ARRANGEMENTS

HNC Electronics

Group Award Code: G7E8 15

and

HND Electronics

Group Award Code: G7E9 16

An SQA National Development

Publications

A Higher National Development under the new SQA HN Design Rules

HNC Electronics

Group Award Code: G7E8 15

and

HND Electronics

Group Award Code: G7E9 16

Arrangements Document: Version 11 (March 2019)

History of changes

It is anticipated that changes will take place during the life of the qualification and this section will record these changes. This document is the latest version and incorporates the changes summarised below. Centres are advised to check SQA's APS Navigator to confirm they are using the up to date qualification structure.

NOTE: Where a Unit is revised by another Unit:

- No new centres may be approved to offer the Unit which has been revised.
- Centres should only enter candidates for the Unit which has been revised where they are expected to complete the Unit before its finish date.

Version number	Description	Date
11	**Addition of Units:** J0HA 34 Computer Programming and J0H9 34 Data Security added as Optional units to HNC and HND frameworks	29/03/19
10	Revision of Unit: DE1K 33 Workplace Communication in English has been revised by H8T2 33 and finishes on 31/07/2016.	08/05/15
09	Removal of finish date from unit DG4P 35 *Mathematics for Engineering 3.* Addition of Credit Transfer Table *see Page 36.*	15/01/15
08	Revision of Units: D77G 34 Communication: Practical Skills revised by H7MB 34. DG4H 33 Mathematics for Engineering 1: Electronics and Electrical revised by H7K0 33 Engineering Mathematics 1. DG4L 34 Mathematics for Engineering 2 revised by H7K1 34 Engineering Mathematics 2 on HNC and HND frameworks finishing 31/07/2016.	21/10/14
07	Engineering Mathematics 3 (H7K2 34), Engineering Mathematics 4 (H7K3 35) and Engineering Mathematics 5 (H7K4 35) added as optional Units to HND framework.	19/08/14
06	Addition of optional Units: Energy Overview (H4J5 34) and Energy Technologies (H4J6 35).	09/08/13
05	Due to the HN Review the following Units have been amended and recoded: DN42 34, DG2X 34 and DG54 34.	26/04/12
04	FY9R 34, FY9T 34 and FY9E 34 added to optional section of framework.	April 2012

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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

