

ARRANGEMENTS

HNC Electronics

and

HND Electronics

A SQA National Development

**A Higher National Development under the new
SQA HN Design Rules**

HNC Electronics

and

HND Electronics

Arrangements Document: Version 2 (January 2006)

HNC ELECTRONICS
HND ELECTRONICS

VALIDATED —

CONTENTS

	Page
1 INTRODUCTION	1
2 RATIONALE	1
2.1 HN Engineering Frameworks	1
2.2 History and Market Research to support the HNC and HND Electronics	5
2.2.1 History of the HNC and HND Electronics	5
2.2.2 Market Research	5
3 AIMS	8
3.1 General aims of the HNC Electronics	8
3.2 Specific aims of the HNC Electronics	8
3.3 General Aims of the HND Electronics	9
3.4 Specific aims of the HND Electronics	9
4 RECOMMENDED ACCESS	18
5 STRUCTURE OF THE QUALIFICATIONS	20
5.1 HNC Electronics Structure	20
5.2 HND Electronics Structure	22
5.3 SCQF Levels	24
5.4 Conditions of Awards	25
5.4.1 HNC Electronics	25
5.4.2 HND Electronics	26
5.5 Graded Unit Assessments	27
6 APPROACHES TO DELIVERY AND ASSESSMENT	28
6.1 Content and Context	28
6.2 Delivery	29
6.3 Assessment	30
6.4 Re-assessment	32
7 GUIDANCE FOR CENTRES	33
7.1 Assessment Moderation	33
7.2 Open and Distance Learning	34
7.3. Special Needs	34
7.4 Credit Transfer Transition Arrangements	34
7.5 General Information for Candidates	37
7.6 Relationship to Other Awards	38
7.7 Articulation Arrangements	39
7.8 History of Change	39

8	GRADED UNIT SPECIFICATION	40
	Electronics: Group Award Graded Unit 1	40
	Electronics: Group Award Graded Unit 2	47
9	CORE SKILLS AUDIT OF HNC AND HND ELECTRONICS UNITS	65
10	EXAMPLES OF HNC AND HND ELECTRONICS TIMETABLES	87
11	GUIDE TO CREDIT TRANSFER ARRANGEMENTS BETWEEN OLD AND NEW ELECTRONICS UNITS	90

1 INTRODUCTION

This Arrangements Document has been written in order to assist centres in preparing for approval for the new HNC and HND Electronics awards and maintaining the awards following successful approval. These two awards were developed under the new SQA Design Principles, were validated in December 2003, and replace the HNC Engineering: Electronics and the HND Engineering: Electronics.

This Document includes details on the background to the development of the new awards, their aims (both general and specific), recommended access requirements, information about the structure of the awards, recommendations on delivery and assessment and other guidance for centres.

2 RATIONALE FOR THE REVISIONS OF THE AWARDS

2.1 HN Engineering Frameworks

In 1996 the SQA validated nationally a large number of new HN Engineering awards including two awards entitled HNC Engineering: Electronics and HND Engineering: Electronics. A major difference between these and previous awards were that they all sat within an HN Engineering Framework which in general terms consisted, for both HNCs and HNDs, of a common core of Units (Units common to all HNC and HND Engineering awards), a principles–technology section and optional section. The benefits of this Framework structure were seen to include the following:

- ◆ provide a wide range of HN Engineering qualifications to meet the needs of different engineering sectors
- ◆ improve the credibility and esteem of individual HN Engineering awards
- ◆ clarify those competencies that were general to all incorporated engineers and those that were specific to particular engineering disciplines
- ◆ provide opportunities for the efficient delivery of HN Engineering Units by, for example, incorporating Units that were common to a number of different HN awards
- ◆ facilitate better progression between HNC, HND and degree engineering awards

Before proceeding with the development of the HNC and HND Electronics, which were the first two Engineering awards developed under the new HN Design Principles, it was necessary to consult with stakeholders to check if the overarching HN Engineering Framework was still valid. Consultation on the HN Engineering Framework consisted of the following five strands:

- ◆ a questionnaire survey with stakeholders of HN Engineering awards
- ◆ a series of meetings with various interested stakeholders of HN Engineering awards
- ◆ desk based research
- ◆ discussions (followed by endorsement) of a proposed HN Engineering Framework at a HN Engineering Steering Group meeting
- ◆ a major consultation event with FE colleges on 24 May 2002 which included a questionnaire survey

The consultation revealed continuing strong support for an overarching HN Engineering Framework but with the following modifications:

- ◆ a reduction in the number of common core Units
- ◆ a strengthening of the Principles/Technology section with an even stronger emphasis on the teaching of core engineering principles and technologies

Optional sections are retained in all HNC and HND Engineering awards.

The revised HNC and HND Engineering Frameworks are shown in block diagram form in Figures 2.1 and 2.2. It should be noted that the PDAs shown in both diagrams may be developed as more HN Units come on stream; currently none of these PDAs exist.

HNC ENGINEERING FRAMEWORK

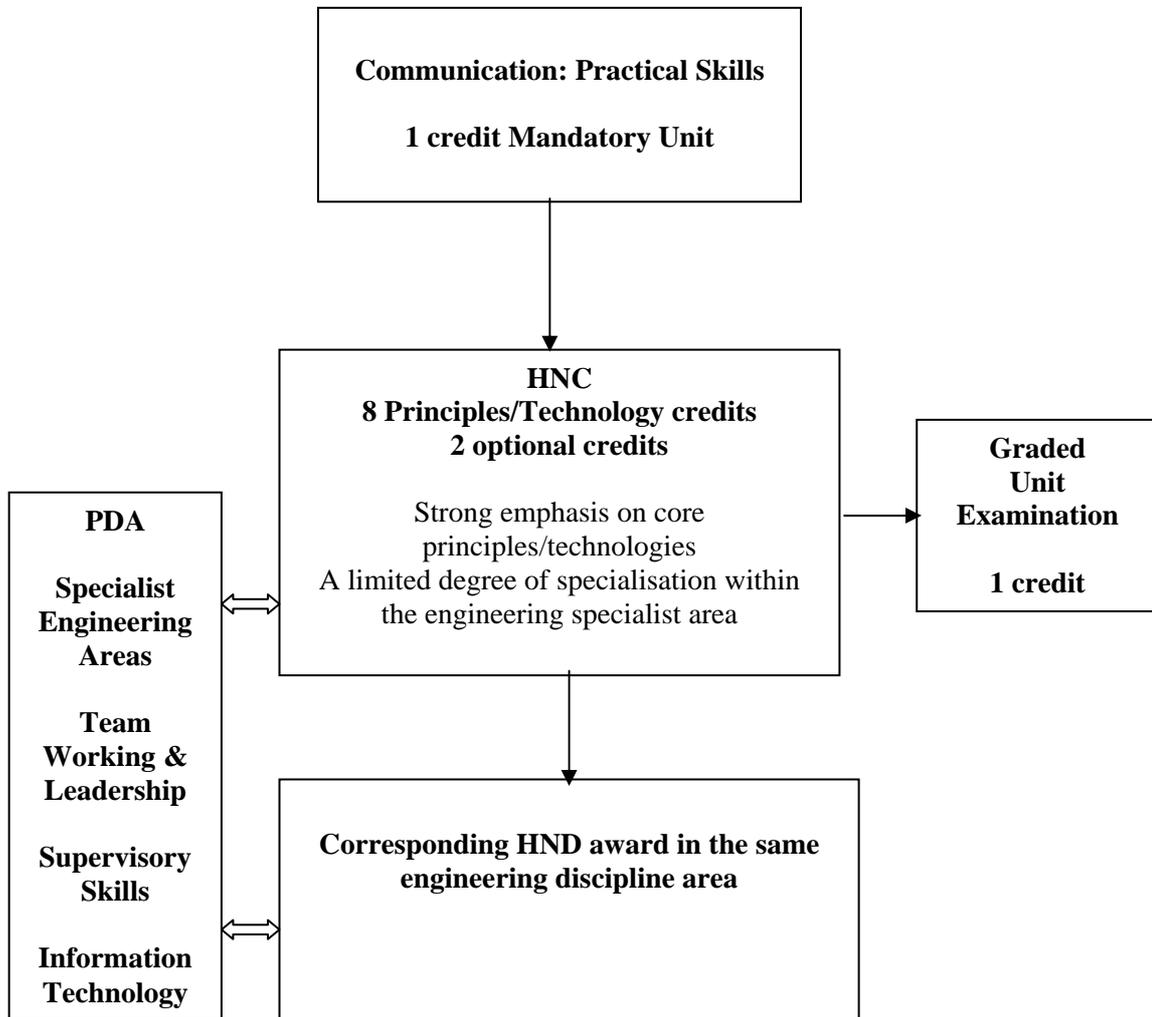


Figure 2.1

HND ENGINEERING FRAMEWORK

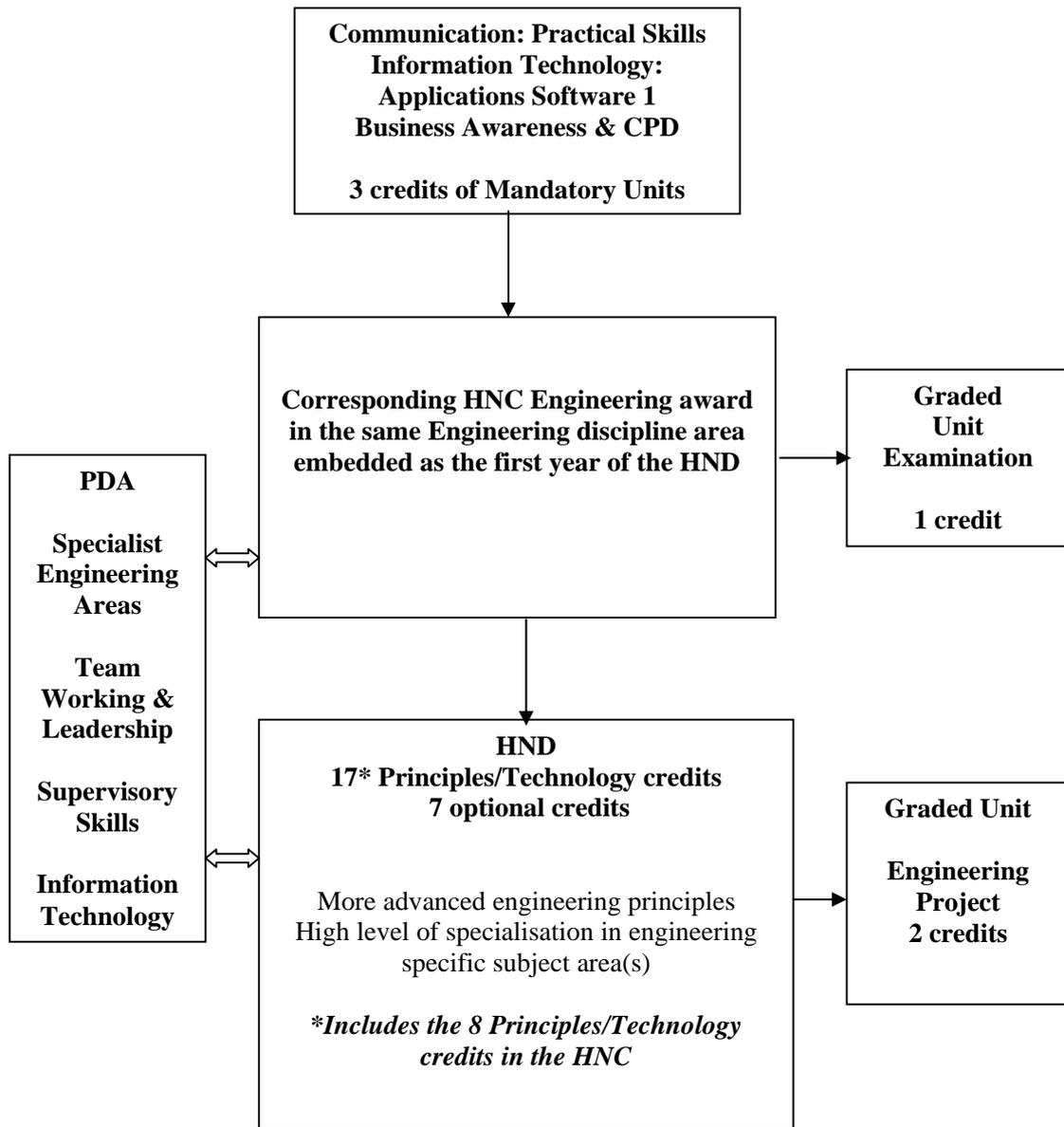


Figure 2.2

2.2 History and Market Research to support the HNC and HND Electronics

2.2.1 History of the HNC and HND Electronics

The introduction of the SCOTVEC Advanced Courses Development Programme led to the replacement of the 132 HND in Electrical and Electronic Engineering award by a competence based HND in Electronic and Electrical Engineering in 1989. Shortly after an HNC in Electronic and Electrical Engineering was introduced as part of a national development and replaced the 101 HNC in Electrical and Electronic Engineering. However, there continued to be little commonality between the new HNC and HND awards. The first attempt to harmonise the two awards took place as part of a consortium development in the early nineties. In 1995 and 1996 the two awards were totally harmonised (ie the HNC Electronics becoming effectively the first year of the HND) as part of a major SCOTVEC national development which saw the introduction of an overarching HN Engineering Framework. The two new awards represent a further development of Higher National Engineering awards taking full account the new HN Design Principles and providing an opportunity to update the awards in light of technological and educational developments.

