Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NMED520	Industrial Robotics	3	0	0	3

Course Objective

•To expose the students to analyses and applications of any standard serial chain industrial robot arm.

Learning Outcomes

Upon successful completion of this course, students will:

- have a broad understanding of classification of robots and robotic manipulators used in the industry.
- have an understanding about basics of robot kinematics, dynamics, control and programming.
- have knowledge of implementing a robot for any industrial use.

Unit No.	Topics to be Covered	Lecture Hours	Learning Outcome
1	Introduction: Robot definition, application, robot anatomy; robot classifications and specifications, serial robots.	4	Understanding robot, its classifications, and general applications
2	Transformations: Grubler-Kutzbach Criterion; DOF of a Robot Manipulator; Pose or Configuration; Denavit-Hartenberg (DH) Parameters; Homogeneous transformation.	6	Understanding the analytical procedure involved in motion transformation from fixed base to the end-effector
3	Robot kinematics: forward and inverse kinematics, link velocity and acceleration analysis: Jacobian matrix; Singularity.	3	This unit demonstrates the kinematic analysis of serial chain robots
4	Industrial Robot Installation and Commissioning: Mastering a Robot, Tool Centre Point Calibration: 4-Point method, External reference method, Orientation calibration: World frame method, Two-point method.	3	This unit would expose to installation and commissioning of a robot and attaching a new tool frame.
5	Calibration of Industrial Robot system: External fixed tool, Workpiece calibration: Direct and Indirect methods, Work Surface calibration: 3-Point method and Indirect method, Linear rail robot mounts and external rotary turn-table.	4	This unit would expose the students top calibrating of the robot workspace and various fixtures that are used in a standard industrial environment.
6	Statics: Link forces and moments; Recursive formulas; force and moment recursion at different joints, Role of Jacobian; Force ellipsoid.	4	Learning the relationships between the joint torques/forces, and the Cartesian moments and forces at the end-effector.
7	Dynamics: Inertial properties, Generalized coordinates; Kinetic and potential energy; Euler-Lagrange and Newton-Euler formulations for obtaining robot dynamic equation of motion - forward and inverse dynamics.	7	Analysing forces and moments causing the motion of different parts of serial chain robotic manipulator
8	Robot Control: Transfer function and state-space representation of a robotic joint, performance and stability of feedback control, P, PI, PD and PID control, state-feedback control, joint controllers; Non-linear control; stability and force control.	7	Using linear and nonlinear control techniques when a robot performs any job.
9	Industrial Robot Programming, Safeties and Norms: Workspace and Operator Safety, Safety triggers and functions, Workspace monitoring and marking	4	This unit would expose the student to various safeties and norms related to robot operation.

	forbidden zones, External and Internal Safety devices, Norms and Regulations.		Implementing various zones of operation and programming a robot.
Total		42	

Text Books:

1. S. K. Saha, Introduction to Robotics, McGraw Hill,2nd Edition,2014
2. John J. Craig, Introduction to Robotics: Mechanics and Control, Prentice Hall

Reference Books:

1. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, Robot Modeling and Control, Wiley
2. K. S. Fu, R. C. Gonzalez, C. S. G. Lee, Robotics: Control, Sensing, Vision and Intelligence McGraw-Hill