

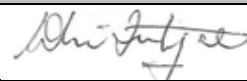
ASSIGNMENT INTERNAL VERIFICATION FORM (2017-2018)

ASSIGNMENT TITLE:	Pick and Place Robot	LEVEL:	4
MODULE :	PSDE4005 – Programmable Logic Controllers	ASSIGNMENT NO (x of y):	2 of 3
PROGRAMME:	HNC Electrical and Electronic Engineering	ASSIGNMENT AUTHOR :	R. Davies

VERSION:	DATE SUBMITTED FOR VERIFICATION :	INTERNAL VERIFIER COMMENTS (Approval or detail of amendments required):	DATE
1.	19/12/17	Conforms to the assessment pattern described in the module syllabus Tests the module learning outcomes appropriately	11/01/18
2.			

INTERNAL VERIFIER PLEASE TICK TO INDICATE THAT THE COURSEWORK:

☐	Conforms to the assessment pattern described in the module syllabus
☐	Tests the module learning outcome(s) appropriately

SIGNATURES OF FINAL APPROVAL:	SIGNATURE	DATE
INTERNAL VERIFIER: I confirm that this version of the assignment specification is ready to be sent to the external examiner		11/01/18
ASSIGNMENT AUTHOR: I confirm that internal verifier and external examiner approval have been received and that this version of the assignment specification will be distributed to students		

LEVEL/ LEFEL 4

SEMESTER 2

MODULE CODE/ COD Y MODIWL: PSDE4005
PROGRAMMABLE LOGIC CONTROLLERS

ASSESSMENT TYPE/ MATH O ASESU: ASSIGNMENT

ASSESSMENT/COMPONENT/ ASESAD/CYDRAN: 2 OF 3

COMPONENT WEIGHTING/ PWYSAU'R CYDRAN: 30%

WORD COUNT (or WORD COUNT EQUIVALENT)/ NIFER Y GEIRIAU:
Around 2500 WORDS/O EIRIAU

MODULE TUTOR / TIWTOR Y MODIWL: ROBERT DAVIES

SUBMISSION DETAILS/ MANYLION CYFLWYNO:

- Make sure that Your Name , Your Student P Number, Your Module Title, Assignment Title and Your Module Lecturer's Name are clearly shown on the front page of your assignment
- All assignments must be submitted electronically to Turnitin unless indicated by the module lecturer here:
- If lecturer additionally requires you to upload coding separately to Moodle it will be indicated here:**NO**
- If a paper submission is required, then it will be indicated here:**NO**
you will then be required to submit the assignment parts in a suitable report folder–
not in poly-pockets - to the module tutor.
For paper submissions only this form (ALL PAGES) MUST be printed out, signed, attached to the front of your assignment and submitted to the module tutor separately from your electronic assignment submission. Paper submission assignments will not be accepted without this form as it is a requirement that you sign the disclosure regarding the referencing convention.
- DO NOT put this form into Turnitin or it will match many similarities with other students' submissions.



ASSIGNMENT SPECIFICATION

Student name:		Student P number:	
Programme:	HNC Electrical and Electronic Engineering		
Lecturer:	Robert Davies	Internal Verifier:	Bill McIntyre
Assignment Title:	Pick and Place Robot		
Hand Out Date:		Submission deadline:	

Referencing:	In the main body of your submission you must give credit to authors on whose research your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have read or quoted in order to complete this assignment (e.g. for books: surname of author and initials, year of publication, <u>title of book</u> , edition, publisher: place of publication).		
Disclosure:	I declare that this assignment is all my own work and that I have acknowledged all materials used from the published or unpublished works of other people. All references have been duly cited.		
Student's Signature:	<i>Hardcopy assignments will not be accepted without a signature here</i>	Date:	

Late submission will result in a late penalty mark, as follows:

Up to one week late, maximum mark of 40% for first attempts. No late submission for resit work.

