



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Instrumentation and Control Engineering

Subject Code : DI04017031

Subject Name : Programmable Logic Controller

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

Prerequisite:	Basic knowledge of electrical circuits, digital logic, and fundamental instrumentation concepts such as sensors, signal types (analog/digital), and control system basics.
Rationale:	This course has designed for diploma students through which they can learn basic to intermediate theory & basic programming concepts of programmable logic controllers. PLCs are used in many industrial and commercial processes. A diploma holder in the industry is required to install, troubleshoot, program & modify PLCs and PLC-controlled systems. Looking at the industrial applications of PLCs in modern industry, this course finds its usefulness in the present curriculum.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
1	Describe basic components of PLC and logical process in automation system.	U
2	Interface analog and digital input / output module with PLC.	A
3	Explain the basic concepts of PLC & ladder logic.	U
4	Use of timer, counter and other intermediate programming functions.	A
5	Develop basic entry-level applications and troubleshooting of PLC.	AN

**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
L	T	PR		C	Theory		Tutorial / Practical	
			ESE(E)		PA(M)	PA(I)	ESE(V)	
3	0	2	4	70	30	20	30	150



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Course Content

Unit	Topics and Sub-topics	No. Of Hrs.	% Weightage
Unit – I Introduction of PLCs.	1.1 Introduction of various process control. a) Continuous Process Control. b) Discrete-state Process Control. c) Composite Process Control. 1.2 Introduction of PLC. 1.3 Architecture of PLC. 1.4 Working of PLC. 1.5 Selection Criteria of PLC 1.6 Application of PLC in the Industry. 1.7 Advantages and limitations of PLC. 1.8 Need of Automation in Industries.	10	24%
Unit – II Peripherals and Interfacing	2.1 Peripherals devices of plc, Input Devices: Pushbutton, Limit switch, proximity switch, level switch, and other sensing devices. Output Devices: Relay, solid state relay, contactor, solenoid valve, and other controlling devices. 2.2 Ladder logic Symbols of PLC. 2.3 Analog Input/output module. 1. AC input module 2. DC input module 2.4 Digital Input/output module. AC Output module DC Output module 2.5 PLC Input/output interfacing diagram.	6	12%
Unit – III Basic of Programming techniques	3.1 Program scan & memory organization. a. PLC operation & program sequence. b. PLC Memory Mapping and I/O addressing for (Allen-Bradley PLC). c. Types of Register use in PLC (Holding, Input, Output register). 3.2 PLC Programming Languages. a. Ladder Logic (LAD) b. Functional Block Diagram (FBD) c. Sequential Functional Chart (SFC) d. Structured Text (ST) e. Instruction List (IL)	10	21%



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	3.3 Ladder diagram of all Basic Logic Gates. 3.4 Ladder diagram of S-R & J-K flip flop. 3.5 Holding (latching relay) contact. 3.6 Concept of simple and complex branching in Ladder logic. 3.7 Boolean algebra law using ladder language.		
Unit – IV Advance Programming functions	4.1 ON Delay timer, Off Delay timer, Retentive timer, Non-retentive timer 4.2 UP Counter, Down Counter, UP-Down Counter 4.3 PLC arithmetic functions. (Addition, Subtraction, Multiplication, Square Root, Division, Negative 4.4 PLC comparison function (Equal, Not equal, less than, greater than or equal, limit test function) 4.5 Skip, Master Control Relay (MCR), Jump To Lab 4.6 Sequencer output (SQO) and Sequencer load (SQL) instruction. 4.7 Data handling instructions: Move, Block Move, Table Move, Register Move. 4.8 Bit Shift Right and Bit Shift Left function.	12	29%
Unit – V Application and Troubleshooting	5.1 PLC-based automation system. 5.2 High-Low level control of the tank. 5.3 LED blinking using various timers. 5.4 DC motor control using PLC. 5.5 Two-way traffic lights system. 5.6 material handling elevator 5.7 Troubleshooting procedure of PLC.	7	14%
Total		45	100

SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) that are the sub-components of the COs. *Some of the PrOs marked ‘*’ are compulsory, as they are crucial for that particular CO. These PrOs need to be attained at least at the ‘Precision Level’ of Dave’s Taxonomy related to ‘Psychomotor Domain’.*

S.No.	Practical Outcomes (PrOs)	Approx. Hrs. required
1	Identify continuous, discrete and composite control system.	2*



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S.No.	Practical Outcomes (PrOs)	Approx. Hrs. required
2	Identify various modules and component of PLC hardware.	2
3	Learn the basics and hardware components of PLC.	4
4	Sketch PLC based automation system with example.	2
5	Identify various peripherals which are interface with PLC.	2
6	Draw basic ladder logic symbols for PLC.	2
7	Determine the No. of digital I/O & Analog I/O of given PLC.	1
8	Draw wiring Diagrams for Digital Input (DI) and Digital Output (DO) signals for PLC.	2
9	Draw wiring Diagrams for Analog Input (AI), and Analog Output (AO) signals for PLC.	2
10	Describe the method of program scanning in PLC.	2
11	Study Memory Mapping and I/O addressing for PLC.	2*
12	Implement a simple ladder logic program using digital inputs and outputs for PLC.	2
13	Develop ladder logic to test functionality of basic logic gates.	2
14	Develop ladder logic to realize S-R flip-flop	2
15	Develop ladder logic to realize J-K flip-flop	2
16	Develop ladder diagram to prepare latching relay.	2*
17	Draw ladder diagram for given Boolean expression.	2
18	Implementation of simple ladder logic program using timer. 1) On delay timer 2) Off delay timer 3) Retentive timer	2*
19	Implementation of simple ladder logic program using Counter 1) Up Counter 2) Down Counter	2



