INTRODUCTION TO ROBOTICS

VI Semester: EEE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB56	Open Elective	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

OBJECTIVES:

The course should enable the students 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.

COURSE OUTCOMES:

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

CO 1 **Outline** the relationship between mechanical structures of industrial robots and their operational workspace characteristics.
CO 2 **Demonstrate** an ability to apply spatial transformation to obtain forward kinematics equation of robot manipulators.
CO 3 **Develop** the mechanism for solving forward and inverse kinematics of simple robot manipulators.
CO 4 **Develop** an ability to obtain the Jacobian matrix and use it to identify singularities.
CO 5 **Outline** the various motions of the manipulator and use it for trajectory.
CO 6 **Explain** an ability to generate the trajectory for given application of robot manipulator.
CO 7 **Identify** the knowledge of robot controllers and actuators used in the manipulators.
CO 8 **Recall** the applications of robot in manufacturing, material handling, assembly and inspections.
CO 9 **Illustrate** the considerations of workspace for a given robot application.

MODULE-I	INTRODUCTION TO ROBOTICS	Classes: 09

Introduction: Automation and robotic, an over view of robotics, classification by coordinate system and control systems, components of the industrial robotics: Degrees of freedom, end effectors: mechanical gripper, magnetic vacuum cup and other types of grippers, general consideration on gripper selection and design.

MODULE-II	MOTION ANALYSIS AND KINEMATICS	Classes: 09

Motion analysis: Basic rotation matrices, composite rotation matrices, equivalent angle and axis homogeneous transformation, problems; Manipulator kinematics: D-H notations, joint coordinates and world coordinates, forward and inverse kinematics, problems.

MODULE-III	KINEMATICS AND DYNAMICS	Classes: 09

Differential kinematics: Differential kinematics of planar and spherical manipulators, Jacobians problems. Robot dynamics: Lagrange, Euler formulations, Newton-Euler formulations, problems on planar two link manipulators.

MODULE-IV	TRAJECTORY PLANNING AND ACTUATORS	Classes: 09
Trajectory planning: Joint space scheme, cubic polynomial fit, avoidance of obstacles, types of motion: Slew motion, joint interpolated motion, straight line motion, problems, robot actuators and feedback components; actuators: pneumatic and hydraulic actuators.		
MODULE-V	**ELECTRIC ACTUATORS AND ROBOTIC APPLICATIONS**	**Classes: 09**
Electric actuators: DC servo motors, stepper motors, feedback components: position sensors, potentiometers, resolvers and encoders, velocity sensors, tactile sensors; Robot application in manufacturing: Material handling, assembly and inspection.		
Text Books:		
1 Groover M. P, "Industrial Robotics", Tata McGraw-Hill, 1st Edition, 2013. 2 J.J Criag, "Introduction to Robotic Mechanics and Control", Pearson, 3rd Edition, 2013.		
Reference Books:		
1. K.S Fu, "Robotics", McGraw-Hill, 1st Edition, 2013 2. Richard, D. Klafter, "Robotic Engineering", Prentice Hall, 1st Edition, 2013.		
Web Reference:		
1. https://www.doc.ic.ac.uk/~ajd/Robotics/RoboticsResources/lecture1.pdf. 2. http://opencourses.emu.edu.tr/course/view.php?id=32 3. https://www.researchgate.net/publication/277712686_Introduction_to_Robotics_class_notes_UG_level		
E-Book:		
1. http://www.robot.bmstu.ru/ 2. http://www.robotee.com/index.php/download-free-robotic-e-books/		