(Academic Quality Handbook 2016/17 7.5 (5))

Only the Extenuating Circumstances Committee may grant an extension.

Learning Outcomes tested (from module syllabus)

1. Demonstrate an understanding of the concepts of process control using industry standard PLC systems.

2. Undertake basic PLC system design and implementation processes, comparing theoretical expectations to actual outputs ensuring correct operation and consideration of maintenance and reliability

TASK DESCRIPTION

Aims and Objectives

The purpose of this assignment is to introduce you to further PLC system design concepts for an industrial process involving a pick and place robot where sequencing is a key factor. You will use the knowledge already gained for IEC programming languages available and their usage, I/O (input and output) device listing, basic program design, testing and documentation. Unlike the previous assignment, you will individually and will need to demonstrate the ability to develop a system that includes maintenance and reliability checking.

Figure 1 shows the pick and place robot to be controlled in this assignment. The axes of the robot are operated by pneumatic pistons controlled by solenoid valves. This allows the robot to move in, out, left, right, up and down while the gripper of the robot can also be opened and closed. There are reed switch sensors distributed around the robot that give indication of the position of each piston. There are four stations, the first being at the bottom of the entry chute and the last being on the top of the exit chute. A proximity switch on the entry chute provides senses an object entering and could be used to automatically trigger the sequence.