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S.No.	Practical Outcomes (PrOs)	Approx. Hrs. required
20	Simulate ladder logic for Industrial application on UP counter.	2
21	Simulate ladder logic for Industrial application on Retentive timer.	2
22	Simulate Industrial application of Arithmetic Function for plc.	2
23	Simulate Industrial application of PLC Data Transfer Functions.	2
24	Simulate Industrial application of Comparison Functions.	2*
25	Simulate Industrial application of PLC Skip and MCR Functions.	2
26 27	Simulate Industrial application of PLC Sequencer Function.	2
27	Simulate Industrial application of PLC Shift Register.	2
28	Write and implement ladder logic program to blink LED using timer.	2*
29	Simulate material handling elevator operation on PLC simulator. Draw connection details for the same process.	2
30	Write and implement ladder logic program to on-off the DC motor using PLC	2
31	Implement traffic light control system using PLC.	2*
32	Simulate Bottle filling process on PLC simulator. Draw connection details for the same process.	2
	Total	65

Note

- i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.
- ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency..



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Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Conceptual clarity.	20
2	Experimental setup, Procedure and conduction by following safety practices.	50
3	Interpretation of Results and Ethical values.	30
Total		100

MAJOR EQUIPMENT/ INSTRUMENTS AND SOFTWARE REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to use in uniformity of practical's in all institutions across the state.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	D.C. power supply, Multi-meter, Breadboard, patch cord.	12 to 32
2	Computer system with latest operating system.	12 to 32
3	PLC trainer kit.	12 to 32
4	8 Digital input/output PLC with SMPS & required cables.	3,12 to 32
5	Digital and analog module.	3,4,5,7
6	Level, flow, proximity and limit switch.	3,4,5,7
7	License/Free copy of ladder logic editor.	12 to 32
8	Simulator software for virtual simulation.	12 to 32
9	Level, flow, pressure control trainer kit.	1,2,3, 12 to 32
10	DC motor, solenoid valve, relay and other switching devices.	3,4,5,32

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 fulfill the development of this course competency.

- Work as a leader/a team member (while doing a micro-project).
- Follow safety practices while using D.C. and AC supply and electrical equipment.
- Work as a group member (while performing experiments and taking readings)



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- d. Practice environmentally friendly methods and processes. (Environment related)

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 perform following activities in group (or individual) and prepare reports of about 5 pages for each activity. They should also collect/record physical evidence for their (student's) portfolio which may be useful for their placement interviews:

- Present seminar on various topics from course content
- Prepare poster of PLC based automation system.
- Mini project for industrial application using PLC

SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- Massive open online courses (*MOOCs*) may be used to teach various topics/subtopics.
- Guide student(s) in undertaking micro-projects.
- '*L*' in section No. 4 means different types of teaching methods that are to be employed by teachers to develop the outcomes.
- Show animation/ video related to course content.
- Co-relating the importance of content of this course with other courses/ practical applications. (e.g. importance of a content course or whole course related to A.C. Machines, Transmission and Distribution of Electrical Power, Energy Conservation Switchgear and Protection etc. and in practical industrial &/ domestic applications.
- Introduce E-waste recycling technology among the students.
- Guide students on how to address issues on environment and sustainability

SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-projects are group-based (group of 3 to 5). However, **in the fifth and sixth semesters**, the number of students in the group should *not exceed three*.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an



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integration of PrOs, UOs and ADOs. Each student will have to maintain a dated work diary consisting of individual contributions in the project work and give a seminar presentation of it before submission. The duration of the micro project should be about **12-14 (fourteen to sixteen) student engagement hours** during the course. The students ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

- a) Make a working model of traffic light control using PLC.
- b) Make a working model of elevator using PLC.
- c) Make a working model of Automatic Car Parking System-multi Level.
- d) PLC Based Automatic Bottle Filling Application.
- e) PLC Based Door Open and Closing System.
- f) PLC Based Automatic Counting System.
- g) PLC Based Level Control System.
- h) PLC Based Automatic Mixing Applications.
- i) Collect specifications from different manufacturers of PLC and prepare a market survey report.

SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Programmable logic Controllers Principles and applications	John W. Webb Ronald A Reis	PHI Learning,
2	Programmable logic Controllers Programming methods and applications	John R Hackworth Frederick D. Hackworth Jr.	Pearson
3	Process Control Principles and applications	Surekha Bhanot	Oxford University press
4	Instrumentation engineer's handbook	B. G. Liptak	Chilton Book Co., Philadelphia



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Sr. No.	Title of Book	Author	Publication with place, year and ISBN
5	Process control Instrumentation technology	Curtis D Johnson	PHI pvt. Ltd.
6	Programmable Logic Control: Principles And Applications	NIIT	PHI EEE edition
7	Programmable Controllers	Thomas A. Hughes	ISA

SUGGESTED LEARNING WEBSITES

- www.control.com
- www.plcs.net
- www.seimens.com
- www.triplc.com
- <https://instrumentationtools.com>
- theautomationblog.com
- www.plccompare.com
- www.plcdev.com
- www.plcprogramming.com
- <https://plcmanual.com/>
- <https://plcademy.com>
- <https://realpars.com/plc>
- www.plcgurus.net

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