

Higher National Graded Unit Specification

General Information for Centres

This Graded Unit has been validated as part of the HND Measurement and Control Engineering. 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: Measurement and Control Engineering:
Graded Unit 2

Graded Unit Code: F014 35

Type of Graded Unit: Project

Assessment Instrument: Investigation

Credit points and level: 2 HN 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 Access 1 to Doctorates.*

Purpose: This Graded Unit is designed to provide evidence that the candidate has achieved the following principal aims of the HND Measurement and Control Engineering:

- ◆ develop the candidate's learning and transferable skills (including Core Skills)
- ◆ develop the candidate's ability to apply analysis and synthesis skills to the solution of Measurement and Control Engineering problems
- ◆ develop a range of Measurement and Control Engineering competences required by employers of those engaged in or aspiring to positions of responsibility
- ◆ enhance employment opportunities in Measurement and Control Engineering through development of performance and personal competence
- ◆ enhance the candidate's opportunities for progression to degree level studies
- ◆ develop a range of Communication knowledge and skills relevant to the needs of Measurement and Control Incorporated Engineers
- ◆ develop and apply a range of integrative competences in Measurement and Control Engineering

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:

DX48 34	Distributed Control Systems
DX4F 34	Measurement Systems 1
DX4K 34	Process Control
DX45 34	Complex Control Systems
DX47 34	Digital Communications in Measurement and Control Engineering

General Information for Centres (cont)

DX46 35	Continuous and Computer Control of Engineering Systems
DX4G 35	Measurement Systems 2
DX4T 35	Transmission of Measurement Signals
DX4M 35	Programmable Logic Controllers: Advanced
DX4P 35	Safe Instrumentated Systems
DG31 34	Application of 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 HND Measurement and Control Engineering programme. As it is anticipated that Centres will deliver the HNC Measurement and Control Engineering as part of the first year of an HND, it is recommended that candidates have completed all HNC Measurement and Control Engineering Units before commencing this project.

The project can draw on any Unit in the HND Measurement and Control Engineering framework. The project can be taken from one Measurement and Control Engineering area or it can span more than one technical area. However, its principle purpose is not to integrate technical content (this is covered in Measurement and Control Engineering: Graded Unit 1) but rather to combine such knowledge and skills as planning, investigating, evaluating and reporting.

Core Skills: The achievement of this Unit gives automatic certification of Problem Solving at SCQF level 5.

The Core Skill of Using Information Technology at SCQF level 6 is signposted in this Graded Unit specification. There may also be opportunities to develop the Core Skills of Written Communication (Writing), Written Communication (Reading), Oral Communication, Using Graphical Information, Using Number, Problem Solving (Critical Thinking), Problem Solving (Planning and Organisation) and Problem Solving (Reviewing and Evaluation) at SCQF level 6 and Working with Others at SCQF level 5.

Assessment: This Graded Unit will be assessed by the use of an investigation. The developed investigation 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 Skill, Working with Others at SCQF level 5.

Administrative Information

Graded Unit Code: F014 35

Graded Unit Title: Measurement and Control Engineering: Graded Unit 2

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Version: 02 (November 2006)

History of Changes:

Version	Description of change	Date
02	Core Skills information amended following audit, Problem Solving at SCQA level 5 now embedded.	21/11/06

Source: SQA

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Higher National Graded Unit Specification: Instructions for designing the assessment task and assessing candidates

Graded Unit Title: Measurement and Control Engineering: Graded Unit 2

Conditions of Assessment

The candidate should be given a date for completion of the investigation. 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

The purpose of the investigation is to provide candidates with an opportunity to apply and integrate a range of knowledge and skills within the Measurement and Control Engineering field.

Candidates should choose an activity, or a group of activities, which is in the area of measurement and control engineering and requires them to carry out an investigation. The investigation should take one of the following formats:

- ◆ An existing problem where the candidate must investigate a range of alternatives and recommend a suitable solution to the problem.
- ◆ A new project where the candidate must investigate a range of alternatives and recommend a suitable solution.

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

The identified project could either be one that is related to their workplace or alternatively it may be a project that is identified by the assessor/supervisor in the Centre. Candidates who are not currently working in the measurement and control engineering field are likely to follow the latter route.

If a candidate undertakes a project that was identified by the assessor in the Centre then the assessor will be assumed to be the customer.

