GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: PROGRAMMABLE LOGIC CONTROLLER AND DISTRIBUTED CONTROL SYSTEM
(Code: 3341702)

Diploma Program in which this course is offered	Semester in which offered
Instrumentation and Control Engineering	**4th Sem**

1. RATIONALE

Different logical process automation is used for optimum controlling of the process parameters and hence Diploma Engineers should be able to maintain them. This requires that they should know very well about logical control action fundamentals. Hence this curriculum has been designed so that the students will be able to explain the construction, working and applications of various logical control strategies for automation.

2. COMPETENCY

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- O**perate and Maintain programmable logical controllers and distributed control system.**

3. COURSE OUTCOMES

  i. Identify logical process control in automation (PLC and DCS based automation).
 ii. Connect the PLC peripherals with the PLC for logical functioning.
iii. Develop basic PLC programmmes.
 iv. Maintain PLC.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
				Theory Marks		Practical Marks		
L	**T**	**P**	**C**	**ESE**	**PA**	**ESE**	**PA**	
3	0	4	7	70	30	40	60	200

Legends: L-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** - Practical; **C** – Credit **ESE** - End Semester Examination; **PA** - Progressive Assessment.

5.   COURSE DETAILS

Unit	Major Learning Outcomes ('Course Outcomes' in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I Logical Process control in automation	1a. Describe different process control techniques. 1b. Explain the working of data logger, DDC, SCADA. 1c. Justify need of automation in industry.	1.1. Introduction to process control 1.2. Continuous Process Control 1.3. Discrete-state Process Control 1.4. Composite Process Control 1.5. Data logger, DDC, SCADA 1.6. Scope of automation in industry.
Unit – II PLC architecture	2a. Draw Block diagram of PLC. 2b. Describe PLC architecture. 2c. Explain the working of PLC. 2d. List the steps to configure the PLC. 2e. List out peripherals for PLC 2f. Draw basic symbols used for PLC. 2g. Describe selection criteria for PLC. 2h. State advantages and Disadvantages of PLC. 2i. List out PLC applications in industries and automation systems.	2.1. Introduction to PLC 2.2. Configuration of PLC(components for modularized PLC) 2.3. Architecture of PLC 2.4. Working of PLC 2.5. PLC peripherals 2.6. PLC symbols 2.7. Selection criteria of PLC 2.8. Advantages and disadvantages of PLC 2.9. PLC applications
Unit – III PLC peripherals and wiring	3a.Identify analog input /output module for PLC. 3b.Identify digital input /output module for PLC. 3c.Describe analog input /output module. 3d.Describe digital input /output module. 3e.Explain and Interface analog/digital input/output module (including wiring) with PLC. 3f.Draw connection diagram to	3.1. Analog input/ output module 3.2. Digital input/ output module 3.3. Switching devices (level, pressure, flow, temperature, timer, proximity switch). 3.4. PLC input/output connection. 3.5. PLC power connection (wiring). 3.6. Isolated and non isolated input/output wiring to PLC.

Unit	Major Learning Outcomes ('Course Outcomes' in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	connect the switching devices with PLC. 3g. Describe the isolation technique. 3h. Draw the Isolated and non-isolated input wiring to PLC. 3i. Explain the Isolated and non isolated input wiring to PLC.	

Unit – IV
Basic PLC programming
	4a. Describe general programming procedure.
	4b. List special key board and display functions of hand-held programmer
	4c. List the steps to upload ON-line, OFF-line program by hand-held programmer
	4d. List the steps for Programming sequence of PLC.
	4e. Describe the legal (proper) / illegal (improper) PLC ladder diagram
	4f. List the important scanning considerations for PLC.
	4g. List the corrective steps to be taken in case of PLC operational fault.
	4h. Develop Relay based logical functions.
	4i. List out different types of PLC Programming languages.
	4j. Develop Ladder logic for NOT, AND, OR, NAND, Ex-OR, Ex-NOR logic.
	4k. Develop ladder logic for given Boolean algebraic equation.
	4l. Develop Ladder logic for holding contact.
	4m. Develop ladder logic for simple and complex branching
		4.1. Introduction to General PLC Programming Procedures.
		    4.1.1 Programming equipment-Hand held programmer
		    4.1.2 Programming sequence
		    4.1.3 PLC Ladder Diagrams
		    4.1.4 Process scanning consideration
		    4.1.5 PLC operational fault.
		
		4.2. NOT ,AND, OR, NAND, NOR, Ex-OR, Ex-NOR logic.
		4.3. PLC Programming languages.
		4.4. Boolean algebraic equation.
		4.5. Holding (latching relay) contact.
		4.6. Branching and complex branching ladder rung.
		4.7. Temperature control using ladder logic.

Unit	Major Learning Outcomes ('Course Outcomes' in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
	ladder rung. 4n. Develop ladder logic for ON-OFF temperature control using timer and limit switches.	
Unit – V Distributed Control System (DCS)	5a. Explain concept of DCS. 5b. Draw Hierarchy of DCS. 5c. Describe Hierarchy of DCS. 5d. List functions of each level of DCS. 5e. Describe functions of each level of DCS. 5f. State Strengths and limitations of DCS. 5g. Explain network topology for DCS. 5h. Describe different display of DCS.	5.1. Introduction to DCS. 5.2. History of DCS. 5.3. Concept of DCS. 5.4. Hierarchy of DCS. 5.5. Functions of each level of DCS. 5.6. Network topology for DCS. 5.7. Display organization (Monitoring facilities) for DCS.

