

Arrangements for:
HNC Engineering Systems
Group Award Code: G85G 15

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Acknowledgement

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of Higher National qualifications.

Contents

History of changes	1
1 Introduction	2
2 Rationale for the revision of the award	2
2.1 Purpose of the Award	2
2.2 History and Market Research to support the HNC Engineering Systems	3
2.2.1 History of the HNC and HND Engineering awards	3
2.2.2 Market Research	3
2.3 Candidates for whom HNC award is intended	4
2.4 Articulation and Professional Body Requirements	4
3 Aims of the award	5
3.1 General Aims of the HNC Engineering Systems	5
3.2 Specific Aims of the HNC Engineering Systems	5
3.3 How the General Aims are met in the HNC Engineering Systems Structure and Content	6
3.4 How the Specific Aims are met in the HNC Engineering Systems Structure and Content	7
4 Access to awards	11
4.1 Access requirements	11
4.2 Alternative Access Arrangements	11
5 Award structure	11
5.1 Structure of the Award	11
5.2 HNC Engineering Systems Award Table	13
5.3 Graded Units	15
5.3.1 Type of Graded Unit	15
5.3.2 Rationale for the Graded Unit Assessment	15
5.4 Core Skills	16
5.4.1 Core Skills Profiles	16
5.4.2 Conditions of the Award	16
5.5 SCQF levels	19
6 Approaches to delivery and assessment	19
6.1 Content and Context	19
6.2 Delivery and Assessment	21
6.3 Open and Distance Learning	28
6.4 Credit Transfer Arrangements	28
7 General information for centres	29
8 General information for candidates	30
9 Glossary of terms	31
10 Appendices	32
Appendix 1	33
Appendix 2	40

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.

Version number	Description	Date	Authorised by

1 Introduction

This is the Arrangement Document for the HNC Engineering Systems award which was validated in December 2005. This document includes: background information on the development of the Group Award, its aims, guidance on access, details of the Group Award structure, and guidance on delivery.

This Arrangements Document has been written in order to assist centres in preparing for the approval of the new HNC Engineering Systems and maintaining the award thereafter. The award was developed under the new SQA HN Design Principles, was validated in December 2005, and replaces the existing HNC Engineering: award.

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

2 Rationale for the revision of the award

2.1 Purpose of the Award

The HNC Engineering Systems is one of a number of ‘multi-disciplinary engineering’ awards which have been developed by the SQA under its new HN Design Principles. Other awards in this category are HNC and HND Mechatronics and Advanced Certificates in Fabrication and Welding, Engineering Manufacture, Engineering Maintenance and Electrical Engineering which all lead into a common HNC Engineering Practice.

The main purpose of redeveloping the HNC Engineering Systems award is to produce a flexible, single or multi-disciplinary Engineering award which nevertheless conforms to the new HN Design Principles. This was not a simple task as the Design Principles with their requirement for mandatory Units and an integrated Unit (Graded Unit) place constraints on the level of flexibility that can be achieved within award structures. To overcome these constraints, the Qualification Design Team had to identify a theme which could be regarded as common to all areas of engineering. The Team chose to take an engineering systems approach as the theme as they believe that this satisfies the needs of different engineering sectors. Thus, the HNC Engineering Systems award comprises of a core set of Units which focus strongly on an engineering systems approach with equal emphasis being given to mechanical and electrical engineering. In addition, there is also an optional section where centres have opportunities to select Units in one or more engineering disciplines to meet their own local client needs. The Qualification Design Team believe that in designing the award in this way they have built flexibility into both core and optional Units by allowing centres to examine different types of engineering systems depending on their area of interest while allowing centres to specialise in an area, or areas, of engineering via the optional Units.

As the award embraces studies in a number of engineering areas and has an engineering systems theme, it was felt that HNC Engineering Systems was an appropriate title.

2.2 History and Market Research to support the HNC Engineering Systems

2.2.1 History of the HNC and HND Engineering awards

SCOTVEC awarded the syllabus based 114 HNC in Multidisciplinary Engineering for a number of year in the eighties and nineties. In 1996 SCOVEC introduced a broad based HNC Engineering award as part of a major SCOTVEC national development which saw the introduction of an overarching HN Engineering Framework. The new award presented in this document represents a further development of general Higher National Engineering awards in as much as it has a particular focus on a systems approach to the delivery and assessment of engineering and fully takes into account the new SQA, HN Design Principles and the latest developments in technology, working practices and education.

2.2.2 Market Research

The development of the new HNC Engineering Systems award included extensive market research which is summarised in Figure 2.2.

Stakeholder	Method
All	Major desk based research gathering and analysing data from various sources (eg SEMTA, FutureSkills Scotland etc.)
Delivery Centres	Two national seminars with workshop sessions where held designed to seek delivery staff views on a range of issues relating to general HN Engineering award developments. Draft Units and outlines of Graded Units were made available to centres.
Employers	Consultation took place through a questionnaire survey and members of the Qualifications Design Team consulting industrial contacts on the framework structure and Unit content.
Higher Education	Letters of support for articulation between the HNC Engineering Systems and degree awards were received from a number of Higher Education institutions.
Professional Bodies	A representative of the Institution of Engineering and Technology (IET) advised the Qualification Design Team on the status of the award in relation to membership of the IET.

Stakeholder	Method
Candidates	While not consulted directly details of candidate experience of the current general HNC Engineering were provided by Qualification Design Team members and other centre staff involved in the delivery of the current award. These experiences were fully taken into account in the design of the new awards.

Figure 2.2: Groups consulted on HN developments

2.3 Candidates for whom HNC award is intended

Full-time HNC candidates will normally be school leavers who have not gained the required University entry qualifications or who have not necessarily decided what branch of engineering they wish to follow and who are using the award as an alternative means of gaining access to a University education. Full-time candidates may also be more mature persons who are seeking a change of employment

Candidates at HNC level may already be in employment and will attend centres on a day-release or other part-time basis. The HNC Engineering Systems award structure is sufficiently flexible enough to allow centres to deliver the HNC award by various modes of delivery for example, two-year day-release, evening attendance etc.