The investigation should involve the following stages:

Stage 1: Planning

1. Prepare a project brief that identifies the customer requirements.
2. Prepare a project specification that has customer agreement.
3. Set specific objectives for the project.
4. Set specific subtasks for the project.
5. Prepare a schedule (probably a Gantt chart) for the completion of the objectives and subtasks.
6. Identify the scope of the technical brief that is to be researched.

Stage 2: Implementation

1. Identify alternative solutions to the project.
2. Search and collect technical data relevant to the alternative solutions.
3. Justify the chosen solution and obtain customer agreement.
4. Monitor actual progress of the objectives and subtasks against a planned timescale.
5. Maintain a log book which contains entries for the key stages of the project.
6. Produce a test and commissioning schedule.

Stage 3: Evaluating

1. Evaluate the overall success of the project in terms of whether the project brief and objectives have been achieved.
2. Assess the planning and implementation of the project
3. Evaluate whether the final chosen option meets the requirements given in the specification.
4. Review actions that were taken to overcome unforeseen circumstances.
5. Identify any new knowledge and skills gained by carrying out the project.
6. Deliver an oral presentation on the project.

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

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
<p>Is a seamless, coherent piece of work which:</p> <ul style="list-style-type: none"> ◆ demonstrates clear and explicit links between the three stages (planning, implementing, evaluating) of the investigation ◆ effectively applies and integrates knowledge and understanding of measurement and control concepts from course Units to all stages of the investigation ◆ demonstrates a high level of self-motivation by the candidate throughout the project ◆ demonstrates that the candidate has undertaken additional research well beyond that demanded by the project ◆ demonstrates that the candidate feeds back to her/his supervisor on a regular basis, updating the supervisor on progress made and action for the next stage of the project ◆ demonstrates a high degree of autonomy during all stages of the investigation but responds to advice and guidance in a constructive, reasoned manner ◆ contains an oral presentation in which the candidate demonstrates, in an enthusiastic manner, a deep understanding of the investigation they have undertaken ◆ demonstrates a comprehensive and imaginative approach to the project brief so that it provides a challenging context within which the candidate can demonstrate to a high level his/her skills in measurement and control engineering 	<p>Is a co-ordinated piece of work which:</p> <ul style="list-style-type: none"> ◆ contains sufficient evidence to meet the minimum requirements of each of the three stages (planning, implementing, evaluating) of the investigation ◆ applies knowledge and understanding of measurement and control concepts from the course Units but does not do so consistently across all stages of the investigation and makes use of a limited range of concepts ◆ demonstrates an acceptable level of motivation by the candidate throughout the project ◆ demonstrates that the candidate has undertaken an acceptable amount of research during the project ◆ demonstrates that the candidate feeds back to her/his supervisor on a least three occurrences providing an indication of progress made ◆ relies heavily on the tutor for guidance and support, may be unwilling to take action without prior confirmation and may respond to advice and guidance in an uncritical fashion ◆ contains an oral presentation in which the candidate demonstrates an acceptable understanding of the investigation they have undertaken ◆ approaches the project brief in a manner which successfully allows the candidate to use his/her skills in measurement and control engineering

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

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 30% of total marks	<p>Produce a written account of the plan which includes:</p> <ul style="list-style-type: none"> ◆ a project brief which outlines the customer requirements ◆ a project specification that has customer agreement ◆ specific objectives for the project ◆ specific subtasks for the project ◆ a schedule (probably a Gantt chart) for the completion of the objectives and subtasks ◆ the scope of the technical brief that is to be researched <p>The plan should be a minimum of 1,000 words long or equivalent (excluding charts and diagrams).</p> <p>Additional guidance on grading</p> <p>This section of the investigation will be assessed by the submission of written documentation and by an individual interview with the tutor (either face to face or remotely by telephone or by other means) during which the candidate will be expected to explain the written material s/he has submitted.</p> <p>This section is worth 30 marks which should be allocated as set out below. Throughout credit should be given to candidates who make valid and relevant references to concepts used in other Units in the HND Measurement and Control Engineering.</p>

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

Project Stage	Minimum Evidence Requirements
Stage 1 — Planning cont'd	<p>Up to 5 marks for a project brief which outlines the customer requirements. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the clarity and comprehensibility of the brief ◆ the extent to which the main technical requirements are identified ◆ how realistic the proposed timescale for the investigation is with respect to the scope of the project ◆ how realistic the proposed costing for the investigation is with respect to the scope of the project <p>Up to 6 marks for a project specification which has customer agreement. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the clarity of the title of the project specification ◆ the clarity of the introduction to the project specification ◆ the extent to which the main body of the specification details the technical requirements of the project ◆ the extent to which standards or any other references relevant to the specification are acknowledged ◆ the extent to which customer agreement is detailed <p>Up to 4 marks for the specific objectives of the project. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the clarity and accuracy of the objectives ◆ the extent to which the objectives fit in with the project brief ◆ the extent to which the objectives fit in with the candidates current knowledge and skills <p>Up to 5 marks for the specific subtasks for the achievement of the project. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the clarity and accuracy of the subtasks ◆ the extent to which the subtasks fit in with the specific objectives ◆ how logical the order of the subtasks are in relation to the project

