

Cambridge TECHNICALS LEVEL 3

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ENGINEERING

Unit 16

Systems and Programming

Model assignment

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Please note:

You can use this assignment to provide evidence for summative assessment, which is when the learner has completed their learning for this unit and is ready to be assessed against the grading criteria.

You can use this assignment as it is, or you can modify it or write your own; we give more information in this document under Guidance for tutors.

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Guidance for tutors on using this assignment

General

OCR Cambridge Technical model assignments are available to download from our website: www.ocr.org.uk.

The purpose of this assignment is to provide a scenario and set of tasks that are typical of how engineers would use systems and programming to enable you to assess your learner against the requirements specified in the grading criteria. The scenario and its tasks are intended to give a work-relevant reason for applying the skills, knowledge and understanding needed to achieve the unit.

This assignment will not instruct learners how to meet the highest grade. Whether learners achieve a pass, merit or distinction will depend on what evidence they produce.

You can modify the scenario we provide in this assignment to make it more relevant to your local or regional needs. Please refer to the information under 'Modifying the model assignment' later in this section.

You don't have to use this assignment. You can use it as a guide to help you to design your own assignment, and we provide an assignment checking service. You'll find more information on these matters in section 8 of the qualification handbook.

In the tasks, we'll refer to the format of evidence. Learners are **not** required to follow that format **unless** we tell them otherwise.

It's essential that the work every learner produces is their own. Please make sure you read through the information we give on authenticity in section 8 of the qualification handbook and make sure that your learners and any staff involved in assessment understand how important authenticity is.

We provide this assignment to be used for summative assessment. You must not use it for practice or for formative assessment.

Before using this assignment to carry out assessment

Learners will need to take part in a planned learning programme that covers the knowledge, understanding and skills of the unit.

When your learners are ready to be assessed, they must be provided with a copy of the following sections of this assignment:

- General information for learners
- Assignment for learners
- Evidence Checklist

They may carry out preparation prior to undertaking the tasks and there is no time limit for this.

When completing the assignment

You should use this assignment in conjunction with the unit specification and qualification handbook.

Please note – if learners are completing this model assignment as part of the Extended Diploma qualification they will be required to complete the synoptic unit 25: Promoting continuous improvement. Before your learners complete this model assignment, you must refer to the specification and model assignment requirements for unit 25, so if applicable you can ensure learners gather the appropriate feedback on their own performance and performance of the system, process or artefact that they will produce in this model assignment.

Resources to complete the tasks

There are resource requirements for this assignment. Every learner will need access to the following resources:

- Learners may produce a working prototype as part of their evidence and will require access to suitable materials. Modelling/construction kits could be adapted for this purpose.
- For task 1, learners will require access to programming software and a system using an embedded device (such as an Arduino, PIC or Raspberry Pi). If the system is constructed practically they could also require access to suitable hardware (e.g. sensors, actuators, interfacing components, connecting wires and tools).
- For task 2, learners will require access to a Programmable Logic Controller (PLC) and suitable programming software.

Tutor information to support the tasks

The scenario provides an opportunity for learners to practically apply their learning to develop a working prototype to represent a model of the automatic door. Although this is not a specific requirement to meet the grading criteria it should make it easier for learners to demonstrate their understanding.

In task 1 the program can be developed through simulation although learners may benefit from programming using physical hardware which includes an embedded device (e.g. Arduino, PIC, Raspberry Pi etc.). This could be connected to appropriate input and output devices (e.g. switches and light emitting diodes (LEDs)) to simulate parts of the task. The scenario can be augmented as appropriate.

In task 2 it is intended that learners load and operate a Programmable Logic Controller (PLC) although this could be done through simulation.

In task 3 learners should test their software objectively for correct operation.

Health and Safety and the use of resources

Health and safety will need to be considered should any of the tasks, or parts of the tasks be undertaken as practical activities. This should include appropriate risk assessments, safe working methods statements and the use of appropriate personal protective equipment (PPE). Learners should be encouraged to take part in assessing risk before conducting any practical activity.

Time

You should plan for learners to have 13–16 hours to complete this assignment.

Learners must be allowed sufficient time to complete all the tasks. The amount of time may vary depending on the nature of the tasks and the ability of individual learners. To help with your planning, against each of the tasks we've given an indication of how long it should take.

Learners can produce evidence in several sessions.

Format of evidence

Learners have to produce evidence that demonstrates how they have met the grading criteria. At the very least they must produce evidence that meets **all** of the pass criteria.

Please make sure your learners realise that missing just one pass criterion means they will not pass the unit, even if they have successfully met the merit and distinction criteria.