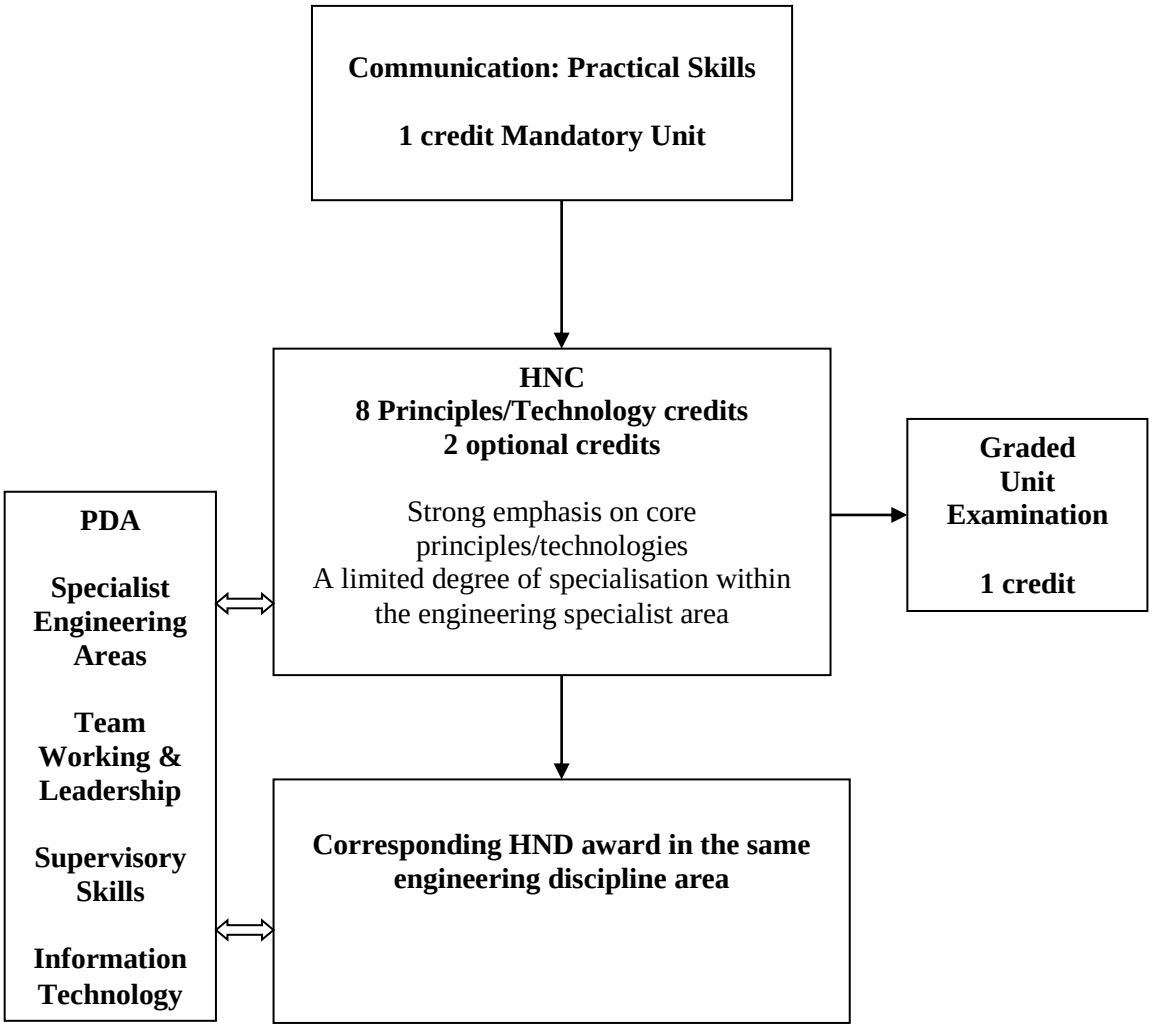

Figure 2.1

HND ENGINEERING FRAMEWORK

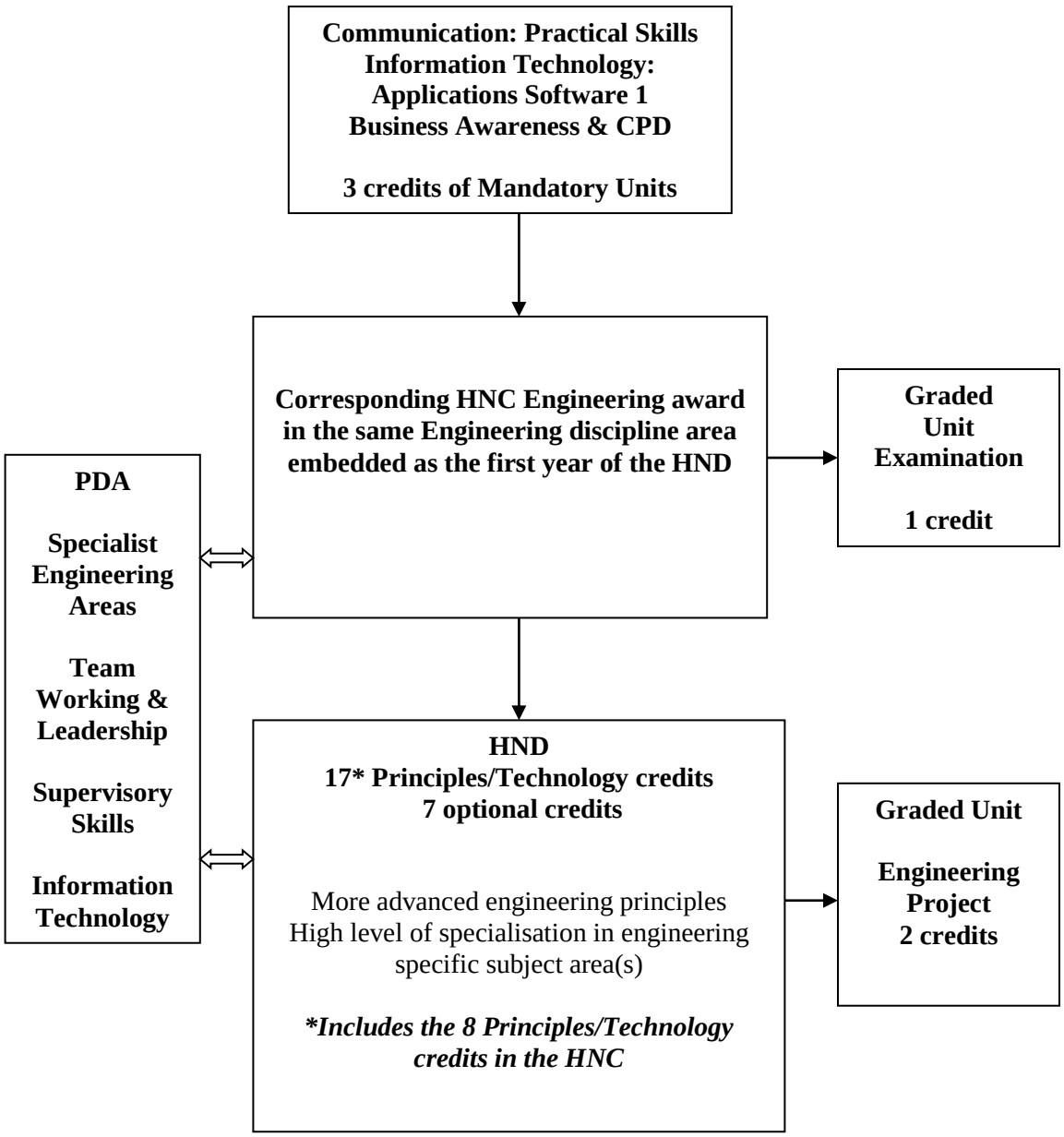

Figure 2.2

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 lead 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	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 Surveys of employers and employees were carried out through Scottish Engineering and the Institute of Incorporated Engineers.
Higher Education	On–going individual meetings with Higher Education staff plus a meeting with university staff to discuss articulation arrangements especially pertaining to Mathematics. Letters of support for articulation between the new HNC and HND Electronics and degree awards.
Professional Bodies	The Chair of the Institute of Incorporated Engineers is a member of the HN Engineering Steering Group and the HN Electronics Development Team. A representative of the Institute of Incorporated Engineers was on the validation panel. Broad support for the two new developments was given.
HN Engineering Steering Group	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.

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
	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.
3.3.1	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.
3.3.2	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.

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	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.
3.2.2 & 3.2.3	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. 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).
3.2.4	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.

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	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. 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.
