15MH423E	Mobile Robotics			L	T	P	C
				3	0	0	3
Co-requisite:	Nil						
Prerequisite:	Nil						
Data Book / Codes/Standards	Nil						
Course Category	P	Professional Elective	Mechatronics Engineering				
Course designed by	Department of Mechatronics Engineering						
Approval	32nd Academic Council Meeting held on 23.07.2016.						

Purpose	To impart knowledge in the field of mobile robotics with special emphasis on autonomous wheeled mobile Robots.							
Instructional Objectives		**Student Outcomes**						
At the end of the course, student will be able to								
1.	Formulate the challenges in developing autonomous mobile Robots.	a	e					
2.	Abstract kinematic control of wheeled mobile Robots.	a	e					
3.	Understand the challenges involved in sensory perception for mobile Robots.	a						
4.	Develop localization and path planning algorithms for mobile Robot navigation.	a		j				
5.	Comprehend the challenges and configurations of legged, aerial and underwater mobile Robots.	a	e	j	k			

Session	Description of Topics	Contact hours	C-D-I-O	IOs	Reference
	Unit I: Introduction to Autonomous Mobile Robots	**6**			
1.	Introduction to autonomous mobile Robots, problems to be addressed.	1	C	1	1
2.	Locomotion aspects of mobile Robots.	1	C	1	1
3.	Introduction to wheeled mobile Robots, applications, wheel types and different configurations of wheeled Robots.	2	C,D	1	1
4.	Maneuverability, controllability and stability of mobile Robots	1	C	1	1
5.	Case studies: Wheeled locomotion.	1	C	1	1
	Unit II: Kinematics of Wheeled Mobile Robot	**9**			
6.	Kinematic constraints of a fixed standard wheel and omni-directional wheel.	1	C	2	1
7.	Forward kinematic model of a differential drive Robot and three wheel omni-directional Robot.	2	C	2	1
8.	Mobility analysis.	1	C	1,2	1
9.	Holonomic and non-holonomic configurations, workspace and trajectory considerations.	1	C,D	2	1
10.	State space modeling and control of a differential drive Robot.	1	C	2	1
11.	Go to goal control, cruise controllers.	2	C	2	1,3
12.	Wheel odometry.	1	C	2,3	1
	Unit III: Perception for Mobile Robots	**7**			
13.	Sensors for mobile Robots, definitions, classification and characteristics applicable to mobile Robots.	1	C	1,3	1
14.	Physical and computational attributes of sensors applicable to mobile Robots: Sensor noise and sensor aliasing.	1	C	1,3	1
15.	GPS and heading sensors: Principles, challenges and interpretation.	1	C,D	3	1
16.	Light and sound based ranging: Principles, challenges and interpretation.	1	C,D	3	1
17.	Vision for mobile Robots.	1	C,D	3	1
18.	Multi-sensor combinations:Types, sensor fusion algorithms.	2	C	1,3	1,2
	Unit IV: Localization and Path Planning	**10**			
19.	Introduction to localization.	1	C	4	1
20.	Brief representations and considerations.	1	C	4	1
21.	Map representations and considerations.	1	C	4	1
22.	Markov localization.	1	C,D	4	1
23.	Kalman filtering: Introduction, Kalman filter for localization.	2	C,D	4	1
24.	Path planning, challenges, types and algorithms types.	1	C,D	4	1

Session	Description of Topics	Contact hours	C-D-I-O	IOs	Reference
25.	D*, distance transform.	1	C	4	1,2
26.	Obstacle avoidance, bug algorithms, vector field histogram approach.	2	C	4	1,2
	Unit V: Legged, Aerial and Underwater Robots	**9**			
27.	Legged Robots: Configurations and challenges.	1	C,D	1,5	2
28.	Modeling and motion control of four legged mobile Robot and biped Robot.	2	C	5	2,4
29.	Aerial Robots: Configurations, challenges and applications.	1	C,D	1,5	2,4
30.	Modeling of a quadrotor aerial vehicle, motion control of a quadrotor aerial vehicle.	2	C	5	2,4
31.	Underwater Robots: Configurations, challenges and applications	1	C,D	1,4	2
32.	Comparison of modelling approach for aerial and underwater robots, Modeling and control of a propeller based underwater vehicle.	2	C	4	2
	Assessment	**4**			
33.	Cycle test-I	1			
34.	Cycle test-II	2			
35.	Surprise test/Assignment and Quiz	1			
	Total contact hours	**45**			

Learning Resources	
Sl. No.	**Text Book**
1.	Siegwart., Nourbakhsh, "*Introduction to Autonomous Mobile Robots*", MIT Press, 2011.
	Reference Books/Other Reading Materials
2.	Bruno Siciliano, OussamaKhatib, "*Handbook of Robotics*", Springer, 2008.
3.	Choset, "*Principles of Robot Motion: Theory, Algorithm and Implementations*", MIT Press, 2005.
4.	Perter Corke, "*Robotics, Vision and Control*", Springer, 2011.

Course nature				**Theory**			
Assessment Method (Weightage 100%)							
In-semester	**Assessment tool**	Cycle test I	Cycle test II	Cycle Test III	Surprise Test	Quiz	**Total**
	Weightage	**10%**	**15%**	**15%**	**5%**	**5%**	**50%**
End semester examination Weightage:							**50%**