We don't have specific requirements for the format of evidence in this assignment. We've said what format the evidence could take for each task. For example, if we say 'You could include a report on ...', the evidence doesn't have to follow any specific reporting conventions. You can modify the format of the evidence, but you must make sure the format doesn't prevent the learner from accessing the grading criteria.

It's possible that certain formats for evidence can naturally cover several grading criteria and avoid the need for excessive amounts of evidence. For example, a report can be a good way to pull together evidence to meet several grading criteria.

For more guidance on generation and collection of evidence, please refer to the section 8 'Internal Assessment', in the qualification handbook.

Group work

This assignment hasn't been written to include group work. If you plan to ask learners to work in a team to complete work for assessment, you need to determine at which point in an assessment task learners can work together.

You must be sure that each learner can produce evidence of their own contribution to each grading criterion. You can give constructive feedback to learners about working as a group and direct them on team working skills because evidence of team working skills is not required by the unit. See our information on authentication, including group work and feedback to learners, in section 8 of the qualification handbook.

If witness statements are used to support learners' evidence, you'll need to complete an individual statement for each learner.

After completing the assignment

Once the learner has submitted their work to you to be assessed, you must judge or 'mark' the work against the grading criteria for the unit and identify one grade for the unit. For further information about assessment, please refer to section 8 of the qualification handbook.

Your assessment decisions must be quality assured across the cohort of learners in your centre who are being entered for the same unit. This must be done through an internal standardisation process. We give information on internal assessment and standardisation in the qualification handbook.

Reworking the assignment

If you and the learner feel they've not performed at their best during the assessment, the learner can, at your discretion, improve their work and resubmit it to you for assessment. If a learner is working on improving their work before it is resubmitted, you and the learner must continue to make sure the work is the learner's own.

Any feedback you give to the learner must not direct them on how to improve their work. You can identify what area of the work could be improved but you cannot give the learner any details about how they could improve it. You must follow the guidelines given in section 8 of the qualification handbook under 'Authenticity of learner work'.

Modifying the model assignment

The tasks in this assignment allow learners access to the full range of grades detailed in the grading criteria of this unit.

If you modify this assignment you must **not** change the grading criteria provided in the tasks for the learner or in the evidence checklist. These grading criteria are taken from the unit.

You can modify the scenario to suit your local or regional needs and the tasks may be contextualised to match any changes you have made to the scenario. If you supply your own specific criterion to support a different scenario, these must be sufficiently detailed for learners to complete the tasks.

You can modify the type of evidence and the format it takes, unless we expressly state that evidence must take a specific format.

You must also make sure that you avoid discrimination, bias and stereotyping and support equality and diversity. For more information, please see the section 'Designing your own assignments for internally assessed units' in section 8 of the qualification handbook.

If modifications are made to the model assignment, whether to the scenario alone, or to both the scenario and individual tasks, it's your responsibility to make sure that all grading criteria can still be met and that learners can access the full range of grades.

If you're using this model assignment and delivering the Foundation Diploma, Diploma or Extended Diploma you have an opportunity to secure meaningful employer involvement by working with an employer to modify it.

General information for learners

Q ***What do I need to do to pass this assignment?***

A You need to produce evidence to meet the requirements of **all** the pass criteria for the unit this assignment relates to. If you miss just one pass criterion, you will not achieve this unit and will receive an unclassified result.

Q ***What do I need to do if I want to get a merit or distinction for this assignment?***

A For a merit, you need to produce evidence to meet the requirements of **all** the pass criteria for the unit this assignment relates to **and** you need to produce evidence to meet **all** the merit criteria.

For a distinction, in addition to the above, you also need to meet **all** the distinction criteria for this unit.

Q ***What help will I get?***

A Your tutor will support you when completing this assignment and will make sure that you know what resources or facilities you need and are allowed to use. We've given your tutor information about how much support they can give you.

Q ***What if I don't understand something?***

A It's your responsibility to read the assignment carefully and make sure you understand what you need to do and what you should hand in. If you are not sure, check with your tutor.

Q ***I've been told I must not plagiarise. What does this mean?***

A Plagiarism is when you take someone else's work and pass this off as your own, or if you fail to acknowledge sources properly. This includes information taken from the internet.

It's not just about presenting a whole copied assignment as your own; you will also be plagiarising if you use the ideas or words of others without acknowledgement, and this is why it's important to reference your work correctly (see Q&A below for more information on referencing).

Plagiarism has serious consequences; you could lose the grade for this unit or you may not be allowed to achieve the whole qualification.

