2016 Suite

OCR
Oxford Cambridge and RSA

Cambridge **TECHNICALS LEVEL 2**

Cambridge TECHNICALS 2016

ENGINEERING

Unit 5

Engineering systems control - operations and application

Model assignment

R/615/2135

Version 1 August 2017

ocr.org.uk/engineering

Contents

Guidance for tutors on using this assignment **3**

General 3

Before using this assignment to carry out assessment 3

When completing the assignment 4

Resources to complete the tasks 4

Tutor information to support the tasks 4

Health and Safety and the use of resources 5

Time 5

Format of evidence 5

Group work 6

After completing the assignment 6

Reworking the assignment 6

Modifying the model assignment 6

General information for learners **8**

Assignment for learners **10**

Scenario 10

The tasks **12**

Task 1: Components and architecture of a control system 12

Task 2: Constructing the control system 13

Task 3: Programming the control system 14

Task 4: Testing, enhancing and refining operation 15

Evidence Checklist **16**

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.

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 could construct, programme and test automated control systems 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.

Resources to complete the tasks

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

- Tools, equipment, components and hardware to construct a prototype of the automatic water tank control system assembly. This includes a water container, pipework, water pump, solenoid valve, sensors, switches and a programmable device including programming software. Suitable interfacing components will also be required to connect sensors and actuators to the programmable device.
- Appropriate personal protective equipment (PPE).
- Programmable device either a microprocessor, microcontroller or programmable logic controller (PLC) and programming software.

Tutor information to support the tasks

You may want to give a general introduction to the function of the water control system presented in the scenario.

Observation and witness statements can be a useful way of providing support and corroboration of learner-generated evidence and skills which are not easily represented in the portfolio of evidence (see the section on Internal Assessment in the Qualification handbook, and in particular the section on the use of witness statements).

In task 1, learners must explain inputs, outputs and functions for the automatic water tank control system. Relationship for open and closed loop systems must be explained in general, and the type of control system for the automatic water tank control system identified and explained. Architecture of programmable devices should be described, including that for the selected programmable device (e.g. inputs, outputs, programming and operating system, storage etc.)

In task 2, learners must construct a prototype of the automatic water tank control system, to include a water container, pump, solenoid valve, pipework, sensors and programmable device. You can select the type of pump and discharge valve, and programmable device. Water level can be detected using simple float switches or more complex water level sensing devices. Switches to select fill level and tank emptying are momentary push buttons meaning that a latching function will require programming in software. It should be noted that the stop switch is a normally-closed switch. There should be scope for enhancements to the physical control system to be able to satisfy the requirements of task 4.

For task 3, suitable software is required to be able to programme the selected programmable device. You can select the programming language and programming environment. For M3 learners could independently transfer their programme to the programme device to be able to operate and test the control system. If learners are unable to implement this transfer you should supply an appropriate programme to allow them to complete P8 in task 4.

In task 4, for D2 results of testing should lead to learners detailing the corrections and refinements they have made to arrive at their final solution. This should culminate at D1 in the presentation of a documented, annotated and justified final design solution. For M2 learners should enhance their control system to extend or improve functionality. This can include making amendments and/or additions to both the physical construction of the automatic water tank control system and to its programming. Examples could include an alarm to detect if water in the tank is too cold and take appropriate actions, or overflow monitoring and control. Learners should be encouraged to consider and implement their own enhancements and improvements.

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 14–19 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 drawings 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 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 5: Engineering systems control - operations and application

Scenario

A processing company uses water supplied by a storage tank like the one shown in Fig. 1.

Fig. 1

Different processes require the tank to be filled to one of three levels so the water in the tank is controlled by an automatic control system using level sensors.

Water is pumped into the tank by an electric pump and discharged from the tank via a controlled solenoid valve.

A control system, see Fig. 2, automatically fills the tank so that it is either ¼ filled, ½ filled or completely filled. It also controls the emptying of the tank.

Momentary push-button switches are used to determine the level to which the tank is filled and a different momentary push-button switch controls the emptying of the tank. There is also a normally-closed stop switch which can be pressed in an emergency to stop the flow of water in or out of the tank.

You are to construct, programme and test a prototype of the automatic water tank control system.