3.4.1	See comments under 2.2.2 and 2.2.3
3.4.2 & 3.4.3	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.

Aim No.	How it is met in HNC and HND
3.4.4	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. 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.
3.4.5	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.
3.4.6	See 3.2.6

Aim No.	How it is met in HNC and HND
3.4.7	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. 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. 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.
3.4.8	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.

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
H7MB 34*	Communication: Practical Skills	1	7
Principles/Technology Units	**(8 credits)**		
H7K0 33*	Engineering Mathematics 1	1	6
DG54 34 *(finishes 31/07/2013)* **OR** FY9E 34	Single Phase AC Circuits DC AC Principles	1 1	7 7
DG2X 34 *(finishes 31/07/2013)* **OR** FY9T 34	Analogue Electronic Principles Analogue Electronic Principles	2 2	7 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

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
H7K1 34*	Engineering Mathematics 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
DN42 34 *(finishes 31/02/2013)* **OR** FY9R 34	Power Electronics Power Electronics	1 1	7 7

Unit No.	Unit Title	Credit Value	SCQF Level
DN3Y 34	Fundamentals of Control Systems and Transducers	1	7
DE3R 34	Personal Development Planning	1	7
H8T2 33*	Workplace Communication in English	1	6
H4J5 34	Energy Overview	1	7
J0HA 34*	Computer Programming	1	7
J0H9 34*	Data Security	1	7

*Refer to History of Changes for revision changes.