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

Project Stage	Minimum Evidence Requirements
Stage 1 — Planning cont'd	<p>Up to 6 marks for a schedule for the completion of the objectives and subtasks. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the inclusion of the final completion date and significant milestones to reaching this date ◆ the incorporation of likely contingencies and the validity of the justification for them ◆ how realistic the schedule is with respect to the project brief and other targets that the candidate must meet ◆ the extent to which the schedule is consistent with the objectives and subtasks for the project <p>Up to 4 marks for the scope of the technical brief that is to be researched. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the extent to which the resources needed have been clearly and fully identified ◆ the clarity and accuracy of the explanation on how they will be obtained ◆ the clarity and accuracy of the explanation of the candidate's role in researching the technical brief <p><i>The candidate must achieve all of the minimum evidence specified above in order to pass the Planning stage. This can be demonstrated by submitting evidence relating to all six aspects of the planning stage and achieving a mark of at least 15/30.</i></p>

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

Project Stage	Minimum Evidence Requirements
<p>Stage 2 — Developing</p> <p>50% of total marks</p>	<p>Produce a written account of the implementing stage which includes:</p> <ul style="list-style-type: none"> ◆ a brief description of alternative solutions to the project ◆ technical data relevant to the alternative solutions that has been collected ◆ a justification of the chosen solution that has customer agreement ◆ progress reports which show the actual progress of the objectives and subtasks being monitored against the planned timescale ◆ a log book that contains entries for the key stages of the project ◆ a test and commissioning schedule <p>The account of the implementation (excluding the log book) should be approximately 3,000 words long or equivalent (excluding charts and diagrams).</p> <p>Additional guidance on grading</p> <p>This section of the investigation will be assessed by the submission of written documentation and by an individual interview with the tutor (either face to face or remotely by telephone or by other means) during which the candidate will be expected to explain the written material s/he has submitted.</p> <p>This section is worth 50 marks which should be allocated as set out below. Throughout credit should be given to candidates who make valid and relevant references to concepts used in other Units in the HND Measurement and Control Engineering.</p> <p>Up to 5 marks for a brief description of the alternative solutions to the project. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the clarity and comprehensibility of the description of the possible solutions ◆ the extent to which the possible solutions are technically viable in relation to the data presented in the specification ◆ the number of possible solutions identified (there should be a minimum of three)

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

Project Stage	Minimum Evidence Requirements
Stage 2 — Developing (cont'd)	<p>Up to 9 marks for the technical data that has been collected on the alternative solutions. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the technical relevancy of the data collected ◆ the extent to which the candidate has used their own initiative to collect data ◆ the range of sources used to obtain technical data (eg. internet, BS publications, books, journals) ◆ the extent to which the candidate has collected all of the data required to enable them to make a decision ◆ the clarity of the candidate's description about how they collected the technical data <p>Up to 8 marks for a justification of the chosen option which has customer approval. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the extent to which the analysis of the technical data collected highlights the technical advantages and disadvantages of the different options ◆ the range of technical factors considered by the candidate when analysing the different solutions ◆ the suitability of the chosen solution in relation to the original project specification ◆ the clarity and technical accuracy of the final justification of the chosen option in relation to the original project specification <p>Up to 10 marks for a series of progress reports that show the actual progress of the subtasks and objectives being monitored against the planned timescale. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the clarity and comprehensibility of the progress reports ◆ the extent to which the progress reports show the progress made on objectives and subtasks ◆ the extent to which the progress reports deal with any adjustments that must be made to the timescales shown in the original schedule ◆ the degree of initiative shown by the candidate in dealing with problems and utilising any additional technical expertise if required ◆ the amount of relevant detail given in the progress reports ◆ the extent to which the entries show discussion that has taken place between the candidate and the customer/project supervisor

