GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Automation and Robotics

Subject Code : DI04041091

Subject Name : Automation System Design

w. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	MOPEC

Prerequisite:	Students should have a basic understanding of electrical and electronic fundamentals, including circuits and wiring. They should be familiar with basic digital logic concepts, PLC Concepts and simple input–output operations.
Rationale:	Automation System Design is a key subject that forms the core foundation for students pursuing a diploma in Automation and Robotics Engineering. Modern industries rely heavily on automated systems to improve productivity, reduce human error, and achieve consistent quality. This subject equips students with the ability to understand automation architecture, select appropriate sensors and actuators, design control logic, and develop PLC-based automation solutions. It also helps learners interpret engineering drawings, wiring diagrams, and system documentation essential for real-world industrial installations. By studying this subject, students gain practical skills in designing, integrating, and troubleshooting automated systems, preparing them for roles in manufacturing, process industries, and system integration. The course builds a critical bridge between basic engineering concepts and advanced industrial automation technologies.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
1	Explain basic concepts, system architecture, and key components of industrial automation system design	U
2	Select suitable sensors, actuators, and control elements for different automation applications.	A
3	Prepare essential technical documents including wiring diagrams, block diagrams, ladder diagrams, and P&ID layouts.	U
4	Develop basic PLC programs using ladder logic, timers, counters, and sequence control.	U
5	Apply systematic troubleshooting, fault diagnosis techniques, safety standards, and preventive maintenance practices in automation systems.	A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE(E)	PA(M)	PA(I)	ESE(V)	
3	0	0	3	70	30	0	0	100

Course Content

Unit	Topics and Sub-topics	No. Of Hrs.	% Weightage
Unit – I Fundamentals of Industrial Automation System Design	1.1 Introduction to industrial automation 1.1.1 Need, scope, and advantages of automation 1.2 Fundamental concepts: control loops, feedback, open-loop & closed-loop systems 1.3Architecture of industrial automation systems 1.3.1 Field level, control level, supervisory level 1.3.2 Centralized vs. distributed control 1.4 Major components: basics of sensors, actuators, PLC, drives, HMI/SCADA 1.5 Industrial power and control circuits 1.6 Role of automation in modern manufacturing & Industry 4.0	9	20
Unit – II Sensors, Actuators, and Control Elements	2.1Classification & working principles of sensors 2.1.1 Proximity, photoelectric, temperature (RTD, Thermistor, Thermocouple), pressure (strain gauge), level (Ultrasonic Sensor), flow (Magnetics Type), displacement 2.1.2 Sensor specification & selection criteria 2.2Actuators: 2.2.1 Pneumatic, hydraulic, and electric actuators 2.2.2Stepper, servo, DC, and AC motors 2.3Control elements: 2.3.1 Basics of Relays, contactors, solenoid valves, control valves 2.3.2 Overload protection, motor starters 2.3.2Sensor–actuator–controller interfacing 2.4 Signal conditioning basics: amplification, filtering, isolation	9	20

Unit – III Technical Documentation for Automation Systems	3.1 Importance of engineering documentation in automation 3.1.1 Symbols and drawing standards (IEC/ISO) 3.1.2 Block diagrams: system representation 3.1.3Wiring diagrams: Power wiring, Control wiring, 3.1.4Cable numbering, terminal blocks, panel layout basics 3.2 Ladder Logic Diagrams: 3.2.1Symbols, rungs, and logic representation 3.2.2 Converting digital logic gates into ladder form 3.3 P&ID (Piping & Instrumentation Diagram): 3.3.1 Symbols for valves, instruments, transmitters, controllers, Reading and preparing P&ID loops 3.3.2 I/O list preparation and documentation workflow 3.3.3 P&ID diagram for Temperature and Pressure control system	9	20
Unit – IV PLC Programming & Sequence Control	4.1 PLC architecture and working principles 4.1.1Understanding PLC scan cycle, memory, addressing 4.1.2Basic ladder logic instructions: AND, OR, NOT, Set/Reset 4.2 Industrial Application 4.2.1 Motor control systems 4.2.2 Conveyor automation 4.2.3 Material handling systems 4.2.4 Packaging and filling machines 4.2.5Traffic and transportation systems	9	20
Unit – V Troubleshooting , Safety & Maintenance in Automation Systems	5.1 Identifying symptoms, isolating faults, verifying solutions 5.2 Fault diagnosis of sensors, actuators, wiring, PLC I/O 5.3 Industrial safety standards: IEC, ISO, OSHA basics 5.4 Electrical & machine safety: Emergency stops, interlocks, lockout–tagout (LOTO) 5.5 Predictive , Preventive and corrective maintenance concepts for automation system design	9	20

	5.6 Case studies on common automation failures such as : Conveyor system failure due to sensor malfunction 5.7 Role of automation system design in environment sustainability		
	Total	**45**	**100**

MAJOR EQUIPMENT/ INSTRUMENTS AND SOFTWARE REQUIRED

These major equipment/instruments and Software required to develop PrOs are given below with broad specifications to facilitate procurement of them by the administrators/management of the institutes. This will ensure conduction of practical in all institutions across the state in proper way so that the desired skills are developed in students.

S. No.	Equipment Name with Broad Specifications
1	PLC Trainer Kit with minimum 8 Digital Inputs, 6 Digital Outputs, and programming software
2	Industrial Sensors set: Proximity, Photoelectric, Temperature, Level, and Pressure sensors
3	Actuators: Solenoid valve, pneumatic cylinder setup, relay modules
4	Electrical Control Panel with MCB, contactor, overload relay, push buttons, and indicator

AFFECTIVE DOMAIN OUTCOMES

The following sample Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfil the development of this competency.

a) Work as a leader/a team member for assigned student activity.
b) Follow safety practices and procedure in Lab.
c) Realize the importance of engineering for societal development.
d) Develop gradually the engineering mindset in day-to-day observation

SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

a) Develop and simulate a basic PLC ladder logic program
b) Prepare wiring diagrams and relay logic circuits using trainer kits.

c) Conduct experiments on different industrial sensors and record observations.
d) Create block diagrams or P&ID layouts for a small automation process.
e) Prepare a short case study on troubleshooting an automation system fault.

SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

Following Sample strategies teacher can use to accelerate the attainment of the various outcomes in this course:

a) Inspire Student to read books on development and evolution networking, instruct them to take notes in form of summary
b) Prepare a short note on applications of factory automation in industry.
c) Guide students to make presentation on applications of Automation Concepts.
d) List out various models used in data communications along with their advantages and limitations.
e) Guide students to make presentation on applications of industrial automation.

SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication (Place, Year, ISBN)
1	Programmable Logic Controllers	F. D. Petruzella	McGraw-Hill, New Delhi, 2010, ISBN: 978-0071067386
2	Introduction to Programmable Logic Controllers	Garry Dunning	Thomson/Delmar, 2005, ISBN: 978-1401884260
3	Industrial Process Automation Systems	Jon Stenerson	Academic Press, 2016, ISBN: 978-0128009390
4	Industrial Automation and Robotics	A. K. Gupta, S. K. Arora	Laxmi Publications, New Delhi, ISBN: 978-8131805923
5	Robotics and Industrial Automation	R. K. Rajput	S. Chand, 2022, ISBN: 978-8121929974
6	Data Communication Networks	Sharma Sanjay	S. K. Kataria and Sons, New Delhi (Latest edition)

SUGGESTED LEARNING WEBSITES

i. www.nptel.iitm.ac.in.
ii. www.isa.org
iii. iii. www.ieee.org
iv. http://www.siemens.com

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