SEMESTER S7

MOBILE ROBOTICS

Course Code	PEMET756	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	NONE	Course Type	Theory

Course Objectives:

1. Providing a foundation to the theory behind numerical computation and optimization techniques used in robotic systems
2. This course will equip the students with mathematical framework for the robotic systems and optimization techniques necessary for mobile robotic systems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Introduction:** Wheeled Mobile Robots, Wheeled locomotion: The design space, wheeled locomotion: Case studies. Mobile manipulators, Legged Mobile Robots- Leg configurations and stability, Examples of legged robot locomotion, aerial robots, underwater robots and surface water robots	8
2	**Kinematic model:** of a differential drive and a steered mobile robot, degree of freedom and maneuverability, Degree of steerability, different wheel configurations, holonomic and non-holonomic robots. **Dynamics of mobile robot:** Lagrange-Euler method, Newton-Euler methods, Differential-Drive WMR, Dynamics of WMR with Slip, Car-Like WMR Dynamic Model, Three-Wheel Omnidirectional Mobile Robot	10
3	**Sensors for mobile robot navigation:** Sensor classification, Characterizing sensor performance, Wheel /motor sensors, Heading sensors, Accelerometers, IMUs, Ground-based beacons, Active ranging, Motion/speed sensors, and Vision-based sensors. **Robot navigation:** Localization, Error propagation model, Probabilistic map-	9

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	based localisation-Kalman method, Autonomous map building, Simultaneous localization and mapping (SLAM).	
4	**Path Planning:** local vs global path planning, Graph search, Potential field-based path planning; Map based path planning- Dijkstra's algorithm, A*, D* algorithms. Obstacle avoidance- Bug algorithm, Vector field histogram, Dynamic window approach. **Control of mobile robots:** Control of differential drive robot and steered robot based on its kinematic model, Case study- design and implementation of a differential drive robot capable of moving to a point, following a line and following a path.	**9**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

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Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Familiarise types of locomotion for mobile Robots	**K2**
CO2	Derive the kinematic model of mobile robots	**K4**
CO3	Derive dynamic model of mobile robots	**K4**
CO4	Choose appropriate Sensors for mobile robot navigation	**K3**
CO5	Perform navigation and path planning mobile robots	**K3**
CO6	Control the mobile robots to follow different paths	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

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CO-PO Mapping Table:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	3	3	3	2	-	-	-	-	-	3
CO2	3	-	3	3	3	2	-	-	-	-	-	3
CO3	3	-	3	3	3	2	-	-	-	-	-	3
CO4	3	-	3	3	3	2	-	-	-	-	-	3
CO5	3	-	3	3	3	2	-	-	-	-	-	3
CO6	3	-	3	3	3	2	-	-	-	-	-	-

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Autonomous Mobile Robots	R. Siegwart, I. R. Nourbakhsh,	The MIT Press,	2011
2	Robotics, Vision and Control: Fundamental Algorithms in MATLAB,	Peter Corke,	Springer Tracts in Advanced Robotics	2011
3	Introduction to Mobile Robot Control,	Spyros G. Tzafestas	Elsevier.	
4	Planning Algorithms	S. M. La Valle	Cambridge University Press	2009

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Probabilistic Robotics.	Thrun, S., Burgard,W., and Fox, D.,	MIT Press, Cambridge, MA,	2005
2	Arduino and Kinect Projects: Design, Build	Melgar, E. R., Diez, C. C	Blow Their Minds,.	2012
3	Introduction to Autonomous Mobile Robots	Siegwart, Roland,	Cambridge, Mass.: MIT Press,	Second Edition,

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Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://archive.nptel.ac.in/courses/112/106/112106298/
2	https://archive.nptel.ac.in/courses/112/106/112106298/
3	https://archive.nptel.ac.in/courses/112/106/112106298/
4	https://archive.nptel.ac.in/courses/112/106/112106298/