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
EXC8041	Robotics	4	--	--	4	--	--	4
		Examination Scheme						
		ISE		MSE		ESE		
		10		30		100 (60% Weightage)		

Pre-requisite Course Codes		EXS 301 : Applied Mathematics III EXS 401 : Applied Mathematics IV EXC 404 : Principles of Control Systems
After successful completion of the course, student will be able to		
Course Outcomes	CO1	Discuss the fundamentals of robotics.
	CO2	Apply the direct and inverse kinematics algorithm for robotic arm manipulation
	CO3	Analyse the equations for velocity kinematics and Dynamics.
	CO4	Discuss the concept of robot motion planning using different algorithms.
	CO5	Justify the need of trajectory planning and robot vision algorithms for robotic arm manipulation

Module No.	Unit No.	Topics	Ref.	Hrs.
1		**Fundamentals of Robotics**		03
	1.1	Robot Classification, Robot Components, Degrees of freedom, Joints, Coordinates, Coordinate frames, workspace, applications	1	
2		**Forward & Inverse Kinematics of Robots**		09
	2.1	Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation	2	
	2.2	Denavit-Hatenberg representation of forward kinematics, Inverse kinematic solutions, Case studies	2	
3		**Velocity Kinematics & Dynamics**		14
	3.1	**Differential motions and velocities :** Differential relationship, Jacobian, Differential motion of a frame and robot, Inverse Jacobian,Singularities.	2	
	3.2	**Dynamic Analysis of Forces :** Lagrangian mechanics, Newton Euler formulation, Dynamic equations of robots, Transformation of forces and moment between coordinate frames	2	
4		**Robot Motion Planning**		04
	4.1	Concept of motion planning, Bug Algorithms – Bug1, Bug2, Tangent Bug	3	
5		**Potential Functions and Visibility Graphs**		08
	5.1	Attractive/Repulsive potential, Gradient descent, wave-front planner, navigation potential functions, Visibility map, Generalized Voronoi	3	

		diagrams and graphs, Silhouette methods		
6		**Trajectory Planning**		**08**
	6.1	Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories	2	
7		**Robot Vision**		**06**
	7.1	Image representation, Template matching, Polyhedral objects, Shape analysis, Segmentation, Iterative processing, Perspective transform.	1	
			Total	**52**

References:

[1] Robert Shilling, Fundamentals of Robotics - Analysis and control, Prentice Hall of India

[2] Saeed Benjamin Niku, "Introduction to Robotics – Analysis, Control, Applications", Wiley India Pvt. Ltd., Second Edition.

[3] Howie Choset, Kevin M. Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia E. Kavraki and Sebastian Thrun, "Principles of Robot Motion – Theory, Algorithms and Implementations", Prentice-Hall of India.

[4] Mark W. Spong , Seth Hutchinson, M. Vidyasagar, "Robot Modeling & Control ", Wiley India Pvt. Ltd.

[5] John J. Craig, "Introduction to Robotics – Mechanics & Control", Third Edition, Pearson Education, India.

[6] Aaron Martinez & Enrique Fernandez, "Learning ROS for Robotics Programming", Shroff Publishers, First Edition.

[7] Mikell P. Groover et.al, "Industrial Robots-Technology, Programming & applications" ,McGraw Hill , New York.