



# Sardar Patel Institute of Technology

Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India  
(Autonomous Institute Affiliated to University of Mumbai)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
ITC8044	Robotics	4	-	-	4	-	-	4
		Examination Scheme						
		ISE		MSE		ESE		
		10	30	100 (60% Weightage)				

Pre-requisite Course Codes	
After successful completion of the course, student will be able to:	
Course Outcomes	CO1 Describe kinematics and dynamics of stationary and mobile robots.
	CO2 Describe trajectory planning for rigid robot and mobile robots.
	CO3 Implement trajectory generation and path planning algorithms.
	CO4 Design interdisciplinary projects .

Module No.	Topics	Ref.	Hrs.
1	<b>Fundamentals</b> Robot Classification, Robot Components, Degrees of freedom, Joints, Coordinates, Coordinate frames, workspace, applications	1	03
2	<b>Kinematics of Robots</b> Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations– position and orientation, Denavit-Haten berg representation of forward kinematics, Inverse kinematic solutions, Case studies	1,2	07
3	<b>Differential motions and velocities</b> Differential relationship, Jacobian, Differential motion of a frame and robot, Inverse Jacobian.	2,3	06
4	<b>Dynamic Analysis of Forces</b> Lagrangian mechanics, Moments of Inertia, Dynamic equations of robots, Transformation of forces and moment between coordinate frames.	3	07
5	<b>Trajectory Planning</b> Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories.	3	07
6	<b>Mobile Robot Motion Planning</b>	3	04



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	Concept of motion planning, Bug Algorithms – Bug1,Bug2, Tangent Bug.		
<b>7</b>	<b>Potential Functions and Visibility Graphs</b> Attractive/Repulsive potential, Gradient descent, wave-front planner, navigation potential functions, Visibility map, Generalized Voronoi diagrams and graphs, Silhouette methods	2,3	
<b>8</b>	<b>Coverage Planning</b> Cell Decomposition, Localization and Mapping	2,3	06
	<b>Total hours of instructions</b>		48

## References:

1. Saeed Benjamin Niku, “*Introduction to Robotics–Analysis, Control, Applications*”, .. Second Edition, 2011, Wiley India Pvt. Ltd.
2. Howie Choset, Kevin M. Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard,
3. Lydia E. Kavraki and Sebastian Thrun, “*Principles of Robot Motion– Theory, Algorithms and Implementations*”, Prentice-Hall of India, 2005.
4. Mark W. Spong & M. Vidyasagar, “*Robot Dynamics & Control*”, 2<sup>nd</sup> edition 2004, Wiley India Pvt.Ltd.
5. John J. Craig, “*Introduction to Robotics–Mechanics & Control*”, Third Edition, Pearson Education, India, 2009
6. Aaron Martinez & Enrique Fernandez, “*Learning ROS for Robotics Programming*”, First Edition, 2013, Shroff Publishers.