



**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**Minor Degree: Control Systems and Sensors Technology**  
**Subject Code: N115AM01**

**Semester – V**

**Subject Name: Process Automation and Virtual Instrumentation**

**Prerequisite:** Digital Logic Design, Concept of Micro Processor and Micro Controller, Relay Logic, Control System, Knowledge of programming and flow charts

**Rationale:** Students of Instrumentation & Control engineering should have detailed skill of controlling any system. Programmable Logic Controller (PLC) is a very important device to control any system and is widely used in industries now a day. Therefore, the person who wants to work in control and automation industries must have enhanced knowledge of PLC. This course gives a detailed knowledge and practice of PLC programming

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	0	30	0	100

**Course Content:**

Unit No	Course Content	No of Hours
1	<b>Basics of Process Automation</b> Basics of control system, PID controller, Introduction to PLC.	6
2	<b>PLC Architecture</b> I/O modules, CPU, Memory, Programming Devices.	2
3	<b>PLC Programming Language</b> Concept of Relay logic, PLC Programming languages, Ladder logic, I/O device interfacing, Arithmetic & Logical instructions	12
4	<b>PLC Advance programming</b> Timer, Counter, Data handling instructions, Program control instructions, PLC Application. e.g., material handling system, temperature control system etc.	13
5	<b>SCADA Basics &amp; Typical SCADA Software package:</b> SCADA key features, Remote Terminal Units (RTU) SCADA software - Wonderware	7
6	<b>Basics of Distributed Control System</b> DCS- Development & History, Basics of DCS Hardware & Software Packages, Typical DCS systems used in industry i.e., siemens.	5
<b>Total Hrs.</b>		<b>45</b>

**Suggested Specification table (Theory):**

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
15	40	25	10	5	0



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**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate  
C: Create and above Levels (Revised Bloom's Taxonomy)**

**Reference books:**

1. Programmable logic controller by Frank D. Petrusella, Tata McGraw-Hill publication
2. Introduction to programmable logic controller by Gary dunning, Thomson Asia Pte Ltd. Publication, Singapore
3. Programmable Logic Controllers: Principles and Applications by John W. Webb and Ronald A. Reis, Prentice – Hall India publication, 5th edition
4. Programmable Logic Controllers by W. Bolton, Elsevier Newnes publication, 4th edition
5. Programmable Controllers An engineer's guide by E.A.Parr, Elsevier Newnes publication 3rd edition
6. S7-200, PLC Manual of Siemens for Instructions
7. S7-300, PLC Manual of Siemens for Instructions
8. Programmable Controller by T. A. Huges, ISA publication, 2nd edition
9. Programmable Logic Controllers: Programming methods and applications by
10. John R. Hackworth and Frederick D. Hackworth Jr., Pearson publication
11. Process Control- Instrument Engineers Handbook by Bela G. Liptak, Chilton book co.
12. Practical Distributed Control Systems (DCS) for engineers and technicians by IDC Technologies

**Course Outcome:**

No	Course Outcomes	% weightage
01	Describe and understand the Hardware structure of PLC, DCS and software packages of SCADA.	35
02	Apply knowledge of digital logic and microcontroller concepts for understanding ladder programming, process scanning and status table updation.	15
03	Interface different on-off switches, push buttons, keypad, analog sensors etc. with input modules and relay, solenoid valve, LED, servo valve, solid state devices etc. to output modules of PLC	20
04	Write, simulate, debug and analyze the ladder programs and SCADA tagging to develop program related to control, arithmetic, relay, data handling, sequencer, timer, counter, interrupt and PID blocks.	25
05	Work as an individual and as a team member to design, formulate, select and implement hardware and software for modern automation system required for industrial application	10

**List of Practical:**

- 1) Introduction to ladder programming& to implement basic logic gates.
- 2) Develop, Simulate and Test Ladder diagram for
  - a. A Door Bell Operation
  - b. A Combination Lock.
- 3) Develop, Simulate and Test Ladder diagram for Bottle Filling system.
- 4) Develop, Simulate and Test Ladder diagram for Traffic Light Control System.



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- 5) Develop, Simulate and Test Ladder diagram for Car Parking system.
- 6) Develop, Simulate and Test Ladder diagram for three phase motor and stepper motor control in forward and reverse direction.
- 7) Develop and test PLC program for two axis Robotic arm for pick and place application
- 8) Develop and test PLC program for PID Controller for Temperature control Application.
- 9) Develop and test PLC program in FBD, SFC, IL, ST, and Ladder Logic Language for Motor starter application.
- 10) Detail study of PLC Hardware and its interfacing.
- 11) Study of important features of SCADA software package
- 12) Study of different type of animations used in SCADA software
- 13) DCS-Flow-sheet symbol (ch. 7.11- B.G. Liptak –II – Process control)
- 14) Study of various DCS display options
- 15) DCS cost estimation procedure (ch. 7.8- B.G. Liptak –II – Process control)