2.2.2 Market Research

The development of the new HNC and HND Electronics included extensive market research which is summarised in Table 2.3.

Stakeholder	Method
All	Major desk based research gathering and analysing data from various sources (eg SEMTA, FutureSkills Scotland)
Delivery Centres	Initial postal survey of all delivery centres followed by three National seminars Draft Units, assessment exemplars and outlines of Graded Units were made available to centres on CD.

Stakeholder	Method
Employers	<p>A member of the HN Electronic Development Team works for a major electronics company and was able to input information on current technological developments and industrial practices</p> <p>Surveys of employers and employees were carried out through Scottish Engineering and the Institute of Incorporated Engineers.</p>
Higher Education	<p>On-going individual meetings with Higher Education staff plus a meeting with university staff to discuss articulation arrangements especially pertaining to Mathematics.</p> <p>Letters of support for articulation between the new HNC and HND Electronics and degree awards.</p>
Professional Bodies	<p>The Chair of the Institute of Incorporated Engineers is a member of the HN Engineering Steering Group and the HN Electronics Development Team.</p> <p>A representative of the Institute of Incorporated Engineers was on the validation panel. Broad support for the two new developments was given.</p>
HN Engineering Steering Group	<p>A group made up of representatives from engineering employers, SEMTA, Higher Education, Further Education, professional bodies, Scottish Enterprise and Scottish Executive who are overseeing the HN Engineering developments under the new Design Principles. The Group provided a significant amount of information, advice and support during the development of the HNC and HND Electronics.</p>

Stakeholder	Method
Students	Whilst not consulted directly the student experience of the current HNC and HND Electronics was taken fully into account in the new developments.

Table 2.3

3 AIMS

The General and Specific Aims of the HNC Electronics are provided below:

3.1 General Aims of the HNC Electronics

The general aims of this award are to:

- 3.1.1 Enhance candidates' employment prospects.
- 3.1.2 Support candidates' Continuing Professional Development and career development.
- 3.1.3 Enable progression within the SCQF (Scottish Credit and Qualifications Framework).
- 3.1.4 Develop candidates' ability to apply analysis and synthesis skills to the solution of electronic problems.
- 3.1.5 Develop learning and transferable skills (including Core Skills).

3.2 Specific Aims of the HNC Electronics

The specific aims of this award are to:

- 3.2.1 Provide an award that will allow candidates to work now, or in the future, as electronic technicians or incorporated electronic engineers.
- 3.2.2 Provide an award that creates a route towards meeting the academic requirements for Incorporated Engineer status.
- 3.2.3 Develop an award that on successful completion will allow candidates' to progress to HND Electronics and/or a degree in Electronics or related subject discipline area.

The development of this new HNC award will also allow candidates' to

- 3.2.4 Develop a range of Communication and Information Technology knowledge and skills relevant to the needs of electronic incorporated engineers.
- 3.2.5 Develop knowledge, understanding and skills in a range of core electrical, analogue electronics and digital electronics principles and technologies at Higher National level (all underpinned by a mandatory Unit in Mathematics).
- 3.2.6 Develop knowledge, understanding and skills to apply a structured approach to high level language or assembly language programming with reference to applications within a microprocessor/embedded system.

- 3.2.7 Allow a degree of specialisation within the following areas: electronic and electrical principles, electronic construction and testing skills, printed circuit board design, manufacture and test, Programmable Logic Controllers, implementation of local area networks, further mathematical studies, information technology applications or employment experience.
- 3.2.8 On successful completion of the award, achieve the Core Skill in Communication at Higher level, the Using Number component at Higher and be provided with opportunities to develop the following Core Skills. Within the Mandatory Section of the award there are opportunities to develop Information Technology Core Skill components at Higher level. Opportunities also exist to acquire the Information Technology Core Skill at Higher and the Core Skill Working With Others at Higher level if the following optional Units are taken; D75X Information Technology: Applications Software 1 and D77H 34 Employment Experience 2.

3.3 General Aims of the HND Electronics

The same as for the HNC Electronics but with the addition of the following:

- 3.3.1 Develop candidates' knowledge and skills in planning and project management.
- 3.3.2 Develop investigation skills.

3.4 Specific Aims of the HND Electronics

The same as for the HNC Electronics but with the addition of the following:

- 3.4.1 Develop an award that on successful completion will allow candidates' to progress to a degree in Electronics or related subject discipline area.

The development of this new HND award will also allow candidates' to:

- 3.4.2 Develop knowledge and understanding of the external and internal factors that influence the performance of modern companies.
- 3.4.3 Recognise the important role Continuing Professional Development plays in career development.
- 3.4.4 Expand on the range of knowledge, understanding and skills of core electrical, analogue electronics and digital electronics principles and technologies included within the HNC Electronics (all underpinned by mandatory Units in Mathematics).
- 3.4.5 Develop a range of practical electronic construction and testing skills.

- 3.4.6 Develop knowledge, understanding and skills to apply a structured approach to high level language and assembly language programming. Use the programming skills developed to control the flow of and process data in an appropriate target system such as a Microprocessor or Microcontroller.
- 3.4.7 Allow for further specialisation within the following subject areas; printed circuit board design, manufacture and test, electronic fault finding, Programmable Logic Controllers, transmission lines and complex waves, implementing small local area networks, microprocessor technology, signal processing and conditioning, systems integration, power electronics and fundamentals of control systems and transducers advanced mathematical studies and employment experience.
- 3.4.8 On successful completion of the award, achieve the Core Skills in Communication, Information Technology, the Using Number component at Higher level and be provided with opportunities to develop the Core Skill of Problem Solving at Higher. Opportunities also exist to acquire the Working with others Core Skill at Higher level if the optional Unit D77H 34 Employment Experience 2 is taken.

3.2 How the General Aims are met in the HNC and HND Award Structures and Content

Aim No.	How it is met in HNC and HND
3.1.1	For many years HNC and HND Electronics qualifications have equipped candidates to seek employment in a wide range of manufacturing, service and public sector organisations. Market research indicates that HNC and HND Electronics are still regarded, as the minimum qualifications required by many organisations to work at electronic technician or incorporated engineer level.
3.1.2	There has been a long tradition of candidates in employment taking HNC Electronic and Electrical awards on a part-time basis to increase their knowledge of Electronic and Electrical Engineering and enhance their career development. In recent years, with increased commonality between HNC and HND Electronic awards and greater flexibility in the way these awards are delivered, candidates in employment have increasingly taken HNDs on a part-time basis. The two new awards contain a balance of core principles and up to date knowledge and skills in Electronic Engineering which lend themselves to the Continuous Professional Development of candidates working at electronic technician and incorporated engineer levels. Furthermore, the award structures have been designed to allow for easy progression between HNC and HND awards.
3.1.3	All Units within the new HNC and HND Electronics awards have been levelled at SCQF levels 6, 7 or 8. The two new awards also conform to the SQA levelling requirements for HNC and HND awards. Thus, successful completion of one or both awards will allow progression within the SCQF.
3.1.4	The nature of Electronics as a discipline lends itself to both the analysis and synthesis of problems. For example, when a complex electronic system is analysed (using say, a block diagram approach) by breaking it down into separate functional parts or alternatively the synthesis of a complex system from simpler electronic systems. The two new awards allow these important skills to be developed further both in the technical subjects and in the core Communication, Information Technology and Business Awareness and Continuing Professional Development Units.
3.1.5	The new HNC and HND Electronic awards provide centres with an opportunity to enhance learning skills not least by creating opportunities for candidates to combine theory and practice to achieve a real understanding of a subject. For example, some Units recommend significant use of practical work and/or computer simulation to reinforce learning. It is also anticipated that centres will use innovative delivery approaches that may make use of sophisticated electronic laboratory equipment and/or on-line delivery and/or Virtual Learning Environments to enhance candidate learning.

Aim No.	How it is met in HNC and HND
	<p>By their very nature Engineering courses require the transfer of technical knowledge and skills from one area to another. For example, a significant level of Electrical Principles and Mathematics has been included in both HNC and HND Electronics awards because these subjects provide underpinning knowledge, understanding and skills which are used elsewhere in both awards. Candidates will also have an opportunity to use the Communication and Information Technology knowledge and skills developed in the mandatory core Units in other parts of the awards to support such activities as report writing, presentation and the application of specialist software packages. Core Skills in general and problem solving in particular, have been regarded as very important since it is recognised that a good level of competence in these skills is essential in the work of an incorporated electronic technician.</p>
3.3.1	<p>The double credit (16 SCQF points) Electronics: group award Graded Unit 2 in the HND Electronics award provides opportunities for candidates to develop both their planning and project management knowledge and skills.</p>
3.3.2	<p>The Business Awareness and Continuing Professional Development Unit provides candidates with the opportunity to develop their investigative skills by exploring the external and internal factors that affect the performance of a modern company and the different ways that people learn. The Electronics: group award Graded Unit 2 also requires candidates to undertake some investigations into the background to and a range of solutions for their engineering project.</p>

3.3 How the Specific Aims are met in the HNC and HND Award Structures and Content

Aim No.	How it is met in HNC and HND
3.2.1	<p>An HNC and HND Electronics have been recognised for many years by employers and other stakeholders of these awards as appropriate qualifications for persons wishing to work at electronic technician or senior technician levels. Market research indicates that there is a growing demand for people with technician level skills in electronics especially as companies automate more of their processes. Thus, it is confidently anticipated that those achieving the HNC and HND Electronics will find employment as electronic technicians and senior electronic technicians in a wide range of small, medium and large companies.</p>
3.2.2 & 3.2.3	<p>An HNC or HND no longer satisfies fully the academic requirements for Incorporated Engineer status although these qualifications continue to completely satisfy Engineering Technician requirements. The minimum qualification for Incorporated Engineer is an ordinary degree. The HND course framework and content is satisfactory in terms of contributing to the education of an Incorporated Engineer. Formal accreditation would require the delivering centre to be audited.</p> <p>Given that clear progression routes already exist between current HNC and HND Electronic awards and degree courses, it is strongly anticipated that similar progression routes will also be developed between the new HNC and HND Electronics and degree courses once the HNC and HND are up and running. Thus, HNC and HND Electronics awards will continue to form very important ‘stepping stones’ towards candidates achieving degrees (and thus satisfy fully the academic requirements for Incorporated Engineer status).</p>
3.2.4	<p>The market research information gathered through various consultations indicates that there continues to be solid support for the inclusion of a distinct Communication Unit in the mandatory core of the HNC and a Communication and Information Technology Unit within the mandatory core of the HND Engineering award. The benefit of having separate Units is that it significantly improves the prospect of sufficient attention being given to the teaching of these two key subjects and they include the Communication and Information Technology Core Skills at Higher level. This was considered to be more appropriate than trying to embed such Core Skills across, say, a range of engineering Units, except at HNC level where there are considerable opportunities to develop Information Technology Core Skills within electronics Units.</p>

Aim No.	How it is met in HNC and HND
	Assessment exemplar materials specifically contextualised to engineering have been developed for each of these Units to address concerns raised by centres about their delivery and assessment in the context of Electronics.
3.2.5	Market research shows that employers place a high priority on employees having the correct technical and practical skills to function effectively in their job. Whilst there continues to be a debate about the precise nature of these skills it is clearly important that electronic technicians and incorporated engineers have a sound knowledge and understanding of core electronic principles. This will serve candidates well in employment and provide the platform for learning more advanced technical skills. The Principles/Technology section of the new HNC Electronics award reflects this by providing studies in the key areas of Electronics namely, analogue electronics, digital electronics, electrical and electronic principles, and engineering programming. A knowledge and understanding of Mathematics is fundamental to the work of electronic technicians and a Mathematics Unit (containing the Using Numbers Core Skill component at Higher level) was therefore included within the Principles/Technology section of the HNC Electronics award. For discussions on practical electronics skills see 3.2.7.
3.2.6	The two new awards do not seek to create software systems or support specialists. Candidates who wish to pursue such a career route would be better to study an HNC or HND Computing. The two programming Units, one in a High Level Language and the other in Assembly Language, were included simply to allow candidates to develop knowledge and skills in the fundamentals of structured programming. This is with a view to providing candidates with a better knowledge and understanding of the role that software plays in the operation of various target devices/systems including Microprocessor and Microcontroller based systems. A knowledge and understanding of Assembly Language programming is so critical to understanding how a target device/system, such as Microprocessor or Microcontroller, operates that a Unit on this was included.
3.2.7	In the 2 credit optional section candidates will be able to specialise further in the following areas; electronic and electrical principles, electronic construction and testing skills, printed circuit board design, manufacture and test, Programmable Logic Controllers, implementation of small local area networks, further mathematical studies and employment experience. Note: It is strongly recommended that candidates with little or no practical electronics experience (eg those on a full-time HNC) take the Electronic Construction Skills Unit as part of their optional studies.