HNC Electronics Structure
Graded Unit (1.0 credit)

Unit No.	Unit Title	Credit Value	SCQF Level
DG2T 34	Electronics: Graded Unit 1 (Examination)	1	7

5.2 HND Electronics Structure
Mandatory Section (23.0 credits required)

Unit No.	Unit Title	Credit Value	SCQF Level
H7MB 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)**		
H7K0 33*	Engineering Mathematics 1	1	6
DG54 34 *(finishes 31/07/2013)*	Single Phase AC Circuits	1	7
OR	**OR**		
FY9E 34	DC and AC Principles	1	7
DG2X 34 *(finishes 31/07/2013)*	Analogue Electronic Principles	2	7
OR	**OR**		
FY9T 34	Analogue Electronic Principles	2	7
DG3C 34	Combinational Logic	1	7
DG53 34	Sequential Logic	1	7
DG58 34	High Level Engineering Software	1	7
OR	**OR**		
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
H7K1 34*	Engineering Mathematics 2	1	7
DG2W 35	Active Electronics Circuit	1	8

Unit No.	Unit Title	Credit Value	SCQF Level
DG50 35	Power Supply Circuits	1	8
DG4Y 35	MSI Devices	1	8
DG52 35	Programmable Logic Devices	1	8
DG5A 35 **OR** DG5C 35	High Level Language: External I/O Transfer **OR** MCU/MPU I/O Hardware Control	1 1	8 8

*Refer to History of Changes for revision changes.

HND Electronics Structure
Optional Section (7.0 credits required)

Unit No.	Unit Title	Credit Value	SCQF Level
DG3P 35	Field Programmable Gate Arrays	1	8
DG4X 35	Microprocessor and Microcontroller Technology	1	8
DG51 34	Printed Circuit Board Design, Manufacture and Test	1	7
DG59 34 **OR** DG58 34	MCU/MPU Assembly Language Programming **OR** High Level Engineering Software	1 1	7 7
DG5C 35 **OR** DG5A 35	MCU/MPU I/O Hardware Control **OR** High Level Language: External I/O Transfer	1 1	8 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 *(finishes 31/07/2013)* FY9R 34	Power Electronics **OR** Power Electronics	1 1	7 7
DN3Y 34	Fundamentals of Control Systems Transducers	1	7
DE3R 34	Personal Development Planning	1	7
H8T2 33* 33	Workplace Communication in English	1	6
DG6E 34 **OR** DG6G 35	Work Role Effectiveness **OR** Work Role Effectiveness	3 3	7 8
H4J5 34	Energy Overview	1	7
H4J6 35	Energy Technologies	1	8

Unit No.	Unit Title	Credit Value	SCQF Level
H7K2 34*	Engineering Mathematics 3	1	7
H7K3 35*	Engineering Mathematics 4	1	8
H7K4 35*	Engineering Mathematics 5	1	8
J0HA 34*	Computer Programming	1	7
J0H9 34*	Data Security	1	7

*Refer to History of Changes for revision changes.

HND Electronics Structure
Graded Unit (3.0 credits)

Unit No.	Unit Title	Credit Value	SCQF Level
DG2T 34	Electronics: Graded Unit 1 (Examination)	1	7
DG2V 35	Electronics: 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 144 SCQF c.p.	Maximum of 128 SCQF c.p. Minimum of 88 SCQF c.p.	**240** **240**	64 SCQF c.p.

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 *(finishes 31/07/2013)*
- DC and AC Principles
- 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 in 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 Disabled candidates and/or those with additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website **www.sqa.org.uk/assessmentarrangements**.

7.2 Internal and external verification

All instruments of assessment used within this/these Group Award(s) should be internally verified, using the appropriate policy within the centre and the guidelines set by SQA.

