Course Code	Course Name	Teaching Scheme (Hrs./Week)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Term Work /Practical	Tutorial	Total
BEITC8044	Robotics	04	02	---	04	01	---	05

Course Code	Course Name	Examination Scheme						
		Theory Marks			Term Work	Practical	Oral	Total
		Internal assessment		End Sem. Exam				
		Test 1	Test 2					
BEITL8044	Robotics	20	20	80	25	---	25	150

Course Objectives: The Lerner is introduced to the fundamentals and kinematics of Robots. The topics like Differential motions & velocities, Trajectory Planning, Mobile Robot Motion Planning etc. are discussed.

Course Outcomes: At the end of this course, learners will be able to

a. Understand kinematics and dynamics of stationary and mobile robots
b. Understand trajectory planning for rigid robot and mobile robots
c. Implement trajectory generation and path planning algorithms
d. Work in interdisciplinary projects

Detailed Syllabus:

1. Fundamentals	Robot Classification, Robot Components, Degrees of freedom, Joints, Coordinates, Coordinate frames, workspace, applications	03 Hrs	Chapter 1 – Text Book 1
2. Kinematics of Robots	Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation, Denavit-Hatenberg representation of forward kinematics, Inverse kinematic solutions, Case studies	07 Hrs	Chapter 2 – Text Book 1
3. Differential motions and velocities	Differential relationship, Jacobian, Differential motion of a frame and robot, Inverse Jacobian	06 Hrs	Chapter 3 – Text Book 1
4. Dynamic Analysis of	Lagrangian mechanics, Moments of	07 Hrs	Chapter 4 –

Forces	Inertia, Dynamic equations of robots, Transformation of forces and moment between coordinate frames		Text Book 1
5. Trajectory Planning	Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories	07 Hrs	Chapter 5 – Text Book 1
6. Mobile Robot Motion Planning	Concept of motion planning, Bug Algorithms – Bug1, Bug2, Tangent Bug	04 Hrs	Chapter 2 – Text Book 2
7. Potential Functions and Visibility Graphs	Attractive/Repulsive potential, Gradient descent, wave-front planner, navigation potential functions, Visibility map, Generalized Voronoi diagrams and graphs, Silhouette methods	08 Hrs	Chapter 4 & 5 – Text Book 2
8. Coverage Planning	Cell Decomposition, Localization and Mapping	06 Hrs	Chapter 6, 9 – Text Book 2

Text Books

1. Saeed Benjamin Niku, "Introduction to Robotics – Analysis, Control, Applications", Wiley India Pvt. Ltd., Second Edition, 2011
2. 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, 2005.

Reference Books

1. Mark W. Spong & M. Vidyasagar, "Robot Dynamics & Control", Wiley India Pvt. Ltd., Second Edition, 2004
2. John J. Craig, "Introduction to Robotics – Mechanics & Control", Third Edition, Pearson Education, India, 2009
3. Aaron Martinez & Enrique Fernandez, "Learning ROS for Robotics Programming", Shroff Publishers, First Edition, 2013.

Term Work:

Term Work shall consist of at least 10 programs based on the above syllabus using any suitable software.

Distribution of marks for term work shall be as follows:
1. Attendance (Theory and Practical): 05 Marks
2. Laboratory work (Performing Experiments and Journal): 20 Marks

The final certification and acceptance of TW ensures the satisfactory performance of laboratory Work and Minimum Passing in the term work.

List of Experiments:

Note: At least one experiment shall be performed from every group. Total number of experiments should be 10.

1. Forward kinematics of n-DOF robot arm – Simulation – (maximum 2 experiments)
2. Inverse Kinematics of n-DOF robot arm – Simulation (maximum 2 experiments)
3. Dynamic modeling of n-DOF robot arm & Simulation (maximum 2 experiments)
4. Trajectory planning of n-DOF robot arm (maximum 2 experiments)
5. Simulation of Bug1, bug2 and tangent bug algorithms (maximum 3 experiments)
6. Simulation of Potential field, voronoi graph, and visibility graph methods (maximum 3 experiments)

Theory Examination:
- Question paper will comprise of 6 questions, each carrying 20 marks.
- Total 4 questions need to be solved.
- Q.1 will be compulsory, based on entire syllabus where in sub questions of 2 to 3 marks will be asked.
- Remaining question will be randomly selected from all the modules.

Weight age of marks should be proportional to number of hours assigned to each module.