

Nirma University
Institute of Technology, School of Technology
MTech Computer Science and Engineering
Semester – II

L	T	P	C
2	0	2	3

Course Code	3CS12D204
Course Title	Introduction to Robotics

Course Learning Outcomes (CLOs):

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

1. comprehend the basic concepts of Robot design, functioning and its applications
2. correlate the integrated working of drives and sensors in Robots
3. analyze robot kinematics and design relevant programs

Syllabus:

**Teaching
Hours:**

Unit I

Fundamentals of Robot: Introduction to Robot Anatomy, Co-Ordinate Systems, Work Envelope, Types and Classification, Pay Load, Robot Parts and Functions, Need for Robots, Various Applications

2

Unit II

Robot Drive Systems and End Effectors: Types of Drives, Motors and types of end effectors.

3

Unit III

Sensors and Machine Vision: Requirements of a Sensor, Principles and Applications, Types of Sensors, Position of Sensors, Range Sensors, Proximity Sensors, Touch Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors. Camera, Frame Grabber, Image formation, Camera Calibration Sensing and Digitizing Image Data, Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis, Data Reduction: Edge Detection, Feature Extraction and Object Recognition Algorithms., Image feature detection, Stereo Vision

10

Unit IV

Robot Kinematics and Robot Programming: Points, Vectors, Pose representation, Rotations, Quaternions, Velocity & acceleration, Interpolating poses (translation and orientation), Forward Kinematics, Inverse Kinematics and Differences, Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom, Four Degrees of Freedom (In 3 Dimensional), Deviations and Problems. Robotic software development Kit (SDK)

7

Unit V

Mobile Robotics: Introduction, Locomotion's Configurations, Localization,

8

Path Planning, Perception, Mapping, SLAM, Case Studies: Unmanned autonomous aerial devices(UAV), Autonomous cars, Robotic Arms

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Work:

Above concepts are to be implemented using robotics S/W and at least 6 experiments are to be carried out.

Suggested Readings[^]:

1. M.P.Groover, Industrial Robotics – Technology, Programming and Applications, McGraw-Hill
2. K.S. Fu, Gonzalz.R.C., and Lee C.S.G., Robotics Control, Sensing, Vision and Intelligence, McGraw-Hill
3. Siegwart, Nourbakhsh and Scaramuzza, Introduction to Autonomous Mobile Robots, PHI

L=Lecture, T=Tutorial, P=Practical, C=Credit

[^]this is not an exhaustive list