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OCR-set Assignment

Information for Learners

OCR Level 1 / 2 Cambridge National Certificate in Systems Control in Engineering

Unit R116: Process control systems

Scenario for the assignment

Microprocessors and microcontrollers are commonly used in many domestic and industrial systems and engineered products that require automatic control.

One example is the automatic gate opener shown.



In this assignment you will investigate how microcontrollers or microprocessors are used in engineered products or systems. You will then design, simulate and test a control system for an automatic gate opener.

Client specification – Automatic Gate Opener

- Separate input control buttons to open or close gate
- Outputs to control gate motor (forward or reverse)
- Gate fully open and gate fully closed limit switches turn off supply to motor when reached
- Beam sensor across gateway detects obstruction:
 - Will not allow gate to be opened or closed if obstruction detected
 - Opens gate fully immediately obstruction detected while currently opening or closing
- Motor protection timer will not allow motor to run for more than 20 seconds.

Read through all of the tasks carefully, so that you know what you will need to do to complete this assignment.

Your Tasks

Task 1 – Applications of microcontrollers and microprocessors

Learning Outcome 1, Understand the application and operation of microcontrollers and microprocessors in engineered products, is assessed in this task.

Microcontrollers and microprocessors are commonly used in engineering products and systems to provide control for a range of functions.

You are to investigate the:

- applications of a range of microcontrollers and microprocessors in products and systems
- layout of microcontrollers and microprocessors in products or systems (note: this is system layout to include relationship of the programmable control device to input and output devices. It is not the internal architecture of the microcontroller or microprocessor itself.)
- function of input – control – output – feedback devices in a range of microcontrollers and microprocessors in products or systems
- operation of microcontrollers/microprocessors control in **one** product or system.

Task 2 – Design, develop and simulate control system solutions

Learning Outcome 2, Be able to design, develop and simulate a control system solution, is assessed in this task.

Study the client specification in the assignment scenario for the automatic gate opener.

Design and develop a simple control system solution to simulate the operation of the automatic gate opener.

You will need to:

- select appropriate input and output sensors and devices to design a solution to the control system problem
- use a programming tool to create a control system programme to solve the control system problem
- simulate the control system programme and carry out modifications to the design of the programme as appropriate
- download the control programme to a controllable device.

You should demonstrate your ability to draw upon relevant skills/knowledge/understanding from other units you have studied in this task.

Task 3 – Testing control systems

Learning Outcome 3, Be able to test control systems, is assessed in this task.

Testing of control systems is vital to ensure correct functionality.

Using the control system designed and developed in Task 2 for the automatic gate opener you will:

- devise a test plan to make sure that the system functions correctly
- test your system against the test plan, and evaluate how well it works
- refine the control system based on the results of your testing.

OCR-set Assignment

Information for Teachers

OCR Level 1 / 2 Cambridge National Certificate in Systems Control in Engineering

Unit R116: Process control systems

Guidance on using this assignment

1 General guidance

- 1.1 OCR assignments are available to download free of charge from our website:
www.ocr.org.uk
- 1.2 OCR assignments are intended to be used for summative assessment of learners. The OCR specification gives more information on the arrangements for assessing internally assessed units.
- 1.3 This assignment has been designed to meet the full assessment requirements of the unit. Learners will need to take part in a planned learning programme that covers the underpinning knowledge, understanding and skills of the unit.

2 Before carrying out the assignment

- 2.1 Learners should be provided with a copy of the *Information for Learners* section of this assignment.
- 2.2 Learners will not need to carry out any preparations prior to undertaking the assessment tasks, such as collating resources to use in the assessment.
- 2.3 We have estimated that it will take approximately 10–12 hours to complete all tasks. Learners would need approximately 2–3 hours to complete Task 1 and approximately 6–7 hours to complete Task 2 and 2 hours to complete Task 3. These timings are for guidance only but should be used by the teacher to give learners an indication of how long to spend on each task. Centres can decide how the time can be allocated between each part or individual task. Centres are also permitted to spread the tasks across several sessions and therefore it is permissible for evidence to be produced over several sessions.

3 When completing the assignment and producing evidence

- 3.1 Each learner must produce individual and authentic evidence for each task within the assignment.
- 3.2 Centre staff may give support and guidance to learners. This support and guidance should focus on checking that learners understand what is expected of them and giving general feedback that enables the learner to take the initiative in making improvements, rather than detailing what amendments should be made. It is not acceptable for teachers/deliverers to provide answers, to work through answers in detail or to detail specifically what amendments should be made.
- 3.3 Learners may use information from any relevant source to help them with producing evidence for the tasks.
- 3.4 Learners must be guided on the use of information from other sources to ensure that confidentiality is maintained at all times.

- 3.5 Usually, the type of evidence required may be modified, with the exception of certain types of evidence listed below under '*Permitted changes*'. It is important to note that it is possible to generate the evidence in a variety of formats. Centres must advise learners as to the most appropriate format of evidence. The nature of this assessment means that learners are free to use the format that they feel is most appropriate for the purpose and target audience for each individual task (see Section 6).

