NIRMA UNIVERSITY

Institute:	Institute of Technology
Name of Programme:	M.Tech. in Electronics & Instrumentation Engineering (Robotics and Artificial Intelligence)
Semester:	II
Course Code:	6ME851CC25
Course Title:	Mobile Robots
Course Type:	Core
Year of introduction:	2025 - 26

L	T	Practical component				C
		LPW	PW	W	S	
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Course Learning Outcomes (CLOs):

After successful completion of the course, student will be able to –

1. apply the concepts of the locomotion systems for mobile robots (BL3)
2. estimate the robot localization using on board sensors data (BL5)
3. formulate the kinematic and dynamic model for wheeled and legged robots (BL6)
4. plan the path of wheeled and legged robots in software environment. (BL6)

Unit	Contents	Teaching Hours (Total 30
Unit I	**Introduction to locomotion Systems** Introduction, locomotion, legged and wheeled robot, different configurations of mobile robot	04
Unit II	**Kinematics and dynamics of wheeled robots** Kinematic model of wheeled robot, wheel configuration, degree of manoeuvrability, degree of steerability, degree of mobility, workspace, kinematic motion control, Dynamic equation of motion for wheeled robot using Lagrange Euler formulation.	08
Unit III	**Kinematics and dynamics of legged robots** Stability in walking robot, generation of periodic gaits, generation of non periodic gaits, forward and inverse kinematic using DH, dynamic of walking robot, linear inverted pendulum model.	08
Unit IV	**Localization of wheeled robots** Introduction, challenges, Localization based navigation, belief and map representation, probabilistic map-based localization, Markov and Kalman filter algorithms, autonomous map building, SLAM formulation	05
Unit V	**Navigation and Path Planning** Sensors for Mobile robots, Path planning and navigation, planning and reacting, path planning, obstacle avoidance, navigation architecture, control localization and techniques for decomposition.	05

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.
Suggested Readings/References:	1. Roland Siegwart, Illah R Nourbaksh, Davide Scaramuzza, Introduction to Autonomous Mobile Robots, PHI learning Pvt Ltd. 2. Todd D. J., Walking Machines: An Introduction to Legged Robots, Springer US 3. Peter Corke, Robotics, Vision, and Control: Fundamental Algorithms in MATLAB, Springer Handbook 4. Gregor Klancar, Andrej Zdesar, Saso Blazic, Igor Skrjanc, Wheeled Mobile Robotics: From Fundamentals Towards Autonomous Systems, Elsevier Science.

Suggested List of Experiments:

Sr. No.	Title	Hours
1.	To carry out the kinematic modelling and simulation of two wheels tank drive robot	02
2.	To carry out the kinematic modelling and simulation of three wheeled omni-drive robot	02
3.	To simulate the dynamic motion of wheeled mobile robot	02
4.	To programme the two wheeled robot for line following motion	02
5.	To programme the two wheeled tank drive robot for obstacle avoidance	02
6.	To programme a bipedal robot for stable walking.	02
7.	To develop different motion algorithms for omni-wheeled robots.	02
8.	To perform Localization and Mapping using a Mobile robot platform	02
9.	To prepare Obstacle avoidance coding for Mobile robot	02
10.	To develop gait pattern simulation for Continuous gait	02
11.	To develop gait pattern simulation for Discontinuous gait	02

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

w.e.f. the academic year 2025 - 26 and onwards