The engineering systems in the core Units and the options chosen by employed candidates may reflect the branch of industry in which they are employed or may be used to gain knowledge of other areas within engineering in order to improve their career opportunities in the employment market. Part-time candidates may also use the HNC award to gain entry to degree level studies.

2.4 Articulation and Professional Body Requirements

The Qualifications Design Team has written to a number of universities in Scotland regarding possible articulation routes between the HNC Engineering Systems and various degree courses offered by the universities. Universities have advised that the HNC Engineering Systems may allow entry into the second year of a B.Sc./B.Eng. in Electrical and Electronic Engineering or Mechanical Engineering or related degree where an appropriate level of Mathematics has been achieved, otherwise entry will be into the first year of a degree course. Mathematics Units are available in this framework to support progression to university. It should also be noted that an HND Engineering Systems is currently under development (available from August 2007) which HNC candidates may choose to progress to.

The Qualifications Development Team has been advised by the Institution of Engineering and Technology (IET) that the HNC Engineering Systems award partially meets the academic requirements for registration as an Incorporated Engineer and fully meets the requirements for registration as an Engineering Technician.

3 Aims of the award

3.1 General Aims of the HNC Engineering Systems

The general aims of the 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' abilities to apply analysis and synthesis skills to the solution of engineering problems
- 3.1.5 develop learning and transferable skills (including Core Skills).

3.2 Specific Aims of the HNC Engineering Systems

The specific aims of the HNC award are to:

- 3.2.1 provide awards that will allow candidates to work now, or in the future, at technician level in an engineering environment
- 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 Engineering Systems (currently under development), or another HND in an Engineering discipline or a degree in Engineering or related subject discipline area
- 3.2.4 develop a range of Communication knowledge and skills relevant to the needs of engineering technicians or incorporated engineers
- 3.2.5 on successful completion of the award, achieve the Core Skill Communication at Higher level. Candidates will also be provided with opportunities to develop the following Core Skills: Information Technology, Numeracy, Problem Solving and Working with Others
- 3.2.6 develop knowledge, understanding and skills in an engineering systems approach to the study of Engineering
- 3.2.7 achieve a degree of specialisation within one or more of the following areas: Electronics, Electrical Engineering, Mechatronics, Mechanical Engineering, Manufacturing Engineering and Fabrication and Welding.

3.3 How the General Aims are met in the HNC Engineering Systems Structure and Content

Aim No.	How it is met in the HNC
3.1.1	For many years HNC and HND Engineering qualifications have equipped candidates to seek employment in a wide range of industrial, service and public sector organisations. Market research indicates that HNC and HND Engineering awards are still regarded as the minimum qualifications required by many organisations to work at engineering technician level.
3.1.2	There has been a long tradition of candidates in employment taking HN Engineering awards on a part-time basis to increase their knowledge of Engineering and enhance their career development. In recent years, with increased commonality between HNC and HND awards and greater flexibility in the way these awards are delivered, candidates in employment have increasingly taken HNDs on a part-time basis to expand their knowledge and skills in a particular area of Engineering and as a result improved their career prospects. The new HNC Engineering Systems award contains a balance of core engineering systems principles and up to date knowledge and skills across a wide range of Engineering disciplines which lend itself to the Continuous Professional Development and career development of candidates working at technician level.
3.1.3	All Units within the new HNC Engineering Systems award have been levelled at SCQF levels 6, 7 or 8. The new award also conforms to the SQA levelling requirements for HNC awards.
3.1.4	The nature of HNC Engineering Systems award, with its emphasis on an engineering systems approach, lends itself to both the analysis and synthesis of problems. For example, when a complex engineering 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 engineering systems. The new awards allow these important skills to be developed further both in the technical subjects and in the core Communication and Mathematics Units.

Aim No.	How it is met in the HNC
3.1.5	<p>The new HNC Engineering Systems award provides 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, the core engineering principles 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 engineering laboratory equipment and/or on-line delivery and/or Virtual Learning Environments to enhance candidate learning. Industrial visits are also highly recommended to consolidate learning in the centre.</p> <p>By their very nature Engineering courses require the transfer of technical knowledge and skills from one area to another. This is particularly the case with the HNC Engineering Systems award where candidates have to transfer their knowledge of electrical and mechanical concepts and principles to electromechanical engineering systems. Candidates will also have an opportunity to use the Communication knowledge and skills developed in the mandatory core Units in other parts of the awards to support such activities as report writing and giving a presentation. Core Skills in general, and problem solving in particular, have been regarded as very important by the Qualification Design Team since it is recognised that a good level of competence in these skills is essential in the work of an engineering technician.</p>

3.4 How the Specific Aims are met in the HNC Engineering Systems Structure and Content

Aim No.	How it is met in the HNC
3.2.1	<p>HNC/D Engineering awards have been recognised for many years by employers and other stakeholders of these awards as appropriate qualifications for persons wishing to work at engineering technician or senior technician levels. Market research indicates that there is still a demand for people with technician level skills in engineering especially as companies automate more of their processes. Thus, it is confidently anticipated that those achieving the HNC Engineering Systems award will find employment as engineering technicians and senior engineering technicians in a wide range of small, medium and large companies.</p>

