TEXT BOOKS:

1. M.P Groover, M Weiss, R M Gnagel and N G Ordrey, *Industrial Robotics*, Tata McGraw-Hill, New Delhi, 2012.
2. R K Mittal and I J Nagrath, *Robotics and Control*, Tata McGraw-Hill, 24th Reprint, New Delhi, 2015.

REFERENCE BOOKS:

1. Saeed B. Niku, *Introduction to Robotics: Analysis, Systems, Application*, Pearson Education, New Delhi, 2011.
2. S. K. Saha, *Introduction to Robotics*, McGraw-Hill Education India, New Delhi, 2008.
3. Ashitava Ghosal, *Robotics: Fundamental Concepts and Analysis* , Oxford University Press, New Delhi, 2006.
4. Merlet, J.P, *Parallel Robots*, Kluwer Academic Publishers, The Netherlands,2000.
5. Lung Wen Tsai, *Robot Analysis: The Mechanics of Serial and Parallel Manipulators*, John Wiley & sons, 1999.