SQA Advanced Graded Unit Specification

General Information for Centres

This Graded Unit has been validated as part of the SQA Advanced Certificate and SQA Advanced Diploma in Mechatronics. Centres are required to develop the assessment instrument in accordance with this validated specification. Centres wishing to use another type of Graded Unit or assessment instrument are required to submit proposals detailing the justification for change for validation.

Graded Unit Title: Mechatronics: Graded Unit 2

Graded Unit Code: HV6M 48

Type of Graded Unit: Project

Assessment Instrument: Practical Assignment

Credit points and level: 2 SQA Credits at SCQF level 8: (16 SCQF credit points at SCQF level 8*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from National 1 to Doctorates.*

Purpose: This Graded Unit is designed to provide evidence that the candidate has achieved the following principal aims of the SQA Advanced Certificate and SQA Advanced Diploma in Mechatronics:

- develop the candidate's ability to apply analysis and synthesis skills to the solution of mechatronics problems
- develop the candidate's learning and transferable skills (including Core Skills)
- develop the candidate's knowledge and skills in planning and project management
- develop the candidate's investigation skills
- develop a range of Communication knowledge and skills relevant to the needs of an incorporated engineers
- develop knowledge, understanding and skills in a range of core Mechatronics principles, robotics and animatronics, design principles and programming skills at SQA Advanced level (these studies in core mechatronics principles and technologies are underpinned by a mandatory Unit in Mathematics)
- develop knowledge and skills in the use of a variety of test instruments
- expand on the range of knowledge, understanding and skills in core mechatronics principles, electrical/electronics interfacing and systems and programming skills

General Information for Centres

Recommended Prior Knowledge and Skills: It is recommended that the candidate should have completed or be in the process of completing the following Units relating to the above specific aims prior to undertaking this Graded Unit:

- Communication: Practical Skills
- Computer Aided Draughting for Engineers
- Business Awareness and Continuing Professional Development
- Mechatronic Systems Elements
- Mechatronic Systems
- Mathematics for Engineering 1: Electronics and Electrical
- Interfacing Electronics
- Electrical Engineering Principles 1
- Engineering Principles
- Engineering Measurement/Electronic Testing Skills
- Robotics and Animatronics: An Introduction
- Robotics and Animatronics
- Material Selection
- Applied Industrial Plant Maintenance
- High Level Engineering Software
- High Level Language: External I/O Transfer
- Mathematics for Engineering 2
- Engineering Design Process: Mechatronics
- Pneumatics and Hydraulics
- Application of Programmable Logic Controllers/Engineering Systems Interfaced with Programmable Logic Controllers

The nature of the project activity detailed in this Specification is such that it is likely that centres will wish their candidates to embark on it from the start of the second year of the SQA Advanced Diploma in Mechatronics programme. As it is anticipated that centres will deliver the SQA Advanced Certificate in Mechatronics as part of the first year of the SQA Advanced Diploma, it is recommended that candidates have completed all SQA Advanced Certificate in Mechatronics Units before commencing this project.

In principle, the project can draw on any Units in the SQA Advanced Diploma in Mechatronics framework although the majority of any Units should be at SCQF Level 8. The project can be taken from one Mechatronics area (e.g. Robotics, Mechatronic Systems also incorporating some programming skills) or it can span more than one technical area. However, its principal purpose is not to integrate technical content (this is covered in Mechatronics: Graded Unit 1) but rather to combine such knowledge and skills as planning, construction, testing, evaluating and reporting

Core Skills: There are no opportunities to develop Core Skills in this Unit.

Assessment: This Graded Unit will be assessed by the use of the practical assignment (Mechatronics project). The developed practical assignment should provide the candidate with the opportunity to produce evidence that demonstrates she/he has met the aims of the Graded Unit that it covers.

In developing this specification it was decided that candidates must do clearly identifiable individual projects. However, this does not preclude individual projects being part of a larger group project. A candidate's contribution to a larger group project has the advantage of creating opportunities for the development of the Core Skills (eg Working with Others etc.)

Administrative Information

Graded Unit Code: HV6M 48

Graded Unit Title: Mechatronics: Graded Unit 2

Original date of publication: November 2017

Version: 01

History of Changes:

Version	Description of change	Date

Source: SQA

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

FURTHER INFORMATION: Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 279 1000. Alternatively, complete our Centre Feedback Form.