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

Further information on internal and external verification can be found in *SQA's Guide to Assessment* (**www.sqa.org.uk**)

7.3 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.

7.4 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	Partial
Fundamentals of Quality Assurance			None
Engineering Project			None*
Single Phase AC Networks	Single Phase AC Circuits or DC and AC Principles	1	Full Particularly where a candidates 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

Old Unit Title	New Unit Title	Credit Value	Status (Full, Partial or No Credit Transfer)
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.

New Unit Title	New Unit Code	Old Unit Title	Old Unit Code	Credit Transfer Conditions
Engineering Mathematics 1	H7K0 33	Mathematics for Engineering 1:Electronics and Electrical	DG4H 33	To gain credit transfer to the new unit candidates will have to provide additional evidence relating to functions as specified in the Evidence requirements in respect of the first three knowledge/skills in Outcome 1 and relating to vectors as specified in the first three knowledge/skills in outcome 3.
Engineering Mathematics 1	H7K0 33	Mathematics for Engineering 1:Mechanical and Manufacturing	DT5X 33	To gain credit transfer to the new unit candidates will have to provide additional evidence relating to functions as specified in the Evidence

				requirements in respect of the first three knowledge/skills in Outcome 1 and relating to 3D vectors and complex numbers as specified in the knowledge/skills in outcome 3.
Engineering Mathematics 2	H7K1 34	Mathematics for Engineering 2	DG4L 34	To gain credit transfer to the new unit candidates will have to provide additional evidence relating to trigonometric and hyperbolic functions as specified in the Evidence requirements in respect of Outcome 1.

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 qualification and this section will record these changes. This document is the latest version and incorporates the changes summarised below. Centres are advised to check SQA's APS Navigator to confirm they are using the up to date qualification structure.

NOTE: Where a Unit is revised by another Unit:

- No new centres may be approved to offer the Unit which has been revised.
- Centres should only enter candidates for the Unit which has been revised where they are expected to complete the Unit before its finish date.

Date	Version Number	Description of Change
October 2014	08	**Revision of Units**: D77G 34 *Communication: Practical Skills* revised by H7MB 34. DG4H 33 *Mathematics for Engineering 1: Electronics and Electrical* revised by H7K0 33 *Engineering Mathematics 1*. DG4L 34 *Mathematics for Engineering 2* revised by H7K1 34 *Engineering Mathematics 2* on **HNC** and **HND** Frameworks finishing 31/07/2016.
August 2014	07	*Engineering Mathematics 3* (H7K2 34), *Engineering Mathematics 4* (H7K3 35) and *Engineering Mathematics 5* (H7K4 35) added as optional Units to HND framework.
August 2013	06	**Addition of optional Units:** Energy Overview (H4J5 34) and Energy Technologies (H4J6 35)
March 2012	05	Due to the HN Review the following Units have been amended and recoded: DN42 34, DG2X 34 and DG54 34.
November 2007	04	Graded Unit specifications removed. Partial Communication Core Skills credit for old Communications Unit.
August 2006	03	HNC — three Units added to the Options section. HND — three Units added to the Options section.
January 2006	02	Personal Development Planning Unit added as option
July 2005	02	Problem Solving fully embedded. Two additional optional Units.

8 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.c. a – Candidates will have opportunities to evidence the efficient use of the following hardware devices: keyboard, mouse, VDU, disk drive and printer. 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.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.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.c. e — Candidates will have opportunities to demonstrate effective use of OS as part of a pc, development system or microcontroller.	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.c. a — Candidates have opportunities to evidence good analysis skills as part of the software user requirement and analysis and problem specifications stages. p.c. b — Candidates will have appropriate opportunities to evidence effective software solutions as part of program testing and verification stages 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.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.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.	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.c. a — Candidates will have opportunities to evidence the efficient use of the following hardware devices: keyboard, mouse, VDU, disk drive and printer. 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.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.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.c. e — Candidates will have opportunities to demonstrate effective use of OS on target pc, microprocessor or microcontroller system.	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.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.c. b — Candidates will have appropriate opportunities to evidence effective software solutions particularly as part of programme debugging and verification. 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.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.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.	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.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.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.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.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.c. e — Candidates will have opportunities to demonstrate effective use of OS as part of the PLC software assignment in Outcome 3.	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.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.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.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.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.c. e — Candidates will have opportunities to evidence the appropriateness of output formats in the report required for Outcome 3.	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					

