INTRODUCTION TO INDUSTRIAL ROBOTICS

(Open Elective-II)

Course Code	23ME2601	Year	III	Semester	II
Course Category	Open Elective - II	Offered Branch	ME	Course Type	Theory
Credits	3	L-T-P	3-0-0	Pre requisites	
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course outcomes: At the end of the course, the student will be able to:

CO	Statement	BTL
CO1	**Explain** the fundamental concepts of automation, robotics, and CAD/CAM integration, and **classify** industrial robots based on coordinate systems, control systems, and structural anatomy, including end-effectors.	L2
CO2	**Compare and analyse** various types of robot actuators such as pneumatic, hydraulic, and electric systems, and **explain** the working of feedback components like position and velocity sensors used in robotic control.	L2
CO3	**Apply** homogeneous transformation matrices to model robot motion and **solve** problems related to manipulator kinematics using D-H parameters for both forward and inverse kinematics.	L3
CO4	**Describe** robotic trajectories considering path planning, obstacle avoidance, and motion types using appropriate robot programming languages and tools.	L2
CO5	**Describe** the basic concepts of machine vision systems and **explain** the image acquisition, digitization, and processing techniques used in robotic applications	L2

Contribution of Course outcomes towards achievement of programme outcomes &Strength of correlations (High:3, Medium: 2, Low:1)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO 1	3	2											2
CO 2	3	3							2				2
CO 3	3	3	2										2
CO 4	2	3	3	2	3								2
CO 5	2				3				2				2

SYLLABUS		
Unit	Contents	Mapped CO
I	**INTRODUCTION:** Automation and Robotics, CAD/CAM and Robotics – An overview of Robotics –present and future applications – classification by coordinate system and control system. **COMPONENTS OF THE INDUSTRIAL ROBOTICS:** Robot anatomy, work volume, components, number of degrees of freedom - robot drive systems, function line diagram representation of robot arms, common types of arms -–requirements and challenges of end effectors, determination of the end effectors.	CO1

II	**ROBOT ACTUATORS AND FEED BACK COMPONENTS:** **Actuators:** Pneumatic, Hydraulic actuators, electric& stepper motors. Comparison of Electric, Hydraulic and Pneumatic types of actuation devices. **Feedback components:** position sensors–potentiometers, resolvers, encoders–Velocity sensors.	**CO2**
III	**MOTION ANALYSIS:** Homogeneous transformations as applicable to rotation and translation – problems. **MANIPULATOR KINEMATICS:** Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics–problems.	**CO3**
IV	**GENERAL CONSIDERATIONS IN PATH DESCRIPTION AND GENERATION:** Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion –straight line motion–Robot programming, languages and software packages-description of paths with a robot programming language.	**CO4**
V	**IMAGE PROCESSING AND MACHINE VISION:** Introduction to Machine Vision, Sensing and Digitizing function in Machine Vision, Training and Vision System, Robotic Applications.	**CO5**

Learning Resources
Text Book(s): 1. Industrial Robotics: Technology, Programming and Applications – M. P. Groover, Pearson Education. 2. Robotics and Control – R. K. Mittal and I. J. Nagrath, Tata McGraw-Hill.
References: 1. Robotics: Control, Sensing, Vision, and Intelligence – K. S. Fu, R. C. Gonzalez, and C. S. G. Lee, McGraw-Hill. 2. Robotic Engineering: An Integrated Approach – Richard D. Klafter, Thomas A. Chmielewski, and Michael Negin, Prentice Hall. 3. Robot Analysis and Control – H. Asada and J. J. E. Slotine, BSP Books Pvt. Ltd. 4. Introduction to Robotics: Mechanics and Control – John J. Craig, Pearson Education..
E-Resources: 1. *Introduction to Industrial Robotics* – NPTEL (ME161) https://onlinecourses.nptel.ac.in/noc25_me161/preview 2. *Control Systems for Robotics* – NPTEL (DE11) https://onlinecourses.nptel.ac.in/noc20_de11/preview 3. *Manufacturing Automation* – NPTEL (ME143) https://onlinecourses.nptel.ac.in/noc23_me143/preview 4. *Industrial Robotics Lecture Videos* – NPTEL (via Digimat) https://tkiet.digimat.in/nptel/courses/video/112104298/L25.html