4 Presentation of work for marking and moderation

- 4.1 Centres wishing to produce digital evidence in the form of an e-portfolio should refer to the appendix in the specification on guidance for the production of electronic assessment.
- 4.2 Centres may wish to discourage learners from excessive use of plastic wallets for presentation of their evidence as this may hinder the assessment process. Instead centres may wish to encourage learners to present their work so that it is easily accessible, e.g. spiral bound, stapled booklet, treasury tag.
- 4.3 All work must be marked against the marking criteria for the unit. Marks are allocated to learning outcomes rather than tasks. Please see Appendix B Marking criteria for centre assessment and Section 4, *The centre assessed units*, in the specification for this qualification for more information on marking, moderation and submission of work.

5 Scope of permitted set assignment modification

The set assignment is self-contained in its present form. The set of tasks form a coherent whole addressing all the learning outcomes and allowing access to the full range of marks.

You must not change the following:

- the learning outcomes
- the marking criteria
- the requirements for supervision and authentication as described in the specification (Section 4 *The centre assessed units*)
- the maximum duration for completion of the assignment.

Permitted changes:

The set assignment can be modified in terms of the areas described below but centres must be sure that learners still have the opportunity to cover all of the learning outcomes and to access the full range of marks:

- the scenario, which can be contextualised or amended to suit local needs
- each specific task may be appropriately contextualised to match with any permitted changes you have made to the scenario.

Should the centre change the context of the assignment they must make sure that the control system to be designed, simulated and tested is of equal complexity to that given in this set assignment. The system may be based on a microprocessor, microcontroller, PIC system, programmable logic controller (PLC) or other similar programmable device, and the design must be fully tested to ensure its correct operation prior to learners undertaking the task.

OCR has ensured that in the language used and the tasks and scenario provided we have avoided discrimination, bias and stereotyping and support equality and diversity. In the development of qualifications and assessments we use the guidance given in the Ofqual publication *Fair access by design*, notably this includes:

- using language and layout in assessment materials that does not present barriers to learners
- using stimulus and source materials in assessment materials (where appropriate) that do not present barriers to learners.

If centres wish to modify the set assignment, we strongly advise that staff responsible for modifying the set assignment and the quality assurance of it refer to the publication *Fair access by design*.

If modifications are made to the set assignment, whether to just the scenario or to both the scenario and individual tasks, it is up to the centre to ensure that all learning outcomes can still be met and that learners can access the full range of marks.

6 Specific guidance on the task

Task 1

Learners will need to describe the layout of a microprocessor or microcontroller (i.e. how it is connected to input and output devices) and the function of these devices (including the control device) in a range of control systems. They should not focus on the internal architecture of the microprocessor or microcontroller in detail, but the system layout, function and operation (including that of input devices, output devices and control devices). System layout can be represented using simple block diagrams.

Task 2

Learners will require access to programming software and hardware (e.g. microprocessor, microcontroller, PIC system, programmable logic controller (PLC)) and components in order to complete the task. Appropriate risk assessment and safe working procedures must be followed. While it is possible to simulate system operation using software alone, the learner will also be required to transfer the control system program to the physical device chosen and to simulate using hardware. Each learner does not require their own hardware – they could use hardware common to the class when they are ready to test and refine their software on the physical system.

A different example to the automatic gate opener may be chosen as the example.

Evidence of control system design, development and simulation must be provided in the portfolio by text/diagrams, digital photographs or video, and screenshots supported by a signed witness statement.

Learners could use knowledge gained in unit R113 to consider the design of systems using the systems approach and the selection of appropriate input and output devices.

Task 3

Learners are required to use their design from Task 2 in order to develop and implement a test plan. They must evaluate the performance of their control system against the test plan and make refinements. For this reason, it is sensible that Task 3 is undertaken on the control system designed and simulated in Task 2.

Learners must provide evidence in the form of text/diagrams, photographs or video and screenshots supported by a signed witness statement.

Total marks for assignment: 60

Witness Statement – Task 2

LEARNER NAME	
Date	
Unit	R116 – Process control systems
LO2	Be able to design, develop and simulate a control system

Independent working to manufacture, appropriate safety precautions and testing	
Witness observations	

Name of witness: _____

Relationship to learner: _____

Assessor comments: How the observations demonstrate achievement against the marking criteria

RECORD OF QUESTIONS/ANSWERS (if applicable)

ASSESSOR QUESTION 1	
LEARNER RESPONSE 1	
ASSESSOR QUESTION 2	
LEARNER RESPONSE 2	
ASSESSOR QUESTION 3	
LEARNER RESPONSE 3	

ASSESSOR SIGNATURE:		DATE:	
LEARNER SIGNATURE:		DATE:	

Witness Statement – Task 3

LEARNER NAME	
Date	
Unit	R116 – Process control systems
LO3	Be able to test control systems

Independent working to test, appropriate safety precautions and testing	
Witness observations	

Name of witness: _____

Relationship to learner: _____

Assessor comments: How the observations demonstrate achievement against the marking criteria

RECORD OF QUESTIONS/ANSWERS (if applicable)

ASSESSOR QUESTION 1
LEARNER RESPONSE 1
ASSESSOR QUESTION 2
LEARNER RESPONSE 2
ASSESSOR QUESTION 3
LEARNER RESPONSE 3

ASSESSOR SIGNATURE:		DATE:	
LEARNER SIGNATURE:		DATE:	