

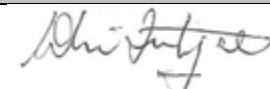
## ASSIGNMENT INTERNAL VERIFICATION FORM (2017-2018)

|                   |                                           |                         |           |
|-------------------|-------------------------------------------|-------------------------|-----------|
| ASSIGNMENT TITLE: | Bytronic Industrial Control Trainer       | LEVEL:                  | 4         |
| MODULE :          | PSDE4005 – Programmable Logic Controllers | ASSIGNMENT NO (x of y): | 1 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.       | 14/09/17                          | Conforms to the assessment pattern described in the module syllabus<br>Tests the module learning outcome appropriately | 25/09/17 |
| 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                                                                 |  | 25/09/17 |
| 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 **1**

MODULE CODE/ COD Y MODIWL: **PSDE4005**  
**PROGRAMMABLE LOGIC CONTROLLERS**

ASSESSMENT TYPE/ MATH O ASESU: ASSIGNMENT

ASSESSMENT/COMPONENT/ ASESAD/CYDRAN: **1** OF 3

COMPONENT WEIGHTING/ PWYSAU'R CYDRAN: **30%**

WORD COUNT (or WORD COUNT EQUIVALENT)/ NIFER Y GEIRIAU:  
**between 2000 and 3000** 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

|                          |                                           |                             |               |
|--------------------------|-------------------------------------------|-----------------------------|---------------|
| <b>Student name:</b>     |                                           | <b>Student P number:</b>    |               |
| <b>Programme:</b>        | HNC Electrical and Electronic Engineering |                             |               |
| <b>Lecturer:</b>         | Robert Davies                             | <b>Internal Verifier:</b>   | Bill McIntyre |
| <b>Assignment Title:</b> | Bytronic Industrial Control Trainer       |                             |               |
| <b>Hand Out Date:</b>    | Week 5                                    | <b>Submission deadline:</b> | Week 10       |

|                             |                                                                                                                                                                                                                                                                                                                                                                                                         |              |  |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|--|
| <b>Referencing:</b>         | 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). |              |  |
| <b>Disclosure:</b>          | 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.                                                                                                                                                                                                         |              |  |
| <b>Student's Signature:</b> | <i>Hardcopy assignments will not be accepted without a signature here</i>                                                                                                                                                                                                                                                                                                                               | <b>Date:</b> |  |

**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.

## TASK DESCRIPTION

### Aims and Objectives

The purpose of this assignment is to introduce you to basic PLC system design concepts for an industrial process involving a conveyor system where critical timing and data handling are key factors. You will gain a knowledge of types of PLC with appropriate applications, IEC programming languages available and their usage, I/O (input and output) device listing, basic program design, testing and documentation. You will also be working as part of a team for some aspects of the assignment in order to demonstrate team working skills.

The industrial control trainer shown in figure 1 of this brief contains the chain conveyor that carries the components comprising a metal peg and a plastic ring to be sorted. The metal peg must be allowed to continue past the sort area and down the feeder chute to the belt conveyor. The plastic pegs must be fired by the sort solenoid into the assembly chute ready to be placed on top of a metal peg. As a metal peg passes the assembly area, a plastic ring will be placed on it. If a fault occurs such that a metal peg is allowed to continue down the belt conveyor without a plastic peg on top of it, it must be rejected by being pushed into the red bucket, before reaching the final product storage.

### Assignment Tasks

The following tasks involve the design, development, testing and documentation of a PLC program in six stages each being an improvement on the previous one. The final program must be fully tested and documented. There is also a requirement to carry out research. A suitable HMI (human machine interface) will be developed to give diagnostic information for the system such as the state of the sensors, the number of rings in the assembly chute and other useful information to assist you in the development of the programs.