Aim No.	How it is met in HNC and HND
3.2.8	<p>The Communication Core Skill at Higher level has been incorporated into the HNC Electronics through the mandatory core Communication: Practical Skills Unit. The Core Skill component Using Number at Higher is embedded in the limit Mathematics for Engineering 1: Electronics and Electrical.</p> <p>Opportunities to develop the Core Skills in Information Technology are signposted within individual Unit specifications. Candidates may achieve the Information Technology and Working with Others Core Skills at Higher Level if they take the optional Units in Information Technology: Applications Software and Employment Experience 2 respectively.</p>
3.4.1	See comments under 2.2.2 and 2.2.3
3.4.2 & 3.4.3	<p>It has been a tradition to deliver some form of Business Studies Unit in HND Engineering awards looking at issues such as costing/pricing of products and services. However, the focus of the new Business Awareness and Continuing Professional Development Unit is quite different as it looks at the changing industrial environment in which incorporated engineers have to work nowadays. This environment is characterised by globalisation of the market place leading to world-wide marketing opportunities and competitive pressures; greater use of advanced technologies and the predominance of Small and Medium Sized Enterprises in the British economy. It is important that in HND Engineering awards candidates are suitably prepared to work in this ever-changing employment environment. The new Unit seeks to do this by allowing candidates to explore the external factors that affect the performance of modern companies and the ways in which companies are responding to these external pressures internally. This Unit also has an Outcome on the important role that continuous learning and Continuing Professional Development will increasingly play in helping candidates to obtain sustainable and rewarding employment.</p>

Aim No.	How it is met in HNC and HND
3.4.4	<p>The Principles/Technology (P/T) section of the HND Electronics award contains all the Units in the P/T section of the HNC Electronics award. In addition, within the P/T section of the HND Electronics awards there are Units which allow candidates to expand their knowledge, understanding and skills in the four key areas of analogue electronics, digital electronics, electrical and electronic principles and engineering computing. For example, in the area of digital electronics candidates will be able to build on their knowledge and understanding of Combinational and Sequential Logic by studying Units in MSI Devices and Programmable Logic Devices.</p> <p>It was considered important to build on the mathematical skills developed in the Mathematics for Engineering 1: Electronics and Electrical Unit by including another core Mathematics Unit (entitled Mathematics for Engineering 2) within the P/T section of the HND award. The subject area of this Unit is Calculus.</p>
3.4.5	<p>It is anticipated that the majority of candidates taking the HND Electronics award will continue to do so on a full-time basis with many of these candidates coming directly from school. Such candidates do not normally possess a wide range of practical electronics skills. The Electronic Construction Skills Unit has been included in the P/T section of the HND Electronics award as a mandatory Unit to allow candidates to develop an appropriate range of practical electronic construction skills. Candidates will also have an opportunity to develop other practical skills via the laboratory work which they will undertake as a part of their course of study.</p>
3.4.6	See 3.2.6

Aim No.	How it is met in HNC and HND
3.4.7	<p>As in the case of the HNC Electronics award, candidates will be able to specialise further into certain areas of Electronics and/or Mathematics in the optional section of the HND Electronics award. All the optional HNC Units that have not been transferred to the HND P/T section are in the optional section of the HND. However, there is a greater choice of Units. For example, there is a Unit in Transmission Lines and Complex Waves. There are also Units in Microprocessor and Microcontroller Technology, Applications of Signal Processing and Conditioning, Power Electronics and Fundamentals of Control Systems and Transducers and Electronic Fault Finding. The inclusion of all these Units will allow candidates to pursue a degree of specialisation in areas such as data communication, integrated circuit technology and/or electronic fault finding at circuit and system levels.</p> <p>The Mathematics for Engineering 3 Unit has been included in the optional section to allow candidates who wish to progress to honours degree level in an engineering discipline to develop the necessary mathematical knowledge and understanding to support such progression.</p> <p>The Systems Integration Unit is a new departure at HND level and reflects the ever increasing trend to integrate electronic hardware and embedded software systems within products. Candidates doing this Unit will have an opportunity to consider the various issues involved in integrating such systems.</p>
3.4.8	<p>The Communication and Information Technology Core Skills at Higher level have been incorporated into the HND Electronics through the mandatory core Communication: Practical Skills and Information Technology: Application Software 1 Units respectively. As already noted for the HNC Electronics, the Core Skill component Using Number at Higher is embedded in the Mathematics for Engineering 1: Electronics and Electrical Unit with opportunities to develop Problem Solving signposted within the Electronics group award Graded Unit 2. Formal validation to have the Problem Solving Core Skill at Higher accredited as part of the Electronics: group award Graded Unit 2 is currently being sought. Candidates may achieve the Core Skill Working with Others Higher level if they take the optional Unit Employment Experience 2.</p>

4 RECOMMENDED ACCESS

In defining the access requirements for both HNC and HND Electronics care was taken to ensure that no artificial barriers were created to prospective candidates. Of equal importance was ensuring that candidates entering for an HNC or HND Electronics award would have a realistic chance of successfully achieving them. It is assumed that most centres will deliver the HNC Electronics as the first year of the HND Electronics and therefore the entry qualifications for the two awards will be the same.

A candidate is regarded as being competent to study for an HNC or HND Electronics if she/he possesses knowledge, understanding and skills in electronic and electrical engineering that is broadly equivalent to level 6 in the Scottish Credit and Qualifications Framework (SCQF). This does not mean that all areas of a potential entry qualification should be at level 6, but it does assume that the majority of the qualification should be at this level.

A qualification which satisfies fully the electronic and electrical knowledge and skills criteria at level 6 is:

- ◆ National Certificate Group Award in Electronic Engineering

Qualifications that contribute significantly towards meeting the electronic and electrical knowledge and skills criteria required include the following:

- ◆ Higher Electronics
- ◆ Higher Electrical Engineering
- ◆ Higher Technological Studies
- ◆ National Certificate Group Award in Electrical Engineering (depending on whether electronic Units are included in this group award)
- ◆ National Certificate Group Award in Electronic Engineering Practice*

* It should be noted that this award contains insufficient Electrical Principles and Mathematics to allow it to be used as an entry qualification for the HNC or HND Electronics awards alone.

In setting out suitable entry qualifications for the HNC and HND Electronics awards it is important to clarify the situation regarding Mathematics. The Mathematics for Engineering 1: Electronics and Electrical Unit is mandatory in both the P/T sections of the HNC and HND Electronics awards. This Unit is at level 6 in the SCQF. Thus, the recommended entry requirement for this Unit would be Mathematics at Intermediate 2 or a Standard Grade pass in Mathematics at credit level (grades 1 or 2).

With the information detailed above it is possible to provide the following as a list of qualifications that would be suitable for entry into and HNC or HND Electronics:

- ◆ National Certificate Group Award in Electronic Engineering
- ◆ National Certificate Group Award in Electrical Engineering preferably supplemented by additional electronic optional Units
- ◆ A choice of any two Highers from Electronics, Electrical Engineering and Technological Studies plus Standard Grade Mathematics at credit level/Intermediate 2 in Mathematics and Standard Grade English at credit level/Intermediate II in English (to support entry into the core Communication Unit in the HNC or HND Electronics)

Highers in Physics and/or Mechatronics may also be regarded as appropriate entry qualifications although it must be borne in mind that neither of these Highers give the same depth of treatment to electronic and electrical engineering as the Highers in Electronics, Electrical Engineering or Technological Studies.

Older qualifications in electrical and electronic engineering may also be regarded as appropriate although it will be important for centres to exercise some caution because some of their content is likely to be dated. Such qualifications may include:

- ◆ 053 Certificate in Electrical and Electronic Engineering
- ◆ 080 Diploma in Electrical and Electronic Engineering
- ◆ ONC/D in Electrical and Electronic Engineering
- ◆ Some City and Guilds Technician Level Certificates in Electronics

Mature candidates with good industrial experience in electronic and electrical industries may also be eligible for admission to the HNC or HND Electronics.

A selection process is recommended where a centre is uncertain if a candidate's qualifications and/or experience is suitable for entry to the HNC or HND Electronics. This may consist of an interview and/or some form of test to assess the candidate's knowledge and understanding of electronic and electrical engineering, and/or mathematics. In broad terms the questions in any test paper on electronic and electrical engineering should be at SCQF Level 6 (Higher) level and any questions on mathematics should be at SCQF Level 5 (Intermediate 2) level.

5 STRUCTURE OF THE QUALIFICATIONS

5.1 HNC Electronics Structure Mandatory Section (9.0 credits required)

Unit No.	Unit Title	Credit Value	SCQF Level
D77G 34	Communication: Practical Skills	1	7
Principles/Technology Units (8 credits)			
DG4H 33	Mathematics for Engineering 1: Electronics and Electrical	1	6
DG54 34	Single Phase AC Circuits	1	7
DG2X 34	Analogue Electronic Principles	2	7
DG3C 34	Combinational Logic	1	7
DG53 34	Sequential Logic	1	7
DG58 34 OR DG59 34	High Level Engineering Software OR MCU/MPU Assembly Language Programming	1 1	7 7
DG3N 34	Electronic Testing Skills	1	7
DE3R 34	Personal Development Planning	1	7

Optional Section (2.0 credits required)

Unit No.	Unit Title	Credit Value	SCQF Level
D75X 34	Information Technology: Applications Software 1	1	7
DG3G 34	Electrical Networks and Resonance	1	7
DG3H 34	Electronic Construction Skills	1	7
DG51 34	Printed Circuit Board Design, Manufacture and Test	1	7
DG31 34	Applications of Programmable Logic Controllers	1	7
DG4L 34	Mathematics for Engineering 2	1	7
DG40 34	Implementing Small Local Area Networks	1	7
DG59 34 OR DG58 34	MCU/MPU Assembly Language Programming OR High Level Engineering Software	1 1	7 7
D77H 34	Employment Experience 2	1	7

Graded Unit (1.0 credit)

Unit No.	Unit Title	Credit Value	SCQF Level
DG2T 34	Electronics: group award Graded Unit 1 — Examination	1	7

**5.2 HND Electronics Structure
Mandatory Section (20.0 credits required)**

Unit No.	Unit Title	Credit Value	SCQF Level
D77G 34	Communication: Practical Skills	1	7
D75X 34	Information Technology: Applications Software 1	1	7
DG3D 35	Business Awareness and Continuing Professional Development	1	8
Principles/Technology Units	17 credits (including 8 from HNC P/T section)		
DG4H 33	Mathematics for Engineering 1: Electronics and Electrical	1	6
DG54 34	Single Phase AC Circuits	1	7
DG2X 34	Analogue Electronic Principles	2	7
DG3C 34	Combinational Logic	1	7
DG53 34	Sequential Logic	1	7
DG58 34 OR	High Level Engineering Software OR	1	7
DG59 34	MCU/MPU Assembly Language Programming	1	7
DG3N 34	Electronic Testing Skills	1	7
DG3H 34	Electronic Construction Skills	1	7
DG3G 34	Electrical Networks and Resonance	1	7
DG56 35	Telecommunications Fundamentals	1	8
DG4L 34	Mathematics for Engineering 2	1	7
DG2W 35	Active Electronics Circuit	1	8
DG50 35	Power Supply Circuits	1	8
DG4Y 35	MSI Devices	1	8
DG52 35	Programmable Logic Devices	1	8
DG5A 35 OR	High Level Language: External I/O Transfer OR	1	8
DG5C 35	MCU/MPU I/O Hardware Control	1	8

HND Electronics Structure
Optional Section (7.0 credits required)

Unit No.	Unit Title	Credit Value	SCQF Level
DG4X 35	Microprocessor and Microcontroller Technology	1	8
DG3P 35	Field Programmable Gate Arrays	1	8
DG51 34	Printed Circuit Board Design, Manufacture and Test	1	7
DG59 34	MCU/MPU Assembly Language Programming	1	7
OR DG58 34	OR High Level Engineering Software	1	7
DG5C 35	MCU/MPU I/O Hardware Control	1	8
OR DG5A 35	OR High Level Language: External I/O Transfer	1	8
DG35 35	Applications of Signal Processing and Conditioning	1	8
DG3J 35	Electronic Fault Finding	1	8
DG4P 35	Mathematics for Engineering 3	2	8
DG40 34	Implementing Small Local Area Networks	1	7
DG31 34	Applications of Programmable Logic Controllers	1	7
DG55 35	Systems Integration	1	8
DG57 35	Transmission Lines and Complex Waves	1	8
D77H 34	Employment Experience 2	1	7
DN42 34	Power Electronics	1	7
DN3Y 34	Fundamentals of Control Systems Transducers	1	7
DE3R 34	Personal Development Planning	1	7

Graded Unit (3.0 credits)

Unit No.	Unit Title	Credit Value	SCQF Level
DG2T 34	Electronics: group award Graded Unit 1 — Examination	1	7
DG2V 35	Electronics: group award Graded Unit 2 — Practical Project	2	8

5.3 SCQF Levels

c.p. = credit points

Tables 4.1 and 4.2 show the distribution of SCQF levels in the HNC and HND Electronics respectively. It can be seen from Table 4.1 that all Units in the HNC Electronics are at level 7 except for one, the Mathematics for Engineering 1: Electronics and Electrical Unit, which is at Level 6. The Table shows that the number of SCQF Level 7 Units substantially exceeds the minimum of 48 SCQF credit points required to be in an HNC to satisfy the new HN Design Principles.

