



National
Qualifications

Engineering Science

Assignment

General assessment information

This pack contains general assessment information for centres preparing candidates for the assignment Component of Higher Engineering Science Course assessment.

It must be read in conjunction with the specific assessment tasks for this Component of Course assessment which may only be downloaded from SQA's designated secure website by authorised personnel.

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Contents

Introduction	1
What this assessment covers	2
Assessment	3
General Marking Instructions	6

Introduction

This is the general assessment information for Higher Engineering Science assignment.

This assignment is worth 60 marks. The marks contribute 40% of the overall marks for the Course assessment. The Course will be graded A-D.

Marks for all Course Components are added up to give a total Course assessment mark which is then used as the basis for grading decisions.

This is one of two Components of Course assessment. The other Component is a question paper.

This document describes the general requirements for the assessment of the assignment Component for this Course. It gives general information and instructions for assessors.

It must be read in conjunction with the assessment task for this Component of Course assessment.

Equality and inclusion

This Course assessment has been designed to ensure that there are no unnecessary barriers to assessment. Assessments have been designed to promote equal opportunities while maintaining the integrity of the qualification.

For guidance on assessment arrangements for disabled candidates and/or those with additional support needs, please follow the link to the Assessment Arrangements web page: www.sqa.org.uk/sqa/14977.html

Guidance on inclusive approaches to delivery and assessment in this Course is provided in the *Course and Unit Support Notes*.

What this assessment covers

This assessment contributes 40% of the total marks for the Course.

The assessment will assess the skills, knowledge and understanding specified for the assignment in the *Course Assessment Specification*. These are:

- ◆ practical application of knowledge and skills from the across the Course to develop a solution to an appropriately challenging engineering problem
- ◆ skills in analysing a problem, designing a solution to the problem, simulating or constructing a solution to the problem, and testing and reporting on that solution

Assessment

Purpose

The purpose of this assessment is to generate evidence for the added value of this Course by means of an assignment.

Assessment overview

The assignment is a meaningful and appropriately challenging task, which should clearly demonstrate application of knowledge and skills, at an appropriate level, from the mechanisms, structures, electronics and control sections of the Course (as defined in the 'Further mandatory information on Course coverage' section of the *Course Assessment Specification*).

The assignment is designed to allow candidates to demonstrate their ability to work independently, as they are required to do in the other Component of the Course assessment, the question paper.

The assignment is set by SQA. A bank of assignments will be provided and centres may select from the bank.

Marks will be awarded for:

- ◆ analysing the problem
- ◆ designing a solution
- ◆ constructing/simulating a solution
- ◆ testing the solution
- ◆ reporting on the solution

The assignment will be internally marked by centre staff, in line with the Marking Instructions provided in this document.

Full instructions for candidates are contained within each assessment task.

Assessment conditions

Assessors must exercise their professional responsibility in ensuring that evidence submitted by a candidate is the candidate's own work.

This assessment is a single assessment event. Candidates should undertake the assessment at an appropriate point in the Course. This will normally be when they have completed most of the work on the Units in the Course.

This is an open-book assessment. There are no restrictions on the resources to which candidates may have access.

Candidates must undertake the assessment independently. However, reasonable assistance may be provided prior to the formal assessment process taking place. The term 'reasonable assistance' is used to try to balance the need for support with the need to avoid giving too much assistance. If any

candidates require more than what is deemed to be 'reasonable assistance', they may not be ready for assessment or it may be that they have been entered for the wrong level of qualification.

Reasonable assistance may be given on a generic basis to a class or group of candidates, for example, advice on how to develop a project plan. It may also be given to candidates on an individual basis. When reasonable assistance is given on a one-to-one basis in the context of something the candidate has already produced or demonstrated, there is a danger that it becomes support for assessment and assessors need to be aware that this may be going beyond reasonable assistance.

Clarification may be sought by candidates regarding the wording of a brief or specification or instructions for the assessment if they find them unclear. In this case, the clarification should normally be given to the whole class.

Some guidance may be provided during the analysis and design stages, **but the candidate should work independently throughout the implementation, testing and evaluation stages.**

Assessor input and advice on the candidate's analysis and design is acceptable in order to allow the candidate to progress to the next stages of the assessment. The assistance provided must be recorded so that the candidate's own analysis and design work can be marked/judged fairly.

