## Unit 42: Further Programmable Logic Controllers (PLCs)

**Unit code**  
H/615/1510

**Unit level**  
5

**Credit value**  
15

### Introduction

Programmable Logic Controllers (PLCs) were invented by the American Richard ('Dick') Morley in 1969, to be used in the manufacture of cars. Prior to that date production lines had been controlled by a mass of hard-wired relays. Using programmable devices in their place meant that changes in production could be implemented much faster without the need to rewire control circuits.

The aim of this unit is to further develop students' skills in the use of PLCs and their specific applications within engineering and manufacturing. Among the topics included in this unit are: device interface methods, PLC signal processing and communications with other devices, PLC programming methodology and alternative programmable control devices.

On successful completion of this unit students will be able to research the design, selection and use of PLCs as part of a larger system, programme a PLC to solve an industrial process problem for a given application and illustrate the alternative strategies for using other available types of programmable control devices.

### Learning Outcomes

By the end of this unit students will be able to:

1. Discuss the selection of a specific PLC for a given industrial application.
2. Evaluate how PLCs exchange information and process signals with other devices.
3. Design a PLC programme to solve an industrial process problem for a given application.
4. Analyse alternative strategies using other types of programmable control devices in industrial applications.
Essential Content

LO1 Discuss the selection of a specific PLC for a given industrial application

PLC selection:
Common PLC industrial applications
Different PLC types, their features and PLC manufacturers
External input and output devices: analogue and digital
PLC operational characteristics: speed, current, voltages, memory
Alternative PLC modules available: Relay, Triac, Transistor, Analogue to Digital

LO2 Evaluate how PLCs exchange information and process signals with other devices

PLC signal processing and communications with other devices:
Communication links and standards
Networked bus systems
Supervisory Control and Data Acquisition (SCADA) systems and Human Machine Interfaces (HMIs)
LO3  **Design a PLC programme to solve an industrial process problem for a given application**

*PLC programming methodology:*
- Fundamentals of logic–ladder diagrams and other programming structures
- PLC programming methods used of PLCs in accordance with IEC 61131
- Logic functions: AND, OR, NOT, EXOR
- Number systems used by PLCs: Binary, Hexadecimal, Octal, BCD
- System input and output allocation data
- Advanced functions: registers, Analogue to Digital (AtoD), performing calculations, high-speed counters and timers
- Program test and debug software functions
- Fault-finding of systems using PLC software remotely
- Software toolbox elements
- Virtual PLC simulations

LO4  **Analyse alternative strategies for using other types of programmable control devices in industrial applications**

*Alternative programmable control devices:*
- Programmable Logic Device (PLD)
- Peripheral Interface Controller (PIC)
- Microcontrollers
- Industrial computers

*Programmable device interface methods:*
- Relays and solid state relays
- Opto couplers
- Opto isolators
- Motor driver interface integrated circuits
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<tr>
<th>Pass</th>
<th>Merit</th>
<th>Distinction</th>
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<tr>
<td><strong>LO1</strong> Discuss the selection of a specific PLC for a given industrial application</td>
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<td><strong>D1</strong> Evaluate and justify the selection of a specific PLC for an industrial application</td>
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<td><strong>P1</strong> Investigate the key industrial application characteristics of a given industrial application</td>
<td><strong>M1</strong> Justify the choice of a specific PLC suitable for a given industrial application</td>
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<td><strong>P2</strong> Compare the operational features and characteristics of PLCs from several manufacturers</td>
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<td><strong>LO2</strong> Evaluate how PLCs exchange information and process signals with other devices</td>
<td><strong>D2</strong> Provide justified and valid rationale for the convergence of PLCs/HMIs and SCADA control systems</td>
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<td><strong>P3</strong> Illustrate the main differences between communication links and standards used within PLC systems</td>
<td><strong>M2</strong> Show how PLCs in industry integrate with HMIs and SCADA</td>
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<td><strong>P4</strong> Review the advantages of using networked bus PLC systems</td>
<td><strong>M3</strong> Evaluate the use of SCADA and HMIs in industry</td>
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<td><strong>LO3</strong> Design a PLC programme to solve an industrial process problem for a given application</td>
<td><strong>P5</strong> Design a PLC programme to solve an industrial application problem</td>
<td><strong>D3</strong> Critically evaluate a PLC programme used to solve an industrial application problem</td>
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<td><strong>P6</strong> Demonstrate the use of PLC programming and simulation software in a given application</td>
<td><strong>M4</strong> Demonstrate the use of test and debug software to correct PLC program faults</td>
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<td><strong>LO4</strong> Analyse alternative strategies for using other types of programmable control devices in industrial applications</td>
<td><strong>M5</strong> Explore the practical uses of PLC advanced functions</td>
<td><strong>D4</strong> Critically evaluate the selection of an alternative programmable device in a given application</td>
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<td><strong>P7</strong> Review the different types of programmable control devices available</td>
<td><strong>M6</strong> Review the problems faced by using alternative devices in an industrial environment</td>
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<td><strong>P8</strong> Examine an industrial application to determine the required characteristics of a control device</td>
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Recommended Resources

Textbooks

Websites
www.seipub.org/ Science and Engineering Publishing Company
International Journal of Information and Computer Science
(Journal)
http://www.airccse.org/ AIRCC Publishing Corporation
International Journal of Computer Science, Engineering and Information Technology
(IJCSEIT) (Journal)

Links
This unit links to the following related units:
*Unit 15: Automation, Robotics and Programmable Logic Controllers (PLCs)*
*Unit 6: Mechatronics*
*Unit 40: Commercial Programme Software*