Aim No.	How it is met in the HNC
3.2.2 & 3.2.3	<p>The Qualification Design Team has been advised by the IET that the HNC Engineering Systems award partially meets the academic requirements for registration as an Incorporated Engineer and meets the academic underpinning requirements for registration as an Engineering Technician.</p> <p>Given the clear progression routes that have been established between existing HNC/D Engineering awards and degree courses by many FE colleges and universities, it is strongly anticipated that similar progression routes will also be developed between the new HNC Engineering Systems award and degree courses. Progression arrangements between HNCs, HNDs and degrees can only be strengthened with the full implementation of the SCQF. A number of letters have been received from Scottish Universities confirming articulation arrangements between the new HNC Engineering Systems and degree programmes.</p>
3.2.4	<p>The current HNC and HND Engineering awards contain separate Communication and Information Technology Applications Units within their mandatory cores. The market research information gathered through various consultations indicated that there continued to be solid support for the inclusion of a distinct Communication Unit in the mandatory core of the HNC Engineering Systems award, but not a core Information Technology Unit as many candidates have acquired good IT skills at an earlier stage (an IT Unit is included in the optional section for those candidates who wish to upgrade their IT skills). The benefit of having a separate Communication Unit is that it significantly improves the prospect of sufficient attention being given to the teaching of this skill area. A separate Unit also makes it possible to ensure that the Communication Core Skill at Higher level is fully embedded within the HNC Engineering Systems award. Award designers considered this a more appropriate way to ensure that this Core Skill is included in the HNC than trying to embed such a Core Skill across, say, a range of engineering Units. It should also be noted that opportunities to develop the Communication Core Skill are signposted in a number of the Units in the award including the three core engineering principles Units.</p>

Aim No.	How it is met in the HNC
3.2.5	<p>The Communication Core Skill at Higher level has been incorporated into the HNC Engineering Systems award through the mandatory core Unit, Communication: Practical Skills. The Core Skill component Using Number is embedded within the mandatory core Unit Mathematics for Engineering: Mechanical and Manufacturing.</p> <p>Opportunities to develop the Core Skills Information Technology, Using Graphical Information (Numeracy Core Skill component), Problem Solving and Working with Others are signposted within individual Unit specifications. Candidates may achieve the Information Technology Core Skills at Higher level if they take the optional Unit Information Technology: Applications Software 1 in the HNC.</p>
3.2.6	<p>As noted earlier, in order to ensure a measure of consistency across various engineering disciplines the Qualification Design Team have taken as a common theme an engineering systems approach. The team has achieved this common approach by developing three new HN Units in Principles of Engineering Systems, Engineering Communication and Engineering Measurement and System Monitoring. The Principles of Engineering Systems has been designed to give candidates a broad knowledge and understanding of a systems approach to the analysis of engineering processes and systems, with equal weighting being given to mechanical and electrical concepts and principles. The Engineering Communication Unit has been developed to allow candidates to develop knowledge, understanding and skills in communicating and analysing a wide range of engineering information. The Engineering Measurement and System Monitoring Unit introduces candidates to measurement of electrical and mechanical quantities, transducer operations and typical responses produced by different engineering systems. The Mathematics for Engineering 1: Mechanical and Manufacturing Unit is included in the mandatory section to support and underpin learning and assessment in the three core Engineering Units. For example, experience has shown that many candidates entering engineering courses have difficulty in manipulating and solving equations commonly found in engineering, yet these skills are required in the three core engineering Units. Outcome 1 in the Mathematics Unit concentrates on the development of these very important skills. Outcome 2 in the Mathematics Unit focuses on vectors in two dimensions which supports the work on engineering quantities in the three core engineering Units. Finally, Outcome 3 in the Mathematics Unit on trigonometrical functions and their graphs and is very useful in supporting, for example, the work on electrical ac waveforms and power within the Principles of Engineering Systems Unit.</p>

Aim No.	How it is met in the HNC
3.2.6 cont'd	The focus throughout the Principles/Technology core Units is to provide an integrated programme of study covering a systems approach to the analysis of engineering processes and systems. As such every opportunity has been sought to combine the delivery and assessment of the four Units. To assist this process SQA intends to develop a range of assessment exemplars and learning materials.
3.2.7	As was also noted earlier, the other aspect of award design was to produce an award which allowed centres flexibility in designing a single or multi-disciplinary award. The Qualification Design Team believes that it has achieved this flexibility by incorporating all the Principles/Technology and optional Units from the following HNCs: Electronics, Electrical Engineering, Fabrication and Welding, Manufacturing Engineering, Mechanical Engineering and Mechatronics within the optional section of the HNC Engineering Systems award and allowing centres to choose any five credits worth of Units from these optional sections. Thus, a centre could choose to focus on one area of Engineering, say, by choosing 5 credits worth of Units from the Mechanical Engineering optional section of the HNC Engineering Systems award or it could go for a multi-disciplinary award by, say, selecting 3 credits worth of Units from the Electrical Engineering optional section of the award and 2 credits worth of Units from the Mechanical Engineering optional section of the award. The precise choice of Units a centre makes will be dictated in large part by the demand of its local employment market and the educational and career aspirations of its candidates.

4 Access to awards

4.1 Access requirements

Admission to the HNC Engineering Systems award should be based on a broad approach to candidate selection but, at the same time, should ensure that candidates are chosen who have the potential and ability to complete the awards successfully. To this end, the following are simply recommendations and should not be seen as a definitive or prescriptive list of entry requirements. Their purpose is simply to give guidance on the selection of candidates. It is recommended that candidates should possess the following:

- ◆ one Higher from Physics, Technological Studies, Mechatronics or Higher Mathematics and at least three Standard Grades 1-2/ Intermediate 2 passes including Mathematics, Physics/Technological Studies and English
- ◆ a National Certification Group Award in an Engineering discipline
- ◆ qualification comparable to the above, gained through other awarding bodies such as City and Guilds, Edexcel etc
- ◆ at the discretion of the Principal of the presenting centre for applicants with a different experiential background who could benefit from taking the course or Units within the course, eg adult returners, overseas students with relevant work experience

4.2 Alternative Access Arrangements

The presenting centre may operate alternative access arrangements in cases where the candidate is convinced that she/he already has the required competences in a given area. These arrangements are as follows:

- ◆ Assessment on demand
- ◆ Credit transfer
- ◆ Accreditation of prior learning
- ◆ Relevant work experience

Individual presenting centres will require to outline their systems for each of these as a part of any approval procedure.

