Robotic Systems and Control

(Elective Subject)

Course Code:	17B1WEC733	**Semester:**	7th Semester, B. Tech (ECE)
Credits:	3	**Contact Hours:**	L-3, T-0, P-0

Course Objectives

The objectives are to study

1. The Robotics' chief objective has always been associated with working for new and updated technologies, for example embedded systems, microcontrollers and VLSI.
2. To use the robotic system for logic building and programming.
3. To use the robotic kits to do any given engineering task which may have not been taught in class.

Course Outcomes

After studying this course the students would gain enough knowledge

1. Students will be equipped with the automation and brief history of robot and applications.
2. Students will be equipped with the principles of various sensors, actuators and their applications in robots.
3. Be able to analyze any physical system using mathematical model.
4. Be able to do the path planning on robotic systems using various control strategies.
5. Students will be equipped with the simulation and hands on robotic kits.

Course Contents

Unit	**Topics**	**References (chapter number, page no. etc)**	**Lectures**
1.	Introduction to Robotics: Introduction – brief history, types, classification and usage, Science and Technology of robots, textbooks and research journals, introduction to simulation environment.	Spong : Chapter 1	3
2.	Elements of Robots: Joints, links, actuators, and sensors: Position and orientation of a rigid body, Homogeneous transformations, Representation of joints, link representation using D-H parameters, Examples of D-H parameters and link transforms, different kinds of actuators – stepper, DC servo and brushless motors, model of a DC servo motor, Types of transmissions, Purpose of sensors, internal and external sensors, common sensors – encoders, tachometers, strain gauge based force-torque sensors, proximity and distance measuring sensors, and vision.	Spong : Chapter 1, 2 eLSI project material	10

3	Robot Arm Kinematics and Dynamics: Forward kinematics, inverse kinematics, Lagrange formulation of dynamics.	Spong : Chapter 3, 4, 6	8
4	Motion Planning and Control: Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Non-linear model based control schemes, Simulation and experimental case studies on serial and parallel manipulators, Control of constrained manipulators, Cartesian control, Force control and hybrid position/force control, Advanced topics in non-linear control of manipulators.	Spong : Chapter 7, 8, 9	8
5	Modeling and Control of Flexible Robot Manipulators: Models of flexible links and joints, Kinematic modeling of multi-link flexible robots, Dynamics and control of flexible link manipulators, Numerical simulations results.	Craig: Chapter 5 NPTEL lectures	6
6	Robot Programming: MATLAB and other simulation platforms, Hands on experiment on robotic kits, working and implementing various Ad-on modules.	eLSI project material	6
		Total Number of Lectures	41

Evaluation Scheme

1. Test 1 :15 marks
2. Test 2 : 25 marks
3. Test 3 : 35 marks
4. **Internal Assessment** : 25 marks
    - 10 Marks : Class performance, Tutorials & Assignments
    - 10 Marks : Quizzes
    - 5 marks : Attendance

Text Books

1. Spong and Vidyasagar, “Robot Dynamics and Control”, John Wiley and Sons.
2. J. J. Craig, “Introduction to Robotics- Mechanics and Control”, Pearson.
3. Sciavicco and Siciliano, “Modeling and Control of Robot Manipulators”, McGraw Hill International Edition.

Reference Books/ Other resources

1. NPTEL Lectures: http://nptel.ac.in/courses/112101099/
2. Material provided by IIT Bomaby under eLSI project: