

Devi Ahilya University, Indore, India Institute of Engineering & Technology				IV Year B.E. (Computer Engg.) (Full Time)			
Subject Code & Name	Instructions Hours per Week			Credits			
CER7E3 Robotics & Numerical Control	L	T	P	L	T	P	Total
	3	1	2	3	1	1	5
Duration of Theory Paper: 3 Hours							

Learning Objectives: To familiarize student with the introductory concepts of Robotics.

Pre-requisites: Basic knowledge of computer, electronics and mathematics is required.

COURSE OF CONTENTS

UNIT 1: INTRODUCTION

Objectives, Classification of robots, Major components of robot, definitions: Kinematics, Controls, and actuators. Robot history, types and applications current and future with examples. Fixed and flexible automation.

UNIT 2: ROBOT ARM KINEMATICS

Introduction, The direct kinematics problem, Rotation Matrices, Composite rotation Matrix, Rotation matrix about arbitrary axis, Rotation matrix with Euler angle representation, Geometric interpretation of rotation matrix, Homogenous coordinates and transformation matrix, Geometric interpretation of Homogenous transformation matrices, Composite homogenous transformation matrices, Links, Joints, and their parameters, The Denavit - Hartenberg representation, Kinematic equation for manipulator, Other specifications of the locations of the end effectors, Inverse kinematics problem.

UNIT 3: CONTROL OF ACTUATORS

Objective, Motivation, Closed loop control in position servo, Effect of friction and gravity, Adaptive control, Optimal control, Computed torque technique, Transfer function of single joint, Position control for single joint, Brief discussion on performance and stability criteria.

UNIT 4: SENSORS

Sensor characteristics, Position sensors- potentiometers, Encoders, LVDT, Resolvers, Displacement sensor, Velocity sensor- encoders, tachometers, Acceleration sensors, Force and Pressure sensors – piezoelectric, force sensing resistor, Torque sensors, Touch and tactile sensor, Proximity sensors-magnetic, optical, ultrasonic, inductive, capacitive, eddy-current proximity sensors.

Hall Effect sensors, Binary sensors, Analog sensors, Force and Torque sensing, Elements of a Wrist sensor.

UNIT 5: VISION AND PROCESSING

Image acquisition, illumination Techniques, imaging geometry, some basic transformations, perspective transformations.

Camera model, camera calibration, stereo imaging, Higher-Level Vision: Segmentation, Edge Linking and Boundary detection, Thresholding. Region-oriented segmentation, Use of motion, Description, Boundary descriptors, Regional descriptors.

TEXT BOOKS:

1. **“Robotics – control, sensing, Vision and Intelligence”**, K.S.Fu, R.C.Gonzalez, C.S.G. Lee, McGraw Hill, 1987.
2. **“Robotic Engineering”** - Richard D Klafter, PHI

REFERENCE BOOKS:

1. **“Introduction to Robotics Mechanics and control”**, John J. Craig, 2nd Edition, Pearson education, 2003.
2. **“Introduction to Robotics”** – Saeed B. Niku, PHI