INTRODUCTION TO ROBOTICS

VII Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AME553	Open Elective	4	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

COURSE OBJECTIVES:

The course should enable the students to:

I. Develop the knowledge in various robot structures and their workspace.
II. Develop the skills in performing kinematics analysis of robot systems.
III. Provide the knowledge of the dynamics associated with the operation of robotic systems.
IV. Provide the knowledge and analysis skills associated with trajectory planning.
V. Understand material handling and robot applications in industries.

COURSE OUTCOMES (COs):

CO1 Understand characteristic features of robots and usage of different grippers for industrial applications.
CO2 Understand direct and inverse kinematics of robot structure.
CO3 Illustrate Differential Kinematics of planar and spherical manipulators.
CO4 Understand classification of robot actuators and trajectory planning.
CO5 Remember material handling and applications in manufacturing.

COURSE LEARNING OUTCOMES (CLOs):

1. Differentiate between automation and robotics.
2. Classify robots and describe its anatomy.
3. Specify various types of industrial sensors.
4. Classify various grippers.
5. Discuss about motion analysis of robot.
6. Understand methods for calculating the kinematics and inverse kinematics of a robot manipulator.
7. Describe D-H notations, joint coordinates and. world coordinates.
8. Discuss about homogeneous transformation.
9. Describe the differential kinematics of planar manipulators.
10. Illustrate Lagrange-Euler formulation.
11. Discuss jacobian and robot dynamics.
12. Illustrate Newton-Euler formulation.
13. Describe joint space scheme.
14. Illustrate cubic polynomial fit.
15. Classify types of motion.
16. Explain actuators and classify them.
17. Illustrate various robot applications in manufacturing.
18. Discuss the role of robots in material handling.
19. Explain work cell design.
20. Discuss the role of robots in assembly and inspection.

Unit-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.

Unit -II	MOTION ANALYSIS AND KINEMATICS	Classes: 09

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

coordinates, forward and inverse kinematics, problems.

Unit -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.

Unit -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.

Unit -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 sensor; Robot application in manufacturing: Material handling, assembly and inspection.

Text Books:

1. Groover M. P, "Industrial Robotics", TataMcGraw-Hill, 1st Edition, 2013.
2. J.J Criag, "Introduction to Robotic Mechanics and Control", Pearson, 3rd Edition, 2013.

Reference Books:

1. Richard D. Klafter, "Robotic Engineering", Prentice Hall, 1st Edition, 2013.
2. Fu K S, "Robotics", McGraw-Hill, 1st Edition, 2013.

Web References:

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-Text Books:

1. http://www.robot.bmstu.ru/
2. http://www.robotee.com/index.php/download-free-robotic-e-books/