3/4 B.Tech. FIFTH SEMESTER

FE **FE - ROBOTICS** **Credits: 4**

Lecture:- 4 periods/week **Internal assessment: 30marks**
Tutorial: _ **Semester end examination: 70 marks**

Objectives:

1. Recognize robot configuration, structures, basic components, workspace and generations of robots.
2. Get acquainted with performing spatial transformations and kinematics of the robot
3. Interpret various sensors, actuators
4. Implement robot programming
5. Get knowledge and analysis skills associated with trajectory planning
6. Identify present &future applications of a robot.

Learning outcomes:

At the end of course the students will be able to:

1. Demonstrate knowledge regarding the structures of industrial robots and their operational workspace characteristics
2. Apply spatial transformation to obtain forward kinematics equations for manipulators
3. Solve direct and inverse kinematic problems
4. Obtain basic idea on working principle of sensors, programs of different operations
5. Generate joint trajectory for path planning
6. Describe applications of robots in industry.

Pre-Requisites:

Mathematics, Electrical and Electronics Engineering, C Programming

UNIT – I

INTRODUCTION TO ROBOTICS:

Automation and Robotics, major component of a robot, robotic like devices, classification of robots , Classification by coordinate system and by control method, Specifications of robots, Architecture, number of degrees of freedom, economic analysis, Overview of robot present and future application.

UNIT – II

ROBOT END EFFECTORS, ACTUATORS:

Introduction, end effectors, types of end effectors, grippers and tools, Requirements and challenges of end effectors. Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors.

UNIT – III

MOTION ANALYSIS:

Homogeneous transformations as applicable to rotation and translation problems

UNIT – IV

TRANSFORMATIONS AND KINEMATICS:

Objectives, homogenous coordinates, forward solution, Denavit Hartenberg procedure. Simple problems involving planar manipulators.

UNIT – V

DIFFERENTIAL TRANSFORMATION:

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

UNIT – VI

TRAJECTORY PLANNING:

Path planning, avoidance of obstacles, path planning algorithms, trajectory planning with cubic polynomial, higher order trajectories, blending – Robot programming, languages and software packages**.**

UNIT – VII

ROBOTIC SENSORY DEVICES:

Objective, Non-optical position sensors – potentiometers, synchros, optical position sensors – optical interrupters, optical encoders (absolute & incremental). **Proximity sensors:** Contact type, non contact type – reflected light scanning laser sensors. **Touch & slip sensors:** Tactile sensors – proximity rod & photo detector sensors, slip sensors Forced oscillation slip sensor, interrupted type slip sensors

UNIT – VIII

ROBOT APPLICATION IN MANUFACTURING:

Material Transfer - Material handling, loading and unloading-Processing - spot and continuous arc welding & spray painting - Assembly and Inspection

Learning resources

Text books:

1. Robotic Engineering, by Richard D.Klafter, Thomas A.Chmielewski, Michael Negin, Prentice Hall India, 2010.
2. Industrial Robotics, by Mikell P.Groover, Mitchell weiss, Roger N. Nagel, Nicholas G.Odrey, Tata McGraw-Hill publishing, 2008.
3. Robotics and Control, by R K Mittal & I J Nagrath, Tata McGraw-Hill Publishing, 2007.

Reference books:

1. Introduction to Robotics, by John J. Ceaig, Addison Wesley
2. Introduction to Robotics, analysis, systems, applications, by Seed B.Niku, Pearson Prentice hall,2006.
3. Robotics, by K. S. Fu, Gonzalez & Hee,Tata McGraw-Hill Publishing.1987.
4. Robotics for Engineers, by Yoram Koren, Mcgraw Hill, New York, New York, 1985