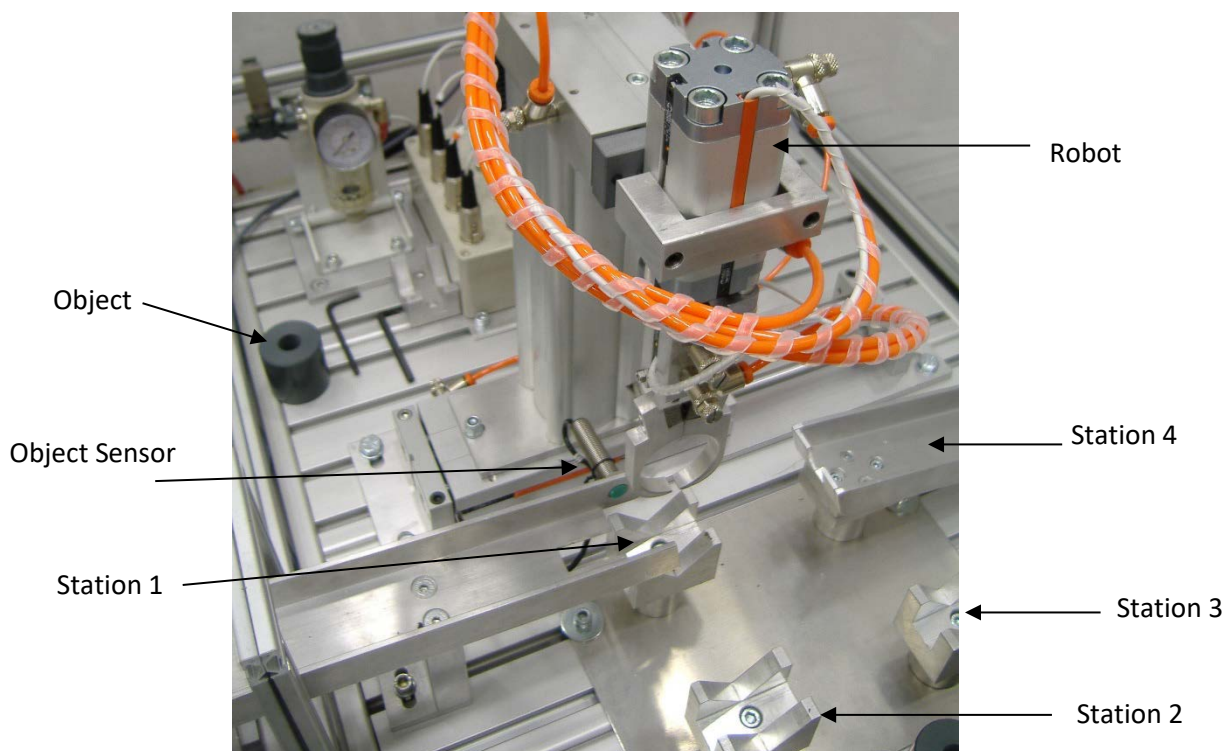


Figure 1: Pick and Place Robot

The overview diagram of figure 2 shows the robot stations 1 to 4 together with the location of the object sensor. The robot sensors and solenoids are connected to a Siemens S7-1214 PLC. There are 3 pushbuttons and 2 rocker switches also connected to the PLC. Compressed air is supplied to the solenoid manifold at around 4 bar.

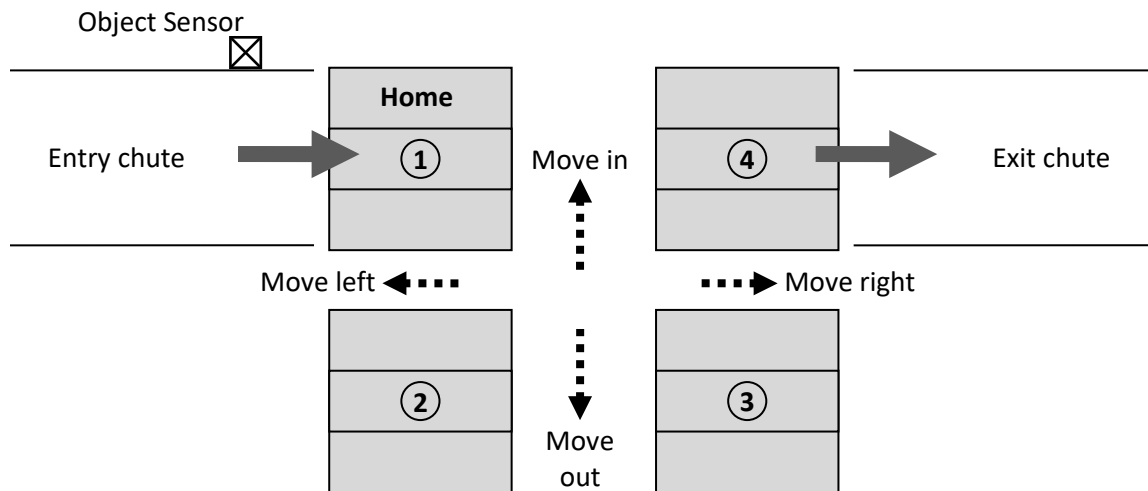


Figure 2: Overview Diagram

Assignment Tasks

Task 1 – Hardware Investigation, System Design and I/O List

Investigate the hardware used on the Pick and Place Robot and provide a complete set of electrical drawings for the PLC system showing the connections between the PLC and the solenoid valves, sensors, pushbuttons and switches using standard symbols. From this, create an input-output list. Investigate and describe the types of valves and sensors used in the system.

Task 2 – Manual controls and HMI screens

1. Two HMI screens should be created, one for the operator and the other for an engineer. Both screen must contain a switch to select auto or manual modes.
2. When in manual mode, each piston should be able to be operated safely via the engineer's screen and all sensor information should be visible.
3. Safety interlocks must be added to prevent the robot from being damaged. These include the following:
 - a. Do not allow the robot to move left, right, in or out unless the robot is in the up position.
 - b. Do not allow the robot to move down unless it is located over one of the stations.
4. Display the number of objects that are currently in the machine and any other information that would assist the operator in the smooth running of the machine.
5. The operator's screen must also contain a selector switch for the loading and unloading sequences for the machine.

Task 3 – Automatic Sequences

A sequential function chart should be created according to the following specification when automatic mode is selected giving two options for the sequence to load or unload the system.