As this assignment is a summative assessment, support and guidance during implementation, testing and evaluation stages should be limited to minimal prompts and questioning, referring the candidate to the instructions provided in the assessment task.

The assignment will be conducted under some supervision and control. Assessors should put in place processes for monitoring progress and ensuring that the work is the candidate's own and that plagiarism has not taken place. For example:

- ◆ regular checkpoint/progress meetings with candidates
- ◆ short spot-check personal interviews
- ◆ checklists, which record activity/progress
- ◆ photographs, film or audio evidence

Group work approaches, as part of the preparation for assessment, can be helpful to simulate real-life situations, share tasks and promote team working skills. However, group work is not appropriate once formal work on assessment has started.

Once the assignment has been completed and submitted, it should not be returned to the candidate for further work to improve their mark.

Evidence to be gathered

The following candidate evidence is required for this assessment:

- ◆ the completed solution (model or photographs and/or hard copy from simulation software)
- ◆ a record of progress through the task, including all items of evidence specified within the assessment task
- ◆ a short report on the testing of the solution (in written, electronic and/or oral form)
- ◆ evidence of candidate's degree of independence and safe working (detailed assessor observation notes)

This evidence must be retained for quality assurance purposes.

General Marking Instructions

In line with SQA's normal practice, the following General Marking Instructions are addressed to the marker. They will also be helpful for those preparing candidates for Course assessment.

The assessment task will be set and externally verified by SQA, and conducted, marked and internally verified in centres under conditions specified by SQA.

All marking will be quality assured by SQA.

General Marking Principles for the assignment

This information is provided to help you understand the general principles you must apply when marking candidate responses to this assignment. These principles must be read in conjunction with the Detailed Marking Instructions, which identify the key features required in candidate responses.

- (a) Marks for each candidate response must always be assigned in line with these General Marking Principles and the Detailed Marking Instructions for this assessment.
- (b) Marking should always be positive. This means that, for each candidate response, marks are accumulated for the demonstration of relevant skills, knowledge and understanding: they are not deducted from a maximum on the basis of errors or omissions.

Detailed Marking Instructions for the assignment

Marks will be awarded for:

- ◆ analysing the problem (10 marks)
- ◆ designing a solution – electronics/control (10 marks)
- ◆ designing a solution – mechanical/structural (10 marks)
- ◆ constructing/simulating a solution (10 marks)
- ◆ testing the solution (10 marks)
- ◆ reporting on the solution (10 marks)

These assignments are designed to provide starting points from which candidates can develop their solutions. The exact coverage is not mandatory and candidates should be encouraged to personalise their solution, while sampling concepts from the Course themes.

Candidates should ensure that they provide the following evidence of appropriate skills and knowledge:

- ◆ At least one output condition is monitored, using automatic closed-loop control using error detection, which allows the chosen desired output condition to be maintained. This can be achieved using operational

amplifiers in comparator mode to provide two-state control, or in difference mode to provide proportional control. Alternatively, an analogue input to the microcontroller can be used to compare the error between the actual output condition with the desired value, and the output adjusted accordingly.

- ◆ There must be integration of analogue and digital electronics. If an op-amp is not used for closed-loop control, it could be used to provide signal conditioning. Alternatively, candidates could design their own MOSFET output driver, by calculating values, instead of using the ones provided by YENKA and hardware output circuits (usually half H for motor direction control).
- ◆ Knowledge and creativity should be used to minimise the number of inputs and outputs, while still achieving the required control. This can be achieved using Course content such as logic and op-amps. The aim should be no more than four inputs or outputs, although there is no upper limit to the inputs or outputs used, where this is appropriate to that particular solution.
- ◆ There should be evidence of Pulse Width Modulation (PWM). Where two-state control is used, then the PWM will simply control the overall energy of the output (speed of a motor, temperature of a heater, etc). Where proportional control is used, the output energy could directly reflect the size of the error to some extent, where this is appropriate to the solution.
- ◆ There should be at least one example of using electronics and control calculations, and one example of using mechanical and structural calculations.
- ◆ The detailed specification should include some values; evidence of reasoned estimates for these values can be given in the evaluation. The test plan should include strategies and results for confirming calculated and reasoned estimates of values, and the evaluation should discuss how these values were arrived at.

