6th Semester	RPR6D002	Robotics and FMS	L-T-P 3-0-0	3 Credits

Module-I: **(10 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.

Mathematical modeling 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 modeling of the manipulator, Denavit-Hartenberg Notation, Kinematic relationship between adjacent links, Manipulator Transformation matrix.

Module-II: **(10 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-III: **(10 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.

Module-IV: **(12 hours)**

Introduction and Description, limitations with conventional manufacturing, Need for FMS Introduction, Definition, Basic Component of FMS, Significance of FMS, General layout and configuration of FMS, Principle Objectives of FMS, Benefits and limitations of FMS, Area of Application of a FMS in Industry, Various Hardware and Software required for an FMS, CIM Technology, Hierarchy of CIM, FMS Justification

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
[4] Introduction to Robotics, S. K. Saha, Tata McGraw Hill
[5] Robotics: Control, Sensing, Vision and Intelligence, K.S.Fu, R.C.Gonzalez and C.S.G.Lee, McGraw Hill
[6] Robot Dynamics and Control, M.W.Spong and M. Vidyasagar , Wiley India.

Digital Learning Resources:

Course Name:	Robotics
Course Link:	https://nptel.ac.in/courses/112/101/112101099/
Course Instructor:	Prof. B. Seth Prof. C. Amarnath Prof. P. Seshu Prof. P.S. Gandhi Prof. K. Kurien Issac IIT Bombay

Course Name:	Robotics: Advanced Concepts and Analysis
Course Link:	https://nptel.ac.in/courses/112/108/112108093/
Course Instructor:	Prof. Ashitava Ghosal, IISc Bangalore

Course Name:	Robotics and Control : Theory and Practice
Course Link:	https://nptel.ac.in/courses/112/108/112108093/
Course Instructor:	Prof. N. Sukavanam, Prof. M. Felix Orlando, IIT Roorkee

Course Name:	Robotics and Control : Theory and Practice
Course Link:	https://nptel.ac.in/courses/112/108/112108093/
Course Instructor:	Prof. N. Sukavanam, Prof. M. Felix Orlando, IIT Roorkee

Course Name:	Introduction to robotics
Course Link:	https://nptel.ac.in/courses/107/106/107106090/
Course Instructor:	Dr. Balaraman Ravindran Dr. T Asokan Dr. Krishna Vasudevan, IIT Madras