SQA Advanced Graded Unit Specification: Instructions for designing the assessment task and assessing candidates

Graded Unit Title: Mechatronics: Graded Unit 2

Conditions of Assessment

The candidate should be given a date for completion of the Mechatronics Project. However, the instructions for the assessment task should be distributed to allow the candidate sufficient time to assimilate the details and carry out the assessment task. During the time between the distribution of the assessment task instructions and the completion date, assessors may answer questions, provide clarification, guidance and reasonable assistance. The assessment task should be marked as soon as possible after the completion date. The final grading given should reflect the quality of the candidate's evidence at the time of the completion date.

The evidence for the project is generated over time and involves three distinct stages, where each stage has to be achieved before the next is undertaken. Thus any reassessment of stages must be undertaken before proceeding to the next stage.

If a candidate fails the project overall or wishes to upgrade, then this must be done using a *substantially different* project, ie all stages are undertaken using a new project, assignment, case study, etc. In this case, a candidate's grade will be based on the achievement in the ***reassessment.***

Instructions for designing the assessment task

The assessment task is a project. The project undertaken by the candidate must be a complex task which involves:

- variables which are complex or unfamiliar
- relationships which need to be clarified
- a context which may be familiar or unfamiliar to the candidate

The assessment task must require the candidate to:

- analyse the task and decide on a course of action for undertaking the project
- plan and organise work and carry it through to completion
- reflect on what has been done and draw conclusions for the future
- produce evidence of meeting the aims which this Graded Unit has been designed to cover

Guidance on grading candidates

Candidates who meet the minimum Evidence Requirements will have their achievement graded as C — competent, or A — highly competent or B somewhere between A and C. The grade related criteria to be used to judge candidate performance for this Graded Unit is specified in the following table.

Grade A	Grade C
Is a seamless, coherent piece of work which:	Is a co-ordinated piece of work which:
♦ The project brief includes all relevant information, is written clearly and concisely and has been agreed fully with the customer	♦ The project brief includes complex, multi-variable information about the main technical requirements of the project and provides a cost indication and expected timescales.
♦ The project specification is well structured, contains relevant, accurate information and any revisions made have been agreed with the customer.	♦ The project specification provides clear details of the following: the title of the project; the objectives of the specification; the project's main technical requirements including multi-variable and an acknowledgement of any references or standards relevant to the specification.
♦ The project objectives accurately and fully reflect the long-term project targets.	♦ The project objectives identify the key long-term project targets and multi-variables.
♦ The initial project schedule (probably in the form of a Gantt chart) contains a comprehensive list of project activities and timings. The information in the initial schedule is used to assess if the project can be completed within timescales. The schedule is monitored on a regular basis to inform on-going project planning and development.	♦ The initial project schedule (probably in the form of a Gantt chart) shows all essential project activities and timings. Evidence that the schedule has been monitored on at least three separate occasions during the life of the project to inform on-going project planning and development should be available.
♦ The candidate develops a substantial knowledge base to support the demands of the project.	♦ The candidate develops a sound knowledge base to support the demands of the project.
♦ The select solution is justified in terms of a thorough evaluation of a range of options.	♦ The selected solution is justified in terms of a sound evaluation involving the solution and at least one viable alternative option.
♦ A comprehensive verification strategy is developed to ensure the product is completely tested.	♦ A verification strategy is developed to test the essential parts of the product.
♦ The candidate feeds back to her/his supervisor on a regular basis, updating the supervisor on progress made and actions for the next stage of the project.	♦ The candidate feeds back to her/his supervisor on at least three occasions providing an indication of progress made.