Assessors should allocate a mark out of 10 for each of the six stages, by following the instructions given below. This mark should be recorded on the assessment record, with a comment justifying why each mark was awarded.

For each of the stages, the assessor should select the band descriptor which most closely describes the evidence gathered. Once the best fit has been selected, follow this guidance:

- ◆ If the evidence almost matches the level above; the highest available mark from the range should be awarded.
- ◆ If the candidate's work just meets the standard described, the lowest mark from the range should be awarded.
- ◆ If neither of the above is appropriate, then the mark from the middle of the range should be awarded.

Notes:

- ◆ If the evidence completely matches the highest level band descriptor for any stage, and has been produced by the candidate working independently, 10 marks should be awarded for that stage.
- ◆ Zero (0) marks should be awarded for any stage where no evidence has been produced by the candidate.

Band descriptors

It should be noted that the band descriptors should be used as a guide to assessment, rather than as an exhaustive list and where assistance is given to candidates this must be reflected in the marks awarded and detailed in the marking commentary

Band descriptors for stage 1:

Analysing the problem: system specification, system and sub-system diagrams

	1 mark	2 marks	3 marks	4 marks
'Top-level' systems diagram	Incomplete system diagram, with missing/incorrect inputs, process and outputs.	Complete and correct system diagram, showing all inputs, process and outputs.		
Sub-systems diagrams	Control diagram, with numerous inconsistencies with sub-system interactions.	Control diagram, with some elements missing and/or some inconsistencies with sub-system interactions.	Complete control diagram, showing feedback, system boundary and interactions between sub-systems.	Detailed and complete control diagram, showing feedback, system boundary and interactions between sub-systems. Identification of all required sub-systems, including output driver sub-systems (amplifier type, where appropriate).
Specification	Basic and incomplete specification.	Partially complete specification, with no numerical values.	Complete and detailed specification, covering most sub-systems and including numerical values (where appropriate).	Complete and detailed specification, covering all sub-systems including numerical values (where appropriate).

Maximum marks available for stage – 10 marks

Band descriptors for stage 2a:

Designing a solution: designing electronic and control sub-systems

	1 mark	2 marks	3 marks	4 marks
Flowchart	Flowchart, displaying significant inconsistencies.	Flowchart, displaying some inconsistencies.	Complete flowchart, showing minimal inconsistencies.	Detailed, complete and correct flowchart, meeting the specification.
Program	Incomplete program code/or code which does not match the flowchart.	Complete program code, fully reflecting the flowchart.		
Circuit diagrams	Incomplete circuit diagram(s), with significant errors.	Incomplete circuit diagram(s), with minimal errors.	Partially complete circuit diagrams, showing some numerical values.	Complete and correct circuit diagrams, showing correct numerical values.

Maximum marks available for stage – 10 marks

Band descriptors for stage 2b:

Designing a solution: designing mechanical and/or structural sub-systems

	1 mark	2 marks	3 marks	4 marks	5 marks
Sketch/ simulation of structural OR mechanical sub-system	Incomplete structural and/or mechanical design showing significant inconsistencies.	Incomplete structural and/or mechanical design showing some inconsistencies.	Incomplete structural and/or mechanical design which mainly meets the specification.	Complete structural and/or mechanical design which mainly meets the specification.	Complete and detailed structural and/or mechanical design which fully meets the specification.
Calculations or reasoned estimates for appropriate values	Incorrect and basic mechanical and/or structural calculations. Inappropriate estimate values with minimal justification of the estimates.	Basic mechanical and/or structural calculations with some inconsistencies. Where values are estimated, minimal justification of the estimates is supplied.	Mechanical and/or structural calculations with some inconsistencies which relate to the design of an appropriate solution. Where values are estimated, limited justification of the estimates is supplied.	Mechanical and/or structural calculations with minimal inconsistencies which relate to the design of an appropriate solution. Where values are estimated, some justification of the estimates is supplied.	Complete, correct and detailed mechanical and/or structural calculations which relate to the design of an appropriate solution. Where values are estimated, reasoned justification of the estimates is supplied.

