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	Industrial Robots: Key Elements, Design, and Safe Operation.
Assessor	Engineering Team

Academic year	1	**Unit Code**	M/651/0731	**Assignment**	2 of 2

Internal Verifier	Dr. Mike Shaw	**Verification Date**	1st September 2025
Issue Date	2nd 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.
- Use the Harvard referencing standard of any of the listed UK universities.
- In 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 modern robotic car manufacturing assembly line is shown below. You are a newly appointed Production Engineer in a car manufacturing plant and your Engineering Manager has informed you that you are required to undertake several tasks associated with the various robots within the plant before you are assigned to active production projects. Before you take on a project, you need to demonstrate that you understand the subject area. Your manager has therefore set you the following tasks to determine your level of knowledge. 
Task 1 **(AIAS – LEVEL 1)** Final submission must be written in the student's own words and demonstrate personal understanding.	(a) Use a simulator and a selection of commands to instruct a robotic arm to reach for a component and pick it up. Illustrate your answer with suitable screen shots and annotations (b) Which types of robot tools, sensors and end effectors may be used on the plant's assembly line, and where? . Include with your written evidence either diagrams and photographic images. (c) Examine any single robotic system in the car plant and suggest enhancements to it. (d) Design and produce a robot program using a Robotic simulator, or any other programming language, for a simple welding task within the car plant. How can your program be enhanced to perform a more complex welding task?. Illustrate your answer with suitable screen shots and annotations and written text. USEFUL LINKS https://cyberbotics.com/ https://www.robotics.org/ https://www.robots.com/

Task 2 **(AIAS – LEVEL 1)** Final submission must be written in the student's own words and demonstrate personal understanding.	(a) Examine the various safety features commonly employed within a large robotic cell on the car plant's production line. Include with your written evidence either diagram and photographic images. (b) How do the safety feature you describe in Task 2 (a) ensure safe operation? (c) For the robotic cell examined in Task 2 (a), conceive a safe working plan, accompanied by a full risk assessment. USEFUL LINKS https://cyberbotics.com/ https://www.robotics.org/ https://www.robots.com/articles/safety-options-for-robotic-systems http://www.bara.org.uk/robots/robot-safety.html https://robotbenchmark.net/benchmark/pick_andplace/simulation.php https://robodk.com/download http://www.hse.gov.uk/risk/controlling-risks.htm

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 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 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
LO3	***Program industrial robots using commands to perform a given task with the knowledge of the key elements and their functions***			**LO3**	
P6	Using a selection of commands, program an industrial robot to perform given task.	**M3**	Investigate a given industrial robotic system and make recommendations for Improvement.	**D3**	Produce a fully working robotic program for a given industry task, with an illustrated scope for further improvements to achieve complex tasks.
P7	Describe the types of robot tools, sensors, and end effectors available and their applications.				
	Pass		Merit		Distinction
LO4	***Investigate the design and safe operation of a robot within an industrial application***			**LO4**	
P8	Investigate the safety systems used within an industrial robotic cell	**M4**	Analyse how the systems in place ensure safe operation of a given industrial robotic cell.	**D4**	Design a safe working plan for an industrial robotic cell in a given production process, including a full risk assessment.