- On power up, the robot must move safely to the home position and wait.
- If the load option is selected and an object is rolled down the entry chute, the robot must pick it up and move it to station 2 where it must be left for 5 seconds during which time, the robot must be held in the up position. After this delay, the object must be moved to station 3 and left there for 5 seconds during which time the robot must be held in the up position. After this time, the object must be moved to station 4 where it will roll down the exit chute. The number of objects exiting the machine must be counted and displayed for the operator.
- If the unload option is selected, the machine must be emptied safely when a start button is pressed.

- Provide a stop button that freezes either of the sequences. The start button must be used to allow the sequence to continue.
- Suitable safety features must be incorporated to prevent the robot placing an object on top of another object when the sequence has been interrupted.
- The robot software must be designed to ensure it is reliable and therefore, you are required to add any information to the engineer's screen that would assist in the maintenance of the system.

Task 4 – PLC Program Coding and Internal Documentation

A PLC program must be written with full internal documentation making use of all three languages available. This program must also be fully explained in the report.

Task 5 – System Testing, Maintenance and Reliability

A testing table must be produced that covers every aspect on the requirements described in tasks 2 and 3. The PLC program and HMI screens must be downloaded and fully tested and compared with the expected results. A discussion of results must be provided in the report and an explanation given of how you have considered the maintenance and tested the reliability of the system.

Task 6 – Conclusions and Recommendations

Write a suitable conclusion based upon the aims and objectives of the assignment showing clearly, how you have satisfied the assessment criteria for the module learning outcomes described on page 2 and what further work could be done to improve the operation of the system.

Task 7 – Report

Submit a professionally written report through Turnit-in using the guidance and structure shown on the next page.

GUIDANCE FOR STUDENTS IN THE COMPLETION OF TASKS

The final grade awarded for this assignment will be based on the five common criteria. The next page provides an opportunity for your tutor to give you feedback on each of these criteria. Actual marks awarded will be based upon the advice given below. Please ensure you read this section carefully. The report must be written using around 2500 words containing the following sections:

1. **Hardware Investigation, System Design and I/O List** (700 words)
2. **Program Documentation and Explanation** (700 words)
3. **System Testing, Maintenance and Reliability** (600 words)
4. **Conclusions and Recommendations** (500 words)

Your pages should be numbered and your figures must also be numbered and listed.

You will be assessed against the following common assessment criteria. Note that sections of your report have been identified as places where the marks will be awarded.

1 Research Informed Literature

Not assessed in this assignment

2 Knowledge and Understanding of subject (30%)

This will be assessed by your descriptions and explanations. (Sections 1 and 2).

3 Analysis (30%)

This will be assessed by the explanation of your testing, evaluation, discussion of maintenance and reliability, conclusions and recommendations. (Sections 3 and 4).

4 Practical Application and Deployment (30%)

This will be assessed by the quality of your program design and network comments, tag names, HMI screen designs and the presentation of your test results. (Sections 2 and 3).

5 Skills for Professional Practice (10%)

This will be assessed by the written and presentational quality of your report including page numbering, figure quality, figure numbering and listing, writing style, punctuation, grammar and spelling. (All sections)