5 Award structure

5.1 Structure of the Award

The structure of the award is shown in block diagram form in Figure 5.1. In order to allow centres to achieve maximum choice in the optional section of the HNC Engineering Systems, the HNC does **not** fit precisely into the overarching HN Engineering award structure.

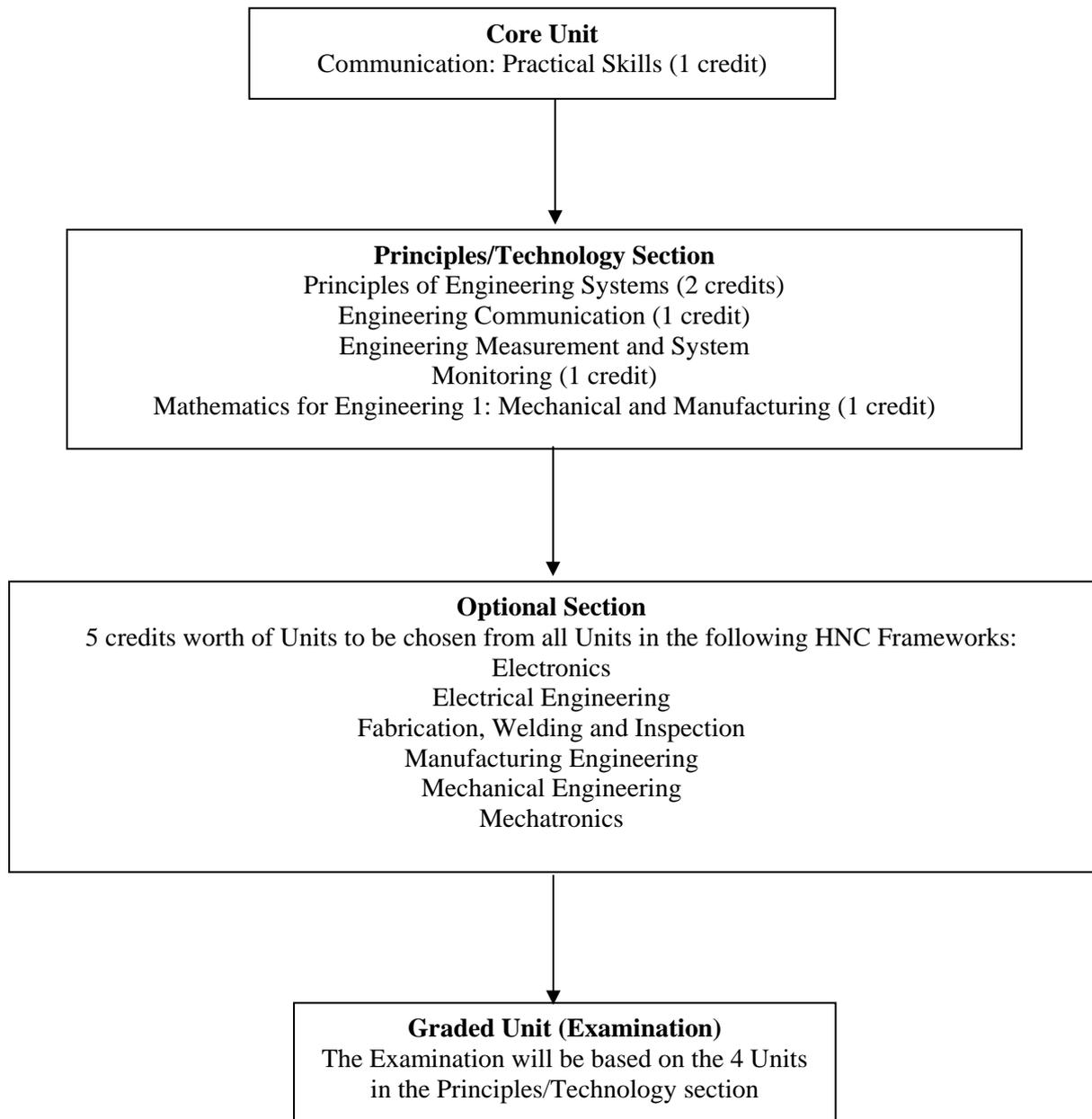


Figure 5.1 HNC Engineering Systems Award Structure

5.2 HNC Engineering Systems Award Table

Group Award: G85G 15
12 Unit Credits

Mandatory Units (6 Credits)

Section	Credit Value	SCQF level	Product Code	Product Title
Common Core	1	7	D77G 34	Communication: Practical Skills
Principles and Technology (5 Credits)	1	6	DT5X 33	Mathematics for Engineering 1: Mechanical and Manufacturing
	2	7	DV9R 34	Principles of Engineering Systems
	1	7	DV9N 34	Engineering Communication
	1	7	DV9P 34	Engineering Measurement and Systems Monitoring

Optional Units (max 5 Credits)

