Unit 15: Automation, Robotics and Programmable Logic Controllers (PLCs)

Unit code K/615/1489
Unit level 4
Credit value 15

Introduction
The word automation was not used until the 1940s and it originated in the automotive manufacturing sector as a method designed to reduce labour costs and improve the quality, accuracy and precision of the finished products. We are all now very familiar with the sight of dancing robots, not only in the production of cars but in everything from washing machines to pharmaceuticals. As a result of this technology the products we purchase may have never been touched by human hands and we all benefit from a reduction in costs and improvement in quality.

The aim of this unit is for students to investigate how Programmable Logic Controllers (PLCs) and industrial robots can be programmed to successfully implement automated engineering solutions.

Among the topics included in this unit are: PLC system operational characteristics, different types of programming languages, types of robots and cell safety features.

On successful completion of this unit students will be able to program PLCs and robotic manipulators to achieve a set task, describe the types and uses of PLCs and robots available, write simple PLC programs, and program industrial robots with straightforward commands and safety factors.

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

1. Describe the design and operational characteristics of a PLC system.
2. Design a simple PLC program by considering PLC information, programming and communication techniques.
3. Describe the key elements of industrial robots and be able to program them with straightforward commands to perform a given task.
4. Investigate the design and safe operation of a robot within an industrial application.
Essential Content

LO1  **Describe the design and operational characteristics of a PLC system**

*System operational characteristics:*

- Modular, unitary and rack mounted systems
- Characteristics, including speed, memory, scan time, voltage and current limits
- Input and output devices (digital, analogue)
- Interface requirements
- Communication standards (RS-232, RS-422, RS-485, Ethernet)
- Internal architecture
- Different types of programming languages (IEC 61131-3)

LO2  **Design a simple PLC program by considering PLC information, programming and communication techniques**

*Programming language:*

- Signal types
- Number systems (binary, octal, hexadecimal)
- Allocation lists of inputs and outputs
- Communication techniques
- Network methods
- Logic functions (AND, OR, XOR)
- Associated elements (timers, counters, latches)

*Test and debug methods:*

- Systematic testing and debugging methods
- Proper application of appropriate testing and debugging methods

LO3  **Describe the key elements of industrial robots and be able to program them with straightforward commands to perform a given task**

*Element considerations:*

- Types of robots
- Mobile robotics
- Tools and end effectors
- Programming methods
- Robot manipulators (kinematics, design, dynamics and control, vision systems, user interfaces)
LO4 Investigate the design and safe operation of a robot within an industrial application

Safety:
Cell safety features
Operating envelope
Operational modes
User interfaces
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<th>Learning Outcomes and Assessment Criteria</th>
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<tr>
<td><strong>Pass</strong></td>
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<tr>
<td><strong>LO1</strong> Describe the design and operational characteristics of a PLC system</td>
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<td><strong>P1</strong> Describe the key differences of PLC construction styles and their typical applications</td>
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<td><strong>P2</strong> Determine the types of PLC input and output devices available</td>
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<td><strong>P3</strong> Describe the different types of communication links used with PLCs</td>
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<td><strong>LO2</strong> Design a simple PLC program by considering PLC information, programming and communication techniques</td>
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<td><strong>P4</strong> Design and describe the design elements that have to be considered in the preparation of a PLC programme program</td>
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<td><strong>P5</strong> Explain how communication connections are correctly used with the PLC</td>
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<td><strong>LO3</strong> Describe the key elements of industrial robots and be able to program them with straightforward commands to perform a given task</td>
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<td><strong>P6</strong> Describe the types of industrial robots and their uses in industry</td>
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<td><strong>P7</strong> Describe the types of robot end effectors available and their applications</td>
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<td><strong>LO4</strong> Investigate the design and safe operation of a robot within an industrial application</td>
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<td><strong>P8</strong> Investigate the safety systems used within an industrial robotic cell</td>
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Recommended Resources

Textbooks

Websites
http://www.plcmanual.com/ PLC Manual (General Reference)
http://www.plcs.net/ PLC Programming Info (General Reference)
http://www.learnaboutrobots.com/ Learn About Robots Industrial Robots (General Reference)

Links
This unit links to the following related units:
*Unit 6: Mechatronics*
*Unit 42: Further Programmable Logic Controllers (PLCs)*