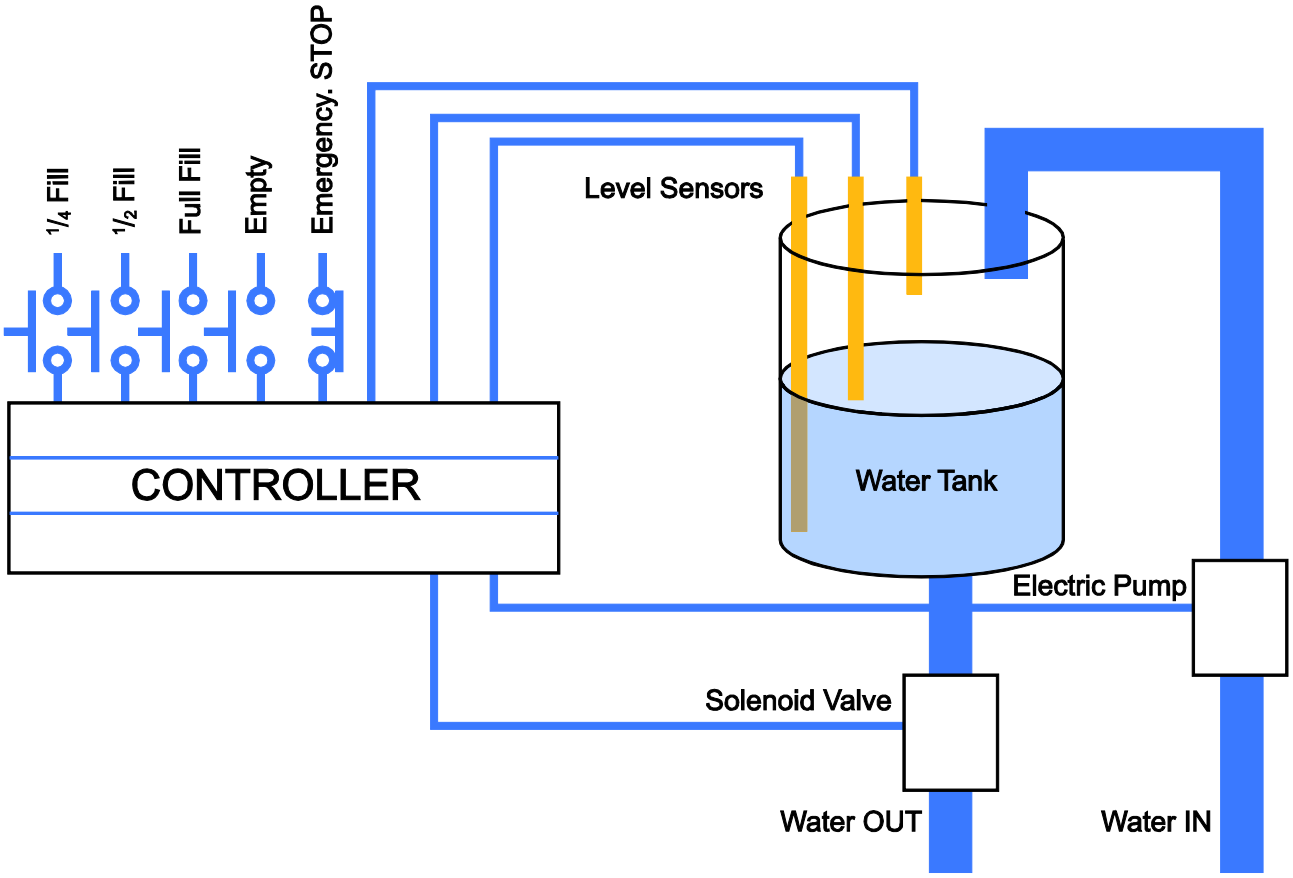

Fig. 2

Task 1: Components and architecture of a control system

(This task should take between 2 and 3 hours.)

Learning Outcome 1: 'Understand the key components, applications and basic architecture of programmable devices' is assessed in this task.

The water tank control system uses input and output (I/O) devices. You must investigate and explain different types of I/O devices that could be used in this control system to control the water level in the tank. You must also explain the function of the control system and the relationship between its I/O devices.

You must investigate the different types of feedback in both open and closed loop systems and explain the relationship between the controller and their I/O devices in both systems. You could use the water tank control system as part of your investigation.

You could describe different applications that use:

- Microprocessor/microcontroller
- Programmable Logic Controller (PLC).

You could also describe the architecture of a programmable device, such as the one detailed in Fig. 2 for the automatic water tank control system.

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td>P1: Explain the inputs, outputs and functions for control systems.</td><td rowspan="2">M1: Describe the architecture and applications for programmable devices.</td><td rowspan="2"></td></tr>
<tr><td>P2: Explain the relationships of feedback systems.</td></tr>
<tr><td colspan="3">Evidence</td></tr>
<tr><td colspan="3">You could present evidence as a written report or a presentation with detailed speaker notes.</td></tr>
</table>

Task 2: Constructing the control system

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

Learning Outcome 2: 'Be able to construct an automated control system using sensors/ transducers, actuators and mechanical devices' is assessed in this task. **NB**: M2 and D1 are assessed in task 4.