9 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 2hours 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 **OR** DC and AC Principles	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: 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 **OR** DC and AC Principles	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: 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: 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	Telecommun-ications Fundamentals		Programmable Logic Devices	Microprocessor and Microcontroller Technology	Electronic Fault Finding	Systems Integration	Electronics: Graded Unit 2

10 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	Analogue Circuit Techniques	DG2X 34 *(finishes 31/07/2013)* or FY9T 34	Analogue Electronic Principles
D4FF 04	Analogue Electronic Devices		Active Electronic Circuits
D4KI 04	Operational Amplifiers	DG2W 35	
D4KG 04	Power Supply Circuits	DG50 35	Power Supply Circuits
Applications of PLCs			
D4FJ 04	Application of Programmable Logic Controllers	DG31 34	Applications of Programmable Logic Controllers

Old Unit Nos.	Old Unit Titles	New Unit Nos.	New Unit Titles
Communication			
D5P3 04	Communication: Presenting Complex Communication for Vocational Purposes Oral Communication element embedded	D77G 34 (Partial)	Communication: Practical Skills Written Communication element **and** Oral Communication element Core Skill of Communication at Higher embedded
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

Old Unit Nos.	Old Unit Titles	New Unit Nos.	New Unit Titles
Electrical Principles			
D4L9 09 D4GN 04	Single Phase AC Networks Electrical Networks	DG54 34 *(finishes 31/07/2013)* or FY9E 34 DG3G 34	Single Phase AC Circuits or DC and AC Principles Electrical Networks and Resonance
Engineering Applications			
D4H4 04 D4H2 04 D4GY 04	Electronic Construction Skills Electronic Testing Skills Electronic Fault Finding	DG3H 34 DG3N 34 DG3J 35	Electronic Construction Skills Electronic Testing Skills Electronic Fault Finding
Engineering Programming			
A4RR 04 D4HA 04 D4H9 04	Engineering Programming Engineering Programming: Assembly Language Engineering Programming: I/O Hardware Control	DG58 34 DG59 34 DG5C 35	High Level Engineering Software MCU/MPU Assembly Language Programming 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		
D4JH 04	Mathematics for Engineering	DG4L 34	
A5NK 04	Calculus for Engineering 1		Mathematics for Engineering 2
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)	

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 *(finishes 31/07/2013)* or FY9T 34	Analogue Electronic Principles – Outcome 1, Outcome 2 Knowledge and Skills Items (a) and (b) only. Analogue Electronic Principles - Outcome 2 Rectification, clipping and clamping only.	 Not covered in O.3 of Analogue Electronic Principles unit – voltage source, demodulation & opto-coupler. 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).

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 *(finishes 31/07/2013)* or FY9T 34	Analogue Electronic Principles Outcome 2 – Knowledge and Skills Item (c) Operational Amplifiers	
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 *(finishes 31/07/2013)* or FY9E 34	Single Phase AC Circuits or DC and AC Principles – 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 *(finishes 31/07/2013)* or FY9E 34	Single Phase AC Circuits DC and AC Principles – 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 Kirchhoff'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 *(finishes 31/07/2013)* or FY9E 34	Single Phase AC Circuits or DC and AC Principles – Outcome 2	Candidates with appropriate NQ Electrical Principles units can gain exemption from Outcome 1 of the Single Phase AC Circuits or DC and AC Principles unit *(specify NQ units)*
			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)	Electrical Network and Resonance – Outcome 2 Q-Factor and Bandwidth for series and parallel resonant 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
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
D4JH 04	Mathematics for Engineering	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.