Credit Value	SCQF level	Product Code	Product Title
Cross-Discipline			
1	7	DG31 34	Applications of Programmable Logic Controllers
1	7	DR1X 34	Computer Aided Draughting for Engineers
1	7	DT5P 34	CNC
1	8	DR3M 35	Design for Manufacture
1	7	DT5R 34	Economics of Manufacture
1	7	DG3G 34	Electrical Networks and Resonance
1	7	DR1W 34	Engineering Drawing
1	7	DT9R 34	Engineering Measurement
1	7	DR3L 34	Engineering Principles
1	7	DN3Y 34	Fundamentals of Control Systems and Transducers
1	7	DG58 34	High Level Engineering Software
1	8	DT5V 35	Industrial Systems
1	7	D75X 34	Information Technology: Applications Software 1
1	8	DT5W 35	Jig and Fixture Design
1	7	DT46 34	Material Selection
1	7	DG4L 34	Mathematics for Engineering 2
1	7	DG59 34	MCU/MPU Assembly Language Programming
1	7	DT9X 34	Pneumatics and Hydraulics
2	8	DT62 35	Process and Equipment Selection
1	7	DT8Y 34	Quality Management: An Introduction
1	7	DR2D 34	Safety Engineering and the Environment
1	7	DG54 34	Single Phase AC Circuits
1	7	DR1T 34	Statics and Strength of Materials
Electrical			
1	6	DN48 33	Application of Electrical and Electronic Instruments
1	7	DN4H 34	Electrical Installation Skills
2	7	DN4J 34	Electrical Machine Principles
1	7	DN4L 34	Electrical Safety
1	7	DN3T 34	Electrical Systems in Potentially Explosive and Gas Hazardous Environments
1	7	DN3W 34	Electricity Power Systems
1	7	DN41 34	Inspection and Testing of Low Voltage Electrical Installations
1	7	DN42 34	Power Electronics
1	8	DN45 35	Three Phase Induction Motors

Credit Value	SCQF level	Product Code	Product Title
1	7	DN47 34	Three Phase Systems
Electronics			
2	7	DG2X 34	Analogue Electronic Principles
1	7	DG3C 34	Combinational Logic
1	7	DG3H 34	Electronic Construction Skills
1	7	DG3N 34	Electronic Testing Skills
1	7	D77H 34	Employment Experience 2
1	7	DG40 34	Implementing Small Local Area Networks
1	7	DG51 34	Printed Circuit Board Design, Manufacture and Test
1	7	DG53 34	Sequential Logic
Fabrication and Welding			
1	7	DR23 34	Containers: Design and Manufacture
1	7	DR22 34	Design Analysis: Fabrication and Welding
1	7	DR21 34	Destructive Testing
1	7	DR20 34	Engineering Project
1	7	DR2H 34	Fabrication and Welding Materials
1	7	DR25 34	Fabrication Forming Processes
1	7	DR2C 34	Fabrication: Preparation, Joining and Assembly
1	7	DR26 34	Inspection Systems
1	6	DR27 33	Performing Liquid Penetrant Inspection
1	6	DR28 33	Performing Magnetic Particle Inspection
1	7	DR29 34	Pipework 1: Construction and Site Installation
1	7	DR2A 34	Pipework 2: Pipe Bending and Pipe System Design
1	7	DR2E 34	Shipbuilding Principles: Advanced Hull and Associated Technologies
1	7	DR2F 34	Shipbuilding Principles: Planning, Production and Assembly
1	7	DR24 34	Welding Procedures: Specification, Qualification and Testing
1	7	DR2G 34	Welding Principles and Applications 1
1	7	DR1Y 34	Welding Principles and Applications 2
Mechanical and Manufacturing			
1	7	DT9T 34	Dynamics
1	7	DT5Y 34	Metal Component Manufacture
1	7	DT61 34	Plastic Component Manufacture
1	7	DT9P 34	Thermofluids
Mechatronics			
1	7	DW8T 34	Mechatronic Systems Elements
1	7	DW8R 35	Mechatronic Systems
1	7	DW8P 34	Interfacing Electronics
1	6	DW6W 33	Electrical Engineering Principles 1
1	7	DR3L 34	Engineering Principles
1	7	DW8W 34	Robotics and Animatronics: An Introduction

Graded Unit (1 Mandatory Credit)

Credit Value	SCQF level	Product Code	Product Title
1	7	DW11 34	Engineering Systems: Graded Unit 1

5.3 Graded Units

The purpose of the Graded Unit within the HNC Engineering Systems award structure is to assess the candidate's ability to apply and integrate knowledge and/or skills gained within individual Units. By this means candidates will demonstrate that they have achieved the aims of the awards as detailed in Section 3. The Graded Units also provide the means by which candidate achievement can be graded.

HNC Engineering Systems candidates will undertake a 1 Credit Graded Unit at SCQF level 7. This will be in the form of a 3 hour written examination.

5.3.1 Type of Graded Unit

Engineering Systems: Graded Unit 1 — Examination

The Specification for the HNC Engineering Systems: Graded Unit 1 is shown in Appendix 1. It will be noted that the Graded Unit draws on the Outcomes in the Principles/Technology section of the award which are studied by all candidates irrespective of what specialist optional Units they choose to study.

The examination paper for the Engineering Systems: Graded Unit 1 should comprise of a Case Study of an engineering system or systems. The Examination paper should have two sections: Section A, comprising of between 8 and 12 short answer and restricted response questions based on the Case Study and covering topics across all Units in the Principles/Technology section of the HNC Engineering Systems award. Candidates should answer all questions in this Section and are able to score a maximum of 50%. The paper should also have a Section B comprising of three 25 mark question of which candidates should answer any two questions. Candidates are able to score a maximum of 50% from Section B. Each of the three questions, while covering topics within the Units in the Principles/Technology section of the HNC Engineering Systems award, should have a particular engineering bias (eg electrical/electronics, mechanical/manufacture/fabrication or mechatronics) to reflect to some degree the candidates specialisation in the optional Units.

It is recommended that candidates do not sit the Graded Unit examination until the end of the HNC given the range of Units that the Graded Unit draws on.

5.3.2 Rationale for the Graded Unit Assessment

The choice of an examination for the Graded Unit was decided through consultation with industry and delivering centres during initial consultation on the overarching HN Engineering Framework (see HNC and HND Electronics Validation document for more details).

