## MMPE3008 ROBOTICS (3-0-0)

**Course Objectives:**

- Introduce the fundamentals and evolution of robotics, including robot components and classifications.
- Develop understanding of the mathematical, kinematic, and dynamic modeling of robotic manipulators.
- Build knowledge in robotic motion planning, trajectory generation, and control strategies.
- Explore various sensors, actuators, and their roles in perception and control in robotic systems.
- Familiarize students with industrial applications of robots and integration in automation systems.

**Module – I (9 Hours)**

Fundamentals of Robotics: Evolution of robots and robotics, Definition of industrial robot, Laws of Robotics, Classification, Robot Anatomy, Work volume and work envelope, Human arm characteristics, Design and control issues, Manipulation and control, Resolution; accuracy and repeatability, Robot configuration, Economic and social issues, Present and future application.

**Module – II (9 Hours)**

Mathematical modelling of a robot: Mapping between frames, Description of objects in space, Transformation of vectors. Direct Kinematic model: Mechanical Structure and notations, Description of links and joints, Kinematic modelling of the manipulator, Denavit-Hartenberg Notation, Kinematic relationship between adjacent links, Manipulator Transformation matrix.

**Module – III (9 Hours)**

Inverse Kinematics: Manipulator workspace, Solvable of inverse kinematic model, Manipulator Jacobian, Jacobian inverse, Jacobian singularity, Static analysis. Dynamic modeling: Lagrangian mechanics, 2D-Dynamic model, Lagrange-Euler formulation, Newton-Euler formulation. Robot Sensors: Internal and external sensors, force sensors, Thermocouples, Performance characteristic of a robot.

**Module – IV (9 Hours)**

Robot Actuators: Hydraulic and pneumatic actuators, Electrical actuators, Brushless permanent magnet DC motor, Servomotor, Stepper motor, Micro actuator, Micro gripper, Micro motor, Drive selection. Trajectory Planning: Definition and planning tasks, Joint space planning, Cartesian space planning. Applications of Robotics: Capabilities of robots, Material handling, Machine loading and unloading, Robot assembly, Inspection, Welding, Obstacle avoidance.

**Course Outcomes:**

CO1 Describe the basic concepts of robotics including evolution, classification, laws of robotics, robot anatomy, and applications.

CO2 Develop kinematic models of robotic manipulators using coordinate transformations and Denavit-Hartenberg notation.

CO3 Solve inverse kinematics problems and analyze manipulator Jacobians, workspaces, and singularities.

CO4 Formulate dynamic models of manipulators using Lagrangian and Newton-Euler methods.

CO5 Identify different types of sensors and actuators used in robotics and explain their roles in control and feedback.

CO6 Plan robot trajectories and demonstrate the industrial applications of robots in areas like material handling, assembly, and welding.

**Text Books:**


1. Robotics Technology and Flexible Automation, S.R.Deb and S. Deb, TMH.
2. Robotics and Control, R.K. Mittal and I.J. Nagrath, Tata McGraw Hill.
3. Introduction to Robotics: Mechanics and control, John J Craig, PHI.


**Reference Books:**


1. Introduction to Robotics, S. K. Saha, Tata McGraw Hill.
2. Robotics: Control, Sensing, Vision and Intelligence, K.S.Fu, R.C.Gonzalez and C.S.G.Lee, McGraw Hill.
3. Robotics, AppuuKuttan K.K., I.K. international.
4. Robot Dynamics and Control, M.W.Spong and M. Vidyasagar, Wiley India.
5. Industrial Robotics Technology, programming and application, M.P.Groover, TMH.
6. Introduction to Robotics: Analysis, Systems, Applications, S.B.Niku, PHI.
7. Robotics: Fundamental Concepts and Analysis, A. Ghosal, Oxford University Press.
8. Fundamentals of Robotics: Analysis and Control, R. J. Schilling, PHI.
9. Robotic Engineering: An Integrated Approach, R.D. KLAFTER, T. A. Chmielewski, and M. Negin, PHI.
10. Robot Technology: Fundamentals: J. G. Keramas, Cengage Learning.