GUJARAT TECHNOLOGICAL UNIVERSITY

MECHATRONICS ENGINEERING (20)
PROGRAMMABLE LOGIC CONTROLLERS
SUBJECT CODE: 2182001
B.E. 8th SEMESTER

Type of course: Engineering Science

Prerequisite: Knowledge of Digital Logic Design, Relay Logic, Knowledge of programming and flow charts

Rationale: 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
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	2	5	70	20	10	20	10	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**PLC Basics:** Introduction to Programmable Logic Controllers (PLCs), history of PLCs, Advantages of PLCs and Comparison of PLC based control systems with other conventional control systems.	03	5
2	**PLC Hardware:** Block diagram of PLC, Internal architecture of PLC, Digital and Analog Input output modules of PLCs, scan cycle and scan time, connections and wiring of various Inputs and Outputs of Plants with the PLC.	04	10
3	**Basics of PLC programming:** Overview of various programming languages of PLCs: (1) Ladder diagram, (2) Functional Block Diagram (FBD), (3) Instruction List (IL), (4) Sequential Flow Chart (SFC) Programming of On-Off inputs and outputs, producing boolean equation from given PLC program, design of PLC program from given boolean function using above programming languages	10	20
4	**PLC Timers and Counter Instructions:** Various types of PLC timers with detailed timing diagrams: On delay timer, Off delay timer, Retentive on delay timer, Pulse timer. Various types of PLC counters: Up counter, Down counter, Up-Down counter Programming of various applications using timers and counters using Ladder diagram only.	10	30

5	**Analog PLC operations:** Programming applications using analog I/O with ladder diagram only. Close loop control using PLC.	**04**	**10**
6	**Numerical applications using PLCs:** Data transfer instructions, data comparison instructions, arithmetic instructions. Programming of various applications using numerical instructions in ladder diagram only	**08**	**15**
7	**Practical aspects:** Designing systems, selection of PLCs, commissioning of PLCs, various fault finding techniques and troubleshooting, safe systems.	**03**	**10**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	**20**	**15**	**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: Forth Edition, by W. Bolton, Pub: Elsevier Newnes
2. Programmable Controllers An engineer's guide, third edition by E.A.Parr, Pub: Elsevier Newnes
3. Programmable Logic Controllers: Principles and Applications, by John W. Webb and Ronald A. Reis, fifth edition, Pub: Prentice – Hall India

Course Outcome:

After successful completion of the course, student will be able to

1. understand the fundamentals of programmable logic controller
2. develop program using standard programming languages
3. select, configure, wiring and troubleshoot of PLC
4. develop an application orientated project using PLC

List of Experiments:

1. Introduction to PLCs and design PLC programs for various logic gates using various PLC programming languages.
2. Simulation of water level control in a tank using various PLC programming languages
3. On off control of DC motor in forward and reverse directions using various PLC programming languages
4. On off control of conveyor belt using various PLC programming languages
5. Ladder diagram for system using timer instructions
6. Ladder diagram for system using counter instructions
7. Ladder diagram for bottle filling application

8. Ladder diagram for flash light control
9. Ladder diagram for traffic light control
10. Ladder diagram for star delta starter of 3 phase induction motor
11. Simulation of industrial application using ladder diagram
12. Ladder diagram for system using analog I/O

Design based Problems (DP)/Open Ended Problem:

1. Servo motor control using PLC.
2. Automatic color mixing plant/machine using PLC
3. Automatic drilling machine using PLC
4. Automatic packing machine using PLC
5. Robotic arm control using PLC

Major Equipment:

(1) PLCs with suitable programming software
(2) DC motor, conveyor belt with suitable power supplies
(3) Various application modules

List of Open Source Software/learning website:

http://www.plcdev.com/book/export/html/9
http://www.plcmanual.com/
http://literature.rockwellautomation.com/
http://www.automation.siemens.com/
http://nptel.ac.in/video.php

Virtual Lab Website

www.vlab.co.in

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 be submitted to GTU.