The consultation indicated that an 'examination' provided a more accurate way of assessing candidates' abilities to apply and integrate knowledge and understanding from various technical and related areas, such as Communication. Furthermore, it was considered that during their HNC studies candidates will not normally develop fully the necessary knowledge and skills to complete a project.

5.4 Core Skills

The HNC Engineering Systems award has been designed using the new HN Design Principles and therefore the importance of Core Skills has been recognised and been incorporated, where appropriate, throughout the award. Evidence to support the inclusion of Core Skills in the HNC Engineering Systems (either as embedded or as developmental opportunities) is shown in Figure 5.4.1 (a). This table was produced as part of the initial market research to support Core Skills inclusion in the overarching HN Engineering framework based on a questionnaire survey of FE College staff, external moderators and Engineering Advisory Group/ HN Steering Group members.

5.4.1 Core Skills Profiles

Core Skills Entry Profile

The recommended Core Skills entry profile for both the HNC Engineering Systems is as follows:

- | | |
|--------------------------|-------------------------------|
| ◆ Communication | SCQF level 5 (Intermediate 2) |
| ◆ Information Technology | SCQF level 5 (Intermediate 2) |
| ◆ Numeracy | SCQF level 5 (Intermediate 2) |
| ◆ Problem Solving | SCQF level 5 (Intermediate 2) |
| ◆ Working with Others | SCQF level 4 (Intermediate 1) |

Core Skills Exit Profile

A candidate who successfully achieves an HNC Engineering Systems will automatically obtain the following Core Skills exit profile:

- | | |
|-----------------|--|
| ◆ Communication | SCQF level 6 (Higher) (fully embedded in the Unit Communication: Practical Skills) |
| ◆ Using Number | SCQF level 6 (Higher) (fully embedded in the Mathematics for Engineering 1: Mechanical and Manufacturing Unit) |

Unit writers have also identified within the individual core engineering principles Units opportunities to develop Core Skills. These development opportunities are summarised in Table 5.4.1 (b).

5.4.2 Conditions of the Award

The conditions of award for the HNC Engineering Systems qualification are as follows:

A candidate will be awarded the HNC Engineering Systems on successful completion of 11 Unit credits plus 1 Graded Unit based on the HNC Engineering Systems award structure shown in Section 5.2. More specifically this award structure requires that candidates achieve the following:

- ◆ the 1 Unit credit Communication: Practical Skills
- ◆ the 5 Unit credits from the Principles/Technology section
- ◆ 5 Unit credits from the optional section
- ◆ Engineering Systems: Graded Unit 1

Results Summary Table

Core Skill	HNC			HND		
	% Yes	% Int 2	% Higher	%Yes	% Int 2	% Higher
Communication	54/56 = 96	29/54 = 54	25/54 = 46	50/53 = 94	11/51 = 22	40/51 = 78
Information Technology	54/56 = 96	18/55 = 33	37/55 = 67	51/53 = 96	5/53 = 9	48/53 = 91
Numeracy	49/56 = 88	15/48 = 31	33/48 = 69	48/53 = 91	6/48 = 13	42/48 = 87
Working with Others	32/56 = 57	19/33 = 58	14/33 = 42	38/53 = 72	12/39 = 31	27/39 = 69

Figure 5.4.1 (a) Combined FE College, External Moderators and Engineering Advisory Group/ HN Steering Group Core Skills Data

Note: CT = Critical Thinking; P &O = Planning & Organisation and R and E = Reviewing & Evaluating

Unit Title	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
	Read	Write	Oral	Using Number	Using Graphical Info.	Using Information Technology	CT	P & O	R & E	Working with Others
Principles of Engineering Systems		SCQF level 6 (Higher)					SCQF level 6 (Higher)			SCQF level 5 (Int 2)
Engineering Communication			SCQF level 6 (Higher)		SCQF level 6 (Higher)	SCQF level 6 (Higher)	SCQF level 6 (Higher)			
Engineering Measurement and System Monitoring		SCQF level 6 (Higher)				SCQF level 6 (Higher)	SCQF level 6 (Higher)			
Engineering Systems: Graded Unit 1	SCQF level 6 (Higher)	SCQF level 6 (Higher)		SCQF level 6 (Higher)			SCQF level 6 (Higher)		SCQF level 6 (Higher)	

Figure 5.4.1 (b) HNC Engineering Systems Core Engineering Units — Core Skills Development Opportunities

5.5 SCQF levels

Tables 5.5.1 show the distribution of SCQF levels in the HNC Engineering Systems award across the Common Core, Principles/Technology and Graded Unit sections of the award. It can be seen from Table 5.5.1 that all mandatory Units in the HNC Engineering Systems are at level 7 except the Mathematics for Engineering 1: Mechanical and Manufacturing Unit. This Unit has been designed as a SCQF level 6 Unit to meet the mathematical abilities of the majority of candidates entering the HNC programme. The Qualifications Design Team used as their benchmarks for levelling Engineering Units, the Highers in Mechanical and Electrical Engineering, various NQ Engineering Units and their knowledge of the content of existing degree courses in Mechanical and Electrical Engineering. The table shows that the number of SCQF level 7 credit points meets the minimum of 48 SCQF credit points required to be in an HNC to satisfy the new HN Design Principles.

Table 5.5.1

Distribution of SCQF levels in the mandatory section of the HNC Engineering Systems

level 6	level 7	level 8	Totals	SQA Minimum Requirement for level 7 Units
8 SCQF c.p.	48 SCQF c.p.	0 SCQF c.p.	56	48 SCQF c.p.

c.p. = credit points

6 Approaches to delivery and assessment

6.1 Content and Context

As noted in previous sections, the main purpose of the Principles/Technology section of the HNC Engineering Systems award is to encourage candidates to develop an engineering systems approach to the analysis and solution of engineering problems. To reinforce this approach an equal weighting has been given to both mechanical and electrical concepts and principles. Centres are encouraged to expose candidates to a range of engineering systems so that candidates get an idea of the range, scale and complexity of engineering systems available in the modern world. Centres can contextualise the HNC Engineering Systems award in such a way as to focus on particular systems that meet, for example, local industrial requirements. However, centres are encouraged to include among their examples of engineering systems alternative systems to the ones chosen for particular applications so that candidates can gain a broader knowledge and understanding of the types and behaviours of engineering systems available.

