

<p style="text-align: center;"><b>B.E MECHANICAL ENGINEERING</b> Choice Based Credit System (CBCS)</p>			
<p><b>Introduction to Robotics (3:0:0) 3</b> (Effective from the academic year 2022-2023)</p>			
Course Code	<b>24ETC15E</b>	Semester	<b>I/II</b>
Teaching Hours/Week (L: T:P: S)	3:0:0	CIE Marks	50
Total Hours of Pedagogy	40	SEE Marks	50
Credits	03	Total Marks	100
Examination Pattern (SEE)	<b>Theory</b>	Exam Hours	03
<p><b>Course objectives:</b> students will be able to</p> <ol style="list-style-type: none"> <li>1. Acquire knowledge on industrial robot anatomy, configuration control system, sensors and end effectors.</li> <li>2. Explore the industrial applications of robots and their benefits.</li> <li>3. Gain the mathematical knowledge to analyze the robot motion in a 2-Degree of freedom scenario.</li> </ol>			
<p><b>Preamble:</b> Industrial robots have been instrumental in transforming the manufacturing sector for the past few decades. It has been supporting in terms of production of parts, assembly, inspection, transportation and storage. Current course is designed to provide the basic understanding on construction, configuration and motion analysis of industrial robots. It also emphasizes various sensors, transducers, machine vision system and end effectors attached to the robots for its functionality. Finally, the course discusses various industrial applications of robots.</p>			
<p><b>Module-1</b></p>			
<p><b>Fundamentals of Industrial Robotics:</b> Robot Anatomy, Robot configurations: Polar, Cartesian, Cylindrical, and Jointed Arm, Robot motions, Robot joints, 3-degree of freedom of robot arm, Joint notation scheme, Work Volume, Robot Drive Systems, Control Systems</p>			
<p><b>Robot control system:</b> Commercially available robot controls, Speed of response and stability, Precision of Movement: Spatial resolution, Accuracy, Repeatability, Compliance.</p>			
<p><b>(08 hours)</b></p>			
<p><b>Module-2</b></p>			
<p><b>End Effectors:</b> Gripper and Tool, Mechanical Grippers: Operation and Types, Mechanism of Actuator: Linkages actuation, Gear and Rack actuation, Cam actuation, Screw actuation. Other Types of Grippers: Vacuum cup, Magnetic, Adhesive, Hooks and scoops. Tools as End Effectors. Considerations in Gripper Selection and Design</p>			
<p><b>(08 hours)</b></p>			
<p><b>Module-3</b></p>			
<p><b>Sensors and Transducers in Robot:</b> Desirable features of Sensors, Tactile Sensors, Proximity and Range Sensors, Miscellaneous Sensors, Uses of Sensors in Robotics</p>			
<p><b>Machine Vision:</b> The Sensing and Digitizing Function, Analog to digital signal conversion, Image Processing and Analysis, Training the Vision System, Robotic Applications of Machine Vision.</p>			
<p><b>(08 hours)</b></p>			

## **Module-4**

**Robot motion analysis:** Manipulator Kinematics, Position Representation, Forward Kinematics of 2-Degree of Freedom Arm, Reverse Kinematics of 2-Degree of Freedom Arm

**(08 hours)**

## **Module-5**

**Industrial Robot Applications:** Material transport and machine loading/unloading, Processing Operations: Spot welding, Arc welding, spray coating. Assembly and Inspection

**(08 hours)**

### **Course outcome (Course Skill Set)**

At the end of the course, the student will be able to:

- CO 1. Describe the configuration, joint notation, drive systems and control of industrial robots.
- CO 2. Appraise various sensors, transducers and end effectors used in an industrial application.
- CO 3. Analyze the motion and position of the end effector of an industrial robot.
- CO 4. Discuss various applications of robots in a manufacturing industrial scenario.

### **Textbooks**

1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and Ashish Dutta, “Industrial Robotics: Technology, Programming and Applications”, 2nd Edition, Tata McGraw Hill, 2017.
2. John J. Craig, “Introduction to Robotics: Mechanism and Control”, 4<sup>rd</sup> Edition, Pearson publication, 2022.

### **Web links and Video Lectures (e-Resources)**

1. Industrial Robotics : Theories For Implementation, Prof. Arun Dayal Udai | IIT-ISM Dhanbad, Link: [https://onlinecourses.nptel.ac.in/noc23\\_me143/preview](https://onlinecourses.nptel.ac.in/noc23_me143/preview)