

ECE244:ELEMENTS OF ROBOTICS

L:3 T:0 P:0 Credits:3

Course Outcomes: Through this course students should be able to

- CO1 :: Discuss the fundamental elements and architecture of robotic systems.
- CO2 :: Describe robot mechanisms, actuators, and transmission systems.
- CO3 :: Identify suitable sensors and embedded controllers for robotic applications.
- CO4 :: Apply basic robot programming and motion control principles
- CO5 :: Analyze robotic systems used in multiple fields of applications.
- CO6 :: Design a simple robotic system by integrating the various elements of robotics

Unit I

Introduction to Robotics and Robot Anatomy : Evolution of robotics, Classification of robots, Components of a robotic system., Degrees of freedom (DOF), Robot coordinate systems, Robot workspace. Robot anatomy, Types of robotic manipulators, Mobile robots, Industrial and service robots

Unit II

Mechanical Elements of Robotics : Robot links and joints, Kinematic chains, Mechanical transmission systems, Gear trains, Belt and chain drives, Lead screw and ball screw mechanisms, Bearings Couplings, Robot end-effectors, Grippers (mechanical, vacuum, magnetic), Structural materials used in robots.

Unit III

Electrical and Electronics Elements : DC motors, Servo motors, Stepper motors, Brushless DC motors (BLDC)., Motor drivers, Encoders., Power supply systems, Batteries, Basic sensors, Proximity sensors, Position sensors, Force sensors, Signal conditioning, Introduction to embedded controllers

Unit IV

Robot Mechanical Design Parameters : Introduction to robot kinematics, Coordinate frames and transformations, Degrees of Freedom (DOF), Position and orientation of robots, Forward kinematics: Concept and applications,, Inverse kinematics: Concept and applications, Velocity kinematics and Jacobian (Introduction), Robot trajectory and path planning (Basics) Introduction to robot dynamics, Newton–Euler formulation (Concept), Lagrangian formulation (Concept), Forces and torques in robotic manipulators, Static and dynamic balance, Applications of kinematics and dynamics in industrial robots.

Unit V

Control and Programming Elements : Open-loop and closed-loop control, Feedback systems, PID control (Introduction), Motion planning basics., Robot programming concepts, Programming languages used in robotics, Embedded programming basics., Arduino and Raspberry Pi overview, Introduction to ROS (Robot Operating System), Human–Robot Interface basics

Unit VI

Intelligent Robotics and Applications : Machine vision overview, Artificial intelligence in robotics., Autonomous robots, Robot communication., Internet of Robotic Things (IoRT), Collaborative robots (Cobots)., Safety in robotics, Ethics in robotics., Industrial automation, Medical, agricultural, logistics, and defense robotics, Emerging trends in robotics.

Text Books:

1. ROBOTICS AND CONTROL by R.K.MITTAL AND I.J.NAGRATH,, Tata McGraw Hill, India

References:

1. ROBOTICS-FUNDAMENTAL CONCEPTS AND ANALYSIS by ASHITAVA GHOSHAL, OUP India
2. INTRODUCTION TO ROBOTICS by S K SAHA, MC GRAW HILL
3. INDUSTRIAL ROBOTICS by M.P.GROOVER, M.WEISS, R.N. NAGELAND N. G.ODREJ, MC GRAW HILL