The Unit Mathematics for Engineering: Mechanical and Manufacturing is included in the mandatory core of the HNC Engineering Systems award to support and underpin the delivery and assessment of the three core engineering Units. For example, experience has shown that many candidates entering engineering courses have difficulty in manipulating and solving equations commonly found in engineering, yet these very skills are required in the three core engineering Units. Outcome 1 in the Mathematics Unit concentrates on the development of these very

important skills. Outcome 2 in the Mathematics Unit focuses on vectors in two dimensions which supports the work on engineering quantities in the three core engineering Units. Finally, Outcome 3 in the Mathematics Unit on trigonometrical functions and their graphs is very useful in supporting, for example, the work on electrical ac waveforms and power within the Principles of Engineering Systems Unit.

Centres have a large measure of flexibility in choosing Units from the optional section, and thus developing their own discreet HNC Engineering Systems programme to meet local employer needs and candidate educational and career aspirations. In developing any discrete programme centres are encouraged to think carefully about the rationale for such a programme eg does it meet a particular local or national employment need, does it aid candidates to progress to more advanced studies etc. Programmes should not be introduced without any clear rationale and simply to satisfy timetabling constraints. Examples of a single discipline Electronics programme and a multi-disciplinary Electro-mechanical programme are shown in Tables 6.1 and 6.2 respectively.

Unit Number	Unit Title	SCQF level	Credit Value
D77G 34	Communication: Practical Skills	7	1
DT5X 33	Mathematics for Engineering 1: Mechanical and Manufacturing	6	1
DV9R 34	Principles of Engineering Systems	7	2
DV9N 34	Engineering Communication	7	1
DV9P 34	Engineering Measurement and System Monitoring	7	1
DG2X 34	Analogue Electronic Principles	7	2
DG3C 34	Combinational Logic	7	1
DG53 34	Sequential Logic	7	1
DG54 34	Single Phase AC Circuits	7	1
DW11 34	Engineering Systems: Graded Unit 1	7	1
	Total		12

Table 6.1: Single discipline Electronics programme

Unit Number	Unit Title	SCQF level	Credit Value
D77G 34	Communication: Practical Skills	7	1
DT5X 33	Mathematics for Engineering 1: Mechanical and Manufacturing	6	1
DV9R 34	Principles of Engineering Systems	7	2
DV9N 34	Engineering Communication	7	1
DV9P 34	Engineering Measurement and System Monitoring	7	1
DG54 34	Single Phase AC Circuits	7	1
DN47 34	Three Phase Systems	7	1

Unit Number	Unit Title	SCQF level	Credit Value
DN45 35	Three Phase Induction Motors	8	1
DR3L 34	Engineering Principles	7	1
DT9X 34	Pneumatics and Hydraulics	7	1
DW11 34	Engineering Systems: Graded Unit 1	7	1
	Total		12

Table 6.2: Multi-disciplinary Electro-mechanical programme

6.2 Delivery and Assessment

Delivery

The new HNC Engineering Systems award can be delivered on a full-time, block-release, part-time day or part-time evening basis. Traditionally most HNC Engineering awards have been offered on a day-release and evening class basis to candidates in employment. However, in recent years HNC Engineering awards have been offered on a full-time basis for school leavers, adult returners etc. Centres may wish to use APL or assessment on demand mechanisms to accredit candidates in employment who can evidence knowledge, understanding and skills in certain areas of the HNC Engineering Systems award.

The SQA has indicated its willingness to develop learning and teaching materials to support the delivery of the four Units in the Principles/Technology section of the HNC award. It is anticipated that these learning and teaching materials will be available from September 2006.

Centres, working on their own or in partnership, might also wish to consider the following approaches to delivering the HNC Engineering Systems award:

- ◆ identification and sharing of good candidate learning support materials on the Internet
- ◆ use of the Internet by candidates to undertake more in-depth investigations in given subject areas
- ◆ development or purchase of paper based and/or electronic candidate learning support and assessment materials for individual Units (e.g. for certain optional Units)
- ◆ development of on-line Unit and Graded Unit assessment materials
- ◆ use of e-mentoring arrangements to support candidates who study at a distance

In timetabling the new award, centre staff should consider whether they wish to adopt one of the following three approaches to delivering the HNC Engineering Systems award:

- ◆ Top down — engineering systems approach first followed by specialisation in one or more areas of Engineering.
- ◆ Bottom up — specialisation in one or more areas of engineering first followed by engineering systems approach to 'pull things together'.
- ◆ Parallel approach.

The choice of approach will clearly influence how the HNC award is timetabled. Examples of all three approaches for a full-time programme are shown in Appendix 2.

The Units in the Principles/Technology section have been designed to be delivered as an integrated engineering systems programme and it is intended that the learning/teaching notes for these four Units, which are currently under development, will illustrate how this can be achieved. Centres may also wish to consider a team teaching approach to the delivery of the Units so that for example a mechanical and electrical engineering lecturer, or lecturers share the delivery of the Units. Centres are strongly encouraged to make every reasonable effort to ensure the integration of the delivery of the four Principles/Technology Units.

Centres should also take account of information contained in the Recommended Prior Knowledge and Skills statement in Unit specifications in sequencing the delivery of Units. This will particularly apply when selecting optional Units.

One of the key reasons the Qualifications Design Team has sought to reduce the time candidates have to spend on summative Unit assessment is to provide lecturers with more time to deliver Units. Lecturers are encouraged, in particular, to use this additional time to reinforce learning in core engineering concepts and principles and in an engineering systems approach to the analysis and solution of engineering problems.