COMMON ASSESSMENT AND GRADING CRITERIA

Assessment Criteria	OUTRIGHT FAIL	UNSATISFACTORY	SATISFACTORY	GOOD	VERY GOOD	EXCELLENT	EXCEPTIONAL
	REFER (equivalent to 0-29%)	REFER (equivalent to 30-39%*	PASS (equivalent to 40-49%)	PASS (equivalent to 50-59%)	MERIT (equivalent to 60-69%)	DISTINCTION (equivalent to 70-79%)	DISTINCTION (equivalent to 80-100%)
1. Research-informed Literature Extent of research and/or own reading, selection of credible sources, application of appropriate referencing conventions	Little or no evidence of reading. Views and findings unsupported and non-authoritative. Referencing conventions largely ignored.	Poor evidence of reading and/or of reliance on inappropriate sources, and/or indiscriminate use of sources. Referencing conventions used inconsistently.	References to a limited range of mostly relevant sources. Some omissions and minor errors. Referencing conventions evident though not always applied consistently.	Inclusion of a range of research-informed literature, including sources retrieved independently. Referencing conventions mostly consistently applied.	Inclusion of a wide range of research-informed literature, including sources retrieved independently. Selection of relevant and credible sources. Very good use of referencing conventions, consistently applied.	A comprehensive range of research informed literature embedded in the work. Excellent selection of relevant and credible sources. High-level referencing skills, consistently applied.	Outstanding knowledge of research-informed literature embedded in the work. Outstanding selection of relevant and credible sources. High-level referencing skills consistently and professionally applied.
2. Knowledge and Understanding of Subject Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.	Major gaps in knowledge and understanding of material at this level. Substantial inaccuracies.	Gaps in knowledge, with only superficial understanding. Some significant inaccuracies.	Evidence of basic knowledge and understanding of the relevant concepts and underlying principles.	Knowledge is accurate with a good understanding of the field of study.	Knowledge is extensive. Exhibits understanding of the breadth and depth of established views.	Excellent knowledge and understanding of the main concepts and key theories. Clear awareness of challenges to established views and the limitations of the knowledge base.	Highly detailed knowledge and understanding of the main theories/concepts, and a critical awareness of the ambiguities and limitations of knowledge.
3. Analysis Analysis, evaluation and synthesis; logic, argument and judgement; analytical reflection; organisation of ideas and evidence	Unsubstantiated generalisations, made without use of any credible evidence. Lack of logic, leading to unsupported/missing conclusions. Lack of any attempt to analyse, synthesise or evaluate.	Some evidence of analytical intellectual skills, but for the most part descriptive. Ideas/findings sometimes illogical and contradictory. Generalised statements made with scant evidence. Conclusions lack relevance.	Evidence of some logical, analytical thinking and some attempts to synthesise, albeit with some weaknesses. Some evidence to support findings/views, but evidence not consistently interpreted. Some relevant conclusions and recommendations, where relevant	Evidence of some logical, analytical thinking and synthesis. Can analyse new and/or abstract data and situations without guidance. An emerging awareness of different stances and ability to use evidence to support the argument. Valid conclusions and recommendations, where relevant	Sound, logical, analytical thinking; synthesis and evaluation. Ability to devise and sustain persuasive arguments, and to review the reliability, validity & significance of evidence. Ability to communicate ideas and evidence accurately and convincingly. Sound, convincing conclusions / recommendations.	Thoroughly logical work, supported by evaluated evidence. High quality analysis, developed independently or through effective collaboration. Ability to investigate contradictory information and identify reasons for contradictions. Strong, persuasive, conclusions, justifiable recommendations.	Exceptional work; judiciously selected and evaluated evidence. Very high quality analysis, developed independently or through effective collaboration. Ability to investigate contradictory information and identify reasons for contradictions. Highly persuasive conclusions
4. Practical Application and Deployment Effective deployment of appropriate methods, materials, tools and techniques; extent of skill demonstrated in the application of concepts to a variety of processes and/or contexts; formulation of innovative and creative solutions to solve problems.	Limited or no use of methods, materials, tools and/or techniques. Little or no appreciation of the context of the application.	Rudimentary application of methods, materials, tools and/or techniques but without consideration and competence. Flawed appreciation of the context of the application.	An adequate awareness and mostly appropriate application of well established methods, materials, tools and/or techniques. Basic appreciation of the context of the application.	A good and appropriate application of standard methods, materials, tools and/or techniques. Good appreciation of the context of the application, with some use of examples, where relevant.	A very good application of a range of methods, materials, tools and/or techniques. Very good consideration of the context of the application, with perceptive use of examples, where relevant. Evidence of some innovation and creativity.	An advanced application of a range of methods, materials, tools and/or techniques. The context of the application is well considered, with extensive use of relevant examples. Application and deployment extend beyond established conventions. Innovation and creativity evident throughout.	Outstanding levels of application and deployment skills. Assimilation and development of cutting edge processes and techniques.
5. Skills for Professional Practice Demonstrates attributes expected in professional practice including: individual initiative and collaborative working; deployment of appropriate media to communicate (including written and oral); clarity and effectiveness in presentation and organisation.	Communication media is inappropriate or misapplied. Little or no evidence of autonomy in the completion of tasks. Work is poorly structured and/or largely incoherent.	Media is poorly designed and/or not suitable for the audience. Poor independent or collaborative initiative. Work lacks structure, organisation, and/or coherence	Can communicate in a suitable format but with some room for improvement. Can work as part of a team, but with limited involvement in group activities. Work lacks coherence in places and could be better structured.	Can communicate effectively in a suitable format, but may have minor errors. Can work effectively as part of a team, with clear contribution to group activities. Mostly coherent work and is in a suitable structure.	Can communicate well, confidently and consistently in a suitable format. Can work very well as part of a team, with very good contribution to group activities. Work is coherent and fluent and is well structured and organised.	Can communicate professionally and, confidently in a suitable format. Can work professionally within a team, showing leadership skills as appropriate, managing conflict and meeting obligations. Work is coherent, very fluent and is presented professionally.	Can communicate with an exceptionally high level of professionalism. Can work exceptionally well and professionally within a team, showing advanced leadership skills. Work is exceptionally coherent, very fluent and is presented professionally.

