

# Higher National Graded Unit Specification

## General Information for Centres

This Graded Unit has been validated as part of the HNC and HND Mechatronics awards. 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 1

**Graded Unit Code:** DX3H 34

**Type of Graded Unit:** Examination

**Assessment Instrument:** Examination

**Credit points and level:** 1 HN Credit at SCQF level 7: (8 SCQF credit points at SCQF level 7\*).

*\*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 Access 1 to Doctorates.*

**Purpose:** This Graded Unit is designed to provide evidence that the candidate has achieved the following principal aims of the HNC Mechatronics:

- ◆ Develop knowledge, understanding and skills in a range of core principles and technologies by undertaking Units in Mechatronic Systems Elements, Mechatronic Systems, Engineering Principles, Robotics and Animatronics: An Introduction, Electrical Engineering Principles 1 and Interfacing Electronics.
- ◆ Develop candidates' ability to apply analysis and synthesis skills to the solution of Mechatronics problems.
- ◆ Develop learning and transferable skills (including Core Skills).

**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 these specific aims prior to undertaking this Graded Unit:

- ◆ Mechatronics Systems Elements
- ◆ Mechatronics Systems
- ◆ Engineering Principles
- ◆ Robotics and Animatronics: An Introduction
- ◆ Electrical Engineering Principles 1
- ◆ Interfacing Electronics

**Core Skills:** There are no Core Skills embedded in this Graded Unit specification.

## General Information for Centres (cont)

**Assessment:** This examination-based Graded Unit is Mechatronics: Graded Unit 1. It will consist of a written examination of three hours.

An exemplar instrument of assessment and marking guidelines have been produced to indicate the national standard of achievement required at SCQF level 7.

## Administrative Information

**Graded Unit Code:** DX3H 34

**Graded Unit Title:** Mechatronics: Graded Unit 1

**Original date of publication:** July 2006

**Version:** 01

### History of Changes:

Version	Description of change	Date

**Source:** SQA

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## **Higher National Graded Unit specification: Instructions for designing the assessment task and assessing candidates**

**Graded Unit Title:       Mechatronics: Graded Unit 1**

### **Conditions of Assessment**

The assessment is based on an examination lasting three hours.

If a candidate does not achieve a pass or if a candidate wishes to upgrade, this must be based on a significantly different examination from that given originally. A candidate's grade will be based on his/her achievement on the new event using a significantly different examination.

The assessment is based on an examination paper consisting of a Section A covering topics within the Units: Mechatronic Systems Elements, Engineering Principles, Robotics and Animatronics: An Introduction, Electrical Engineering Principles 1, Interfacing Electronics. Candidates should attempt all questions in this Section and be able to score a maximum of 40 marks. The paper should also have a Section B which should cover topics: Mechatronic Systems, Engineering Principles, Robotics and Animatronics: An Introduction, Electrical Engineering Principles 1, Interfacing Electronics. Candidates should be able to select any three from five questions in Section B and should be able to score a maximum of 60.

The examination should be conducted under closed book, supervised conditions but with candidates being allowed access to standard formulae and appropriate data sheets where required.

The grade given will reflect the candidate's achievement on the first assessment event. A candidate may wish to retake the group award Graded Unit but this should be based on a significantly different examination.

The examination should be unseen and the assessment should be conducted in controlled and invigilated conditions.

At all times, the security, integrity and confidentiality of examinations must be ensured.

### **Instructions for designing the assessment task:**

The examination should be designed to assess the candidate's critical knowledge and understanding of the topics relating to the specific aims which this Graded Unit is designed to cover. The questions and corresponding marks should be designed in accordance with the ranges indicated in the table that follows. However, the overall total mark for the examination is 100.

