GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: PROGRAMMABLE LOGIC CONTROLLER
(COURSE CODE: 3362402)

Diploma Programme in which this course is offered	Semester in which offered
Power Electronics	Sixth

1.   RATIONALE

With the advancement of technology use of PLC is increasing day by day and hence this course is intended to enable the student understand the basic concepts, operation, programming and advance applications of Programmable Logic Controller. With the help of Communication and Networking student would able to control industrial process with wireless technology. These skills developed through this course will help the student to function confidently in his/her career. It is also aimed to expose students to some of the advanced techniques used in Industrial Automation system in different industries.

2.   COMPETENCY

The course content should be taught and curriculum should be implemented with the aim to develop required skills in students so that they are able to acquire following competency:
  • **Maintain PLCs used in industrial automation applications.**

3.   COURSE OUTCOMES (COs)

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning outcomes in cognitive, psychomotor and affective domain to demonstrate following course outcomes .
   i.   Analyse the major components of a Programmable Logic Controller (PLC)
  ii.   Interpret the operation of PLC modules
 iii.   Execute the PLC programming with different condition.
  iv.   Establish Communication and Networking with PLC
   v.   Use PLC, DCS and SCADA for industrial process control.

4.   TEACHING AND EXAMINATION   SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	**T**	**P**	**C**	**ESE**	PA	**ESE**	PA	
4	0	2	6	70	30	20	30	**150**

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

5.   COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (In Cognitive Domain)	Topics and Sub-topics
Unit – I Introduction to PLC	1a. Justify the need of PLC in industrial automation 1b. Write different functions of PLC with its advantages	1.1 PLC: Characteristics, Operation, function, Types of PLC
	1c. Describe Architecture of PLC 1d. Develop simple application programmes for PLC 1e. Compare the use of PC v/s PLC	1.2 Architecture Of PLC 1.3 Applications of PLC 1.4 PC v/s PLC
Unit – II Input / Output Modules and Power Supply	Classify I/O modules of PLC. Sketch the block schematic of I/O system. 2c. Describe input-Output systems	2.1. Overview of I/O system. 2.2. Classification: serial, parallel, discrete, analog special 2.3. Direct I/O, Parallel I/O, Serial I/O
	2d. Explain Discrete(digital) input and output modules	2.4. discrete input modules: DC input, AC input, Rectifier with filter, Isolation, logic section. 2.5. Discrete output modules: operating principals
	2e. Explain Analog input Modules with its strengths and limitations	2.6. Analog input modules: single ended, differential input
	2f. Discuss Power supply Requirements in PLC	2.7. Common AC source, isolation, protection 2.8. configuration, power line conditioner
Unit – III PLC programming	3a. Explain the different Ladder logic with sketches	3.1. Ladder diagram: of logic gates, multiplexer, Ladder diagram for different logical conditions or logical equations or truth table.
	3b. Describe characteristics of PLC timer 3c. Explaining the working principle of a PLC timer. 3d. Develop Ladder diagram using timer	3.2. Timers: types of timer, Characteristics 3.3. Function of timer in PLC 3.4. Classification of a PLC timer 3.5. Ladder diagram using timer.
	3e. Write function and operation of PLC counter. 3f. Develop Ladder diagram using counter	3.6. PLC counter 3.7. Ladder diagram using counter.
Unit – IV Communication and Networking	4a. Describe Management Hierarchy of an industry 4b. Describe evolution of industrial process	4.1. Introduction of Management Hierarchy of an industry 4.2. Industrial control process 4.3. Parallel and Serial

Unit	Major Learning Outcomes (In Cognitive Domain)	Topics and Sub-topics
	4c. Explain types of communication interface 4d. Describe communication mode 4e. Describe different serial interface	communication interface 4.4. Simplex, Half duplex, Full duplex 4.5. RS 232- DB-25 connector, DB-9 connector, RS 422, EIA 485 interface
	4f. Describe industrial network 4g. Explain network topology 4h. Write advantages and disadvantages of different network topology	4.6. Introduction of industrial network 4.7. Bus topology, Ring topology, Star topology, Tree topology
Unit – V Industrial Automation	5a. Describe working of the Distributed Control System (DCS) 5b. Describe Advantages and Disadvantages of the Distributed Control System (DCS)	5.1. basic Concept, History and Hierarchy of DCS 5.2. Functions of each level. 5.3. Advantages and Disadvantages.
	5c. Describe working of Supervisory Control and Data Acquisition System(SCADA) 5d. Describe Advantages and Disadvantages of Supervisory Control and Data Acquisition System(SCADA)	5.4. Architecture of SCADA 5.5. Working of SCADA
	5e. Compare suitability of PLC, DCS and SCADA 5f. Describe different process control applications of Industrial Automation	5.6. PLC, DCS and SCADA suitablility 5.7. Applications: Thermal power plant, Irrigation and Cement factory

6. SUGGESTED SPECIFICATION TABLE WITH HOURS and MARKS (Theory)

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to PLC	8	2	7	2	11
II	Input / Output Modules and Power supply	10	2	8	4	14
III	PLC programming	14	2	6	8	16
IV	Communication and Networking	12	2	8	4	14
V	Industrial Automation	12	3	7	5	15
	Total	**56**	**11**	**36**	**23**	**70**