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

Project Stage	Minimum Evidence Requirements
Stage 2 — Developing (cont'd)	<p>Up to 10 marks for maintaining a log book which contains entries for the key stages of the project. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the legibility and comprehensibility of the entries ◆ the level of detail in the log book entries ◆ the number and regularity of the entries in the log book ◆ the extent to which the entries relate to the objectives and subtasks of the project ◆ the extent to which the entries show discussions with the customer/project supervisor ◆ the extent to which the log book entries reflect the candidate's thoughts <p>Up to 8 marks for a test and commissioning schedule. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the clarity and comprehensibility of the test and commissioning schedule ◆ the level of technical detail in the test and commissioning schedule ◆ the technical accuracy of the test and commissioning schedule <p><i>The candidate must achieve all of the minimum evidence specified above in order to pass the Developing stage. This can be demonstrated by submitting evidence relating to all six aspects of the Developing stage achieving a mark of at least 25/50.</i></p>
Stage 3 — Evaluating 20% of total marks	<p>Produce a written account evaluating effectiveness during the investigation and deliver an oral presentation on the project which includes:</p> <ul style="list-style-type: none"> ◆ an evaluation of the overall success of the project in terms of the extent to which the project brief and the objectives have been achieved ◆ an assessment of the planning and implementation of the activity in terms of which aspects went well and why and which aspects did not go as well and why ◆ an evaluation to the extent to which the final chosen option meets the requirements given in the specification ◆ a review of the actions that were taken to overcome any unforeseen circumstances ◆ an identification of any new knowledge and skills gained by carrying out the project ◆ an oral presentation on the project that is given to the peer group and the supervisor(s)

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

Project Stage	Minimum Evidence Requirements
Stage 3 — Evaluating (cont'd)	<p>The evaluation should be a minimum of 1,000 words long or equivalent (excluding charts and diagrams). The oral presentation should be of approximately 10 minutes duration.</p> <p>Additional guidance on grading</p> <p>This section of the investigation will be assessed by the submission of written documentation and by an individual interview with the tutor (either face to face or remotely by telephone or by other means) during which the candidate will be expected to explain the written material s/he has submitted.</p> <p>This section is worth 20 marks which should be allocated as set out below. Throughout credit should be given to candidates who make valid and relevant references to concepts used in other Units in the HND Measurement and Control Engineering.</p> <p>Up to 4 marks for an evaluation of the overall success of the project in terms of the extent to which the project brief and the objectives have been achieved. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ clear identification of whether the project brief was achieved and a relevant justification if it was not achieved ◆ clear identification of whether the objectives were achieved and a relevant justification if they were not achieved ◆ the extent to which conclusions are drawn for the future of the project <p>Up to 4 marks for an assessment of the planning and implementation of the activity in terms of which aspects went well and why and which aspects did not go as well and why. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ making reference to several aspects of both planning and implementation stages ◆ clear identification of aspects that went well ◆ clear identification of aspects that did not go as well as expected ◆ the strength and validity of the reasons given to support points that were made ◆ the extent to which the actual timescale of the project is reviewed against the planned timescale in the original schedule

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

Project Stage	Minimum Evidence Requirements
Stage 3 — Evaluating (cont'd)	<p>Up to 3 marks for an evaluation of the extent to which the final chosen option meets the requirements given in the specification. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ clear identification of any changes that were made to the original specification as the project progressed ◆ clear identification of whether the final chosen option met the specification ◆ clear identification of the strengths and weaknesses of the chosen option <p>Up to 2 marks for a review of the actions that were taken to overcome unforeseen circumstances. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the extent to which the candidate responded to unforeseen circumstances ◆ how realistic the actions taken by the candidate were in relation to the problem <p>Up to 2 marks for an identification of any new knowledge and skills gained by the candidate in carrying out the project. Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the relevancy of the knowledge and skills identified by the candidate ◆ the range of knowledge and skills identified by the candidate <p>Up to 5 marks for an oral presentation on the project that is given to the peer group and the supervisor(s). Marks should be awarded on the basis of:</p> <ul style="list-style-type: none"> ◆ the quality of the presentation in terms of it being structured, clear, comprehensible, containing relevant information and delivered using appropriate visual aids ◆ clear identification of the project brief ◆ clear identification of the project specification ◆ clear identification of the possible solutions to the project ◆ clear analysis and justification of the chosen option ◆ clear evaluation of whether the chosen option satisfied the project brief and specification <p><i>The candidate must achieve all of the minimum evidence specified above in order to pass the Evaluating stage. This can be demonstrated by submitting evidence relating to all six aspects of the Evaluating stage and achieving a mark of at least 10/20.</i></p>

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.