GUJARAT TECHNOLOGICAL UNIVERSITY

POWER ELECTRONICS
PROGRAMMABLE LOGIC CONTROLLER FOR POWER ELECTRONICS
SUBJECT CODE : 2182408
B.E. 8th SEMESTER

Type of course: Engineering Science (Instrumentation & Control Engineering)

Prerequisite: 1) 2142406 - Digital Electronics and its Applications
2) 2152408 - Industrial Instrumentation
3) 2152409 – Microcontroller for Power Electronics
4) 2162410 - Industrial Communication Systems
5) 21724XX - Industrial Automation

Rationale: Students of Power Electronics engineering should have basic 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 enhance 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
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	20	10	150

Content:

Sr. No.	Topic	Teaching Hrs.	Module Weightage%
1	**PLC Basics** **An Overall Look at Programmable Logic Controllers -** Introduction, definition & history of the PLC, manufacturing & assembly process, PLC advantage & disadvantage, overall PLC system, CPU & programmer/monitors, PLC input & output modules, printing PLC information. **The PLC: A Look Inside -** Introduction, the PLC as a computer, the central processing unit, solid state memory, the processor, I/O modules, power supplies. **General PLC Programming Procedures -** Introduction, programming equipment, programming formats, proper construction of PLC ladder diagrams, process scanning consideration, PLC operational faults. **Devices to Which PLC Input and Output Modules Are Connected -** Introduction, input ON/OFF switching device, input analog device, output ON/OFF device, output analog device.	**07**	**15**
2	**Basics PLC Programming** **Programming On/Off Inputs to Produce On-Off Outputs -** Introduction, PLC input instruction, output: coils, inductors & others, operational procedures, contact & coil input/output programming examples, a look at fail-	**07**	**15**

	safe circuit, industrial process examples. **Relation of Digital Gate Logic to Contact/Coil Logic -** Digital logic gates, Boolean algebra PLC programming, conversion examples. **Creating Ladder Diagrams from Process Control Descriptions -** Ladder diagram & sequence listing, large process ladder diagram construction, flow charting as programming method.		
3	**Basic PLC Functions** **Register -** Introduction, general characteristics of registers, module addressing, holding registers, input registers: single & group, output registers: single & group. **PLC Timer Functions -** Introduction, PLC timer functions, examples of timer function industrial application, industrial process timing application. **PLC Counter Functions -** Introduction, PLC counters examples of counter function industrial application.	**04**	**10**
4	**Intermediate Functions** **PLC Arithmetic Functions -** Introduction, PLC addition & subtraction, the PLC repetitive clock, PLC multiplication, division & square-root: PLC trigonometric & log function, other PLC arithmetic functions. **PLC Number Comparison Functions -** Introduction, PLC basic comparison function, PLC basic comparison function application, PLC advanced comparison function. **Numbering Systems and PLC Number Conversion Functions -** Introduction, numbering system: decimal, binary & BCD, PLC conversion between decimal & BCD, OCTAL & HEX DECIMAL numbering system, other numbering & code system.	**06**	**15**
5	**Data Handling Functions** **The PLC SKIP and MASTER CONTROL RELAY Functions -** Introduction, the SKIP function & application, the MASTER CNTROL RELAY function & application. **Jump Functions -** Introduction, jump with non-return, jump with return. **PLC Data Move Systems -** Introduction, PLC MOVE function & application, moving large blocks of PLC data, PLC table & registers moves, other PLC MOVE functions. **Other PLC Data Handling Functions -** Introduction, PLC FIFO functions, the FAL function, the one shot (ONS), clear (CLR) & SWEEP functions.	**06**	**15**
6	**PLC Functions Working with Bits** **PLC Digital Bit Functions and Applications -** Introduction, bit pattern in a register, changing a register bit status, shift register function, shift register application. **PLC Sequencer Functions -** Introduction, electromechanical sequencing, the basic PLC sequencer function, a basic PLC sequencer application with timing, other PLC sequencer function, cascading sequencer. **Controlling a Robot with a PLC -** Introduction, basic two axis ROBOT with PLC sequencer control, industrial three axis ROBOT with PLC control. **PLC Matrix Functions -** Introduction, applying matrix functions to reduce program length, the PLC AND & OR matrix function, the PLC COMPLEMENT & COMPARE matrix function, combination PLC matrix operation.	**06**	**15**
7	**Advanced PLC Functions**	**04**	**10**