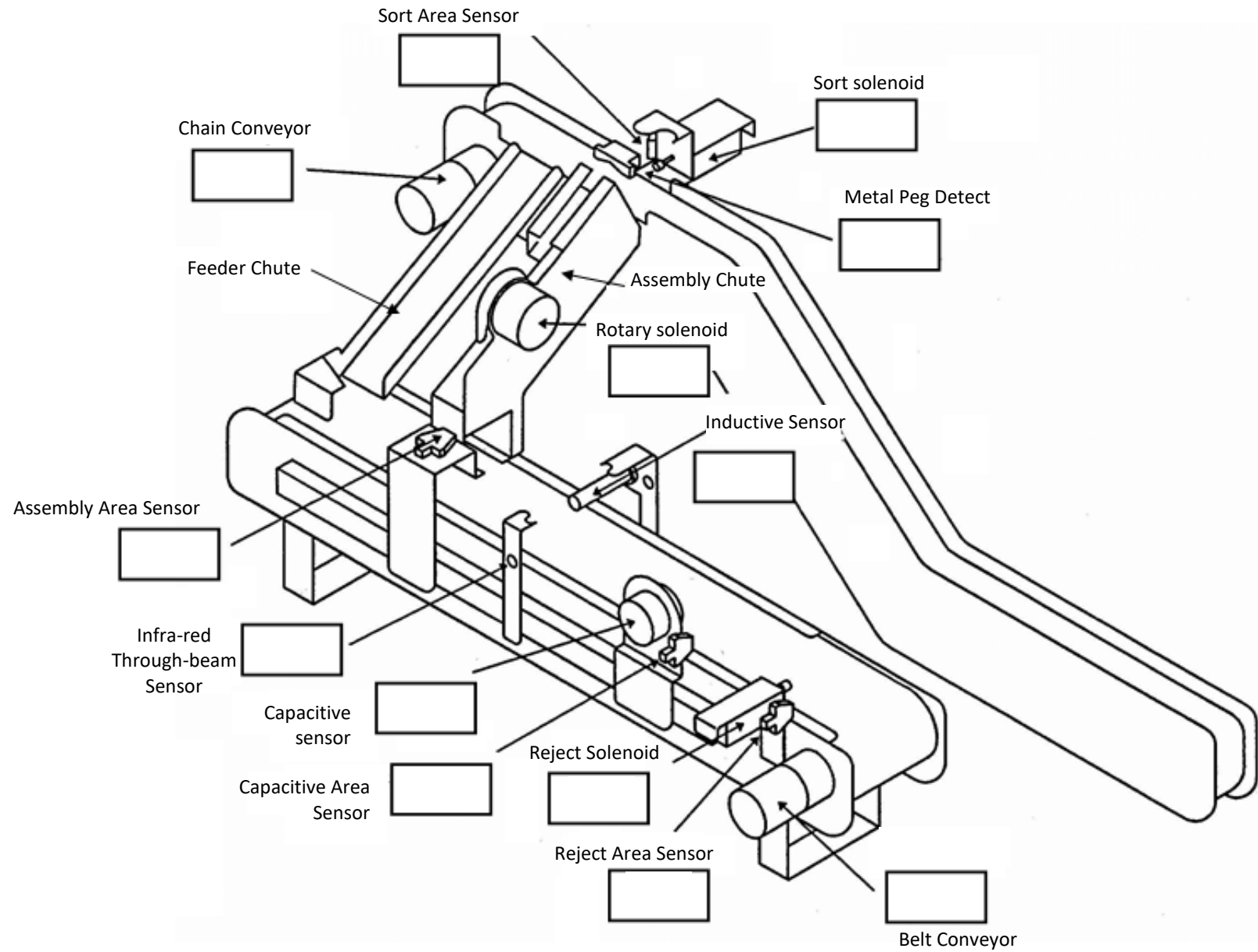


Figure 1 – Industrial Control Trainer

## Task 1 - Research

Carry out research into the following areas:

- Types of PLC currently available to the systems designer with performances and costs from one particular manufacturer with suitable applications for each type of PLC.
- Types of IEC PLC programming languages available with the preferred choice of language for different applications or processes.

**This is an individual task.**

## Task 2 – Hardware Description

Describe the hardware of the 'Industrial Control Trainer' using photographic evidence to support your description of the PLC and the actual conveyor system, its sensors and actuators. **This is an individual task.**

## Task 3 – Input-Output List

Draw up a detailed I/O list in readiness for the program design and use as a basis for the program tags. This is a group task but the actual I/O table must be typed up individually for insertion into the report.