Always remember that the work you produce must be your own work. You will be asked to sign a declaration to say that it is.

Q ***What is referencing and where can I find out more information about it?***

A Referencing is the process of acknowledging the work of others. If you use someone else's words and ideas in your assignment, you must acknowledge it, and this is done through referencing.

You should think about why you want to use and reference other people's work. If you need to show your own knowledge or understanding about an aspect of subject content in your assignment, then just quoting and referencing someone else's work will not show that **you** know or understand it. Make sure it's clear in your work how you are using the material you have referenced **to inform** your thoughts, ideas or conclusions.

You can find more information about how to reference in *The OCR Guide to Referencing* available on our website: <http://www.ocr.org.uk/Images/168840-the-ocr-guide-to-referencing>.

Q ***Can I work in a group?***

A Yes. However, if you work in a group at any stage, you must still produce work that shows your individual contribution. Your tutor can advise you how to do this.

Q ***Does my work for each task need to be in a particular format?***

A You can present your work in a variety of ways – it can be handwritten, word-processed, on video or in digital media. What you choose should be appropriate to the task(s) and your tutor can advise you. There may be times when you need proof that you have completed the work yourself: for example, if you do something during work placement that you want to use as evidence, the tutor might ask the employer to provide a witness statement.

Make sure you check the wording in each task carefully. For each task, we'll tell you if your evidence has to be in a specific format:

- If we say use the word '**must**', for example 'You must produce a report' or 'Your evidence/work must include a diagram', then you must produce the work in the stated format.
- If we use the word '**could**', for example 'You could include sketches of your ideas' or 'You could do this by annotating your diagram', this means that you are not required to follow the format we have given, but you must make sure that the work you do produce allows you to demonstrate the requirements of the grading criteria.

If you are unsure about what evidence you need, please ask your tutor.

Q ***Can I ask my tutor for feedback on my work?***

A Yes, but they can't give you detailed feedback.

We have given your tutor instructions on what kind of feedback they can give you. For example, they are **not** allowed to tell you exactly what to do to make your work better, but they **can** remind you about what they've taught you and you can use this additional learning to try and improve your work independently. They can say what they've noticed might be wrong with your work, for example if your work is descriptive where an evaluation is required, but your tutor can't tell you specifically what you need to do to change it from a description to an evaluation – you will need to work out what you need to do and then do it for yourself.

Q ***When I have finished, what do I need to do?***

A If you have included the personal details (such as name, address or date of birth) of someone other than yourself in your work, this must be blanked out (anonymised) – your tutor will tell you how to do this. You don't need to do this for information contained in references.

You can complete the evidence checklist to show your tutor where they can find the evidence for each grading criterion in your work.

You should make sure your work is labelled, titled and in the correct order for assessing.

Hand in the work that you've completed for each task to your tutor. They might ask to see your draft work, so please keep your draft work in a safe place.

Q ***How will my work be assessed?***

A Your work will be marked by someone in your centre who has been authorised to do so. They will use the information in the grading criteria to decide which grade your work meets. The grading criteria are detailed in each unit and are also given in the tasks within this assignment. Please ask your tutor if you are unsure what the grading criteria are for this assignment.

Assignment for learners

Unit 16: Systems and Programming

Scenario

Systems and programming – Automatic garage door

OCR Door Systems wants to develop a control system solution to automate the opening of a garage door (similar to the one shown below).



The Head of Research and Development (R&D) has given you a brief to research the development of an automatic door mechanism that includes the following design features:

- it must open and close automatically when the appropriate button is pressed
- detection to stop the door
 - in the fully open and fully closed position
 - lowering if an obstruction is detected
 - lowering should it hit an object
- protection against motor burn-out through a timed automatic shut-off (e.g. after 10 seconds)
- record of the number of times the
 - garage door has opened and closed
 - safety sensors have been activated.

You may also augment the design features if desired.

Your research could be in the form of a working prototype to represent a model of the automatic door. Moving components can be represented by using suitable materials, modelling/construction kits could be adapted for this purpose.

The tasks

Task 1: Programming embedded systems

(This task should take between 5 and 6 hours.)

Learning Outcome 1: ‘Understand programming techniques’ and **Learning Outcome 2:** ‘Be able to program embedded devices in a system’ are assessed in this task.

Your task is to write a well-structured computer program for the embedded device that controls the automatic door mechanism and satisfies all the design features specified by the Head of R&D.

The Head of R&D has asked for a documented program and a report on the processes and considerations you have made when developing this program.

