PLC Technology with the AB CompactLogix

COURSE-SERIES OUTLINE

Contents

Course Name	**PLC Technology 1 with the Allen-Bradley CompactLogix**
Catalogue Number	8230-0010
Category	Automation / PLCs
Duration	15 Hours
Prerequisites	None

1. Defining PLCs

The LearnMate Interface

Using the Glossary

What is a PLC?

Control Systems

Basic PLC Functions

The Scan Cycle

2. PLC History and Major PLC Brands

Relays – Precursors to PLCs

Relays and the PLC

PLC Development Timeline

Major PLC Manufacturers

Total Automation

Programmable Automation Controllers (PACs)

3. PLC Hardware

- Essential PLC Hardware Components
- Structure Based on Function
- PLC Hardware Tour
- Compact PLC Structure
- Modular PLC Structure
- Modular PLC Block Diagram

4. Field Devices and Signal Types

- Input and Output Devices
- Analog and Digital
- Signal Types
- Wiring Field Devices
- Wiring Diagrams

5. PLC Programming Languages

- The Five Standardized PLC Programming Languages
- Ladder Diagram and other Graphical Languages
- Textual Programming Languages
- Other Programming Languages
- Mixing Programming Languages

6. Ladder Logic Basics

- Ladder Diagram Structure
- Basic Input and Output Bit Instructions
- Instruction Representation
- Scan Cycle Steps
- How a Ladder is Scanned
- PLC Tags
- Tag Creation
- Tag Components
- Referencing Tags

7. The Studio 5000 Interface

- Screen Components
- Project Hierarchies
- Important Project Window

8. Project: Connecting Your PLC

- PLC1 Kit Components
- Inventory and Safety Checks
- Creating a New Project
- Hardware Configuration
- Establishing Communication
- PLC Modes
- Downloading the Project
- Saving and Archiving Projects
- Inventory Check and Shut Down

9. Project: Creating a Program

- Programming a Basic Ladder Diagram
- Creating and Monitoring Tags
- Building a Ladder Diagram
- Placing Instructions
- Branching
- Online and Monitoring
- Debugging and Troubleshooting
- Downloading and Testing

10. Boolean Logic Functions

- Bit Logic
- AND, OR and NOT Logic
- Advanced Logic Gates

11. Project: Controlling a Sorting System

- Controlling a Sorting System
- Programming the Ladder Diagram
- Inventory and Safety Checks
- Downloading and Testing the Program
- Inventory Check and Shut Down

12. Project: Improving Control and Safety

- Improving Control and Safety
- Programming with NOT Logic
- Inventory and Safety Checks
- Testing the New Program
- Inventory Check and Shut Down

13. Project: Elevator Control

- Controlling an Elevator
- Programming with AND Logic
- Designing the Ladder Diagram
- Inventory and Safety Checks
- Modifying the Elevator Control System
- Inventory Check and Shut Down

14. Project: Elevator Safety

- Programming with OR Logic
- Programming with OR Logic
- Inventory and Safety Checks
- Running the Program
- Adding a Warning Lamp to the System
- Inventory Check and Shut Down

15. Project: Arsenic Filling Station

- Arsenic Filling Station
- Designing the Ladder Diagram
- Inventory and Safety Checks
- Simulating the Arsenic Filling Station
- Inventory Check and Shut Down

Course Name	PLC Technology 2 with the Allen-Bradley CompactLogix
Catalogue Number	8230-0020
Category	Automation / PLCs
Duration	15 Hours
Prerequisites	None

