

Higher National Certificate/Diploma Assessment

Qualification		Pearson BTEC Higher Nationals for England (2024)			
Unit number and title		4015: Automation, Robotics and Programmable Logic Controllers (PLCs) (L4)			
Assignment title		PLC Design, Operation, and Program Design			
Assessor		Engineering Team			
Academic year	1	Unit Code	M/651/0731	Assignment	1 of 2
Internal Verifier	Dr. Mike Shaw		Verification Date	1 st September 2025	
Issue Date	1st September 2025		Final Submission Date	No later than 31st August 2026	

Policy on the Use of Artificial Intelligence (AI)

- Students are required to acknowledge the use of AI in the preparation of any assignment.
- AI tools **may be** permissible for use as learning aids, subject to the AI Assessment Scale designation given below.
- AI cannot be used to generate the final, submitted work in its entirety.
- AI cannot be used to substitute for a student's own critical thinking, analysis, and original expression.
- Assignments must reflect the student's original thought and understanding.
- Assignments are checked automatically on submission for AI content, through Turnitin.
- Assignment grades are only confirmed following viva voce examination at the end of each unit.

Artificial Intelligence Assessment Scale (AIAS)

Full details of the Artificial Intelligence Assessment Scale (AIAS) are available at [this link](#).

The AI Assessment Scale (AIAS)

Level	Description	Guidelines
1 NO AI	The assessment is completed entirely without AI assistance in a controlled environment, ensuring that students rely solely on their existing knowledge, understanding, and skills.	You must not use AI at any point during the assessment. You must demonstrate your core skills and knowledge.
2 AI PLANNING	AI may be used for pre-task activities such as brainstorming, outlining and initial research. This level focuses on the effective use of AI for planning, synthesis, and ideation, but assessments should emphasise the ability to develop and refine these ideas independently.	You may use AI for planning, idea development, and research. Your final submission should show how you have developed and refined these ideas.
3 AI COLLABORATION	AI may be used to help complete the task, including idea generation, drafting, feedback, and refinement. Students should critically evaluate and modify the AI suggested outputs, demonstrating their understanding.	You may use AI to assist with specific tasks such as drafting text, refining and evaluating your work. You must critically evaluate and modify any AI-generated content you use.
4 FULL AI	AI may be used to complete any elements of the task, with students directing AI to achieve the assessment goals. Assessments at this level may also require engagement with AI to achieve goals and solve problems.	You may use AI extensively throughout your work either as you wish, or as specifically directed in your assessment. Focus on directing AI to achieve your goals while demonstrating your critical thinking.
5 AI EXPLORATION	AI is used creatively to enhance problem-solving, generate novel insights, or develop innovative solutions to solve problems. Students and educators co-design assessments to explore unique AI applications within the field of study.	You should use AI creatively to solve the task, potentially co-designing new approaches with your instructor.

This assignment is based on the AIAS level indicated by the colour above.
Follow the instructions for that level.

If the submitted work falls outside the scope of the AIAS designation above, the assignment will be failed.

References

- Prepare your references and correctly cite them within the body of your assignment using [zbib.org](https://www.zbib.org).
- Use the Harvard referencing standard of any of the listed UK universities.
- In [zbib.org](https://www.zbib.org), create a 'Link to this Version' and copy it into your References section.
- **Assignments will be rejected if this process is not followed correctly.**

Submission Format

All text elements of your submission should be word processed, mathematical solutions can be handwritten (neatly) and scanned into your document.

Assignment Format

- **Organisation:** Use clear headings, paragraphs, and sub-sections, to ensure clarity and ease of reading. Refer to Task numbers or sections to make it clear which question you are answering. **Assignment Structure**

Your assignment **MUST** include the following sections:

- **Cover Page:** Your Course, Name, Unit Name and Assignment number/name
- **Contents Page:** List tasks or questions with page numbers.
- **References:** Correctly cite and list all sources used, but do not use Wikipedia. Please see the detailed advice on page 1.

Submission Requirements

By submitting your assignment, you confirm the following:

- **Originality:** The work is your own, with all sources properly cited.
- **Plagiarism:** You acknowledge that plagiarism and collusion are forms of academic misconduct and are strictly prohibited.
- **Plagiarism Detection:** Your assignment will be submitted to TurnItIn, a plagiarism detection service, that compares your work against databases, online sources, and other students' work.
- **False Declaration:** Making a false declaration is academic misconduct.

**Vocational
Scenario or
Context**

A typical bottled drinks manufacturing production line uses one or more PLC's, and as a newly appointed Production Engineer, your Engineering Manager has informed you that you are required to investigate its operation, including the production of a PLC program controlling it.