MARKING CRITERIA AND STUDENT FEEDBACK

This section details the assessment criteria. The *extent* to which these are demonstrated by you determines your mark. The marks available for each criterion are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Common Assessment Criteria Applied	Marks available	Marks awarded
1. Research-informed Literature Extent of research and/or own reading, selection of credible sources, application of appropriate referencing conventions.	n/a	
n/a		
2. Knowledge and Understanding of Subject Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.	30	
Section 1: Hardware Investigation -	10	
Section 1: System Design and I/O list -	10	
Section 2: Program Explanation –	10	
3. Analysis Analysis, evaluation and synthesis; logic, argument and judgement; analytical reflection; organisation of ideas and evidence	30	
Section 3: System Testing –	10	
Section 3: Maintenance and Reliability -	10	
Section 4: Conclusions and Recommendations -	10	
4. Practical Application and Deployment Deployment of methods, materials, tools and techniques; application of concepts; formulation of innovative and creative solutions to solve problems.	30	
Section 2: Program Network Comments -	10	
Section 2: HMI Screen Designs –	10	
Section 3: Presentation of Test Results -	10	
5. Skills for Professional Practice Attributes in professional practice: individual and collaborative working; deployment of appropriate media; presentation and organisation.	10	
All sections -	10	

Assignment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)	Late Submission Penalties (tick if appropriate)		%
	Up to one week late		
	1 st /2 nd /3 rd attempt?	1st	

SPECIFIC LEARNING OUTCOMES FOR IENG

This section lists the IEng learning outcomes for full accreditation that are relevant to the assignment. The marks allocated are extracted from the Marking Criteria and Student Feedback form. The grade awarded for the particular LO is also shown. These grades are then transferred onto a 'global' sheet related to each student ensuring all IEng LO's are assessed at least twice across all modules

Code	Learning Outcome	Relevant Tasks in Assignment	Marks available	Marks awarded	Grade awarded
Science & Mathematics					
	N/A				
Engineering Analysis					
EA4i	Ability to apply an integrated or systems approach to engineering problems through know-how of the relevant technologies and their application.	Sections 1,2,3,4:	90		
Design					
D4i	Apply problem-solving skills, technical knowledge and understanding to create or adapt design solutions that are fit for purpose including operation, maintenance, reliability etc..	Section 3: Maintenance and Reliability	10		
Economic, Legal, Social, Ethical and Environmental context					
	N/A				
Engineering Practice					