



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Mechatronics Engineering

Subject Code: DI04020051

Subject Name : Programmable Logical Controllers

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

Prerequisite:-	Basic knowledge of electrical circuits, digital logic, and fundamental concepts such as sensors, signal types (analog/digital), and control system basics.
Rationale:	In previous semesters students have learnt the fundamentals of mechatronics systems, digital circuits they are capable to understand and develop a basic circuit. To use this knowledge and programming skill in the field of automation it is also necessary to learn about Programmable Logic Controller. Programmable Logic Controllers (PLCs) are the backbone of modern industrial automation. Industries such as manufacturing, automotive, process control, packaging, robotics, and material handling rely extensively on PLCs for reliable, flexible, and efficient control of machines and systems. For mechatronics diploma graduates, understanding PLC principles, its memory and its applications is essential. This course enables students to develop the skills required to design, program, troubleshoot, and maintain PLC-based automation systems. It builds competency in ladder logic, input-output interfacing, sensors and actuators.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Definition, purpose, and basic architecture of a Programmable Logic Controller (PLC).	U / A
02	Identify and describe the use of various PLC memory & Recognize different types of sensors commonly interfaced with PLCs	U
03	Use of Boolean algebra to simplify designs.	A / U
04	Use of Ladder Logic Functions and advance function for PLC programming.	R / U / A
05	Selection of PLCs for relevant applications.	R/U/C

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



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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)	
03	00	02	04	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Introduction to PLC	06	15
2.	PLC Memory and Logical Sensor	11	26
3.	Boolean Logic Design and Timers, Counter, Latch Concept	11	24
4.	Ladder Logic Functions and Advance Functions	11	24
5.	PLC's selection criteria	06	11
	Total	45	100

Unit	Major Learning Outcomes(Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I Introduction to PLC	1a. What is PLC? 1b.Types of PLC? 1c.Describe hardware components of PLC. 1d.Explain the block diagram of PLC. 1e. Explain the Concept of SCADA	1.1 History of PLC 1.2 Principles of operation of PLC 1.3 PLC verses computer 1.4 PLC Architecture 1.5 Scan time of a cycle 1.6 Manufacturers of PLC 1.7 Need of Automation in Industries. 1.8 Concept of SCADA



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Unit– II PLC Memory and Logical Sensor	2a. Explain different types of memories available for PLC. 2b. PLC input and output. 2c. PLC programming languages.(LAD) 2d.Distinguish between various data files: User Bits Memory, Timer Counter Memory, PLC Status Bits, User Function Control Memory, Integer Memory, Floating Point Memory 2e.Use addresses for locations in memory. 2f.Distinguish between Switches, TTL, Sinking and sourcing, Connection of switch 2g. Distinguish the various types of human/product presence detection sensors interfacing and calibration	2.1 Memory Address. 2.2 Program Files. 2.3 Data files: User Bits Memory, Timer Counter Memory, PLC Status Bits, User Function Control Memory, Integer Memory, Floating Point Memory 2.4 Sensor wiring: Switches, TTL, Sinking and sourcing, Connection of switch 2.5 Human/ product Presence Detection Sensors: Reed Switch, Optical Sensor, Capacitive Sensor, Inductive Sensor
Unit– III Boolean Logic Design and Timers, Counter, Latch Concept	3a. Explain logic design for a given application 3b. Simplify designs with Boolean algebra. 3c. Use timers, latch and counters in various designs 3d. Use counter as per requirement 3e.Apply latch in ladder logic	3.1 Boolean algebra: Rules of Boolean Algebra, Logic Design for a given application 3.2 Common Logic Forms: Complex gate forms, Multiplexer. 3.3 Timers: On-delay timer, Off-delay timer, Retentive timer. 3.4 Counters: Up-Counters, Down-Counter, Up-Down Counter. 3.5 Master Control Relay.



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Unit-IV Ladder Logic Function and Advance Functions	4a. Explain various programme control instructions (Mathematical, logical, move, data conversion). 4b. Manipulate the data for various applications 4c. Develop ladder logics for a particular design 4d. Develop programmes for given applications.	4.1 Data handling Function: Move Function, Mathematical Function, Conversion Function 4.2 Logic Function: Comparison of Value, Boolean Function 4.3 List Function: Shift registers, Stacks, 4.4 Program Control: Branching and Looping.
Unit-V PLC's selection criteria	5a. State the criteria for selection of PLC 5b. Select right PLC for a given application / software. 5c. Prepare the specifications of a PLC	5.1 PLC selection criteria. 5.2 PLC specifications 5.3 PLC Advantages & Disadvantages

