NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	BTech in Electronics and Instrumentation Engineering
Semester:	VI
Course Code:	3EI303ME24
Course Title:	Robotic Control System
Course Type:	Department Elective – II
Year of Introduction:	2024-25

L	T	Practical component				C
		LPW	PW	W	S	
3	0	2	-	-	-	4

Course Learning Outcomes (CLOs):

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

1. relate the implementation of robots in real world complex applications **(BL2)**
2. illustrate properties of robotic hardware useful in various robots **(BL2)**
3. interpret programming methods for autonomous mobile robots **(BL3)**
4. develop control algorithm for decision making in intelligent robotic system. **(BL4)**

	Contents	Teaching hours (Total 45)
Unit-I	**Introduction** Fundamental of traditional robots, anatomy and classification of robot, advancement in robots.	**02**
Unit-II	**Robot control strategy** Introduction to fundamental control loop, robot pose control, use of sensor for odometry and dead reckoning for tracking and localization, motion control concept using motor controller and drive controller, case study of fuzzy logic control system in robotics, fuzzy controlled vs hard controlled based navigation.	**08**
Unit-III	**Autonomous land vehicles** Introduction to autonomous mobile robots, application of differential drive and omni drive robots, use of ackerman steering controlled vehicle, concept of adaptive cruise control on autonomous land vehicle, vision based automated system, mapping system for exploration of environment, working with point-cloud using LIDAR data, path planning on topological maps, concept of intelligent autonomous driving vehicles.	**12**
Unit-IV	**Robots in practice** Types of robots based on application, sorting and delivery robots, robots for survey and inspection, mining automation, space robotics, military reconnaissance, agricultural robots with challenges in field, robots for domestic application, humanoid robot interfacing, development and use of biologically-inspired robots, collaborative robots for mobile robot applications.	**12**
Unit-V	**Interfacing of robot within simulator** Introduction to robot operating system, use of robotic hardware in simulation, working with robot operating system for specific application, testing of robot in virtual environment using SLAM, wheel based odometry and navigation of robot in virtual simulator, case study of robotic application in simulators, implementing and testing path planning and navigation in virtual environment.	**08**

Unit-VI **Intelligent robotic system** **03**

Introduction to artificial intelligence in robotics, reasoning about robot space, case study of visual servoing in robotics, case study for intelligent robotics.

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:

This shall consist of at least 10 practical based on the above syllabus.

Suggested Reading:

1. Robin R. Murphy, Introduction to AI robotics, MIT press
2. Diwakar Vaish, Python robotics projects: build smart and collaborative robots using python, Packt Publishing
3. Robin tommy, Rinu Michael, building smart robots using ROS, Bahri publication board
4. Morgan Quigley, Programming Robots with ROS, O'Reilly Media
5. Lloyd Brombach, Practical robotics in C++, Bahri publication board
6. Karsten Berns, Ewald Puttkamer, Autonomous Land Vehicles: Steps towards Service Robots, Vieweg+Teubner Verlag,Central Book Services - Springer

Suggested List of Experiments:

1.	To demonstrate working of motion/wheel sensor	**(02 Hrs)**
2.	To demonstrate working of inertial measurement unit sensor	**(02 Hrs)**
3.	To study obstacle avoidance algorithm using range sensor data	**(02 Hrs)**
4.	To learn and demonstrate area scanner using LIDAR for 2D plane	**(02 Hrs)**
5.	To determine speed control using fuzzy logic control	**(02 Hrs)**
6.	To learn path planning algorithm using bio-inspired robot	**(02 Hrs)**
7.	To learn navigation using autonomous robot into simulator	**(02 Hrs)**
8.	To demonstrate obstacle avoidance for land vehicle	**(02 Hrs)**
9.	To demonstrate cruise control algorithm on land vehicle navigation	**(02 Hrs)**
10.	To demonstrate direction control for omni wheeled mobile robot in simulator	**(02 Hrs)**
11.	To simulate sensor-based navigation on robotic vehicle	**(02 Hrs)**
12.	To simulate SLAM algorithm on multi robot system	**(02 Hrs)**

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