1. PLC Memory

Bits, Bytes, and Words

Memory Types

Important PLC Locations

Use of Memory Units

Online and Offline Programming

2. Project: Tags and Data Types

Identifying Memory Components

Online Testing

Examining Bit and Word Values

Data Monitor and Tag Editor

Tag Columns

Tag Data Types

Forcing I/O

3. Latch and Unlatch

Retentive and Non-Retentive Output Instructions

The Unlatch and Latch Instructions

Other Latching and Unlatching Methods

4. Project: Gate Control

Gate Control with PLCs

Ladder Design

Output latch (OTL) and Output Unlatch (OTU) Instructions

Programming with OTL and OTU

Inventory and Safety Checks

Running the Program

Inventory Check and Shut Down

5. **Project: Modern Elevator**
    - Elevator Control with OTL and OTU
    - Designing a Ladder Diagram to Control a Freight Elevator
    - Inventory and Safety Checks
    - Running the Program
    - Inventory Check and Shut Down
6. **One Shot**
    - Retentive and Non-Retentive Inputs
    - Inputs and the Scan Cycle
    - One Shot Instructions
    - ONS, OSR, and OSF
7. **Project: Automatic Stapler**
    - Controlling an Automatic Stapler
    - The ONS Instruction
    - Designing the Ladder Diagram
    - Programming Without the ONS Instruction
    - Inventory and Safety Checks
    - Running the Program
    - Revising a Program by Adding an ONS Instruction
    - Running the Modified Program
    - Inventory Check and Shut Down
8. **Timer Structures**
    - Generic Timer Structure
    - Box Structure
    - Timer Files
    - Timer Structure Members
    - TON, TOF, and RTO
    - Applications of Timer Instructions

9. Project: Timer On Delay

- Adding a Delay
- Timer ON Delay (TON)
- Programming with the TON Instruction
- Inventory and Safety Checks
- Running the Program
- Monitoring Timer Tags
- Inventory Check and Shut Down

10. Project: Timer Off Delay

- Controlling an Automatic Punch
- Timer OFF Delay (TOF)
- Programming with the TOF Instruction
- Inventory and Safety Checks
- Running the Program
- Activating the Solenoid Using a TON (Instead of a TOF)
- Inventory Check and Shut Down

11. Timer Projects

- Controlling Outputs for Different Time Ranges
- Inventory and Safety Checks
- Flashing Lamps
- Short Cycle and Long Cycle Switch
- Programming and Running the Ladders
- Inventory Check and Shut Down

12. Counter Instructions

- Generic Counter Structure
- Counter Box Structure
- Counter Files
- Counter Structure Members
- Counter Memory
- CTU and CTD

13. Project: Counter Up and Reset

- Using a PLC to Control a CNC Lathe
- The Count Up (CTU) Instruction
- The Reset (RES) Instruction
- Writing a CNC Lathe Control Program
- Inventory and Safety Checks
- Programming with the CTU Instruction
- Running the Program
- Modifying the Program
- Inventory Check and Shut Down

14. Project: Counter Down

- Using a PLC to Control a Parking Lot
- The Count Down (CTD) Instruction
- Designing the Ladder Diagram
- Inventory and Safety Checks
- Programming with the CTU and CTD Instruction
- Simulating the Parking Lot Control Program
- Modifying the System to Include an Automatic Gate
- Inventory Check and Shut Down

15. Final Project: The Lifting Platform

- Project Specifications
- Inventory and Safety Checks
- Programming the Ladder Diagram
- Running the Program
- Modifying the Program
- Inventory Check and Shut Down

Course Name	PLC Technology 3 with the Allen-Bradley CompactLogix
Catalogue Number	8230-0030
Category	Automation / PLCs
Duration	15 Hours
Prerequisites	None

1. Tips and Tricks

Review of PLC Hardware and Functionality

Review of Bit Logic, Timer, and Counter Ladder Diagram Instructions

Review of the Studio 5000 Interface

Ladder Editor View Options

Instruction Shortcuts and Short Forms

Compile Errors and Verifying a Routine

2. Compare Instructions

Introduction to Compare Instructions

Placement of instructions

Instruction Parameters (Sources)