## Task 4 – Programming Exercises

Carry out the following LABWORK exercises. Ensure each member of the team has a copy of the program at the end of each session. At the end of each exercise, fully test the program to ensure it meets the exercise requirements. You must also ensure that the latest version of each program still meets the requirements of the previous exercises as modifications can affect previously working parts of the program. Suitable network comments must be added at each stage to the program. Only the final program needs to be explained and evidence provided of complete testing. Develop suitable HMI screens to assist an operator to run the machine and an engineer to maintain it.

### ***LABWORK 1 – SORTING ROUTINE:***

The objectives for this task are:-

1. When the power is switched on, start both conveyors.
2. Detect a plastic component travelling along the chain conveyor and push it down the assembly chute using the sort solenoid which must be energised for 0.5seconds.
3. Detect a metal peg travelling along the chain conveyor and allow it to continue down the feeder chute.

### ***LABWORK 2 – QUEUE COUNTING:***

The objectives for this task are:-

1. Create a queue counter for the assembly chute.
2. Ensure that no more than 5 plastic parts are allowed in the assembly chute.
3. Ignore plastic parts when the chute is full. This should cause them to continue into the excess bin.

### ***LABWORK 3 – DISPENSING AND OPERATION TIMING:***

The objectives for this task are:-

1. A plastic component must be dispensed into the assembly area when it is empty using the rotary solenoid.
2. The rotary solenoid must only be operated if there is at least one plastic component in the assembly chute.
3. A time delay must be introduced so that the rotary solenoid operates 2 seconds after the assembly area becomes empty.
4. The rotary solenoid must be energised for around 0.5 seconds.
5. The queue counter must be decremented each time the rotary solenoid is operated to allow more plastic components into the assembly chute if full.

**LABWORK 4 – PLASTIC RING DETECTION AND SORTING:**

The objectives for this task are:-

1. Detect if a plastic component has reached the reject area on the belt conveyor.
2. Reject the plastic component at the reject area by energising the reject solenoid for 0.5 seconds.
3. Reset any component detection memory to allow further components to be rejected.

**LABWORK 5 – METAL COMPONENT DETECTION AND SORTING:**

The objectives for this task are:-

1. Detect if a metal peg has reached the reject area on the belt conveyor without a plastic component assembled on the top of it.
2. Reject the metal peg at the reject area by energising the reject solenoid for 0.5 seconds.
3. Reset any component detection memory to allow further components to be rejected.

**LABWORK 6 – COMPONENT ASSEMBLY DETECTION AND SORTING:**

The objectives for this task are:-

1. Detect that an incorrectly assembled component has reached the reject area.
2. Reject an incorrectly assembled component at the reject area by energising the reject solenoid for 0.5 seconds.
3. Reset all component detection memory on power up.

**Task 5 – System Testing and Evaluation**

Draw up a table of tests to be carried out on the final program ensuring all of the required features are covered by this program. Record the outcome of each test. Write a description of how you tested each part of this final program. Discuss and evaluate your results. The actual testing will be a group task but the recording of the test results and the description of the method and the results is an individual task.

**Task 6 – Program Explanation**

Ensure each member of the team has the final copy of the program which must be fully commented. Explain how the program works by copying sections of code into the report, number as a figure and explain with reference to the operation of the system and the HMI screens developed. Include pictures of the HMI screens as figures. This is an individual task.

**Task 7 – Conclusions and Recommendations**

Provide suitable conclusions to your report stating how successful you have been in meeting the requirements of the system and the criteria on the front page. Provide suitable recommendation as to how the system could be improved. This is an individual task.

**Task 8 – Collaboration**

You must give details of how you collaborated within your small group. You are permitted to share the program design but all drawings, figures, tables etc., must be done individually and explanations must be unique.

# 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. **Research** (500 words)
2. **Hardware Description and I/O List** (500 words)
3. **Program Explanation** (500 words)
4. **System Testing and Evaluation** (500 words)
5. **Conclusions and Recommendations** (300 words)
6. **Collaboration** (200 words)
7. **Citation List**

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

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

## 1 Research Informed Literature (20%)

This will be assessed via the quality of your research. The Harvard method of citation and listing must be used for citing books, periodicals, chapters in compilations, manufacturer's datasheets and web-sites used in producing this report and sources must be listed. (Sections 1 and 8).