It can be seen from Table 4.2 that the minimum number of SCQF Level 8 Units a candidate can chose in the HND Electronics is 88 SCQF credit points which comfortably exceeds the minimum requirement of 64 SCQF credit points as stated in the HN Design Principles. A number of the SCQF Level 8 Units in the HND follow on from corresponding Level 7 Units and are, therefore, appropriately levelled at SCQF Level 8.

Table 4.1 Distribution of SCQF Levels in the HNC Electronics

Level 6	Level 7	Level 8	Totals	SQA Minimum Requirement for Level 7 Units
8 SCQF c.p.	88 SCQF c.p.	0 SCQF c.p.	96	48 SCQF c.p.

Table 4.2 Distribution of SCQF Levels in the HND Electronics

Level 6	Level 7	Level 8	Totals	SQA Minimum Requirement for Level 8 Units
8 SCQF c.p.	Minimum of 104 SCQF c.p.	Maximum of 128 SCQF c.p.	240	64 SCQF c.p.
	Maximum of 144 SCQF c.p.	Minimum of 88 SCQF c.p.	240	

5.4 Conditions of Awards

The conditions of award for HNC and HND Electronic qualifications are as follows:

5.4.1 HNC Electronics

A candidate will be awarded HNC Electronics on successful completion of 11 Unit credits plus 1 Graded Unit based on the HNC Electronics award structure shown in section 5. More specifically this award structure requires that candidates achieve the following:

- ◆ the 1 Unit credit Communication: Practical Skills
- ◆ eight Unit credits from the Principles/Technology section
- ◆ two Unit credits from the optional section
- ◆ electronics: group award Graded Unit 1

Core Skills in the HNC Electronics

Exit Profile

A candidate who successfully achieves an HNC Electronics will automatically obtain the following Core Skills Exit Profile

- ◆ Communication Higher (fully embedded in the Communication: Practical Skills)
- ◆ Numeracy The Using Number component at Higher

Core Skills Entry Profile

Given the information on Core Skills provided in the previous section the following candidate Core Skills Entry Profile is recommended.

- ◆ Communication Intermediate 2
- ◆ Information Technology Intermediate 2
- ◆ Numeracy Intermediate 2
- ◆ Problem Solving Intermediate 2

The level of the Communication and Numeracy Core Skills have been selected on the basis that the level of the entry Core Skill would normally be one level below that of the exit Core Skill. The level of the Information Technology Core Skill has been chosen to reflect the fact that the Information Technology: Applications Software 1 optional Unit has the Information Technology Core Skill at Higher embedded in it and it is anticipated that this Unit will be a popular option. The level of the Problem Solving Core Skill has been set at Intermediate 2 because it is regarded as the minimum acceptable level for this Core Skill to enter an HNC Electronics award. No level has been set for the Working with Others Core Skill because there are so few opportunities to develop this Core Skill in the HNC that there seems no point in creating any artificial barriers to entry to the award.

Development Opportunities

A Core Skills audit of all the Units in the HNC was undertaken to identify opportunities for candidates to develop or be assessed on the component parts of the Information Technology, Problem Solving and Working with Others Core Skills. The results of this audit are shown in Annex 3. The audit revealed that there were clear opportunities for candidates to develop components of the Information Technology Core Skill in the two Engineering Programming Units and the Applications of Programmable Logic Controllers Unit. This is not to say that there are not opportunities to develop the Information Technology Core Skill in other Units (eg where candidates use software simulation) only that it was more difficult to quantify these opportunities in terms of the Information Technology Core Skill Unit specification.

The same was also found to be the case with the Problem Solving and Working with Others Core Skills. By its very nature an electronics award provides numerous opportunities to develop problem solving skills, however it was very difficult to match these opportunities with the Problem Solving Core Skills Framework. Likewise it is difficult to identify opportunities to develop the Core Skill 'Working with Others'. This is perhaps not surprising given the strong technical rather than interpersonal focus of electronics Units. Candidates in employment who particularly wish to access the Working with Others Core Skill can do so by taking the Employment Experience 2 optional Unit which has the Working with Others Core Skill at Higher Level embedded in it.

5.4.2 HND Electronics

A candidate will be awarded HND Electronics on successful completion of 27 Unit credits plus 3 Graded Unit Assessment credits based on the HND Electronics award structure shown in section 5.2. More specifically this award structure requires that candidates achieve the following:

- ◆ the three Unit credits Communication: Practical Skills, Information Technology: Applications Software 1 and Business Awareness and Continuing Professional Development
- ◆ seventeen Unit credits from the Principles/Technology section
- ◆ seven Unit credits from the optional section
- ◆ Electronics: group award Graded Unit 1 and Electronics: group award Graded Unit 2

Core Skills in the HND Electronics

Exit Profile

A candidate who successfully achieves an HND Electronics will automatically obtain the following Core Skills Exit Profile

- ◆ Communication Higher
- ◆ Information Technology Higher (fully embedded in the Information Technology: Applications Software 1 Unit)

- ◆ Problem Solving Higher (fully embedded in Electronics Graded Unit 2)
- ◆ Numeracy Using Number Core Skills component at Higher

Core Skills Entry Profile

The recommended Core Skills Entry Profile is as follows (it should be noted that it is the same as for the HNC Electronics).

- ◆ Communication Intermediate 2
- ◆ Information Technology Intermediate 2
- ◆ Numeracy Intermediate 2
- ◆ Problem Solving Intermediate 2

As in the case of HNC Electronics the level of the Communication, Information Technology and Numeracy Core Skills have been selected on the basis that the level of the entry Core Skill would normally be one level below that of the exit Core Skill. The level of the Problem Solving Core Skill has once again been set at Intermediate 2 level because this is regarded as the minimum acceptable level for this Core Skill to enter the HND. As was the case with the HNC no level has been set for the Working with Others Core Skill simply because there are so few opportunities to develop this Core Skill in the HND and there seems no point in creating any artificial barriers to entry to the award.

Development Opportunities

A Core Skills audit was also carried out on all HND Electronics Units for the Problem Solving and Working with Others Core Skills. The results of this audit are shown in Annex 3. As was the case with the HNC Electronics it proved very difficult to align Core Skill opportunities identified in individual Units with the outcomes and performance criteria in the Problem Solving and Working with Others Core Skills Unit specifications. The notable exception to this was in the Electronics: group award Graded Unit 2 specification where strong development opportunities were identified for the Problem Solving Core Skill at Higher. Problem Solving has now been formally validated as a Core Skill at Higher level with the Electronics: Graded Unit 2.

5.5 Graded Unit Assessments

The purpose of the graded Units in HN awards is to assess candidates' ability to apply and integrate knowledge and/or skills developed in individual Units in order to demonstrate that they have achieved the principal aims of the award. Graded Units allow for the grading of candidate achievement.

The HNC Graded Unit, entitled Electronics: group award Graded Unit 1, is a 1 credit Unit levelled at SCQF Level 7. It consists of a three hour examination which must be conducted under controlled, supervised conditions. The examination paper comprises six, 25 mark questions of which the candidate should answer any four. Each question should include a measure of integration from two of the following three Electronic subject areas: Analogue Electronics, Digital Electronics and Electronics and Electrical Principles. The examination paper should also include opportunities to assess core Communication and Mathematics knowledge and skills. For further details please see the Electronics: group award Graded Unit 1 specification in Annex 1.

The HND Graded Unit, entitled Electronics: group award Graded Unit 2, is a 2 credit Unit levelled at SCQF Level 8. The Graded Unit specification is modelled closely on the current 2 credit Engineering Project Unit. The Graded Unit consists of a Project (Practical Assignment) which must involve the construction of some form of product (either hardware, hardware and software or software). Where the product is only software, the candidate must demonstrate that the software can drive a piece of hardware. While the Graded Unit involves a practical electronics project, drawing from one or more technical areas, it also provides opportunities to apply and integrate non-technical knowledge and skills. Thus, the Graded Unit provides candidates with opportunities to develop and integrate skills in such areas as project planning and management, investigation, practical electronic skills, developing and testing systems, oral and written communication and evaluation. Candidates must prepare a written report and undertake an oral presentation as part of the Graded Unit. For further details please see the Electronics: group award Graded Unit 2 specification in Annex 2.

6 APPROACHES TO DELIVERY AND ASSESSMENT

6.1 Content and Context

Throughout the design and development of the HNC and HND Electronics awards a high priority was placed on producing awards that allow candidates to develop appropriate technical and practical skills. As noted earlier, it is not possible to quantify such technical and practice skills in exact detail. However, the best way to prepare candidates to meet the changing technical and practical requirements of the modern Electronics industry is to ensure candidates have a solid foundation of theory and practical upon which they can build new knowledge, understanding and skills. Thus, the Principles/Technology section of the HNC Electronics contains fundamental studies in Analogue Electronics, Digital Electronics, Electrical Principles and Engineering Programming. The HND Electronics Principles/Technology section builds on and extends these studies. A good grasp of mathematics is essential to the understanding of Electronics. The Electronics Units are therefore underpinned by the inclusion of a core Mathematics Unit in the HNC and two core Mathematics Units in the HND.

The optional sections of both the HNC and HND Electronics provide candidates with the opportunity to specialise in technical and/or non-technical subjects. In line with normal good practice centres are encouraged to advise candidates to choose those options that best meet their future career and educational aspirations.

The two new awards also contain opportunities for candidates to develop a range of related skills which would make the holder of the award better prepared for employment and/or degree studies. For example, the Communication: Practical Skills Unit has been included within the mandatory cores of both HNC and HND awards to provide candidates with the opportunity to develop their written and group discussion skills about complex vocational issues.

Whilst a discrete Information Technology Unit is no longer included within the HNC mandatory section centres will still have the opportunity to access such a Unit via the optional section of the HNC (Information Technology: Applications Software 1). Even where centres choose not to select this Unit from the optional section there are a number of opportunities to develop Information Technology knowledge and skills within individual Electronics Unit (see Annex 3). The Information Technology: Applications Software 1 Unit has been included within the core of the HND to allow centres to concentrate on business applications, such as word processing, spreadsheets, databases, or engineering specific applications or a combination of the two.

The Business Awareness and Continuing Professional Development Unit, in the core of the HND Electronics focuses on two areas considered important to working in the modern electronics industry: namely the external and internal factors that affect business performance and the need for continuing learning and development if candidates are to have sustainable and rewarding employment in the future.

6.2 Delivery

The new HNC and HND Electronics awards can be delivered by the following modes of delivery

- ◆ full-time,
- ◆ block-release
- ◆ part-time day
- ◆ part-time evening basis

In timetabling the two new awards, centre staff should take account of information contained in the Recommended Prior Knowledge and Skills statement in Unit specifications in sequencing the delivery of Units. For example, the Single Phase AC Circuits Unit would normally be delivered before the Electrical Networks and Resonance. Examples of full-time HNC Electronics, part-time HNC Electronics and 2nd Year HND Electronics timetables are shown in Annex 4. Each of these timetables assumes a semester length of 20 weeks with each period of study lasting two hours.

One of the key features of the new awards is the reduction in the time candidates have to spend on summative Unit assessment. This should provide lecturers with more time to deliver Units. Lecturers are encouraged, in particular, to use this additional time to reinforce learning in core electronic principles and technologies and enhance the development of candidates' practical electronics skills.

Lecturers may use a variety of teaching and learning approaches in delivering the Units. These may include lecturing, group work, laboratory and practical work, computer simulation (using appropriate electronic packages), project work and case studies. The use of open and distance learning and on-line materials may help to supplement and support the learning that takes place in the classroom, laboratory or workshop.

