**5.3 PROGRAMMABLE LOGIC CONTROLLERS AND MICRO CONTROLLERS**

## RATIONALE

**L T P**

**5 - 2**

A diploma holder when employed in automated industrial process controls or in automated power station will be required to know the basics of Programmable Logic Controllers, their working and their programming. In industry, many manufacturing processes demand a sequence of operation, which are to be performed repetitively. Early automation systems were mechanical in design, timing and sequencing being effected by gears and cams. Slowly these design concepts were replaced by electrical drives which were controlled by relays and now by programmable logic controllers (PLCs). A PLC is a solid state device, designed to operate in noisy industrial environments and can perform all logic functions. PLCs are widely used in all industries for efficient control operations. A diploma holder in industry is called upon to design , modify and troubleshoot such control circuits. Looking at the industrial applications of PLCs in the modern industry, this subject finds its usefulness in the present curriculum.

Microcontrollers have also assumed great significance in the field of electronics and comma goods industry, and thus considered to be an important field of engineering. This subject aims to expose the students to both of these and give them adequate knowledge of these topics.

## LEARNING OUTCOMES

After undergoing the subject, students will be able to:

* Explain functioning of PLC
* Identify inputs and outputs modules and configure with PLC module.
* Write a simple ladder logic program to realize logic functions.
* Use PLCs for simple applications
* Explain working of SCADA system for simple applications
* Explain the architecture and pin diagram of 8051 microcontroller
* Write a simple program to demonstrate Input and Output operations
* Interface Keypad, 7-segment display and stepper motor with micro controller.

## DETAILED CONTENTS

1. Introduction to PLC (06 Periods)

What is PLC, concept of PLC, Building blocks of PLC, Functions of various blocks, limitations of relays. Advantages of PLCs over electromagnetic relays. Different programming languages, PLC manufacturer etc.

1. Working of PLC (08 Periods)
   * Basic operation and principles of PLC
   * Architectural details processor
   * Memory structures, I/O structure
   * Programming terminal, power supply
2. Instruction Set (12 Periods)
   * Basic instructions like latch, master control self holding relays.
   * Timer instruction like retentive timers, resetting of timers.
   * Counter instructions like up counter, down counter, resetting of counters.
   * Arithmetic Instructions (ADD,SUB,DIV,MUL etc.)
   * MOV instruction
   * RTC(Real Time Clock Function)
   * Comparison instructions like equal, not equal, greater, greater than equal, less than, less than equal
3. Ladder Diagram Programming (10 Periods)

Programming based on basic instructions, timer, counter, sequencer, and comparison instructions using ladder program.

5 Applications of PLCs (10 Periods)

* Assembly line
* Packaging
* Process controls
* Car parking
* Traffic light control
* Washing machine
* Motor in forward and reverse direction
* Star-Delta, DOL Starters
* Filling of Bottles
* Room Automation

1. Introduction to SCADA (02 periods)
2. Micro Controller Series (MCS)-51 Over View (08 Periods)
   * Difference between micro processor and micro controller
   * Pin details
   * I/o Port structure
   * Memory Organisation
   * Special function registers
3. Instruction Set and Addressing Modes (08 Periods)
   * Timer operation
   * Serial Port operation
   * Interrupts
4. Assembly language programming (08 Periods)
   * Data Transfer operations
   * Input/Output operations
5. Design and Interface (06 Periods)

Examples like: keypad interface, 7- segment interface, LCD, stepper motor.

11. Application of Micro controllers (02 Periods) Listing different types of Micro controllers and their typical applications (one each)

## LIST OF PRACTICALS PLCs

1. Demonstration of various components/sub-components of a PLC, Learning functions of different modules of a PLC system
2. Practical steps in programming a PLC (a) using a Hand held programmer (b) using computer interface
3. Demonstration to step 5 programming language, ladder diagram concepts, instruction list syntax
4. Basic logic operations, AND, OR, NOT functions
5. Logic control systems with time response as applied to clamping operation
6. Sequence control system e.g. in lifting a device for packaging and counting
7. Use of PLC for an application( teacher may decide)

## Micro Controllers

1. Demonstration and study of Micro Controllers (8051) kit
2. Testing of general input/output on Micro controller board
3. Controlling of LEDs using microcontroller program

## INSTRUCTIONAL STRATEGY

Introduce the subject and make the students familiar with applications of PLCs and Microcontrollers. The inputs shall start with theoretical inputs to architecture, instruction set, assembly language programming, Small projects may be identified, be designed and implemented. PLC ladder diagram and programming should be supplemented with visits to industry. More emphasis may be given to practical work.

## MEANS OF ASSESSMENT

* Assignments and quiz/class tests, mid-term and end-term written tests.
* Actual laboratory and practical work, model/prototype making, assembly and disassembly exercises and viva-voce

## RECOMMENDED BOOKS

1. Programmable Logic Controller by Job Dan Otter; P.H. International, Inc, USA
2. Introduction to PLCs by Gary Dunning. McGraw Hill
3. Module on PLCs and their Applications by Rajesh Kumar, NITTTR Chandigarh
4. Programmable Logic Controller and Microcontrollers by Gurpreet Kaur and SK Sahdev by Uneek Publications, Jalandhar
5. Module on “Allen Bradlag PlC (SLC 500), Institution set-1, by Rajesh Kumar, NITTTR, Chandigarh
6. Module on “PLC Applications based on SLC 5/03” By Rajesh Kumar, NITTTR Chandigarh
7. The 8051 Micro controllers Architecture, programming and Applications by Ayala; Penram International
8. Microcontrollers by Mazidi
9. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

## Websites for Reference:

[http://swayam.gov.in](http://swayam.gov.in/)

## SUGGESTED DISTRIBUTION OF MARKS

|  |  |  |
| --- | --- | --- |
| **Topic No.** | **Time Allotted (Periods)** | **Marks Allocation (%)** |
| 1. | 06 | 05 |
| 2. | 08 | 13 |
| 3. | 12 | 12 |
| 4. | 10 | 10 |
| 5. | 10 | 10 |
| 6. | 02 | 05 |
| 7. | 08 | 12 |
| 8. | 08 | 10 |
| 9. | 08 | 11 |
| 10. | 06 | 07 |
| 11. | 02 | 05 |
| **Total** | **80** | **100** |

## Recommended Books of PLC & micro controllers:-

## Text books:

1. Programmable Logic controllers and microcontrollers by sanjeev Gupta and dr. sanjiv Kumar, Ishan publications.
2. Programmable Logic Controller and Microcontrollers by Gurpreet Kaur and SK Sahdev by Uneek Publications, Jalandhar

**Guide Books:**

1. Module on “Allen Bradley PLC (SLC 500), Institution set-1, by Rajesh Kumar, NITTTR, Chandigarh
2. Module on PLCs and their Applications by Rajesh Kumar, NITTTR Chandigarh
3. Microcontrollers by Mazidi

**Reference Books:**

1. Programmable Logic Controller by Job Dan Otter; P.H. International, Inc, USA
2. Introduction to PLCs by Gary Dunning. McGraw Hill
3. The 8051 Micro controllers Architecture, programming and Applications by Ayala; Penram International

**Note:** e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.