## 2 Knowledge and Understanding of subject (20%)

This will be assessed by your descriptions and explanations. (Sections 2 and 3).

## 3 Analysis (20%)

This will be assessed by your testing, evaluation, conclusions and recommendations. (Sections 4 and 5).

## 4 Practical Application and Deployment (30%)

This will be assessed by the quality of your program network comments and tag names, HMI screen designs and the presentation of your test results. (Sections 3 and 4).

## 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, spelling and your explanation of how you worked as part of a team. (All sections and particularly section 6)

# 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%)                                                                                                                                                                                                                                            |
| <b>1. Research-informed Literature</b><br>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.                                                                     |
| <b>2. Knowledge and Understanding of Subject</b><br>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.                                                                                                                           |
| <b>3. Analysis</b><br>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 |
| <b>4. Practical Application and Deployment</b><br>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.                                                                                                                                                |
| <b>5. Skills for Professional Practice</b><br>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 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------|
| <b>1. Research-informed Literature</b><br>Extent of research and/or own reading, selection of credible sources, application of appropriate referencing conventions.                                    | 20              |               |
| Section 1: Your research -                                                                                                                                                                             | 15              |               |
| Section 8: Your use of Harvard for citing and listing -                                                                                                                                                | 5               |               |
| <b>2. Knowledge and Understanding of Subject</b><br>Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.                                        | 20              |               |
| Section 2: Hardware Description and I/O list -                                                                                                                                                         | 10              |               |
| Section 3: Program Explanation –                                                                                                                                                                       | 10              |               |
| <b>3. Analysis</b><br>Analysis, evaluation and synthesis; logic, argument and judgement; analytical reflection; organisation of ideas and evidence                                                     | 20              |               |
| Section 4: System Testing and Evaluation -                                                                                                                                                             | 10              |               |
| Section 5: Conclusions and Recommendations -                                                                                                                                                           | 10              |               |
| <b>4. Practical Application and Deployment</b><br>Deployment of methods, materials, tools and techniques; application of concepts; formulation of innovative and creative solutions to solve problems. | 30              |               |
| Section 3: Program Network Comments -                                                                                                                                                                  | 10              |               |
| Section 3: HMI Screen Designs –                                                                                                                                                                        | 10              |               |
| Section 4: Presentation of Test Results -                                                                                                                                                              | 10              |               |
| <b>5. Skills for Professional Practice</b><br>Attributes in professional practice: individual and collaborative working; deployment of appropriate media; presentation and organisation.               | 10              |               |
| All sections -                                                                                                                                                                                         | 5               |               |
| Section 6: Team working -                                                                                                                                                                              | 5               |               |

| 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 <sup>st</sup> /2 <sup>nd</sup> /3 <sup>rd</sup> 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 |
|-------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|-----------------|---------------|---------------|
| <b>Science &amp; Mathematics</b>                                  |                                                                                                                                                 |                              |                 |               |               |
|                                                                   | N/A                                                                                                                                             |                              |                 |               |               |
| <b>Engineering Analysis</b>                                       |                                                                                                                                                 |                              |                 |               |               |
| EA4i                                                              | Ability to apply an integrated or systems approach to engineering problems through know-how of the relevant technologies and their application. | Sections 2, 3, 4, 5:         | 70              |               |               |
| <b>Design</b>                                                     |                                                                                                                                                 |                              |                 |               |               |
|                                                                   | N/A                                                                                                                                             |                              |                 |               |               |
| <b>Economic, Legal, Social, Ethical and Environmental context</b> |                                                                                                                                                 |                              |                 |               |               |
|                                                                   | N/A                                                                                                                                             |                              |                 |               |               |
| <b>Engineering Practice</b>                                       |                                                                                                                                                 |                              |                 |               |               |
| EP7i                                                              | Awareness of team roles and the ability to work as a member of an engineering team.                                                             | Section 6:                   | 5               |               |               |