Figure 1 - A typical drinks botting

A typical drinks bottling

Produce a written report for the following tasks. Include any relevant sketches, diagrams and photographic images as required. Ensure you include references to any external sources used.

**Task 1
(AIAS – LEVEL 1)**

Final submission must be written in the student's own words and demonstrate personal understanding.

- Identify three types of PLC construction styles, particularly those relevant to such a bottling plant. Illustrate your answer with suitable diagrams and or photographic images.
- Identify and discuss the different types of devices that may be connected to the inputs and outputs of a typical PLC. Illustrate your answer with suitable sketches or diagrams.
- Large drinks production lines usually incorporate communication links between a computer system and the PLC. With the aid of diagrams, identify four types of communication link that are typically employed.
- As part of your investigation, you have identified 5 different programming languages commonly used in PLC systems. Provide a brief example and explanation of each. Identify, with reasons, which language would be the most suitable to be used within the drinks bottling industry. Illustrate your answer with either written examples or screen shots.
- With the aid of sketches, evaluate the internal architecture of a commonly used PLC within the plant, and explain its overall function.

**Task 2
(AIAS – LEVEL 1)**

Final submission must be written in the student's own words and demonstrate personal understanding.

- Describe the design elements which need to be considered as part of a PLC programme required to drive the section of the bottling line which controls a conveyor belt. The PLC requires an operator switch, a photo sensor to detect when objects have been placed on the conveyor belt, and a sensor to detect when they have reached the end of the conveyor. With the addition of basic logic gates and a block diagram to show these elements, and their connection to the PLC which controls the conveyor system.

- b) Describe, with examples, the communications which take place between the input and output devices, and the PLC. Illustrate your answer with suitable diagrams and or photographic images
- c) Describe the test and debugging methods used on the hardware and software for a typical manufacturer's PLC of your choice. Include examples from manufactures web sites.
- d) For the typical bottling line shown above, use a simulator of your choice, such as plcfiddle.com, to produce a PLC program to perform the following steps:
 - start the conveyor
 - pause the conveyor at an appropriate point, determined by a sensor, to allow labels to be affixed to the bottles
 - restart the conveyor
 - halt the conveyor at the end of the production process
 - It is required that a manual emergency stop override button must also be incorporated into your design.
- e) Produce screenshots of your simulation of the process and a brief description of the simulation.

**Sources of
information to
support you with
this Assignment**

Auat F., Prieto P. and Fantoni G. (Editors) (2022) *Rapid Roboting: Recent Advances on 3D Printers and Robotics* [2] *Intelligent Systems, Control and Automation: Science and Engineering* 82 (Hardback). Springer.

Bolton W. (2015) *Programmable Logic Controllers*. 6th Ed. Elsevier.

Bozek P., Krenický T. and Nikitin Y. (Editors) (2022) *Automation and Robotics: Latest Achievements, Challenges and Prospects* (Hardback). Mdpi AG.

Dawkins N. (ed.) (2014) *Automation and Controls: A guide to Automation, Controls, PLCs and PLC Programming*.

Johnson Jr C.H. and Sanusi A.L. (2022) *PLC Programming from Novice to Professional: Learn PLC Programming with Training Videos (Paperback)*. Ojula Technology Innovations.

Kumar K. and Babu B.S. (Editors) (2023) *Industrial Automation and Robotics* [2] *Techniques and Applications*. 1st Ed. CRC Press.

Manesis S. and Nikolakopoulos G. (2018) *Introduction to Industrial Automation*. 1st Ed. Routledge, Taylor and Francis Group.

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

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

Stewart G.R. (2021) *Siemens Plc Programming For Beginners: (Step-by-Step Instructions) How Can I Quickly and Easily Learn PLC Programming At Home?* Independent publication.

White M.T. (2023) *Mastering PLC Programming: The software engineering survival guide to automation programming (Paperback)*. Packt Publishing Limited.

Relevant Learning Outcomes and Assessment Criteria

Pass		Merit		Distinction	
LO1	<i>Describe the design and operational characteristics of a PLC system</i>			LO1	
P1	Describe the key differences of PLC types and configurations, and their typical applications.				
P2	Determine the types of PLC input and output devices available	M1	Explain the different types of PLC programming languages available.	D1	Analyse the internal architecture of a typical PLC to determine its operational applications.
P3	Describe the different types of communication links used with PLCs.				
Pass		Merit		Distinction	
LO2	<i>Design a simple PLC program by considering function requirements, PLC information, programming and communication techniques</i>			LO2	
P4	Design key elements that have to be considered in the preparation of a PLC program.				
P5	Explain how communication connections are correctly used with the PLC.	M2	Integrate methods used for testing and debugging PLC hardware and software.	D2	Create a fully functional PLC design for a given industrial task, with performance analysis.