6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS (THEORY)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Logical Process control in automation	04	01	02	04	07
II	PLC architecture	08	02	04	08	14
III	PLC peripherals and wiring	08	02	04	08	14
IV	Basic PLC programming	12	03	06	12	21
V	Distributed Control System	10	02	04	08	14
Total		**42**	**10**	**20**	**40**	**70**

Legends: R = Remembrance; U = Understanding; A = Application and above levels (Revised Bloom's taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

7.   SUGGESTED LIST OF EXERCISES/PRACTICALS

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills **(outcomes in psychomotor and affective domain)** so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.

S. No.	Unit No.	Practical Exercises (Outcomes' in Psychomotor Domain)	Approx. Hrs. Required
1.	I	Identify continuous, discrete control and composite control system.	2
2.	I	Connect direct digital control for a process.	2
3.	I	Connect data logger to a process.	2
4.	I	Identify components of SCADA.	2
5.	II	Prepare PLC specification for given situation for automation.	2
6.	II	Identify various modules and component of PLC hardware.	2
7.	III	Assemble various modules and component of PLC to make a PLC system.	2
8.	III	Wire given level control system for automation.	2
9.	III	Wire given temperature control system for automation.	2
10.	III	Wire given flow control system for automation.	2
11.	IV	Use relay as a switch to make circuit ON.	2
12.	IV	Implement NOT, AND & OR logic using relay(s).	2
13.	IV	Implement NAND & NOR logic using relay(s).	2
14.	IV	Implement EX-OR & EX-NOR logic using relay(s).	2
15.	IV	Identify programming formats and proper construction of ladder diagrams of given PLC.	2
16.	IV	Build NOT, AND & OR logic using ladder diagram with the help of PLC.	2
17.	IV	Build NAND & NOR logic using ladder diagram with the help of PLC.	2
18.	IV	Build EX-OR & EX-NOR logic using ladder diagram with the help of PLC.	2
19.	IV	Develop ladder diagram to prepare latching relay.	2
20.	IV	Develop ladder to switch ON motor for given condition	2
21.	IV	Develop ladder diagram for given level control system using	2

		level switch	
22.	IV	Develop ladder diagram for given temperature control system using temperature switch	2
23.	IV	Develop ladder diagram for given flow control system using flow switch	2
24.	V	Identify various level of distributed control system	2
25.	V	Indentify various display of distributed control system	2
26.	V	Connect personal computers in network using ring topology	2
27.	V	Connect personal computers in network using star topology	2
Total hours			54

8. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities like:

i. Assemble PLC power supply PLC, Input / Output module on mounting rack.
ii. Wire automatic level control system using various components.
iii. Wire automatic temperature control system using various components.
iv. Wire automatic flow control system using various components.
v. Connect personal computer using star topology.
vi. Connect personal computer using ring topology.

9. SPECIAL INSTRUCTIONAL STRATEGIES

i. **V**isits to Industries.
ii. Use free simulators for PLC programming in the class when teaching.
iii. Video films/animation films on working of different type automatic system such as PLC, DDC, SCADA and DCS, from YouTube and other resources.
iv. Mini project.

10. SUGGESTED LEARNING RESOURCES

A) List of Books

S. No.	Title of Book	Author	Publication
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
5	Process control Instrumentation technology	Curtis D Johnson	PHI pvt. Ltd.

B) List of Major Equipment/ Instrument with Broad Specifications

 i.   Electrical tool kit
 ii. Multi-meter
 iii. Master PLC with Power supply and Hand held PLC programmer (touch   screen teach pendent).
 iv. Slave PLC with Power supply and Hand held PLC programmer.
 v.   24 analog input module (8 analog input module 3NO.)
 vi. 24 analog output module (8 analog output module 3NO.)
 vii. 24 digital input module (8 digital input module 3 NO.)
 viii. 24 digital output module (8 digital output module 3 NO.)
 ix. level switches
 x.   temperature switches
 xi. flow switches
 xii. 3" conveyor system operated 12V DC motor with digital shaft encoder
 xiii. Proximity switches (Inductive, Optical, motion, light etc.)
 xiv. 12 V DC motor with digital shaft encoder
 xv. PLC based Automatic bottle filling plant
 xvi. Flow, temperature, level control setup for PLC based automation using Flow, temperature, level switches.

C) List of Software/Learning Websites

 i.   www.control.com
 ii. www.wikipedia.org
 iii. www.youtube.com
 iv. www.ourinstrumentationgroup.com
 v.   www.googlebooks.com

11. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculty Members from Polytechnics

- **Prof. R. P. Merchant** HOD IC Engineering, Govt. Polytechnic, Gandhinagar
- **Prof. A. K. Bilakhia** Lecturer IC Engineering, Govt. Polytechnic, Gandhinagar
- **Prof**. **N. B. Mehta** Lecturer IC Engineering, Govt. Polytechnic, Ahmedabad
- **Prof. S. K. Raval**, Lecturer IC Engineering, Govt. Polytechnic, Ahmedabad

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. Joshua Earnest**, Professor, Department of Electrical and Electronics Engineering.
- **Prof. (Mrs.) Susan S. Mathew**, Associate Professor, Department of Electrical and Electronics Engineering.