GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Industry Led Minor/Hons.

Level: UG

Branch: Industrial Robotics

Course / Subject Code : BE04IAU011

Course / Subject Name :Applied Industrial Robot Simulation

w. e. f. Academic Year:	2025-2026
Semester:	4th
Category of the Course:	Core Courses

Prerequisite:	Basics in Mechanical Engineering and Electrical Engineering.
Rationale:	This course introduces learners to the fundamentals of industrial robotics, including structure, motion types, coordinate systems, and safety practices. Through simulation and hands-on activities, participants learn to operate and program basic robotic movements. The course builds essential understanding of robotic operations and prepares learners for advanced modules in collaborative robotics, robotic welding, and automation system integration.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level*
01	Explain industrial robot simulation environments and demonstrate robot motion control across different coordinate frames.	**R,U,A**
02	Develop and configure a virtual robotic work cell by integrating end-effectors, workpieces, and peripheral devices.	**U**
03	Calibrate and validate Tool Center Points (TCP) and user/work frames for accuracy and repeatability within a simulation environment	**N,A**
04	Design and implement robot motion and logic programs to simulate automation processes for various industrial applications.	**R,C**
05	Analyze and optimize robot cycle time through simulation-based performance evaluation and process improvement.	**N,E**

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours/week)			Total Credits	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
4	0	2	5	100	0	0	0	100

*Total Lecture Hrs. (L) =60	Total Practical Hrs. (PR) =30.	Total Hours =90 Hrs

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction to Industrial Robot Simulation: • Concept, importance, and applications of robot simulation in industrial automation. • Overview of simulation environments, workspace layout, and coordinate systems. • Robot jogging and motion control in different modes: Joint, World/Cartesian, Tool Frame, and User Frame.	**15**	**18**
2.	Setting Up a Virtual Work Cell: • Designing a complete virtual work cell layout with robot, peripherals, and environment setup. • Configuring key components such as End-of-Arm Tools (gripper, welding torch, painting nozzle), workpieces, fixtures, and sensors. • Aligning and validating the spatial configuration for accurate robot–peripheral interaction and collision-free operation.	**15**	**20**
3.	TCP and User Frame / Work Object Configuration: • Understanding and defining the Tool Center Point (TCP) for precise tool motion and path accuracy. • Creating and calibrating User Frames or Work Objects to establish task-specific reference coordinates. • Loading and verifying calibration data in the controller to ensure accuracy and repeatability.	**15**	**18**
4.	Programming Algorithm and Process Flow: • Developing robot programs using motion (Joint, Linear, Circular) and logic instructions for process automation. • Building task algorithms with conditions, loops, and interlocks for sequencing and synchronization. • Simulating industrial applications such as pick-and-place, welding, and painting to validate program correctness and workflow efficiency.	**20**	**22**

5.	Cycle Time Analysis and Optimization: • Executing complete robot simulations and analysing cycle times for performance assessment. • Identifying redundant or non-productive movements and optimizing motion parameters like speed and acceleration. • Validating optimized paths and comparing simulation results to achieve efficient and realistic robot operations.	**20**	**22**
	Total	**90**	**100%**

Suggested Specification Table with Marks :

Distribution of Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**20**	**20**	**20**	**15**	**15**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

Skill & Practical Activities to be carried out during Semester

Sr. No.	**Category of Engagement**	**Describe the activities to be carried out by students in brief**	**Expected Frequency & Duration**	**Mode of Delivery (Online / Offline / Hybrid)**	**Tools / Platforms / Equipment / Machinery to be Used**	**Expected major Learning outcomes**
1	Projects / Industry Assignments	Cycle Time Analysis and Optimization	20	offline	Laptop or PC with Roboguide	Layouting robotic cell with optimized simulation program
2	Tutorials / Guided Technical Sessions	Offline Technical Sessions as per course content	70	offline	Laptop or PC with Roboguide	Knowhow of simulation environment
3	Case Studies / Bootcamps / Workshops	Setting Up a Virtual Work Cell	15	offline	Laptop or PC with Roboguide	Setting up virtual robot cell layout with tools
4	Quizzes / Competency-Based Evaluation	Module Assessment as per course content	01	offline	Laptop or PC with LMS	Reinforcement of theoretical and applied robotic concepts.

5	Hands-on Training / Lab Exercises / Tool-Based Learning	70% of the session is hands on session	63	offline	Laptop or PC with Roboguide	Knowhow of simulation environment
6	Simulation-Based / Demonstration-Based Learning Sessions	Simulating industrial applications such as pick-and-place, welding, and painting to validate program correctness and workflow efficiency.	20	offline	Laptop or PC with Roboguide	Programming a application in the virtual environment and handle the design challenges
7	Equipment Familiarization / Machine Handling	Introduction to Industrial Robot Simulation:	15	offline	Laptop or PC with Roboguide	Understanding of basic component of roboguide

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