Maximum marks available for stage — 10 marks

Band descriptors for stage 3:

Constructing/simulating a solution: electronic, control, mechanical and/or structural sub-systems

	1 mark	2 marks	3 marks	4 marks	5 marks
Construction/simulation of control sub-system AND electronic/mechanical/structural sub-system	One sub-system, simulated and/or constructed with inconsistencies.	One sub-system, correctly simulated and/or constructed.	One sub-system, simulated and/or constructed from either programmable control or electronic driver. At least one simulated and/or constructed mechanical or structural sub-system.	Programmable control and electronic driver circuit sub-systems, simulated and/or constructed, including microcontroller code. At least one simulated and/or constructed mechanical or structural sub-system.	Programmable control and electronic driver circuit sub-systems, correctly simulated and/or constructed, including correct microcontroller code. At least one correctly simulated and/or constructed mechanical or structural sub-system.
Sub-system integration	Control sub-system, integrated with at least one other sub-system. This can be constructed and/or simulated. An incomplete description of a fully integrated solution.	Control sub-system, integrated with at least one other sub-system. This can be constructed and/or simulated. A description of a complete, fully integrated solution.			
Fully justified decisions on materials and components	Basic decisions for material and component choices given.	Justified decisions on materials and components. Material property data comparisons with alternative materials and	Fully justified decisions on materials and components. Material property data appropriately sourced and included. Comparisons		

		components given.	with alternative materials and components given.		
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Maximum marks available for stage – 10 marks

Band descriptors for stage 4:

Testing the solution

	1 mark	2 marks	3 marks	4 marks
Description of the planned tests	Test plan, covering some sub-systems. The plan states some tests to be carried out.	Logical test plan, covering some sub-systems. The plan describes some tests to be carried out, detailing actions and equipment/ software used.	Logical and thorough test plan, covering most sub-systems. The plan describes most tests to be carried out, detailing actions and equipment/ software used.	Logical and thorough test plan, covering all sub-systems. The plan fully describes all tests to be carried out, detailing actions and equipment/ software used. Justification of the appropriateness of all tests.
Description of expected results	Expected results of some tests, covering some sub-systems stated.	Expected results of most tests, covering most sub-systems stated.	Expected results of all tests, covering all sub-systems detailed in a logical manner.	
Description of actual results and any amendments made	Expected results of some tests, covering some sub-systems stated.	Actual results of most tests, covering most sub-systems stated.	Actual results of all tests, covering all sub-systems detailed in a logical manner. Detailed descriptions of any amendments made to sub-systems, as a result of the testing.	

Maximum marks available for stage – 10 marks

Band descriptors for stage 5:

Reporting: keeping a record of progress, record of testing, and evaluation

	1 mark	2 marks	3 marks	4 marks	5 marks	6 marks
Evaluation	Very basic evaluation, with inconsistencies	Basic evaluation, with inconsistencies . The evaluation compares few sub-systems with some specification statements.	Well-argued evaluation, but with inconsistencies . The evaluation compares some sub-systems with some specification statements, stating how well the specification is met.	Clear, detailed, well-argued evaluation. The evaluation compares most sub-systems with associated specification statement(s), by referring to the testing results and describing how well the specification is met.	Clear, detailed, well-argued evaluation. The evaluation compares all sub-systems with associated specification statement(s), by referring to the testing results and describing how well the specification is met.	Clear, detailed, well-argued evaluation. The evaluation compares all sub-systems with associated specification statement(s), by referring to the testing results, describing how well the specification is met and making recommendations for improvement , where appropriate.
Record of progress	A basic lesson-by-lesson record of what was done.	Lesson-by-lesson record of what was done.	Lesson-by-lesson record of what was done, what was learned and the level of teacher assistance received.	A detailed, lesson-by-lesson record of what was done, what was learned, the level of teacher assistance received and plans for the next lesson.		

Maximum marks available for stage – 10 marks

Administrative information

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History of changes

Version	Description of change	Authorised by	Date
1.1	Amendments made to Marking Instructions for clarification.	Qualifications Manager	September 2015

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