Industrial visits are encouraged wherever possible to provide 'real life' industrial examples of the application of the theory and practice learnt in the classroom, laboratory or workshop.

Computer simulation, such as electronic design and implementation software, plays a very important role in the modern electronics industry. The use of computer simulation wherever appropriate is recommended but not at the expense of candidates doing practical work. It is very important that candidates get as much exposure as possible to practical electronic hand skills, the use of electronic test equipment and other practical electronic activities if they are to be suitably prepared to work in industry.

Lecturers should also seek opportunities to integrate Core Skills within their teaching and learning programmes. Such opportunities may include the following:

- ◆ giving candidates opportunities to give full answers to questions asked by the lecturer
- ◆ correcting poor English in written responses
- ◆ allowing candidates to develop their communication skills in group work activities
- ◆ reinforcing numeracy and mathematical skills when teaching electronic and electrical principles topics
- ◆ reinforcing information technology skills when delivering high level language or assembly language Units and when using computer simulation
- ◆ developing problem solving skills by providing candidates with ranges of increasingly difficult problems to solve
- ◆ developing team working and team leadership skills through group and project work

6.3 Assessment

A key design feature of the new awards was to ensure an appropriate assessment strategy was in place for the HNC and HND. The strategy is shown below:

Aims

To ensure that:

- (1) consistent, rigorous and efficient approaches are adopted for the development and administration of HN Engineering assessment instruments at both Unit and Graded Unit levels, which satisfy nationally agreed standards.
- (2) the assessment load on students and staff is sensible and assessment does not unduly detract from teaching and learning.
- (3) as far as possible reliable and rigorous moderation processes are put in place in order to ensure that consistent national standards are achieved for HN Engineering assessments

Objectives

Listed below are the measures that have been put in place to meet the aims:

- 1 Develop nationally at least one assessment exemplar pack for each mandatory Unit, which clearly sets out the standards of assessment expected in the Unit.
- 2 Adopt a holistic approach to Unit assessment. The implications of this are as follows:
 - (i) Assessment instruments will normally be designed only to sample knowledge and skills in a Unit (this is consistent with the new HN Unit format)
 - (ii) A Unit assessment strategy will be adopted, where possible, to produce a single assessment instrument for the whole Unit. Where this is not possible the assessment strategy will seek to ensure that the minimum number of assessment instruments required is consistent with maintaining agreed national standards.
- 3 Whilst not seeking to be entirely prescriptive with regard to the time spent on assessment in each HN Unit, over assessment should be avoided if the following guidelines are adopted for the maximum time spent on an HN Unit assessment:
 - (i) One and a half hours per Unit credit for HN Units at SCQF levels 6 and 7
 - (ii) Two hours per Unit credit for HN Units at SCQF level 8
- 4 Produce assessment exemplar packs for the two Graded Units. For the Graded Unit examination produce an exemplar exam paper to show the standards expected in such a paper. Likewise, for the 2 credit Graded Unit Electronics Project produce a set of materials which clearly set out the standards of candidate response required to achieve a Grade A and a Grade C.
- 5 Actively encourage colleges to work in partnership in producing Graded Unit assessment materials, which meet nationally agreed standards reducing, in turn, the workload on staff in individual colleges.
- 6 Ensure that consistent and rigorous internal and external moderation procedures operate through both HN Unit level and Graded Unit processes. This places a clear responsibility both on centres and the SQA.

As far as has been practical the above objectives have been adhered to when developing assessment exemplar and Graded Unit materials.

Assessment Exemplar Materials

Assessment exemplar packs have been produced for the following Units and Graded Units as shown in the list below:

- ◆ Active Electronic Circuits
- ◆ Analogue Electronic Principles
- ◆ Applications of Programmable Logic Controllers
- ◆ Business Awareness and Continuing Professional Development
- ◆ Combinational Logic
- ◆ Communication: Practical Skills (two available — generic and contextualised)
- ◆ Transmission Lines and Complex Waves
- ◆ Single Phase AC Circuits
- ◆ Electrical Networks and Resonance
- ◆ Electronic Construction Skills
- ◆ Electronic Testing Skills
- ◆ High Level Engineering Software
- ◆ High Level Language: External I/O Transfer
- ◆ Information Technology: Applications Software 1 (two available — generic and contextualised)
- ◆ Mathematics for Engineering 1: Electronics and Electrical
- ◆ Mathematics for Engineering 2
- ◆ MCU/MPU Assembly Language Programming
- ◆ MCU/MPU I/O Hardware Control
- ◆ MSI Devices
- ◆ Power Supply Circuits
- ◆ Programmable Logic Devices
- ◆ Sequential Logic
- ◆ Telecommunications Fundamentals
- ◆ Electronics: group award Graded Unit 1
- ◆ Electronics: group award Graded Unit 2

Graded Unit Assessment Exemplars

It is recommended that candidates do not sit the Graded Unit examination until the end of the HNC (1st Year of the HND) given the range of Units that it draws from. It is recommended that given the size and complexity of the project, the Graded Unit project is started at the beginning of the second year of the HND.

Formative Assessment

Formative assessment should be used throughout the delivery of Units to reinforce learning, build candidates' confidence and prepare candidates' for summative assessment.

6.4 Re-assessment

The way in which centres reassess candidates is integral to the way they manage the award assessment process as a whole. Reassessment should be subject to rigorous internal moderation in exactly the same way as assessment is.

Candidates may require to be reassessed on only a part of an assessment where their evidence has been generated over a period of time and/or a discrete part of the Unit, such as an Outcome, has been assessed previously. On other occasions it may not be possible to reassess candidates on parts of their performance which are unsatisfactory. Situations where candidates may have to re-do a whole assessment include:

- ◆ assessments which test knowledge and understanding and where it may not be possible to extract some of the items for reassessment purposes
- ◆ where parts of several outcomes are involved
- ◆ where a project has been designed as an integral assessment and where there is a requirement to complete the project as a single complex task

Re-assessment Opportunities

Reassessment should operate in accordance with a centre's assessment policy and the professional judgement of the assessor. SQA advises that there should normally be one, or in exceptional circumstances two, reassessment opportunities. Please refer to the SQA publication *Guide to Assessment and Quality Assurance for Colleges of Further Education*, August 2003 revision.

Developing Alternative Assessments

The design of original assessments should inform the reassessment process to a large extent, as the original determines the type of assessment instruments used and the purpose of the assessment. It is normal practice for centres to build up a bank of assessments which can be used in whole or in part for reassessment purposes.

Assessment writers should always refer to the Unit specification when developing an alternative assessment to ensure that it is of equal demand to the original assessment and that it covers all the necessary criteria. Where candidates have not provided satisfactory evidence for knowledge and/or skills items which have been sampled, they should be reassessed on a different sample.

Re-assessing HN Graded Units

Reassessment of the Electronics: group award Graded Unit 1 should be based on an alternative examination paper. Reassessment of Electronics: group award Graded Unit 2 should normally entail a candidate undertaking a completely new project. Where a candidate marginally fails the Electronics: group award Graded Unit 2 the centre may wish to reassess her/him on that part(s) of the performance which was unsatisfactory. Such reassessment would be at the discretion of the centre and should be subject to rigorous internal moderation.

7 GUIDANCE FOR CENTRES

7.1 Assessment Moderation

All assessment instruments used within the HNC and HND Electronics awards should be internally moderated, including assessment exemplar materials, using appropriate policies within the centre and guidelines provided by SQA. This will ensure the validity and reliability of the instruments of assessment used within the centre.

External moderation will be carried out by SQA to ensure that internal assessment is within the national guidelines for these qualifications.

For further information on internal and external moderation refer to the SQA publication *Guide to Assessment and Quality Assurance for Colleges of Further Education*, August 2003 revision.

7.2 Open and Distance Learning

There are a number of different open and distance learning packages available in the Electronic and Electrical Engineering area. Their relevance/value in new awards has not yet been evaluated.

Advice on the use of open and distance learning is given in individual Unit specifications. However, where it is used with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangements would require to be put in place to ensure that the assessment or assessments were conducted under the conditions specified in the Unit specification. For example, in the case of a Unit which involved a Unit end test a centre would have to make arrangements for the test to be conducted under controlled, supervised conditions. Likewise, where a Unit involved a practical based assessment, a centre would have to make arrangements for candidates to come into the centre to undertake the assessment under the conditions specified in the Unit specification.

It should be noted that the same requirements as specified in the previous paragraph apply where part or all of a Unit is delivered on-line.

For information on normal open learning arrangements, please refer to the SQA guide *Assessment and Quality Assurance of Open and Distance Learning*, SQA 2000.

7.3 Special Needs

The two awards have been designed to ensure that there are no artificial barriers to learning or assessment. Centres should take account of the special needs of individual candidates when planning learning experiences, selecting assessment instruments or considering special alternative Outcomes for Units. SQA is currently reviewing a guidance document on special assessment arrangements. Please contact the Publications Department for further information.

7.4 Credit Transfer Transition Arrangements

A Guide to Credit Transfer Document containing information on credit transfer arrangements between old HN Electronics Units (those developed as part of the 1996 HN Engineering Review) and the new HN Electronic Units (the Units written as part of this development) is included in Annex 5. This document has been designed to make it as straightforward as possible for course admission tutors to work out the level of credit transfer that should be given. The use of this document is illustrated below.

An Example of the use of the Guide to Credit Transfer Document

A candidate has an HNC Engineering: Electronics having successfully achieved the list of Units shown below. She now wishes to study for a new HND Electronics. A course admission tutor has been given the task of determining the level of credit transfer the candidate has towards the HND Electronics.

List of Units successfully achieved as part of the HNC Engineering: Electronics

Unit Number	Unit Title
A6AN 04	Information Technology Applications 2
D5P3 04	Communication: Presenting Complex Communication for Vocational Purposes
BA24 04	Fundamentals of Quality Assurance
D4H7 04	Engineering Project
D4L9 04	Single Phase AC Networks
D4FF 04	Analogue Electronics Devices
D4FH 04	Analogue Circuit Techniques
D4 FR 04	Combinational Logic
D4L7 04	Sequential Logic
D4K1 04	Operational Amplifier
D4G7 04	D/A and A/D Converters
D4H4 04	Electronic Construction Skills
D4H2 04	Electronic Testing Skills
D4JH 04	Mathematics for Engineering

Credit Transfer Available to Candidate (using Credit Transfer Document)

Old Unit Title	New Unit Title	Credit Value	Status (Full, Partial or No Credit Transfer)
Information Technology Applications 2	Information Technology: Applications Software 1	1	Full
Communication: Presenting Complex Communication for Vocational Purposes	Communication: Practical Skills	1	Full
Fundamentals of Quality Assurance			None

Old Unit Title	New Unit Title	Credit Value	Status (Full, Partial or No Credit Transfer)
Engineering Project			None*
Single Phase AC Networks	Single Phase AC Circuits	1	Full Particularly where a candidate has successfully achieved a number of NQ Electrical Principles Units
Analogue Electronics Devices, Analogue Circuit Techniques, Operational Amplifier	Analogue Electronic Principles, Active Electronic Circuits	3	Full
Combinational Logic, Sequential Logic, D/A and A/D Converters	Combinational Logic, Sequential Logic, MSI Devices	3	Full
Electronic Construction Skills, Electronic Testing Skills	Electronic Construction Skills, Electronic Testing Skills	2	Full
Mathematics for Engineering	Mathematics for Engineering 1: Electronics and Electrical		Partial Outcomes 1 and 2 of Mathematics for Engineering Unit only (although candidate could get full credit if they have analysed trigonometrical functions and their graphs elsewhere)
	Total	11	

It can be seen from the above table that the candidate can obtain 11 credits towards the HND Electronics using credit transfer.

* With reference to the new two credit, Electronics: group award Graded Unit 2 (Electronics Project) the HN Electronics Development Team have taken the view that the old Engineering Project cannot be counted for credit transfer purposes towards the new Graded Unit 2 because it contains no mechanism for grading candidates on the A, B or C scale.

7.5 General Information for Candidates

The following note may be used to provide candidates with general information about the HNC and HND Electronics:

The awards have been designed by an expert team of educators and an industrialist with a view to allowing you to meet the educational requirements to work as an electronics technician. They contain up-to-date and relevant electronics subject content and skills and satisfy the new SQA Higher National Design Principles.

The awards have been designed to give you opportunities to learn and understand the core principles and technologies that underpin Electronics. Learning these will be essential in providing you with a platform for tackling many electronics tasks and in allowing you to develop a more in-depth knowledge of Electronics. At the same time you will have opportunities to develop sound practical electronics construction, testing and project skills which are critical to being a good electronics technician.

