

Subject Code: 01ME0712

Subject Name: Design and Synthesis of Robots

B. Tech. Year - III (Semester - 7)

Type of course : Core

Pre requisite : Basic knowledge of Theory of machines

Rationale : The course intends to provide understanding of recent developments in Industrial robotics to graduate students. The course enhance their ability to understand the mechanism of robots

Course Outcome :

After completion of this course, student will be able to

1. Understand the concept of Industrial Robotics.
2. Know the Kinematics and Synthesis of Robots.
3. Understand the Robot applications, Robot language and Programming.
4. Acquainted the use of sensors in robots for industrial applications
5. Prepare programs for some robot

Teaching and Examination Scheme :

Teaching Scheme			Credits	Examination Marks					Total Marks
Theory	Tutorial	Practical		Theory Marks			Practical Marks		
			ESE(E)	IA	CSE	Viva (V)	Term Work (TW)		
4	0	2	5	50	30	20	25	25	150

Content :

Sr. No.	Content	Total Hrs.
1	Introduction: Introduction to Robotics; Classification of Robots Payback period of robots; Application of Robots: Robots in Industry, Robots in Handling, Machine Loading and Unloading, Materials Transfer, Palletizing, Welding, Arc Welding, Spot Welding, Compliance, Assembly, Injection Moulding Advantages and Limitation of robots in application	04
2	Grippers and Tools of Industrial robots: Introduction, Definitions of Industrial Robot, Configuration and Work Volume, Configuration of Human Body, Human Work Volume, Industrial Robot Configuration, Structural Configuration, Robot Work Volume, Precision of Movement , Spatial Resolution, Example, Accuracy, Repeatability, Degrees of Freedom, Examples, End Effectors, Grippers, Tools	08

3	<p>Co-ordinate transformation: Introduction, 2D Coordinate Transformation, Example, 2D Homogeneous Transformation, Example, Description of Object, Example, 3D Coordinate Transformation, Examples, Inverse Transformation, Kinematic Chain, Composite Transformation Matrix, Algorithm for Composite Transformation, Examples, Object Manipulation, Example, The Wrist – Example</p>	08
4	<p>Kinematics of robots Introduction, Joint Coordinate Space, Kinematics and Inverse Kinematics, A Two-Joint Two-DoF Robot, Use of Homogeneous, Transformations, Robot Vision System, Link Parameters, Joint Parameters, D-H Notation of Coordinate Frames, D-H Transformation Matrix, Symbolic Procedure, D-H Algorithm Application ,Examples Manipulator Jacobian, Jacobian Singularities</p>	10
5	<p>Robot sensors: Introduction, Internal and External Sensors, Applications of Robot Sensors, Desirable Features of Robot Sensors, Proximity and Tactile Sensors, Proximity, Sensors, Touch Sensors, Slip Sensors, Range Sensors, Opto Range Sensors, Ultrasonic Range Sensors, Force Sensors, Vision System for Inspection</p>	06
6	<p>Robot Control: Introduction, Euler–Lagrange Equation, Joint Motion, Linear Control Systems, Second order Systems, State space Equations, Lyapunov Stability, Lyapunov First Method, Lyapunov Second Method, Control Unit, Electric, Hydraulic and Pneumatic Drives, Industrial Vision System, Inspection Using Industrial Vision Camera</p>	06

Distribution of Theory Marks

R Level	U Level	A Level	N Level	E` Level	C Level
10	20	25	25	10	10

Legends: R: Remember; **U:** Understand; **A:** Apply; **N:** Analyze; **E:** Evaluate; **C:** Create

List of Experiments :

1. To study of various sensors in automation.
2. Comparative study on the configuration of Human body with Industrial robots
3. Apply the Composite Transformation algorithm on a robotic arm.
4. Prepare a program of move nine objects on a pallet to a location.
5. Develop a program to pick up identical objects and stack on top of each other to a maximum height of four objects.
6. Develop a Program for industrial robot which picks up a part from one location and transport to another location.
7. Prepare a transformation matrix for prismatic joint.
8. Determine the Kinematic parameters of a Twist-Rotation-Rotation (TRR) robot.
9. Case study on Spot welding application of Robots
10. Case study on Material Handling application of Robots

Reference books :

1. Mikell P. Groover, Mitchell Weiss, Roger N Nagel, Nicholas G Odrey, “Industrial Robotics
Technology, Programming and Applications”, Tata –McGraw Hill Pub. Co., 2008.
2. Deb.S.R and Sankha Deb, "Robotics Technology and Flexible Automation", Tata McGraw
Hill Publishing Company Limited, 2010
3. Robert J Schilling, “Fundamentals of robotics: analysis and control”, Dorling Kindersley (india)
Pvt Ltd, 2006

List of Open Base Software / learning website :

1. www.nptel.ac.in
2. <https://swayam.gov.in/explorer>