Grade A	Grade C
Is a seamless, coherent piece of work which:	Is a co-ordinated piece of work which:
♦ The candidate accesses component and/or, software and/or materials of the correct specification from a range of sources at the most economic price.	♦ The candidate accesses components and/or software and/or materials of the correct specification from a range of sources.
♦ The product is constructed to a high standard and functions correctly.	♦ The product is constructed to an acceptable standard of quality.
♦ All test on the product are conducted in a technically correct way with due account being taken of inaccuracies introduced by the measurement processes.	♦ Tests are carried out in a technically proficient way.
♦ The interpretation of test results is accurate and the analysis of the results is used to identify improvements in product performance.	♦ The interpretation of test results is correct.
♦ The log book is regularly maintained and provides a detailed, informal record of the candidate's thinking as the project develops including reflective comments.	♦ The log book contains a complex level of detail about project ideas and progress and there is evidence that entries have been made on at least six occasions during the life of the project.
♦ The project report is well structured, contains only relevant information, has clear and accurate conclusions and recommendations and is written in clear and correct English.	♦ The project report meets acceptable standards in terms of structure, use of English and clarity, and has accurate conclusions and recommendations.
♦ The project report includes a complex and comprehensive evaluation of the project strategy and activities and includes clear evaluation of what the candidate has learnt from undertaking the project and the factors involved.	♦ The project includes an evaluation of the project strategy and activities and includes an evaluation of what the candidate has learnt from undertaking the project.
♦ The oral presentation is well structured, contains only relevant information, is to time and includes the use of appropriate aids.	♦ The oral presentation is acceptably structured, contains largely relevant information and is to time.
♦ The candidate gives clear, concise and technically accurate answers to questions raised during the oral presentation.	♦ The candidate gives technically correct answers to questions raised as part of the oral presentation.

Grade A	Grade C
Is a seamless, coherent piece of work which:	Is a co-ordinated piece of work which:
♦ The candidate includes a complex, reflective account of the success, or otherwise, of project activities against project objectives in the oral presentation.	♦ The candidate includes a reflective account of the success, or otherwise, of the project in the oral presentation.
♦ The candidate undertakes the project with the minimum of supervision.	♦ The candidate undertakes the project without unnecessary interventions from the project supervisor to ensure the project remains on track.
♦ The candidate identifies clear and full details of the new knowledge and skills she/he has developed as a result of doing the project such as project management skills, keeping to deadlines, recognising limitations of knowledge — approaching expert sources.	♦ The candidate provides at least three examples of new knowledge and skills she/he has developed as a result of doing the project.
♦ The candidate introduces a significant novel feature into the project.	♦ None.
♦ The candidate demonstrates a high level of self — motivation throughout the project	♦ The candidate demonstrates an acceptable level of motivation throughout the project.
♦ The candidate undertakes additional research well beyond that demanded by the project.	♦ None.

Important Note:

Centres **must** complete the following Grading Checklist for each Mechatronics Project.

Completed checklists will be used as part of the external verification process to ensure the accuracy and consistency of grading between candidates in a centre and across centres

Notes on completion of the Grading Checklist are shown on page 15.

Scottish Qualifications Authority

Mechatronics: Graded Unit 2 (Project)

Grading Unit Checklist

Centre Name: _____

Centre Number: _____

Grading Checklist

No.	No Grade	Grade C Criteria	Grade C	Grade B	Grade A	Grade A Criteria
1	Yes	The project brief includes complex, multi-variable information about the main technical requirements of the project and provides a cost indication and expected timescale	Yes	Yes	Yes	The project brief includes all relevant information, is written clearly and concisely and has been agreed fully with the customer
2	Yes	The project specification provides clear details of the following: the title of the project; the objectives of the specification; the project's main technical requirements including multi-variables and an acknowledgement of any references or standards relevant to the specification	Yes	Yes	Yes	The project specification is well structured, contains relevant, accurate information and any revisions have been agreed with the customer
3	Yes	The project objectives identify the key long-term project targets and multi-variables	Yes	Yes	Yes	The project objectives accurately and fully reflect the long-term project targets
4	Yes	The initial project schedule (probably in the form of a Gantt chart) shows all essential project activities and timings. Evidence that the schedule has been monitored on at least three separate occasions during the life of the project to inform on-going project planning and development should be available	Yes	Yes	Yes	The initial project schedule (probably in the form of a Gantt chart) contains a comprehensive list of project activities and timings. The information in the initial schedule in used to assess if the project can be completed within the timescales. The schedule is monitored on a regular basis to inform on-going project planning and development

Grading Checklist (cont)

