Unit 5009: Further Programmable Logic Controllers (PLCs)

Unit Code: F/651/0863

Level: 5

Credits: 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:

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

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

LO3 Design a PLC programme to solve an industrial process problem for a given application

LO4 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		
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.	**D1** Evaluate and justify the selection of a specific PLC for an industrial application.
LO2 Evaluate how PLCs exchange information and process signals with other devices		
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.	**D2** Provide a justified and valid rationale for the convergence of PLCs/HMIs and SCADA control systems.
LO3 Design a PLC programme to solve an industrial process problem for a given application		
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.	**D3** Critically evaluate a PLC programme used to solve an industrial application problem.
LO4 Analyse alternative strategies for using other types of programmable control devices in industrial applications.		
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.	**D4** Critically evaluate the selection of an alternative programmable device in a given application.

Recommended Resources

Note: See HN Global for guidance on additional resources.

Print Resources

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.

Petruzella F. (2023) *Programmable Logic Controllers*. 6th Ed. McGraw Hill.

Rehg A. R. and SARTOR J. G. (2014) *Programmable Logic Controllers.* 2nd Ed. Pearson.

Stewart G. R. (2021) *Plc Programming for Beginners*. SIEMENS.

Websites

http://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 4006: Mechatronics

Unit 4015: Automation, Robotics and Programmable Logic Controllers (PLCs)

Unit 5007: Commercial Programming Software.

