

Higher National Graded Unit Specification

General Information for Centres

This Graded Unit has been validated as part of the HNC/D Electrical 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: Electrical Engineering: Graded Unit 2

Graded Unit Code: DN3X 35

Type of Graded Unit: Project

Assessment Instrument: Practical Assignment

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 HNC/D awards Electrical Engineering: Graded Unit 2:

- ◆ develop the candidate's ability to apply analysis and synthesis skills to the solution of electrical engineering 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 electrical incorporated engineers
- ◆ develop knowledge, understanding and skills in a range of core electrical principles, electrical power systems, electrical machine principles and electrical safety at Higher National level (these studies in core electrical principles and technologies are underpinned by a mandatory Unit in Mathematics)
- ◆ develop knowledge and skills in the use of electrical and electronic instruments
- ◆ expand on the range of knowledge, understanding and skills in core electrical principles, electrical machines and systems and electrical installation
- ◆ allow for further specialisation within the following subject areas: Inspection and Testing of Low Voltage Installations, Programmable Logic Controllers, Electrical Systems in Hazardous Environments, Analogue and Digital Electronics, Engineering Quality Systems, Electrical Installation Skills, Industrial Plant Maintenance, High Level Engineering Software, additional Control Systems studies, Power Supply Circuits, Switchgear and Protection, Standby Systems, Electrical Installation Design: Computer Aided, advanced Mathematical studies and Employment Experience

General Information for Centres (cont)

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
- ◆ Information Technology: Applications Software 1
- ◆ Business Awareness and Continuing Professional Development
- ◆ Electrical Safety
- ◆ Mathematics for Engineering 1: Electronics and Electrical
- ◆ Electrical Networks and Resonance
- ◆ Single Phase A.C. Circuits
- ◆ Three Phase Systems
- ◆ Electricity Power Systems
- ◆ Electrical Machine Principles
- ◆ Power Electronics
- ◆ Fundamentals of Control Systems and Transducers
- ◆ Mathematics for Engineering 2
- ◆ Transmission Lines and Complex Waves
- ◆ Electrical Installation Design
- ◆ Electrical Motor Drive Systems
- ◆ Transformers
- ◆ Utilisation of Electrical Energy in Buildings
- ◆ Application of Electrical and Electronic Instruments

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 Electrical Engineering programme. As it is anticipated that centres will deliver the HNC Electrical Engineering as part of the first year of the HND, it is recommended that candidates have completed all HNC Electrical Engineering Units before commencing this project.

In principle, the project can draw on any Units in the HND Electrical Engineering Framework although the majority of any Units should be at SCQF level 8. The project can be taken from one Electrical Engineering area (eg Machines) or it can span more than one technical area. However, its principal purpose is not to integrate technical content (this is covered in Electrical Engineering: Group Award Graded Unit 1) but rather to combine such knowledge and skills as planning, construction, testing, evaluating and reporting.

Core Skills: This Unit contains automatic certification of the Problem Solving core skill at Higher level.

Assessment: This Graded Unit will be assessed by the use of the practical assignment (electrical engineering project). The “fleshed-out” 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.

An assessment exemplar pack has been produced to provide centres and candidates with clear guidance as to the national standard of achievement required at SCQF level 8.

General Information for Centres (cont)

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. Candidates' contribution to a larger group project has the advantage of creating opportunities for the development of the core skill, Working with Others.

Administrative Information

Graded Unit Code:	DN3X 35
Graded Unit Title:	Electrical Engineering: Graded Unit 2
Date of publication:	May 2005
Source:	SQA

Special Needs: This Graded Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special 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 Special Assessment Arrangements* (December 2001, AA0645/3).

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

Graded Unit Title: Electrical Engineering: Graded Unit 2

Conditions of Assessment

The candidate should be given a date for completion of the Electrical Engineering 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. Reassessment of this Graded Unit should be based on a significantly different assessment task.

At this level, candidates should work independently. It is up to Centres to take reasonable steps to ensure that the project is the work of the candidate. For example, Centres may wish to informally question candidates at various stages on their knowledge and understanding of the project on which they have embarked. Centres should ensure that where research etc, is carried out in other establishments or under the supervision of others that the candidate does not receive undue assistance.

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.

It should be noted that in the following table the term 'product' could mean one of the following:

- ◆ electrical hardware only
- ◆ hardware and software

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

- ◆ an electrical design (which may include the use of software)
- ◆ feasibility study of a technical issue leading to a report with a clear set of recommendations

Which ever category is chosen, the project must relate to a practical situation demonstrating how electrical engineering is utilised in the service of society.

Grade A	Grade C
<p>Is a seamless, coherent piece of work which:</p> <ul style="list-style-type: none"> ◆ The project brief includes all relevant information, is written clearly and concisely and has been agreed fully with the customer ◆ The project specification is well structured, contains relevant, accurate information and any revisions made have been agreed with the customer ◆ The project objectives accurately and fully reflect the long term project targets ◆ 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. 	<p>Is a co-ordinated piece of work which:</p> <ul style="list-style-type: none"> ◆ 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 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 identify the key long term project targets and multi-variables ◆ 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.

