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

Learning Outcomes and Assessment Criteria

Pass	Merit	Distinction
LO1 Discuss the selection of a specific PLC for a given industrial application		**D1** Evaluate and justify the selection of a specific PLC for an industrial application
P1 Investigate the key industrial application characteristics of a given industrial application **P2** Compare the operational features and characteristics of PLCs from several manufacturers	**M1** Justify the choice of a specific PLC suitable for a given industrial application	
LO2 Evaluate how PLCs exchange information and process signals with other devices		**D2** Provide justified and valid rationale for the convergence of PLCs/HMIs and SCADA control systems
P3 Illustrate the main differences between communication links and standards used within PLC systems **P4** Review the advantages of using networked bus PLC systems	**M2** Show how PLCs in industry integrate with HMIs and SCADA **M3** Evaluate the use of SCADA and HMIs in industry	

Pass	Merit	Distinction
LO3 Design a PLC programme to solve an industrial process problem for a given application		**D3** Critically evaluate a PLC programme used to solve an industrial application problem
P5 Design a PLC programme to solve an industrial application problem **P6** Demonstrate the use of PLC programming and simulation software in a given application	**M4** Demonstrate the use of test and debug software to correct PLC program faults **M5** Explore the practical uses of PLC advanced functions	
LO4 Analyse alternative strategies for using other types of programmable control devices in industrial applications		**D4** Critically evaluate the selection of an alternative programmable device in a given application
P7 Review the different types of programmable control devices available **P8** Examine an industrial application to determine the required characteristics of a control device	**M6** Review the problems faced by using alternative devices in an industrial environment	

Recommended Resources

Textbooks

BOLTON, W. (2015) *Programmable Logic Controllers*. 5th Ed. Newes.

KAMEL, K. and KAMEL, E. (2013) *Programmable Logic Controllers: Industrial Control*. McGraw-Hill Education.

MORTON, J. (2005) *The PIC Microcontroller: Your Personal Introductory Course*. 3rd Ed. Newnes.

PEREZ, E. (2012) *Introduction to PLCs: A beginner's guide to Programmable Logic Controllers*. Elvin Perez Adrover.

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