You will need to:

- Interpret the basic architecture of PICs, microprocessors and microcontroller that could be used to control the automatic door.
- Describe practical applications for embedded devices and explain how they differ from microprocessors.
- Develop and explain the use of flow charts, modules and subroutines.
- Apply logic functions (logic gates) derived from Boolean operations to write a program for the embedded devices used in the automatic door mechanism and explain how to use comments for programming maintenance and debugging.
- Explain the conversion of high level programming languages to machine code and then to binary/hexadecimal.
- Apply appropriate programming techniques to your embedded device such as validation and testing of programs.

Pass	Merit	Distinction
P1: Interpret the basic architectures of devices.	M1: Explain the conversion of high level programming languages to machine code and then to binary/hexadecimal.	D1: Produce a well-structured and documented program for an embedded device applying appropriate programming techniques.
P2: Apply logic functions derived from Boolean operations.		
P3: Explain the use of flow charts, modules, subroutines and comments in programming.		
P4: Explain how embedded devices differ from microprocessors.		
P5: Describe practical applications for embedded devices.		
P6: Write a program for an embedded device.		
Evidence		
You could present evidence as a written report which should include the algebraic logic functions (Boolean) you have used and your well-structured and documented program (which could include screen shots). You could include annotated photographs from key stages of your prototype.		

Task 2: Programmable Logic Controller (PLC)

(This task should take between 5 and 6 hours.)

Learning Outcome 3: 'Be able to program Programmable Logic Controllers (PLCs)' is assessed in this task.

Your task is to model, load and operate a PLC program using ladder logic to control the automatic door mechanism that satisfies the design features specified by the Head of R&D. This should include ladder code to represent at least one latching function.

Pass	Merit	Distinction
P7: Model a PLC program which demonstrates understanding of ladder logic.	M2: Construct ladder code to represent a latching function.	
P8: Load and operate a PLC program.		
Evidence		
You could present evidence of your PLC program by including screen shots and annotated photographic evidence of the program being loaded to a PLC and in operation on the system. Print outs of the ladder logic used. You could include annotated photographs from key stages of your prototype.		

Task 3: Testing software

(This task should take between 3 and 4 hours.)

Learning Outcome 4: 'Understand commercial testing and validation strategies' is assessed in this task.

Your task is to investigate how software is tested and validated.

The Head of R&D has asked for a report on the approaches to testing and validating the program you have developed in tasks 1 and 2.

You will need to:

- Explain the structured approach you have taken when testing the software to minimise defects (bugs), include the four accepted levels of testing:
 - unit
 - integration
 - system
 - acceptance.
- Analyse the differences between the commercial use of alpha and beta testing.
- Evaluate how metrics are used commercially to assess quality of software.

Pass	Merit	Distinction
P9: Explain structured approaches to the testing of software.	M3: Analyse the differences between the commercial use of alpha and beta testing.	D2: Evaluate how metrics are used commercially to assess quality of software.
P10: Explain the four accepted levels of testing.		
Evidence		
You could present evidence in a written report or a presentation with detailed speaker notes. You could include annotated photographs of your working prototype.		

Evidence Checklist

OCR Level 3 Cambridge Technicals in Engineering Unit 16: Systems and Programming

LEARNER NAME:

For PASS have you: (as a minimum you have to show you can meet every pass criterion to complete the unit)	Where can your tutor find the evidence? Give page no(s)/digital timings, etc.
Interpreted the basic architectures of devices. (P1)	
Applied logic functions derived from Boolean operations (P2)	
Explained the use of flow charts, modules, subroutines and comments in programming. (P3)	
Explained how embedded devices differ from microprocessors. (P4)	
Described practical applications for embedded devices. (P5)	
Written a program for an embedded device. (P6)	
Modelled a PLC program which demonstrates understanding of ladder logic. (P7)	
Loaded and operated a PLC program. (P8)	
Explained structured approaches to the testing of software. (P9)	
Explained the four accepted levels of testing. (P10)	

For Merit have you:	Where can your tutor find the evidence? Give page no(s)/digital timings, etc.
Explained the conversion of high level programming languages to machine code and then to binary/hexadecimal. (M1)	
Constructed ladder code to represent a latching function. (M2)	
Analysed the differences between the commercial uses of alpha and beta testing. (M3)	

For Distinction have you:	Where can your tutor find the evidence? Give page no(s)/digital timings, etc.
Produced a well-structured and documented program for an embedded device applying appropriate programming techniques. (D1)	
Evaluated how metrics are used commercially to assess quality of software. (D2)	

To find out more

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Alternatively, you can email us on **vocational.qualifications@ocr.org.uk**



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