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

Grade A	Grade C
<ul style="list-style-type: none"> ◆ The candidate develops a substantial knowledge base to support the demands of the project ◆ The selected solution is justified in terms of a thorough evaluation of a range of options ◆ A comprehensive verification strategy is developed to ensure the product is completely tested ◆ 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 accesses component and/or, software and/ or materials of the correct specification from a range of sources at the most economic price ◆ The product is constructed to a high standard and functions correctly ◆ All tests on the product are conducted in a technically correct way with due account being taken of inaccuracies introduced by the measurement processes 	<ul style="list-style-type: none"> ◆ The candidate develops a sound knowledge base to support the demands of the project ◆ The selected solution is justified in terms of a sound evaluation involving the solution and at least one viable alternative option ◆ A verification strategy is developed to test the essential parts of the product ◆ The candidate feeds back to her/his supervisor on at least three occasions providing an indication of progress made ◆ The candidate accesses components and/or software and/or materials of the correct specification from a range of sources ◆ The product is constructed to an acceptable standard of quality ◆ Tests are carried out in a technically proficient way

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

Grade A	Grade C
<ul style="list-style-type: none"> ◆ The interpretation of test results is accurate and the analysis of the results is used to identify improvements in product performance ◆ 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 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 includes a complex and comprehensive evaluation of the project strategy and activities and includes clear evaluation of what the candidates has learnt from undertaking the project and the factors involved ◆ The oral presentation is well structured, contains only relevant information, is to time and includes the use of appropriate aids ◆ The candidate gives clear, concise and technically accurate answers to questions raised during the oral presentation 	<ul style="list-style-type: none"> ◆ The interpretation of test results is correct ◆ 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 meets acceptable standards in terms of structure, use of English and clarity, and has accurate conclusions and recommendations. ◆ 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 acceptably structured, contains largely relevant information and is to time ◆ The candidate gives technically correct answers to questions raised as part of the oral presentation

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

Grade A	Grade C
<ul style="list-style-type: none"> ◆ The candidate includes a complex, reflective account of the success, or otherwise, of project activities against project objectives in the oral presentation 	<ul style="list-style-type: none"> ◆ The candidate includes a reflective account of the success, or otherwise, of the project in the oral presentation
<ul style="list-style-type: none"> ◆ The candidate undertakes the project with the minimum of supervision 	<ul style="list-style-type: none"> ◆ The candidate undertakes the project without unnecessary interventions from the project supervisor to ensure the project remains on track
<ul style="list-style-type: none"> ◆ 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 	<ul style="list-style-type: none"> ◆ The candidate provides at least three examples of new knowledge and skills she/he has developed as a result of doing the project
<ul style="list-style-type: none"> ◆ The candidate introduces a significant novel feature into the project 	<ul style="list-style-type: none"> ◆ None
<ul style="list-style-type: none"> ◆ The candidate demonstrates a high level of self motivation throughout the project 	<ul style="list-style-type: none"> ◆ The candidate demonstrates an acceptable level of motivation throughout the project
<ul style="list-style-type: none"> ◆ The candidate undertakes additional research well beyond that demanded by the project 	<ul style="list-style-type: none"> ◆ None

Important Note:

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

Completed checklists will be used as part of the external moderation 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 18.

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

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 Electrical Engineering: Graded Unit 2. All activities must be undertaken in a totally safe and healthy manner.

Project Stage	Minimum Evidence Requirements
Stage 1 — Planning	<ul style="list-style-type: none">◆ 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◆ complies with Health and Safety procedures <p><i>The candidate must achieve all of the minimum evidence specified above in order to pass the Planning stage.</i></p>

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

Project Stage	Minimum Evidence Requirements
Stage 2 — Developing	<ul style="list-style-type: none"> ◆ practical output from the project (design, analysis, installation etc) ◆ written records of progress underpinning the project such as: <ul style="list-style-type: none"> — log book — progress reports — test results as part of the verification strategy — complies with Health and Safety procedures <p><i>The candidate must achieve all of the minimum evidence specified above in order to pass the Developing stage</i></p>
Stage 3 — Evaluating	<ul style="list-style-type: none"> ◆ 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 <p><i>The candidate must achieve all of the minimum evidence specified above in order to pass the Evaluating stage.</i></p>

Scottish Qualifications Authority

Electrical Engineering: 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 is 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 off 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	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				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 learned 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 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 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 Electrical Engineering Project. It will also be used by external moderators as part of the external moderation of project work.

A Grading Checklist form should be completed for each candidate who has been entered for the Electrical Engineering: Graded Unit 2 (Electrical Engineering 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 the 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 five 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) Centre's may provide additional comments and/or evidence in support of their grading decisions.

Candidates with Additional Support Needs

This Graded Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. 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 Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs*, which is available on the SQA website www.sqa.org.uk