Legends: R = Remember**, U** = Understand**, A**= Apply and above Level (Bloom's revised 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 PRACTICAL / EXERCISES

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 mainly 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/Exercise (Outcomes' in Psychomotor Domain)	Approx. Hrs. Required
1	I	Assemble various modules and component of PLC to make a PLC system.	2
2	II	Execute/Prepare INPUT-OUTPUT module chart	2
3	III	Execute/Prepare ladder diagram of AND, OR, NOT, NAND, NOR, X-OR, X-NOR gate	2
4	III	Execute/Prepare ladder diagram for different Arithmetic operations.	2
5	III	Execute/Prepare ladder diagram for logical operations along with truth table.	2
6	III	Execute/Prepare ladder diagram for different logical conditions-for Timer	4
7	III	Execute/Prepare ladder diagram for different logical conditions-for Counter	4
8	III	Execute/Prepare allover ladder diagram for industrial process and control.	4
9	III	Develop ladder diagram for a temperature, level, flow control system	4
10	IV	Interface personal computers in network using different topology	4
11	IV	Interface RS232- DB-25 connector, DB-9 connector, RS 422, EIA 485 interface	2
12	V	Use SCADA system.	2
13	V	Identify various level of distributed control system.	2
		Total	**36**

Note: Perform any of the practical exercises from above list for total of minimum 28 hours depending upon the availability of resources so that skills matching with the most of the outcomes of every unit are included.

8.   **SUGGESTED STUDENT ACTIVITIES**
Following is the list of proposed student activities like:
  i.   Students have to find practical applications of various parameters of ladder logical applications.
  ii.   Students are instructed to list various practical applications
  iii. Students are instructed to take any one applications

9.   **SPECIAL INSTRUCTIONAL STRATEGIES (if any)**
  i.   Arrange Lectures
  ii.   Online animation/flash
  iii. Show Video/ Animation film explaining different field applications of PLC,DCS and SCADA.
  iv.   Prepare a chart related to PLC,DCS and SCADA Hierarchy
  v.   Arrange a visit to industry using PLC

10.   **SUGGESTED LEARNING RESOURCES**

A)   **Books**

S. No.	Title of Books	Author	Publication/Year
1	Programmable Logic Controllers and Industrial Automation an Introduction	Mitra, Madhuchanda; Gupta, Samarjit Sen	Param International Publising (India) Pvt. Ltd., New Delhi, Latest edition
2	Programmable logic controllers: principles and applications	Webb, John W.; Reis, Ronald A.	PHI Learning Pvt. Ltd. New Delhi, Latest edition.
3	Programmable logic control: principles and applications	NIIT	PHI Learning Pvt. Ltd. New Delhi, Latest edition.
4	Practical SCADA for Industry	Bailey, David; Wright, Edwin	Newnes , Burlington, MA

B. Major Equipment/Materials with Broad Specification
  i.   PLC - Siemens, Allen Bradley trainers
  ii.   Compatible PLC software for the above
  iii. SCADA system for renewable energy/wind power system at laboratory level

C.   List of Software/ Learning Websites
  i.   https://www.fer.unizg.hr/_download/repository/Practical_SCADA_for_Industry.pdf
  ii.   http://www.personal.kent.edu/~asamba/tech43550/Chap04.pdf
  iii. http://www.slideshare.net/veenitamore2/ppt-on-plc
  iv.   http://www.slideshare.net/JitenderSinghShekhaw/plc-dcs-plc-vs-dcs-by-j-s-shekhawat?next_slideshow=1
  v.   http://www.slideshare.net/parbatrajpurohit16/43542179-programmablelogiccontrollerplcppt
  vi.   https://www.youtube.com/watch?v=GajoFTQjJrY
  vii. http://plc-scada-dcs.blogspot.com/p/downloads.html#axzz3DYGDBl00
  viii. http://www.youtube.com/watch?v=zvS_BuQlSXo#t=27
  ix.   http://en.wikipedia.org/wiki/Programmable_logic_controller

x.   http://educypedia.karadimov.info/electronics/control-systems-plc.htm#PLC
xi.   http://engineeronadisk.com/V2/book_PLC/engineeronadisk.html

11.   COURSE CURRICULUM DEVELOPMENT COMMITTEE
        Faculty Members from Polytechnics
- **Smt. J. M. Patel**, ALPE, Dept. of Power Electronics, Dr. S. and S. S. Ghandhy College of Engg. and Technology, Surat
- **Prof. Shailesh L. Dhoriyani**, LPE, Dept. of Power Electronics, Dr. S. and S. S. Ghandhy College of Engg. and Technology, Surat

        Coordinator and Faculty Members from NITTTR Bhopal
- **Prof. A.S. Walkey**, Associate Professor, Department of Electrical and Electronics Engineering
- **Dr. Anjali Potnish** Assistant Professor, Department of Electrical and Electronics Engineering