Your task is to construct the hardware such as switches, sensors, actuators, controller, tank and pipework for a working prototype of the automatic water tank control system.

Pass	**Merit**	**Distinction**
P3: Construct a designed automated control system to include identified components.		
Evidence		
Evidence could be annotated photographic evidence showing the step-by step physical construction of the automatic water tank control system supported by a witness statement(s) from your tutor.		

Task 3: Programming the control system

(This task should take between 6 and 8 hours.)

Learning Outcome 3: 'Be able to programme an identified automated control system' is assessed in this task. **NB**: D2 is assessed in task 4.

You must create a block diagram representation of the system functions for the automatic water tank control system using instruction sets for your chosen programmable device.

You must also write programme code for the automatic water tank control system integrating instruction sets as appropriate.

You could upload your programme to your chosen programmable device.

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td>P4: Create block diagrams to represent system functions.</td><td rowspan="3">M3: Implement the transfer or load of a programme to operate the identified programmable device.</td><td rowspan="3"></td></tr>
<tr><td>P5: Create instruction sets for identified automated control system functions.</td></tr>
<tr><td>P6: Write programme code for an identified automated control system.</td></tr>
<tr><td colspan="3">Evidence</td></tr>
<tr><td colspan="3">Evidence could be in the form of annotated block diagrams, annotated screen shots showing how you used instruction sets to write programme code and a printed copy of your written code.
You could use annotated screen shots and photographic evidence to show how you loaded your programme to the selected programmable device this could be supported by a witness statement(s) from your tutor.</td></tr>
</table>

Task 4: Testing, enhancing and refining operation

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

Learning Outcome 4: 'Be able to test the operation of an automated control system' is assessed in this task together with LO2:M2/D1 and LO3/LO4:D2.

You must develop a test plan for the operation of the automatic water control system and then test your system against the plan.

You could interpret and document the results of your testing as well as detailing corrections and refinements made to the system.

You could enhance the automatic water control system using different or improved components that extend or improve its functionality. The water tank is located outside and is liable to the water freezing in extreme weather conditions so you could include a water temperature warning system that would alert the operator if the water temperature fell below 4^0c.

You could then produce an annotated final design solution for the completed control system solution and justify the components you have used.

<table>
<tr><th>Pass</th><th>Merit</th><th>Distinction</th></tr>
<tr><td>P7: Develop a test plan for an identified control system.</td><td rowspan="2"></td><td rowspan="2">D2: Interpret and document results of testing detailing corrections and refinements that have been made in an automated control system.
(LO3/LO4)</td></tr>
<tr><td>P8: Test identified control system against test plan.</td></tr>
<tr><td></td><td>M2: Enhance constructed control system using different components to extend or improve functionality.
(LO2)</td><td>D1: Produce an annotated design solution for a complete control system solution justifying the components used.
(LO2)</td></tr>
<tr><td colspan="3">Evidence</td></tr>
<tr><td colspan="3">You must produce a written test plan for the system.
You must produce evidence, which could include annotated screen shots and photographs to show how you tested your control system against the test plan. This could be supported by a witness statement(s) from your tutor.
You could produce evidence, which could be a written report, interpreting and documenting testing results, corrections and refinements made.
You could produce evidence, which could include annotated photographs showing how you enhanced the physical construction of the system. This could be supported by a witness statement(s) from your tutor.
You could produce a final written report or presentation with detailed speaker notes of your complete solution with a justification of the components used. This could include annotated photographs.</td></tr>
</table>

Evidence Checklist

OCR Level 2 Cambridge Technicals in Engineering
Unit 5: Engineering systems control - operations and application

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.**
P1: Explained the inputs, outputs and functions for control systems?	
P2: Explained the relationships of feedback systems?	
P3: Constructed a designed automated control system to include identified components?	
P4: Created block diagrams to represent system functions?	
P5: Created instruction sets for identified automated control system functions?	
P6: Written programme code for an identified automated control system?	
P7: Developed a test plan for an identified control system?	
P8: Tested identified control system against test plan?	

For Merit have you:	**Where can your tutor find the evidence? Give page no(s)/digital timings, etc.**
M1: Described the architecture and applications for programmable devices?	
M2: Enhanced constructed control system using different components to extend or improve functionality?	
M3: Implemented the transfer or load of a programme to operate the identified programmable device?	

For Distinction have you:	**Where can your tutor find the evidence? Give page no(s)/digital timings, etc.**
D1: Produced an annotated design solution for a complete control system solution justifying the components used?	
D2: Interpreted and documented results of testing detailing corrections and refinements that have been made in an automated control system?	

To find out more
ocr.org.uk/engineering
or call our Customer Contact Centre on **02476 851509**

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

OCR
Oxford Cambridge and RSA