Data Type Requirements

Overview of Compare Instructions

Bit Masks

3. Project: The Equal (EQU) Instruction

Using PLC to Control a CNC Lathe

The Equal (EQU) Instruction

Instructions Designing the Ladder Diagram

Inventory and Safety Checks

Programming with EQU

Inventory Check and Shut Down

4. **Project: The Not Equal (NEQ) Instruction**
    - Using PLC to Control a Sign with Flashing Lights
    - The Not Equal (NEQ) Instruction
    - Designing the Ladder Diagram
    - Inventory and Safety Checks
    - Programming with the NEQ (Not Equal) Instruction
    - Testing the Flashing Lights Application
    - Inventory Check and Shut Down
5. **Project: Conveyors**
    - Using a PLC to Control Three Conveyors with Three Separate Motors
    - Designing the Ladder Diagram
    - Inventory and Safety Checks
    - Programming with the EQU and NEQ Instruction
    - Simulating the Conveyor Control Program
    - Adding a Buzzer to the Control System
    - Inventory Check and Shut Down
6. **Project: The Less Than (LES) Instruction**
    - Using a PLC to Control an Automatic Caliper System
    - The Less Than (LES) Instruction
    - Designing the Ladder Diagram
    - Inventory and Safety Checks
    - Programming with the Less Than (LES) Instruction
    - Running the Automatic Caliper Control Program
    - Inventory Check and Shut Down
7. **Project: The Greater Than (GRT) Instruction**
    - Using a PLC to Control an Ice Cream Filling Station
    - Designing the Ladder Diagram
    - The Greater Than (GRT) Instruction
    - Inventory and Safety Checks
    - Programming with the GRT (Greater Than) Instruction
    - Running the Application
    - Modifying the Program to Stop the Filling Process when the Time Exceeds 15 Seconds
    - Inventory Check and Shut Down

8. Project: Oven Conveyor System

- Using a PLC to Control an Oven Conveyor System
- Designing the Ladder Diagram
- Inventory and Safety Checks
- Programming with the GRT and LES Instructions
- Running the Oven Conveyor Control Program
- Inventory Check and Shut Down

9. Project: The Limit Instruction

- Controlling Three Devices
- Designing the Ladder Diagram
- Inventory and Safety Checks
- Programming with the LIM Instruction
- Running the Machining Application
- Inventory Check and Shut Down

10. Project: The Move (MOV) Instruction

- Using a PLC to Control a Butter Filling Station
- The Move (MOV) Instruction
- Source and Destination
- Instructions Designing the Ladder Diagram
- Inventory and Safety Checks
- Programming with the Move (MOV) Instruction
- Running the Butter Filling Control Program
- Modifying the Program to Lengthen the Pause Between Each Cycle
- Inventory Check and Shut Down

11. Mathematical Instructions

- Introduction to mathematical instructions
- Placement of instructions
- Memory requirements for instructions
- Instruction Parameters
- Overview of Compute/Math Instructions
- Conversion Instructions
- Decimal, Binary, and BCD

12. Project: The Automated Crane

- Using a PLC to Control a Crane
- The ADD Instruction
- Designing the Ladder Diagram
- Inventory and Safety Checks
- Programming with the ADD Instruction
- Running the Crane Control Program
- Inventory Check and Shut Down

13. Project: The Subtract (SUB) Instruction

- Using a PLC to Control a Coffee Machine
- The Subtract (SUB) Instruction
- Designing the Ladder Diagram
- Inventory and Safety Checks
- Programming with the Subtract (SUB) Instruction
- Running the Coffee Machine Control Program
- Modifying the Coffee Machine Control Program
- Inventory Check and Shut Down

14. Project: The Tallying System

- Project Specifications
- Designing the Ladder Diagram
- Monitoring the Count
- Inventory and Safety Checks
- Programming the Tallying System
- Running the Tallying System Program
- Inventory Check and Shut Down

15. Final Projects

- Project Specifications
- Inventory and Safety Checks
- Programming the Applications
- Running the Applications
- Inventory Check and Shut Down

Course Name	PLC Technology 4 with the Allen-Bradley CompactLogix
Catalogue Number	8230-0040
Category	Automation / PLCs
Duration	15 Hours
Prerequisites	None