As well as studying Electronics subjects you will also take Communication and have the option to take Information Technology as part of the HNC. Good Communication skills are essential to understanding technical material, and in communicating with others whether on an individual basis or when working as part of a team. Information Technology underpins much of the work in Electronics whether this is through computer simulation of electronic circuits or systems or in preparing a written report on the work you have been involved in. Opportunities to develop Information Technology knowledge and skills are also available in a number of Units in the HNC.

The Communication and Information Technology Units are mandatory within the HND Electronics although you will not need to study these Units if you have already done so as part of the HNC. There is an additional mandatory core Unit in the HND Electronics entitled Business Awareness and Continuing Professional Development. This Unit will provide you with an awareness of the business pressures on modern electronics companies and what strategies they are adopting to meet these pressures. This Unit will also provide you with the opportunity to develop your own career and education action plan for the next five years or so.

As already mentioned Electronics is very much about learning and understanding core principles and technologies whilst also doing practical work such as constructing and testing circuits and project work. Thus, whilst taking the HNC and HND Electronics you can anticipate that the teaching and learning approaches adopted by your lecturers will include the following: lecturing, group work, practical electronics work involving basic electronics skills such as soldering, constructing and testing circuits, computer simulation of circuits and systems and project work.

The two awards have been designed to reduce the assessment load so that more time is available for you to learn the electronic principles and technologies and the practical skills that are essential to being a good electronics technician.

You can expect to be assessed at individual Unit level and at qualification level. At Unit level assessment will consist of some form of written end test, or a combination of short written test and practical exercise or a purely practical exercise. Your lecturer should tell you at the start of the Unit what form the Unit assessment will take. In addition to Unit tests there will also be a three hour examination at HNC level and a 2 credit project at HND level. Both these assessments have been designed to allow you to demonstrate your ability to integrate knowledge, understanding and skills learnt in the two awards as a whole. Your performance in these Units will also be graded at A, B or C.

It is recommended that a candidate has one of the following qualifications before entering the HNC or HND Electronics:

- 1 Two Highers from the following list: Electronics, Electrical Engineering, Technological Studies, Physics or Mathematics
- 2 A National Certificate in Electronic Engineering or Electrical Engineering
- 3 Equivalent qualifications or experience to those shown in (1) and (2)

An HNC or HND Electronics no longer satisfies the full academic requirements to become an incorporated engineer (a degree is now required). However, the new HNC and HND Electronics provide a very solid platform for candidates to proceed to the advanced stages of a degree programme in electronics. Ask your lecturer about progression arrangements your college has with any university (ies).

7.6 Relationship to Other Awards

An HNC and HND Electrical Engineering are currently under development. Once these awards are validated, it is anticipated that candidates will have opportunities to transfer a significant number of Units between HNC and HND Electronics and HNC and HND Electrical Engineering and vice versa. More limited opportunities will exist for candidates to transfer Units between HNC and HND Electronics and HNCs and HNDs in Mechanical Engineering, Manufacturing Systems and Fabrication and Welding and vice versa.

7.7 Articulation Arrangements

Good articulation routes have always existed between HNC and HND Electronics awards and degree courses in Electronics. Indications from Higher Education institutions are that good articulation arrangements will continue and are likely to be strengthened by the levelling of HNC and HND of SCQF levels 7 and 8 respectively (broadly equivalent to first and second year degree).

It should be noted that the Mathematics for Engineering 3 has been included in the HND award framework to facilitate progression between the HND and the advanced stages of degree courses.

7.8 History of Change

It is anticipated that changes will take place during the life of the two awards eg additional optional Units, updating Unit specifications, updating articulation arrangements etc. This section of the Arrangements Document will be used to record any such changes.

The updated Arrangements Document will be published on the SQA website and course leaders should ensure they check the Arrangements Document on a six-monthly basis.

Date	Version Number	Author	Description of Change
July 05	02	GO'H	Problem Solving fully embedded.
			Two additional optional Units.
January 2006	02	GO'H	Personal Development Planning Unit added as option

Higher National group award Graded Unit Specification

General Information for centres

This group award Graded Unit has been validated as part of the HNC and HND Electronics awards. Centres are required to develop the assessment instrument in accordance with this validated specification. Centres wishing to use another type of group award Graded Unit or assessment instrument are required to submit proposals detailing the justification for change for validation.

Group award Graded Unit Title: Electronics: Group Award
Graded Unit 1

Group award Graded Unit Code: DG2T 34

Type of group award Graded Unit: Examination

Assessment Instrument: Closed book examination

Credit value: 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 group award Graded Unit is designed to provide evidence that the candidate has achieved the following principal aims of the HNC and HND Electronics.

- Develop knowledge, understanding and skills in a range of core electrical, analogue electronics and digital electronics principles and technologies at Higher National level (these studies in core electronic and electrical principles are underpinned by a mandatory unit in Mathematics).
- Develop candidates' ability to apply analysis and synthesis skills to the solution of electronic problems.
- Develop learning and transferable skills (including Core Skills).
- Develop a range of Communication knowledge and skills relevant to the needs of electronic incorporated engineers.

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 group award Graded Unit:

- Analogue Electronic Principles
- Combinational Logic
- Sequential Logic
- Single Phase A.C. Circuits
- Mathematics for Engineering 1: Electronics and Electrical
- Communication: Practical Skills

General Information for centres (cont)

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

Assessment: This examination-based group award Graded Unit is Electronics: Group Award 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:	DG2T 34
Graded Unit Title:	Electronics: Group Award Graded Unit 1
Date of publication:	June 2004
Source:	SQA

Special Needs: This Group Award 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 group award Graded Unit specification: Instructions for designing the assessment task and assessing candidates

Group award Graded Unit Title: Electronics: Group Award Graded Unit 1

Conditions of Assessment

The assessment is based on an examination paper consisting of six, 25 mark questions with candidates being allowed to answer any four out of the six questions. The written examination paper should last three hours.

The examination should be conducted under closed book conditions but with candidates being allowed access to a standard formula sheet and appropriate data sheets.

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.

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 group award 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.

Topic	Level of knowledge/ understanding	Weighting/ Mark Allocation
Analogue Electronic Principles	Describe applications of semiconductor diodes Describe transistor applications Describe linear operational amplifier applications Describe Silicon Controlled Rectifier (SCR) applications Describe applications of specialised analogue Integrated Circuits.	30%

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

Combinational Logic	Draw truth tables for common logic gates and derive combinational logic expressions in various forms Interpret TTL and CMOS data sheets and be able to use these devices in digital systems.	30%
Sequential Logic	Describe the operation of sequential logic devices	
Single Phase A.C. Circuits	Solve single-phase ac circuit problems using complex notation	20%
Mathematics for Engineering 1: Electronics and Electrical	Apply algebraic techniques to manipulate expressions and solve equations commonly found in engineering Carry out operations involving complex numbers Analyse trigonometric functions and their graphs	10%
Communication: Practical Skills	Respond to written information on a complex vocational issue Produce written information in a prescribed format on a complex vocational issue	10%

The structure of each question should normally conform to the following marking structure:

Knowledge and understanding	5 marks
Applications	10 marks
Analysis and synthesis	10 marks

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

The structure of the paper should follow the following format:

2 questions majoring on Analogue with a little Principles

2 questions majoring on Digital with a little Analogue

2 questions majoring on Principles with a little Analogue or even Digital

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 group award Graded Unit based on the following grade boundaries:

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

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

Guidance to Centres

Centres are encouraged to study this Electronics: Group Award Graded Unit 1 specification and the associated specimen paper carefully before embarking on the writing of any HNC Electronics Examination paper.

The main purpose of the Electronics: Group Award Graded Unit 1 specification is to assess candidates' abilities to solve problems which involve the integration of some knowledge and skills from one of the three main Electronics areas of Analogue Electronics, Digital Electronics and Electrical Principles into another of these areas. In addition, limited opportunities are also provided to assess some Communication and Mathematical skills, although any such assessment of these skills should be set within the context of Electronics.

Integration involves an ability to apply knowledge, understanding and skills obtained in one subject area to another area. For example, it is well known that good knowledge and skills in Electrical Principles is essential when solving many problems in Analogue Electronics. Likewise, a knowledge and understanding of Analogue Electronics is very important when delivering and assessing Digital Electronics. This does not mean that the Electronics: Group Award Graded Unit 1 Examination should not involve some recall of knowledge only that this should be limited to avoid duplication with what is being assessed in individual units.

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. Yet, in the Electronics industry an ability to apply knowledge, understanding and skills from different subject areas to solve complex electronics problems is a vital skill. The Electronics: Group Award Graded Unit 1 provides opportunities to develop these critical transferability and problem solving skills. The Unit, as well as consisting of a 3-hour Examination, includes a notional study time of 37 hours to allow candidates to practice solving problems which involve the transfer of knowledge, understanding and skills in Electrical Principles to Analogue and/or Digital Electronics, or Analogue Electronics to Digital Electronics and/or Electrical Principles and so on. Centres should use a range of formative assessments to support such skills development.

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

Higher National group award Graded Unit Specification

General Information for Centres

This group award Graded Unit has been validated as part of the HNC and HND Electronics awards. Centres are required to develop the assessment instrument in accordance with this validated specification. Centres wishing to use another type of group award Graded Unit or assessment instrument are required to submit proposals detailing the justification for change for validation.

Group Award Graded Unit Title: Electronics: Group Award
Graded Unit 2

Group Award Graded Unit Code: DG2V 35

Type of group award Graded Unit: Project

Assessment Instrument: Practical Assignment

Credit value: 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 group award Graded Unit is designed to provide evidence that the candidate has achieved the following principal aims of the HNC and HND Electronics awards:

- Develop an ability to apply analysis and synthesis skills to the solution of electronic problems
- Develop learning and transferable skills (including Core Skills)
- Develop knowledge and skills in planning and project management
- Develop investigation skills
- Develop a range of Communication and Information Technology knowledge and skills relevant to the needs of electronic incorporated engineers
- Develop knowledge, understanding and skills in a range of core electrical, analogue electronics and digital electronics principles and technologies at Higher National level
- Develop knowledge, understanding and skills to apply a structured approach to high level language and assembly language programming. Use the programming skills developed to control the flow of and process data in an appropriate target system such as a Microprocessor or Microcontroller
- Develop a range of practical electronic construction and testing skills
- Allow for further specialisation within the following subject areas: printed circuit board design, manufacture and test, electronic fault finding, Programmable Logic Controllers, Telecommunications; implementing small local area networks; microprocessor and microcontroller technology, signal processing and conditioning, systems integration, 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 group award Graded Unit:

- ◆ Communication: Practical Skills
- ◆ Mathematics for Engineering 1: Electronics and Electrical
- ◆ Single Phase A.C. Circuits
- ◆ Analogue Electronic Principles
- ◆ Combinational Logic
- ◆ Sequential Logic
- ◆ High Level Engineering Software or MCU/MPU Assembly Language Programming
- ◆ Electronic Testing Skills

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 Electronics. As it is anticipated that centres will deliver the HNC Electronics as a part of the first year of the HND it is recommended that candidates have completed all HNC Electronics units before commencing the project.

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

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

Assessment: This group award Graded Unit will be assessed by the use of a practical assignment (electronics project). 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.

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:	DG2V 35
Graded Unit Title:	Electronics: Group Award Graded Unit 2
Date of publication:	June 2004
Source:	SQA

Special Needs: This Group Award 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 group award Graded Unit Specification: Instructions for designing the assessment task and assessing candidates

Group award Graded Unit Title: Electronics: Group Award Graded Unit 2

Conditions of Assessment

The candidate should be given a date for completion of the electronics 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 group award 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 group award Graded Unit has been designed to cover

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

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:

It should be noted that in the following table the term ‘product’ could mean a piece of electronic hardware, a combination of electronic hardware and software or a piece of software only. In the case where the project involves developing only software the candidate must demonstrate that the software can drive some electronic hardware.

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 Electronics 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 15.

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 group award Graded Unit.

