ROBOTICS

VI Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEC32	Elective	3	0	0	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Prerequisite: Kinematics of Machinery, Dynamics of Machinery

I. COURSE OVERVIEW:

Robotics is recognised as one of the important aids of mechatronics systems and provides applications in the unmanned areas of industrial automation. The course emphasis on the design and development of robot geometry, sensors and actuators to meet the kinematic requirements and trajectory planning of the manipulaotr. The overall applications in the manufacturing automation are to minimal elimination of human intervention.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The fundamental concepts of various configurations of the robot manipulators and their working principles used in the industries.
II. The basics of motion analysis of manipulator and process to find forward kinematics and inverse kinematics of the robot manipulator.
III. The path planning of a robot manipulator for given polynomial equation and how to avoid obstacles in its path.
IV. The performance of various feedback components like sensors and actuators and how they can be used according to the specifications of the manipulator.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Outline** the relationship between mechanical structures of industrial robots and their operational workspace characteristics.	Understand
CO 2	**Develop** the mechanism for solving forward and inverse kinematics of simple robot manipulators.	Apply
CO 3	**Develop** an ability to obtain the Jacobian matrix and use it toidentify singularities.	Apply
CO 4	**Outline** the differential kinematics methods used to study the motion of robot manipulators.	Understand
CO 5	**Explain** an ability to generate the trajectory for given application of robot manipulator.	Understand
CO 6	**Recall** the working of electric actuators and applications of robot inxmanufacturing, material handling, assembly and inspections.	Remember

IV. COURSE SYLLABUS:

MODULE-I: INTRODUCTION AND COMPONENTS OF THE INDUSTRIAL ROBOTICS (09)

Introduction: Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications. Components of the Industrial Robotics: common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

MODULE –II: MOTION ANALYSIS: (09)

Motion Analysis: Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems. Manipulator Kinematics-H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulation.

MODULE –III: TRAJECTORY PLANNING (09)

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion – straight line motion.

MODULE –IV: ROBOT ACTUATORS AND FEEDBACK COMPONENTS (09)
Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors.

MODULE –V: ROBOT APPLICATION IN MANUFACTURING (09)
Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

V. TEXT BOOKS

1. Groover M P, "Industrial Robotics", Mc Graw Hill.
2. Ramachandran Nagarajan, "Introduction to Industrial Robotics", Pearson,

VI. REFERENCE BOOKS:

1. Spony, Vidyasagar, "Robot Dynamics and Controls", John Wiley,
2. Asada, Slotine, "Robot Analysis and control", Wiley Inter-Science,

VII. WEB REFERENCES:

1. http://nptel.ac.in/courses/112101099
2. http://www.intechopen.com/books/robot-control http://www.som.com