SUGGESTED PRACTICAL EXERCISES:-

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

Sr. No.	Practical Outcomes (PrOs)	Approx. Hrs. required
1.	(a) Identify various modules and component of PLC hardware. (b) Learn the basics and hardware components of PLC.	04*
2.	Identify various peripherals for interfacing with PLC.	02*
3.	(a) Draw wiring Diagrams for Digital Input (DI) and Digital Output (DO) signals for PLC. (b) Draw wiring Diagrams for Analog Input (AI), and Analog Output (AO) signals for PLC.	02*
4.	Describe the method of program scanning in PLC.	02*
5.	Develop ladder logic to test functionality of basic logic gates.	02*
6.	Develop ladder diagram to prepare latching relay.	02*



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7.	Draw ladder diagram for given Boolean expression.	02*
8.	To Study Different Types of Timers & Counters in PLC.	02*
9.	Implementation of simple ladder logic program using timer. 1) On delay timer 2) Off delay timer 3) Retentive timer	02*
10.	Simulate Industrial application of Arithmetic Function for plc.	02*
11.	Simulate Industrial application of Comparison Functions.	02*
12.	Develop ladder programming for a given statement - To on the bulb 1 after 5 sec of switch1 on. Turn the bulb 2 on after the 5 sec of bulb1 on and test.	02*
13.	Develop ladder programming for a given statement -To on the bulb After 5 sec of switch off. Turn the bulb 2 off after the 5 sec of bulb1 on and test.	02*
Total (Hours)		28

NOTES:-

I. More Practical Exercises can be designed and offered by the concerned course teacher to develop the industry-relevant skills/outcomes to match the COs. The above table is only a representative list.

II. It is compulsory to prepare log book/continuous records of exercises. It is also required to get each exercise recorded in log book/continuous records, checked and duly dated signed by teacher. CA component of practical marks is dependent on continuous and timely evaluation of exercises.

III. Term work report must not include any photocopy/ies, printed manual/pages, litho, etc. It must be hand written / hand drawn by student only.

a. Brief details of industry visited.

b. Type, location, products, rough layout, human resource, etc., of industry.

c. Details, description and broad specifications of machineries/processes observed.

d. Safety norms and precautions observed.

e. Student's own observation on industrial environment, productivity concepts, quality consciousness and quality standards, cost effectiveness, culture and attitude.

f. Any other details/ observations asked by accompanying faculty.

IV. For practical ESE part, students are to be assessed for competencies achieved. They should be assigned the necessary data and should be given any one experience to perform. 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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SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

Programmable logic Controllers being a most important subject of Mechatronics, teachers are expected to lay considerable stress on understanding the basic concepts, principles, and applications. For this purpose, teachers are expected to give simple problems in the classroom and provide tutorial exercises to develop the necessary knowledge for comprehending the basic concepts and principles. As far as possible, teaching the subject is supplemented by demonstrations and practical work in the laboratory using various PLC Simulation Software's.

References/Suggested Learning Resources:

(a) Books:

Sr. No	Title of Book	Author	Publication
1.	Programmable Logic Controller, 5th Edition	John W. Webb and Ronald A. Reis	PHI Learning, New Delhi
2.	Programming Language Concept	Peter sestoft	Springer
3.	Automating Manufacturing System	Hugh Jack	McGraw Hill, New Delhi
4.	A practical Handbook to PLC	Alireza H. Fassih	New Generation publication
5.	Programmable Logic Controllers, 5th Edition	W. Bolton	Newnes

(b) Open source software and website:

- www.plcs.net
- www.automation.siemens.com
- www.abb.co.in
- www.ia.omron.com

MAJOR EQUIPMENT / INSTRUMENTS AND SOFTWARE REQUIRED

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1.	D.C. power supply, Multi-meter, Breadboard,	1,2
2.	Computer system with latest operating system.	1,2
3.	PLC trainer kit.	1,2,4
4.	Digital and analog module.	3



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5.	Level, flow, proximity and limit switch.	6,7,8
6.	License/Free copy of ladder logic editor.	1 to 13
7.	Simulator software for virtual simulation.	1 to 13
8.	DC motor, solenoid valve, relay and other switching devices.	1 to 13

Suggested Project List & Student Activities:

Sr. No.	Activity.
1.	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.
2.	They should also collect/record physical evidence for their (student's) portfolio which may be useful for their placement interviews: a) Present seminar on various topics from course content b) Prepare poster of PLC based automation system. c) Mini project for industrial application using PLC
3.	Prepare/Download a dynamic animation to illustrate the following: a) Working principle of Timer b) Working principle of Counter c) Working of different types Ladder logic.
4.	Carry out a market survey of local dealers for PLC and compare them on mentioned points: (a) Rating (b) Memory (c) Cost (d) Programming language and (e) Performance