Project Stage	Minimum Evidence Requirements
Stage 1 — Planning	<p><i>The candidate must achieve all of the minimum evidence specified below in order to pass the Planning stage.</i></p> <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 different solutions • Justification of chosen solution • Verification Strategy • Maintenance of log book
Stage 2 — Developing	<p><i>The candidate must achieve all of the minimum evidence specified below in order to pass the Developing stage</i></p> <ul style="list-style-type: none"> • Practical output from the project (e.g. hardware, software or hardware plus software) • Written records of processes underpinning the project such as: <ul style="list-style-type: none"> • Log book • Progress reports • Test results as part of the Verification Strategy

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

Stage 3 — Evaluating	<p><i>The candidate must achieve all of the minimum evidence specified above in order to pass the Evaluating stage.</i></p> <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 results• 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• Identification of any knowledge and skills which have been gained by the candidate
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Scottish Qualifications Authority

Electronics: Group Award Graded Unit 2 (Project)

Grading Unit Checklist

Centre Name: -----

Centre Number: -----

Candidate Name: -----

Candidate 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

Core Skills Audit of HNC and HND Electronics Units

Core Skills Signposting

There may be opportunities to gather evidence towards Core Skills or Core Skills components, however there is only automatic certification as detailed below:

Core Skill	Component	HN Unit	Level	Mandatory/ Optional
Communication	Oral Communication	Embedded in D77G 34 Communication: Practical Skills	Higher	Mandatory HNC and HND
	Written Communication	Embedded in D77G 34 Communication: Practical Skills	Higher	Mandatory HNC and HND
Numeracy	Using Graphical Information	Mathematics for Engineering 1: Electronics and Electrical. Electronics Units within mandatory section of the awards	development opportunities	
	Using Number	Mathematics for Engineering 1: Electronics and Electrical	Higher	Mandatory HNC and HND
Information Technology	Using Information Technology	Embedded in D75X 34 Information Technology: Applications Software 1	Higher	Optional in HNC Mandatory in HND
		High level Engineering Software, MCU/MPU Assembly Language Programming, High Level Language: External I/O Transfer, MCU/MPU I/O Hardware Control, Applications of Programmable Logic Controllers	development opportunities	
Working with Others		Embedded in D77H 34 Experience 2	Higher	Optional in HNC and HND

Core Skills Audit of HNC and HND Electronics Units

Using Information Technology (Higher) — Applicable to the HNC Electronics

Outcome — Use an IT system effectively

Performance Criteria

- a — Operation of hardware devices is efficient.
- b — Operation of the system is responsible and considerate of other users.
- c — Problems are identified and corrected effectively.
- d — Security and management of data is effective and efficient.
- e — Use of operating systems is effective.

Unit	Knowledge/Skills/Evidence	Developed/ Assessed	a	b	c	d	e
High Level Engineering Software	<p>p.c. a – Candidates will have opportunities to evidence the efficient use of the following hardware devices: keyboard, mouse, VDU, disk drive and printer.</p> <p>p.c. b — Candidates would normally be taught and evidence responsible and considerate operation of a system as part of the delivery of this unit.</p> <p>p.c. c – Candidates will have opportunities to engage in problem identification and correction during the development of different pieces of software but particularly at the compiling and debugging and program verification stages.</p> <p>p.c. d— Candidates would normally be taught and evidence the secure and manageable use of data (eg backing-up files, passwords, virus checks etc) in effective and efficient ways as part of the delivery of this unit.</p> <p>p.c. e — Candidates will have opportunities to demonstrate effective use of OS as part of a pc, development system or microcontroller.</p>	Developed	√	√	√	√	√

Using Information Technology (Higher) — Applicable to the HNC Electronics

Outcome — Use software in an unfamiliar context to produce complex information

Performance Criteria

- a — The analysis of the information requirements is correct.
- b — The design of the solution is effective.
- c — The selection of the application packages is appropriate.
- d — The data components are assembled and integrated.
- e — The output format is appropriate to the purpose and audience.

Unit	Knowledge/Skills/Evidence	Developed/ Assessed	a	b	c	d	e
High Level Engineering Software	<p>p.c. a — Candidates have opportunities to evidence good analysis skills as part of the software user requirement and analysis and problem specifications stages.</p> <p>p.c. b — Candidates will have appropriate opportunities to evidence effective software solutions as part of program testing and verification stages</p> <p>p.c. c — Candidates may have opportunities to evidence this in, for example, the choice of high level language and word-processing package they use.</p> <p>p.c. d — Candidates will have opportunities to evidence this p.c. as part of their detailed design, particularly with regard to the design and assembly of individual software modules.</p> <p>p.c. e — Candidates will have opportunities to evidence the appropriateness of output formats in their logbooks and /or portfolios and particularly via the documentation requirements in Outcome 4.</p>	Developed	√	√		√	√

Using Information Technology (Higher) — Applicable to the HNC Electronics

Outcome — Use an IT system effectively

Performance Criteria

- a — Operation of hardware devices is efficient.
- b — Operation of the system is responsible and considerate of other users.
- c — Problems are identified and corrected effectively.
- d — Security and management of data is effective and efficient.
- e — Use of operating systems is effective.

Unit	Knowledge/Skills/Evidence	Developed/ Assessed	a	b	c	d	e
MCU/MPU Assembly Language Programming	<p>p.c. a — Candidates will have opportunities to evidence the efficient use of the following hardware devices: keyboard, mouse, VDU, disk drive and printer.</p> <p>p.c. b — Candidates would normally be taught and evidence responsible and considerate operation of a system as part of the delivery of this unit.</p> <p>p.c. c — Candidates will have opportunities to engage in problem identification and correction during the development of different pieces of software but particularly when debugging software on a target system.</p> <p>p.c. d — Candidates would normally be taught and evidence the secure and manageable use of data (eg backing-up files, passwords etc) in effective and efficient ways as part of the delivery of this unit.</p> <p>p.c. e — Candidates will have opportunities to demonstrate effective use of OS on target pc, microprocessor or microcontroller system.</p>	Developed	√	√	√	√	√

Using Information Technology (Higher) — Applicable to the HNC Electronics

Outcome — Use software in an unfamiliar context to produce complex information

Performance Criteria

- a — The analysis of the information requirements is correct.
- b — The design of the solution is effective.
- c — The selection of the application packages is appropriate.
- d — The data components are assembled and integrated.
- e — The output format is appropriate to the purpose and audience.

Unit	Knowledge/Skills/Evidence	Developed/ Assessed	a	b	c	d	e
MCU/MPU Assembly Language System	<p>p.c. a — Candidates have some opportunities to evidence analysis skills as part of analysing the data flow and programming requirements associated with the software exercises they undertake in this unit.</p> <p>p.c. b — Candidates will have appropriate opportunities to evidence effective software solutions particularly as part of programme debugging and verification.</p> <p>p.c. c — It is unlikely that candidates will have a sufficiently large range of software to choose from to regard this as a development opportunity.</p> <p>p.c. d — Candidates will have opportunities to evidence this p.c. as part of their detailed software design, particularly with regard to the use of subroutines in Outcome 4.</p> <p>p.c. e — Candidates will have opportunities to evidence the appropriateness of output formats in their logbooks and/or portfolios and reports they have to be generate for Outcomes 2, 3 and 4.</p>	Developed	√	√		√	√

Using Information Technology (Higher) — Applicable to the HNC Electronics

Outcome — Use an IT system effectively

Performance Criteria

- a — Operation of hardware devices is efficient.
- b — Operation of the system is responsible and considerate of other users.
- c — Problems are identified and corrected effectively.
- d — Security and management of data is effective and efficient.
- e — Use of operating systems is effective.

Unit	Knowledge/Skills/Evidence	Developed/ Assessed	a	b	c	d	e
Applications of Programmable Logic Controllers	<p>p.c. a — Candidates will have opportunities to evidence the efficient use of the following hardware devices: keyboard, mouse, VDU, disk drive and printer particularly if they program a PLC via a p.c.</p> <p>p.c. b — Candidates would normally be taught and evidence responsible and considerate operation of a system as part of the delivery of this unit.</p> <p>p.c. c — Candidates will have opportunities to engage in problem identification and correction during the programming, testing and verification of the PLC software in Outcome 3.</p> <p>p.c. d — Candidates would normally be taught and evidence the secure and manageable use of data in effective and efficient ways as part of the delivery of this unit.</p> <p>p.c. e — Candidates will have opportunities to demonstrate effective use of OS as part of the PLC software assignment in Outcome 3.</p>	Developed	√	√	√	√	√

Using Information Technology (Higher) — Applicable to the HNC Electronics

Outcome — Use software in an unfamiliar context to produce complex information

Performance Criteria

- a — The analysis of the information requirements is correct.
- b — The design of the solution is effective.
- c — The selection of the application packages is appropriate.
- d — The data components are assembled and integrated.
- e — The output format is appropriate to the purpose and audience.

Unit	Knowledge/Skills/Evidence	Developed/ Assessed	a	b	c	d	e
Applications of Programmable Logic Controllers	<p>p.c. a — Candidates have opportunities to evidence good analysis skills as part of the programming, editing, testing and verification PLC assignment in Outcome 3 .</p> <p>p.c. b — Candidates will have appropriate opportunities to evidence effective software solutions as part of the programming, testing and verification stages of the assignment in Outcome 3.</p> <p>p.c. c — Candidates may have opportunities to evidence this in, for example, the choice of PLC system they use to do the assignment in Outcome 3.</p> <p>p.c. d — Candidates will have opportunities to evidence this p.c. as part of their detailed design, particularly with regard to the design and assembly of individual parts of their PLC programme for the assignment in Outcome 3.</p> <p>p.c. e — Candidates will have opportunities to evidence the appropriateness of output formats in the report required for Outcome 3.</p>	Developed	√	√		√	√

Using Information Technology (Higher) — Applicable to the HNC Electronics

Outcome — Carry out searches to extract and present relevant information

Performance Criteria

- a — Selection of data sources is effective.
- b — Search strategy selected is efficient and effective.
- c — Data is correctly extracted using several selection criteria.
- d — Information is presented effectively.

Unit	Knowledge/Skills/Evidence	Developed/ Assessed	a	b	c	d
High Level Engineering Software	None					
MCU/MPU Assembly Language System	None					
Applications of Programmable Logic Controllers	None					

Examples of HNC and HND Electronics Timetables

Examples of HNC Electronics Timetables

It should be noted that in all the following timetables each semester is 20 weeks long and each period is 2 hours in duration.

Full – Time (1 – Year, 15 credits)

Semester 1

Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8
Mathematics for Engineering 1: Electronics and Electrical	Single Phase AC Circuits	Analogue Electronic Principles	Combinational Logic	Information Technology: Applications Software 1	Electronic Testing Skills	Communication: Practical Skills	

Semester 2

Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8
Mathematics for Engineering 2	Electrical Networks and Resonance	Analogue Electronic Principles	Sequential Logic	High Level Engineering Software or MCU/MPU Assembly Language Programming	Electronic Construction Skills	Applications of Programmable Logic Controllers	Electronics: group award Graded Unit 1

Possible HNC Electronics Timetables

Day-Release (2 – Year, 12 credits)

Year 1, Semester 1

Period 1	Period 2	Period 3
Mathematics for Engineering 1: Electronics and Electrical	Electronic Testing Skills	Analogue Electronic Principles

Year 1, Semester 2

Period 1	Period 2	Period 3
Single Phase AC Circuits	Combinational Logic	Analogue Electronic Principles

Year 2, Semester 1

Period 1	Period 2	Period 3
Communication: Practical Skills	Sequential Logic	High Level Engineering Software or MCU/MPU Assembly Language Programming

Year 2, Semester 2

Period 1	Period 2	Period 3
Implementing Small Local Area Networks	Applications of Programmable Logic Controllers	Electronics: group award Graded Unit 1

An Example of a 2nd Year HND Electronics Timetable

(This timetable assumes that the full-time HNC timetable shown above is also the first year HND Electronics timetable)

Semester 1

Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8
Mathematics for Engineering 3	Active Electronics Circuit	Power Supply Circuits	MSI Devices	High Level Language: External I/O Transfer or MCU/MPU I/O Hardware Control	Printed Circuit Board Design, Manufacture and Test	Business Awareness and Continuing Professional Development	Electronics: Group Award Graded Unit 2

Semester 2

Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8
Mathematics for Engineering 3	Telecommunications Fundamentals		Programmable Logic Devices	Microprocessor and Microcontroller Technology	Electronic Fault Finding	Systems Integration	Electronics: group award Graded Unit 2

Guide to Credit Transfer Document

SCOTTISH QUALIFICATIONS AUTHORITY

HNC and HND in ELECTRONICS

A GUIDE TO CREDIT TRANSFER

ARRANGEMENTS BETWEEN

OLD AND NEW

HN ELECTRONICS UNITS

Introduction

This Guide has been prepared in order to clarify credit transfer arrangements between old HN Electronics units (those units developed as part of the 1996 HN Engineering validation process and called old units from now on) and new HN Electronics units (units developed under the new HN Design Principles and called new units from now on). Course admission tutors may use the Guide when advising candidates who have achieved some old HN Electronics units or an old HNC Engineering: Electronics how much credit transfer they have towards the new HNC and HND Electronics

In developing this Guide, a pragmatic view was taken towards the interpretation of credit transfer. In practice, credit transfer has not been interpreted in terms of a strict 100% content match between old and new Units, but rather that the content and standard of the two units are broadly equivalent. It is hoped that this approach will help to ease credit transfer between old and new HN Electronic awards for a significant number candidates

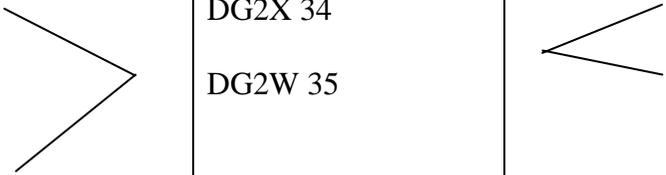
The Guide comprises of two parts. In the first part a series of tables are included showing one for one unit replacements between units in the old and new Frameworks. These tables also show where a cluster of units in the old Framework are a direct replacement for a cluster of units in the new Framework. These clusters are indicated by > and occur because in some cases the unit content and standards across, say, three old HN Units is broadly comparable to three new HN units.