	Analog PLC Operation - Introduction, types of PLC, analog modules & systems, PLC analog signal processing, BCD or multi-bit data processing, PLC analog output application examples.		
8	**Application development and Automation for industry verticals** Application development and automation for following industries – Power, Pharmaceuticals and Automobile.	**04**	**05**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (%)					
R Level	U Level	A Level	N Level	E Level	C Level
30	**25**	**25**	**10**	**10**	**-**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create 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

Reference Books:

1 Programmable Logic Controllers: Principles and Applications by John W. Webb and Ronald A.Reis, Prentice – Hall India publication, 5th edition

2 Programmable logic controller by Frank D. Petrusella, Tata McGraw-Hill publication

3 Programmable Logic Controllers by W. Bolton, Elsevier Newnes publication, 4th edition

4 Programmable Logic Controllers: Programming methods and applications, by John R. Hackworth and Frederick D. Hackworth Jr., Pub: Pearson

5 Computer Aided Process Control, S.K.Singh, PHI

6 Computer Based Process Control, Krishna Kant, PHI

Course Outcome:

After learning the course the students should be able to:

1. Ccompare conventional sequential control with programmable logic control system
2. Develop programs using different PLC programming languages for sequential and continuous process
3. Interface analog and digital input/ output devices with PLC using different communication protocol
4. Test the PLC based system and troubleshoot the errors associated with it.

List of Experiments:

Directions for Laboratory work:

- The list of experiments is given as a sample.
- The laboratory report should be prepared in digitized form.
- Minimum 10 experiments should be carried out.

1. To study the block diagram of Programmable Logic Controller.

2. To study Input and Output modules interface of PLC.

3. Introduction to ladder programming& to implement basic logic gates.
4. Develop, Simulate and Test Ladder diagram for Door Bell Operation.
5. Develop, Simulate and Test Ladder diagram for Bottle Filling system.
6. Develop, Simulate and Test Ladder diagram for Traffic Light Control System.
7. Develop, Simulate and Test Ladder diagram for Car Parking system.
8. Develop Simulate and Test Ladder diagram for an alarm annunciator system.
9. Develop, Simulate and Test Ladder diagram for Batch Mixer.
10. Develop, Simulate and Test Ladder diagram for Drink Dispenser system.
11. Develop and test PLC program for three phase motor in both direction.
12. Develop, Simulate and Test Ladder diagram for stepper motor control in forward and reverse direction.
13. Develop, Simulate and Test Ladder diagram for Packing line system.
14. Develop, Simulate and Test Ladder diagram for an Elevator system.
15. To study different Registers of PLC.
16. To study different Timers of PLC.
17. To study different Counters of PLC.
18. To perform basic PLC programs using Timer.
19. To perform basic PLC programs using Counter.
20. To study the PLC application for Power Plant.

Design based Problems (DP)/Open Ended Problem:

Speed measurement using counter
DC motor control in both direction
Level controller of underground and overhand tank.
Servo motor control
Automatic Stamping machine
Automatic Drilling machine
Automatic painting machine
Four-way traffic light control
Control of robotic arm

Major Equipment:

Computers, simulation software, PLCs, Input/ Output devices.

List of Open Source Software/learning website:

Learning website:
- http://nptel.iitm.ac.in/courses.php
- http://coep.vlab.co.in/?sub=33&brch=97
- http://www.plcdev.com/book/export/html/9
- http://www.plcmanual.com/
- http://literature.rockwellautomation.com/
- http://www.automation.siemens.com/

- http://www.abb.com
- http://www.schneider-electric.co.in
- http://www.ge.com

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.