**Higher National Graded Unit specification: Instructions for designing the assessment task and assessing candidates (cont)**

Key Topics	Level of demand	Percentage weighting for each topic
Mechatronic engineering drawing	Interpret engineering drawings and modifications.	4%
Key principles behind electronic interfacing devices,	Identify electronic interfacing devices and their principle of operation.  Select or describe appropriate interface devices  Basic calculations for device selection	17%
Fundamental understanding of mechatronic systems.        Programming mechatronic systems.	Demonstrate a knowledge and understanding of the following:  <ul style="list-style-type: none"> <li>◆ systems and system elements</li> <li>◆ open/closed loops</li> <li>◆ control types</li> <li>◆ transducers/sensors</li> <li>◆ actuators</li> <li>◆ power sources and prime movers</li> </ul> Describe and evaluate methods of programming a mechatronic system and controllers.  Write and modify mechatronic programme elements.	30%
DC and AC electrical concepts.	Demonstrate an understanding and/or solve problems relating to:  <ul style="list-style-type: none"> <li>◆ electrical concepts of dc circuits</li> <li>◆ Faraday's and Lenz's laws</li> <li>◆ Kirchoff's laws</li> </ul> Demonstrate a basic knowledge of ac theory	15%

## Higher National Graded Unit specification: Instructions for designing the assessment task and assessing candidates (cont)

Key Topics	Level of demand	Percentage weighting for each topic
<p>Static equilibrium and compressive, tensile and shear loadings on materials.</p> <p>Linear motion and problems relating to impulse, conservation of momentum, work, energy or power.</p>	<p>Solve problems relating to static equilibrium.</p> <p>Solve problems relating to compressive, tensile and shear loading on materials.</p> <p>Solve problems relating to linear motion.</p> <p>Solve problems relating to impulse, conservation of momentum, work, energy and power.</p>	17%
<p>Introduction of robotic and animatronic systems and elements</p>	<p>Describe:</p> <ul style="list-style-type: none"> <li>◆ the basic elements of robotic/animatronic systems</li> <li>◆ the function and form of a typical robotic/animatronic system</li> </ul> <p>Analyse a robotic/animatronic system and select the appropriate motor and encoder.</p>	17%

Questions in Section A of the examination paper should normally comprise a number of short answer, restricted response and calculation based questions.

In Section B the structure of each question should normally conform to the following marking structure:

Knowledge and Understanding	4 marks
Applications	8 marks
Analysis and Evaluation	8 marks

The examination will be marked out of 100. Assessors will aggregate the marks achieved by the candidate to arrive at an overall mark for the examination. Assessors will then assign a grade to the candidate for this Graded Unit based on the following grade boundaries:

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

## **Higher National Graded Unit specification: Instructions for designing the assessment task and assessing candidates (cont)**

### **Candidates with Disabilities and/or Additional Support Needs**

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative assessment arrangements. For information on these, please refer to the SQA document *Guidance on Alternative Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs*, which is available on SQA's website: [www.sqa.org.uk](http://www.sqa.org.uk).

## Guidance to Centres

Centres are encouraged to study this Mechatronics: Graded Unit 1 Specification and the associated assessment exemplar paper carefully before embarking on the writing of any HNC Mechatronics examination paper.

The main purpose of the Mechatronics: Graded Unit 1 specification is to assess the candidate's ability to solve problems based on the Mechatronics Units specified under the Recommended Prior Knowledge and Skills in this Graded Unit specification. Centres should make every attempt to ensure that questions are set within a realistic industrial context. Centres should also make every reasonable effort to integrate the knowledge and understanding gained in one subject area to another area so that the candidate's ability to transfer knowledge and understanding from one subject area to another can also be assessed. Experience shows that candidates often have great difficulty in transferring knowledge, understanding and skills from one subject area to solve problems in another area of study. Candidates tend to compartmentalise knowledge, understanding and skills into subject areas with considerable reluctance to transfer across subject boundaries. It is important in Engineering that candidates can apply knowledge, understanding and skills from different subject areas to the solution of complex problems.

As well as having a three hour examination, the Unit includes a notional study time of 37 hours to allow candidates to practise solving problems which should include the transfer of knowledge, understanding and skills across the subject boundaries. Centres should use a range of formative assessment to support such skills development.

Centres are also strongly recommended not to limit opportunities for the transferability of knowledge, understanding and skills within Mechatronics to the Mechatronics: Graded Unit 1 only but to seek opportunities for the consolidation of these critical skills throughout the whole HNC and HND Mechatronics awards.