No.	No Grade	Grade C Criteria	Grade C	Grade B	Grade A	Grade A Criteria
5	Yes	The candidate develops a sound knowledge base to support the demands of the project	Yes	Yes	Yes	The candidate develops a substantial knowledge base to support the demands of the project
6	Yes	The selected solution is justified in terms of a sound evaluation involving the solution and at least one viable alternative option	Yes	Yes	Yes	The selected solution is justified in terms of a thorough evaluation of a range of options
7	Yes	A verification strategy is developed to test the essential parts of the product	Yes	Yes	Yes	A comprehensive verification strategy is developed to ensure the product is completely tested
8	Yes	The candidate feeds back to her/his supervisor on at least three occasions providing an indication of progress made	Yes	Yes	Yes	The candidate feeds back to her/his supervisor on a regular basis, updating the supervisor on progress made and actions for the next stage of the project
9	Yes	The candidate accesses components and/or software and/or materials of the correct specification from a range of sources	Yes	Yes	Yes	The candidate accesses components and/or software and/or materials of the correct specification from a range of sources at the most economic price
10	Yes	The product is constructed to an acceptable standard of quality	Yes	Yes	Yes	The product is constructed to a high standard and functions correctly

Grading Checklist (cont)

No.	No Grade	Grade C Criteria	Grade C	Grade B	Grade A	Grade A Criteria
11	Yes	Tests are carried out in a technically proficient manner	Yes	Yes	Yes	All tests on the product are conducted in a technically correct way with due account being taken of inaccuracies introduced by the measurement process
12	Yes	Practical activities are carried out to an acceptable level of health and safety	Yes	Yes	Yes	Practical activities are carried out in a totally safe and healthy manner
13	Yes	The interpretation of test results is correct	Yes	Yes	Yes	The interpretation of test results is accurate and the analysis of the results is used to identify improvements in product performance
14	Yes	The log book contains a complex level of detail about project ideas and progress and there is evidence that entries have been made on at least six occasions during the life of the project	Yes	Yes	Yes	The log book is regularly maintained and provides a detailed, informal record of the candidate's thinking as the project develops including reflective comments
15	Yes	The project report meets acceptable standards in terms of structure, use of English and clarity, and has accurate conclusions and recommendations **Double Weight**	Yes	Yes	Yes	The project report is well structured, contains only relevant information, has clear and accurate conclusions and recommendations and is written in clear and concise English **Double Weight**

Grading Checklist (cont)

No.	No Grade	Grade C Criteria	Grade C	Grade B	Grade A	Grade A Criteria
16	Yes	The project includes an evaluation of the project strategy and activities and includes an evaluation of what the candidate has learnt from undertaking the project	Yes	Yes	Yes	The project report includes a complex and comprehensive evaluation of the project strategy and activities and includes a clear evaluation of what the candidate has learnt from undertaking the project and the factors involved
17	Yes	The oral presentation is acceptably structured, contains largely relevant information and is to time **Double Weight**	Yes	Yes	Yes	The oral presentation is well structured, contains only relevant information, is to time and includes the use of appropriate aids **Double Weight**
18	Yes	The candidate gives technically correct answers to questions raised as part of the oral presentation	Yes	Yes	Yes	The candidate gives clear, concise and technically accurate answers to questions raised during the oral presentation
19	Yes	The candidate includes a reflective account of the success, or otherwise, of the project in the oral presentation	Yes	Yes	Yes	The candidate includes a complex, reflective account of the success, or otherwise, of project activities against project objectives in the oral presentation
20	Yes	The candidate undertakes the project without unnecessary interventions from the project supervisor to ensure the project remains on track	Yes	Yes	Yes	The candidate undertakes the project with the minimum of supervision

Grading Checklist (cont)

No.	No Grade	Grade C Criteria	Grade C	Grade B	Grade A	Grade A Criteria
21	Yes	The candidate provides at least three examples of new knowledge and skills in relation to Mechatronics she/he has developed as a result of completing the project	Yes	Yes	Yes	The candidate identifies clear and full details of the new knowledge and skills she/he has developed as a result of doing the project such as project management skills, keeping to deadlines, recognising limitations of knowledge – approaching expert sources
22	Yes	None	Yes	Yes	Yes	The candidate introduces a significant novel feature into the project
23	Yes	The candidate demonstrates an acceptable level of motivation throughout the project	Yes	Yes	Yes	The candidate demonstrates a high level of self-motivation throughout the project
24	Yes	None	Yes	Yes	Yes	The candidate undertakes additional research in Mechatronics systems well beyond that demanded by the project

Guidance on the Completion of the Grading Checklist

Centre staff are asked to read the following guidance notes before completing the Grading Checklist.