The second part of the Guide gives information, also in tabular format, of old units which have some overlapping content with new units or in a few cases where the content of old units do not overlap at all with new units.

To assist the reader to use the Guide, old and new units have been categorised under the following headings:

- Analogue Electronics
- Application of PLCs
- Communication
- Digital Electronics
- Electrical Principles
- Engineering Applications
- Engineering Programming
- Information Technology
- Mathematics
- Telecommunication

Part 1: Information on direct replacements of units on a one to one or cluster basis

Old Unit Nos.	Old Unit Titles	New Unit Nos.	New Unit Titles
Analogue Electronics			
D4FH 04 D4FF 04 D4KI 04 D4KG 04	Analogue Circuit Techniques Analogue Electronic Devices Operational Amplifiers Power Supply Circuits	DG2X 34 DG2W 35 DG50 35	 Analogue Electronic Principles Active Electronic Circuits Power Supply Circuits
Applications of PLCs			
D4FJ 04	Application of Programmable Logic Controllers	DG31 34	Applications of Programmable Logic Controllers
Communication			
D5P3 04	Communication: Presenting Complex Communication for Vocational Purposes	D77G 34	Communication: Practical Skills

Old Unit Nos.	Old Unit Titles	New Unit Nos.	New Unit Titles
Digital Electronics			
D4FR 04	Combinational Logic	DG3C 34	Combinational Logic
D4L7 04	Sequential Logic	DG53 34	Sequential Logic
D4G7 04	D/A and A/D Converters	DG4Y 35	MSI Devices
D4FR 04	Combinational Logic	DG3C 34	Combinational Logic
D4L7 04	Sequential Logic	DG53 34	Sequential Logic
D4KY 04	Programmable Logic Devices	DG52 35	Programmable Logic Devices
D4HN 04	Field Programmable Gate Arrays?	DG3P 35	Field Programmable Gate Arrays
Electrical Principles			
D4L9 09	Single Phase AC Networks	DG54 34	Single Phase AC Circuits
D4GN 04	Electrical Networks	DG3G 34	Electrical Networks and Resonance

Old Unit Nos.	Old Unit Titles	New Unit Nos.	New Unit Titles
Engineering Applications			
D4H4 04	Electronic Construction Skills	DG3H 34	Electronic Construction Skills
D4H2 04	Electronic Testing Skills	DG3N 34	Electronic Testing Skills
D4GY 04	Electronic Fault Finding	DG3J 35	Electronic Fault Finding
Engineering Programming			
A4RR 04	Engineering Programming	DG58 34	High Level Engineering Software
D4HA 04	Engineering Programming: Assembly Language	DG59 34	MCU/MPU Assembly Language Programming
D4H9 04	Engineering Programming: I/O Hardware Control	DG5C 35	MCU/MPU I/O Hardware Control

Old Unit No.	Old Unit Titles	New Unit No.	New Unit Titles
Information Technology			
A6AM 04	Information Technology: Applications 1	D75X 34	Information Technology: Applications Software 1
A6AN 04	Information Technology: Applications 2	D75X 34	Information Technology: Applications Software 1
Mathematics			
D4JB 04	Introductory Mathematics for Engineering	DG4H 33	 Mathematics for Engineering 1: Electronics and Electrical
D4JH 04	Mathematics for Engineering	DG4H 33	
D4JB 04	Introductory Mathematics for Engineering	DG4L 34	 Mathematics for Engineering 2
D4JH 04	Mathematics for Engineering		
A5NK 04	Calculus for Engineering 1		
A5P2 04	Calculus for Engineering 2		

Part 2: Information on units where only some or no overlap of content occurs

Old Unit No.	Old Unit Title	New Unit No.	New Unit Title Replacement	Content which is NOT Covered in New Unit/Comments
Analogue Electronics				
D4FH 04	Analogue Circuit Techniques	DG2W 35	Active Electronic Circuits – Outcomes 1 and 4 only (Negative and Positive Feedback) Analogue Electronic Principles –Outcome 6 only (Use of Specialised Analogue I.C.s)	

Old Unit No.	Old Unit Title	New Unit No.	New Unit Title Replacement	Content which is NOT Covered in New Unit/Comments
D4FF 04	Analogue Electronic Devices	DG2X 34	<p>Analogue Electronic Principles – Outcome 1, Outcome 2 Knowledge and Skills Items (a) and (b) only.</p> <p>Analogue Electronic Principles - Outcome 3 Rectification, clipping and clamping only.</p> <p>Analogue Electronic Principles - Outcome 4 Knowledge and Skills Items (b) and (c).</p>	<p>Not covered in O.3 of Analogue Electronic Principles unit – voltage source, demodulation & opto- coupler.</p> <p>Not covered in O.4 of Analogue Electronic Principles unit – electronic switch, power amplifiers and specialist analogue circuits (long-tailed pair or Darlington pair or cascade amplifier or current mirror).</p>

Old Unit No.	Old Unit Title	New Unit No.	New Unit Title Replacement	Content which is NOT Covered in New Unit/Comments
D4KI 04	Operational Amplifiers	DG2X 34	Analogue Electronic Principles Outcome 2 – Knowledge and Skills Item (c) Operational Amplifiers plus all of Outcome 5 of Analogue Electronic Principles	
Digital Electronics				
D4G7 04	D/A and A/D Converters	DG4Y 35	MSI Devices - Outcomes 1,2 and 4 Knowledge and Skills Items 1 and 2 (Convert digital to analogue signals and convert analogue to digital signals)	MSI Devices Outcome 3 (Explain the operation of specific MSI devices) and Outcome 4 (Build and test a circuit containing an input and output MSI Device) not covered
D4JV 04	Microprocessor System Fundamentals	DG4X 35	Microprocessor and Microcontroller Technology – Outcome 1 Microprocessor part only	Microprocessor and Microcontroller Technology – Outcome 2 (Understand modern memory devices) and Outcome 3 (Program, test and interface a memory device) not covered

Old Unit No.	Old Unit Title	New Unit No.	New Unit Title Replacement	Content which is NOT Covered in New Unit/Comments
D4JT 04	Microcontroller: Architecture, Programming and Applications	DG4X 35	Microprocessor and Microcontroller Technology – Outcome 1 Microcontroller part only	

Old Unit No.	Old Unit Title	New Unit No.	New Unit Title Replacement	Content which is NOT Covered in New Unit/Comments
Electrical Principles				
D4FT 04	Complex Waves and Bridges	DG57 35	Transmission Lines and Complex Waves – Outcome 4 Calculations involving a fundamental and two harmonics in series and parallel circuits	Transmission Lines and Complex Waves – Outcome 4 Selective Resonance and the effects of harmonics on electrical measurements not covered

Old Unit No.	Old Unit Title	New Unit No.	New Unit Title Replacement	Content which is NOT Covered in New Unit/Comments
D5MW 04	DC Networks	DG54 34	Single Phase AC Circuits – Outcome 1 Knowledge and Skills Items Ohm’s Law, circuit reduction techniques as applied to combinations of series/parallel resistors and energy and power covered Electrical Network and Resonance – Outcome 1 Knowledge and Skills Items Kirchhoff’s Laws, Superposition, Thevenin and Norton and Maximum Power Transfer Theorems covered	
D4GP 04	Electrical and Magnetic Fields	DG54 34	Single Phase AC Circuits – Outcome 1 Knowledge and Skills Items electrostatic and magnetic fields and circuit reduction techniques (as applied to combinations of series and parallel capacitors only) covered	

Old Unit No.	Old Unit Title	New Unit No.	New Unit Title Replacement	Content which is NOT Covered in New Unit/Comments
D4GN 04	Electrical Networks	DG3G 34	Electrical Network and Resonance – Outcome 1 Kirchoff’s Laws and Thevenin and Norton’ Theorems covered	Electrical Network and Resonance Outcome 1 - Superposition and Maximum Power Transfer Theorems not covered
D4L9 04	Single Phase AC Networks	DG54 34	<p>Single Phase AC Circuits – Outcome 2</p> <p>Electrical Network and Resonance – Outcome 2 Partial coverage of knowledge and skills items only (i.e. resonant frequency and impedance for series and parallel resonant circuits covered)</p>	<p>Candidates with appropriate NQ Electrical Principles units can gain exemption from Outcome 1 of the Single Phase AC Circuits unit (<i>specify NQ units</i>)</p> <p>Electrical Network and Resonance – Outcome 2 Q-Factor and Bandwidth for series and parallel resonant circuits not covered)</p>

Old Unit No.	Old Unit Title	New Unit No.	New Unit Title Replacement	Content which is NOT Covered in New Unit/Comments
D4LN 04	Transmission Lines	DG57 35	Transmission Lines and Complex Waves – Outcomes 1,2 and 3	
Engineering Applications				
D4HI 04	Electronic Test Instruments	DG3N 34	Electronic Testing Skills – Outcomes 1 and 2. Partial coverage of Outcome 3 (use of logic probes and testing on combinational logic circuits covered)	Electronic Testing Skills – Outcome 3 Specification and use of pulse sources not covered Electronic Testing Skills - Outcome 4 Identification of short circuit and open circuit faults in simple electronic circuits not covered

Old Unit No.	Old Unit Title	New Unit No.	New Unit Title Replacement	Content which is NOT Covered in New Unit/Comments
Engineering Programming				
D4H9 04	Engineering Programming: I/O Hardware Control	DG5C 35	MCU/MPU I/O Hardware Control OR High Level Language: External I/O Transfer (Outcome 1 and only if an A/D or D/A Converter was the subject of parallel transfer of data)	This exemption assumes that the candidate did the Engineering Programming: I/O Hardware Control unit in Assembly Language
D4GJ 04	Digital Signal Processing		No equivalent unit	The new Applications of Signal Processing and Conditioning unit is substantially different in content from the Digital Signal Processing unit

Old Unit No.	Old Unit Title	New Unit No.	New Unit Title Replacement	Content which is NOT Covered in New Unit/Comments
Mathematics				
D4JB 04	Introductory Mathematics for Engineering	DG4H 33 DG4L 34	Mathematics for Engineering 1: Electronics and Electrical — Outcomes 1 and 3 Mathematics for Engineering 2 – Outcome 1 Partial coverage of differentiation and integration of standard functions	

Old Unit No.	Old Unit Title	New Unit No.	New Unit Title Replacement	Content which is NOT Covered in New Unit/Comments
Mathematics for Engineering	D4JH 04	DG4H 33	Mathematics for Engineering 1: Electronics and Electrical — Outcome 1 Partial overage only (changing subject of formulae and solving equations)	Mathematics for Engineering 1: Electronics and Electrical — Outcome 1 Numerical evaluation of expressions, simplification of algebraic expressions, using scientific/engineering notation not covered although candidates who entered directly into the Mathematics for Engineering unit probably covered these subjects at an earlier stage
		DG4H 33	Mathematics for Engineering 1: Electronics and Electrical — Outcome 2	
		DG4L 34	Mathematics for Engineering 2 Outcome 1 – Completion of coverage of differentiation and integration of standard functions	

Old Unit No.	Old Unit Title	New Unit No.	New Unit Title Replacement	Content which is NOT Covered in New Unit/Comments
A5NK 04	Calculus 1 for Engineering		Mathematics for Engineering 2 – Outcome 2 (except for Newton – Raphson Method)	
A5P2 04	Calculus 2 for Engineering	DG4L 34 DG4P 35	Mathematics for Engineering 2 – Outcome 2 (Newton – Raphson Method covered) Mathematics for Engineering 3 – Outcome 3 (except candidate may not have used computer algebra to solve differential equations)	Mathematics for Engineering 3 – Outcome 1 (Matrix Methods) and Outcome 2 (use of computer algebra in differential and integrative techniques not covered)
	Advanced Calculus for Electrical and Electronic Engineering	DG4P 35	Mathematics for Engineering 3 – Outcome 4 (except candidate may not have used computer algebra to solve Fourier problems)	

Old Unit No.	Old Unit Title	New Unit No.	New Unit Title Replacement	Content which is NOT Covered in New Unit/Comments
Telecommunications				
D4LG 04	Telecommunication Fundamentals	DG56 35	Telecommunications Fundamentals	Limited coverage of content in new unit only. Insufficient coverage to grant any credit transfer.