1. Getting Back to the Basics

Bit Logic Instructions Review

Counters and Timers Review

Comparison Instructions Review

Mathematical Instructions Review

Logix Designer Review

Project Documentation

Routine Documentation

Hiding/Showing Documentation

2. PLC Communication

Communication Protocols and Mediums

Ethernet and LANs

TCP and OSI Models

IP Addresses and Subnets

Network Switches

3. HMIs

Introducing HMIs

Everyday HMIs and Industrial HMIs

Working with HMIs

Functions of HMIs

HMI Programming

HMI-PLC Communication

SCADA Architecture

4. **Project: Introduction to View Designer**
    - Your HMI Module
    - The View Designer Interface
    - Screen Design
    - JMTS Setup and Connections
    - Creating a Base Project
    - Going Online
    - Creating a New View Designer Project
    - Downloading the Runtime Application
    - Testing the HMI Project
    - Shutdown
5. **Project: Navigation and Monitoring**
    - HMI Project Planning
    - Types of Screens
    - Screen Hierarchy
    - Creating the Control Application
    - Navigation Between Screens
    - Building the HMI Screen
    - Downloading and Testing
    - Shutdown
6. **Project: The Stuck Conveyor**
    - The Scenario
    - DC Motor Control in Previous Projects
    - DC Motor Control with an HMI
    - Numeric Inputs
    - Animations
    - Building the Control Program
    - Navigation and a New Screen
    - Creating Animations
    - Downloading and Testing
    - Shutdown

7. Project: Jump to Subroutine

- Tasks, Programs, and Subroutines
- Tasks and Task Types
- Programs
- Subroutines for Organization
- Creating Subroutines
- The JSR Instruction
- Creating Subroutines
- Using the JSR Instruction
- Removing Parameters
- Downloading and Testing
- Shutdown

8. Project: SBR and RET

- Subroutines as Functions
- Subroutine Label (SBR)
- Return from Subroutine (RET)
- Creating the Temperature Conversion Subroutine
- Adding JSR Instructions to the Main Routine
- Building the HMI Screen
- Downloading and Testing
- Challenge Activity
- Shutdown

9. Project: Arrays

- Introduction to Arrays
- Array Subscripts
- Array Dimensions
- Creating an Array
- Get System Value (GSV)
- File Copy (COP) and File Fill (FLL)
- Building the Array and Subroutine
- Copying the Array
- The HMI Screen
- Downloading and Testing
- Shutdown

10. Project: UDTs

- Predefined Data Types
- Module Defined Data Types
- The Need for User Defined Data Types (UDTs)
- Working with UDTs
- Creating UDTs
- The HMI Screen
- Downloading and Testing
- Shutdown

11. Project: The Faults in Our Controllers

- Introduction to Controller Faults
- Main Fault Categories
- Major, Minor, and I/O Faults
- Fault Recovery: Best Practices
- Example Faults and How to Resolve Them
- Logix 5000 Controllers Fault Codes
- Creating the Routine with the Fault
- Clearing and Resolving the Fault
- Preventing the Fault from Returning
- Shutdown

12. Project: Alarms and Automatic Diagnostics

- Controller Alarms
- Alarms on the HMI
- Alarm Conditions
- Alarm States
- The ALMD Instruction
- The Logix Designer Alarm List
- Faults and Automatic Diagnostics
- Creating, Triggering, and Acknowledging an Instruction-Based Alarm
- Creating, Triggering, and Acknowledging a Tag-Based Alarm
- Shutdown

13. PLC Communication – Part 2

- Industrial Ethernet
- Local and Remote I/O
- Adding Local and Remote I/O Modules to a Project
- Adding Third Party Vendor Hardware to a Project
- Introduction to IO-Link
- Network Topologies
- Interactions Between CompactLogix Controllers
- Produced and Consumed Tags

14. PLC Challenge Projects

- Challenge 1: The Crosswalk
- Challenge 2: The Memory Game
- Challenge 3: Factory Application

ⓘ ***Important Note:*** *This outline is subject to change.*