The checklist had been designed to help assessor(s) decide what Grade should be awarded to a candidate completing the Mechatronics Project. It will also be used by external moderators as part of the external verification of project work.

A Grading Checklist form should be completed for each candidate who has been entered for the Mechatronics: Graded Unit 2 (Mechatronics Project)

In completing the checklist, assessors should take note of the following points.

1 For each item shown in the checklist, the Yes should be circled which most closely reflects the candidate's performance. It can be seen from the checklist that grade criteria for Grade C and Grade A passes have been included in the checklist and items 15 and 17 are double weighted.

2 A Grade B should be awarded where a candidate's performance lies approximately mid-way between a Grade C and a Grade A (ie better than a Grade C (Competent) but not good enough to be a Grade A (Highly Competent)).

3 No grade should be awarded where a candidate's performance is not good enough to satisfy a Grade C Pass (i.e. a competent level of performance).

4 Once centre assessor(s) have completed the twenty four items, they should then apply their own professional judgement to decide what Grade to award the candidate.

5 In arriving at the grade, due account should be taken of the distribution circles around 'Yes'. For example, if 19 out of the 24 items have been circled 'Yes' under the Grade B column and the other 5 have been circled under the Grade C column, then it is likely that the assessor(s) will award the candidate a Grade B. Professional judgement is much more involved where, for example, if 'Yes' is circled 12 times under the Grade A column and 12 times under the Grade B column. The assessor's first-hand knowledge of the candidate's performance will influence whether the candidate is awarded Grade A or Grade B. External moderators are unlikely to overturn the grading awarded by the Centre assessor(s) unless they are not happy that grading judgements have been awarded in a fair, consistent and rigorous manner.

6 Centres may provide additional comments and/or evidence in support of their grading decisions.

The project will be marked out of 100. Assessors will mark each stage of the project, taking into account the criteria outlined. The marks will then be aggregated to arrive at an overall mark for the project. Assessors will then assign an overall grade to the candidate for this graded unit based on the following grade boundaries.

A = 70% — 100%
B = 60% — 69%
C = 50% — 59%

Note: the candidate must achieve all of the minimum evidence specified below for each stage of the project in order to achieve the Graded Unit.

Evidence Requirements

The project consists of three stages: planning; developing; and evaluating. The following table specifies the minimum evidence required to pass each stage.

Note: The candidate must achieve **all of the minimum evidence** specified below for each stage of the project in order to pass the Graded Unit.

Project Stage	**Minimum Evidence Requirements**
Stage 1 — Planning	♦ A project brief identifying customer requirements ♦ A project specification that the customer has agreed ♦ A set of project objectives ♦ A project schedule ♦ Information about the different solutions ♦ Justification of the chosen solution ♦ Verification strategy ♦ Maintenance of a log book ♦ Complied with Health and Safety procedures *The candidate must achieve all of the minimum evidence specified above in order to pass the Planning stage.*

Project Stage	Minimum Evidence Requirements
Stage 2 — Developing	♦ Practical output from the project (design, analysis, implementation etc.) ♦ Written records of progress underpinning the project such as: — log book — progress reports — test results as part of the verification strategy ♦ Complies with Health and Safety procedures *The candidate must achieve all of the minimum evidence specified above in order to pass the Developing stage.*
Stage 3 — Evaluating	♦ Review of project specification as the project progresses ♦ Review of project schedule as the project progresses ♦ Analysis used to decide project option ♦ Progress reporting and goal setting as part of project implementation ♦ Actions taken to overcome unforeseen circumstances ♦ Interpretation of test results ♦ Action taken as a result of test result interpretation ♦ An assessment of the strengths and weaknesses of the practical output of the project ♦ An evaluation of the extent to which the project brief and objectives have been overtaken ♦ Reflective part of oral presentation ♦ Indication of any knowledge and skills which have been gained by the candidate ♦ Complies with Health and Safety procedures *The candidate must achieve all of the minimum evidence specified above in order to pass the Evaluating stage.*

Equality and inclusion

The unit specifications making up this group award have been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners will be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website www.sqa.org.uk/assessmentarrangements.