Lecturers may use a variety of teaching and learning approaches in delivering the Units in the HNC Engineering Systems award. These may include lecturing, group work, laboratory and practical work, computer simulation (using appropriate software 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 strongly encouraged wherever possible to provide ‘real life’ industrial examples of engineering systems and the application of mechanical and electrical concepts and principles within these systems.

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

<p>Communication</p>	<ul style="list-style-type: none"> ◆ Providing candidates opportunities to develop their oral skills by allowing them to give full answers to questions asked by the lecturer and by giving an oral presentation as part of the Engineering Communication Unit. ◆ Developing complex, vocationally specific reading skills (eg Communication: Practical Skills.) ◆ Developing report writing skills in a number of Units (eg Principles of Engineering Systems, Engineering Measurement and System Monitoring etc.) ◆ Allowing candidates to develop their Communication skills in group work activities (eg Communication: Practical Skills, Principles of Engineering Systems).
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Numeracy	<ul style="list-style-type: none"> ◆ Reinforcing Numeracy and Mathematical skills when teaching mechanical and electrical engineering principles (eg Mathematics for Engineering 1: Mechanical and Manufacturing.) ◆ Reinforcing Using Graphical information skills by use of a range of graphical representations (eg Engineering Communication).
Information Technology	<ul style="list-style-type: none"> ◆ Develop Information Technology skills through the application of I.T. within Engineering systems approach (eg Engineering Communication and Engineering Measurement and System Monitoring).
Problem Solving Skills	<ul style="list-style-type: none"> ◆ Develop Critical Thinking Skills through the application of mechanical and electrical concepts and principles to solve engineering systems problems (all three Principles/Technology engineering Units).
Working with Others	<ul style="list-style-type: none"> ◆ Develop Working with Others skills through group discussion on the solution to engineering problems (eg Communication: Practical Skills and Principles of Engineering Systems).

Assessment

From the outset of developments the Qualifications Design Team recognised the need to have an appropriate assessment strategy in place for the HNC Engineering Systems award. Such a strategy was developed and is shown below:

Aims

The aims of the strategy are to ensure that:

- (1) Consistent, rigorous and efficient approaches are adopted to 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 that 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 all 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 the Communication: Practical Skills Unit and two assessment exemplars for the Principles/Technology Units, 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 are 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 HN Unit assessment:
 - (i) One and a half hours per Unit credit for HN Units at SCQF levels 6 and level 7.
 - (ii) Two hours per Unit credit for HN Units at SCQF level 8.
 - (iii) Two and half hours per Unit credit for HN Units at SCQF level 9.
- (4) Produce assessment exemplar packs for the Graded Unit. In addition, for the Graded Unit examination produce at least one sample exam paper to show the standards expected in such a paper.
- (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 assessment processes. This places a clear responsibility on both 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.

Figure 6.2 shows a summary of the details of assessment and opportunities for the integration of assessment for the four Units in the Principles/Technology section of the HNC Engineering Systems award. Lecturers are advised to read individual Unit specifications to obtain full details of assessment. It will be noted that candidates can prepare portfolios/reports in their 'own time.' By this the Qualification Development Team mean that the majority of the portfolio/report should be prepared in the candidates own time although some class time should also be used to prepare the portfolio/report. Candidates should be able to access their lecturers for feedback on their portfolios/reports. Centres should make every reasonable effort to ensure that a portfolio/report is the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist should be used to record oral evidence of the candidate's knowledge and understanding.

Unit Number	Unit Title	Assessment Details	Opportunities or integrating assessment
DV9N 34	Engineering Communication	<p>O.1 — Portfolio of sketches covering systems layouts and component level representation. Portfolio developed in candidate's own time.</p> <p>O.2 — Assignment on a mechanical and electrical system involving computer simulation and the production of a portfolio containing drawings of systems, analysis of results, evaluation of simulation process and suggestions for further work. Portfolio developed in candidate's own time.</p> <p>O.3 — Presentation lasting 10 minutes plus 5 minutes Question and Answer session.</p>	<p>Centres may combine the block diagram aspects of this assessment with the assessment for O.1 in the Principles of Engineering Systems Unit.</p> <p>The presentation may be based on the engineering systems studied in O.2.</p>

Unit Number	Unit Title	Assessment Details	Opportunities or integrating assessment
DV9P 34	Engineering Measurement and System Monitoring	<p>O.1 — Practical exercises involving the measurement of engineering quantities and production of short report. Report should be produced in candidate's own time.</p> <p>O.2 — Report describing the principle of operation of two electrical and one mechanical transducer. The report should also include details of the procedures used to calibrate one electrical and one mechanical transducer. Report should be produced in candidate's own time.</p> <p>O.3 — An assignment involving practical work or computer simulation on the response of a mechanical and equivalent electrical system plus the production of a report based on the practical work. Report should be produced in candidate's own time.</p>	<p>The delivery and assessment of this Outcome may be linked to O.8 in the Principles of Engineering Systems Unit.</p>

Unit Number	Unit Title	Assessment Details	Opportunities or integrating assessment
DV9R 34	Principles of Engineering Systems	<p>O.1, O.2, O.3 and O.7 — assessed as four separate assignments plus 4 reports.</p> <p>O.4, O.5 and O.8 — assessed by three separate 30 minute tests.</p> <p>O.6 — Assignment in which candidates conduct an energy audit on a practical engineering system plus the production of a report based on the audit. Report should be produced in candidate's own time.</p>	<p>Single assignment plus single report based on the same electromechanical system covering the work of the four Outcomes.</p> <p>Single test lasting 1 and 1/2 hours covering the work in all three Outcomes.</p>
DT5X 33	Mathematics for Engineering 1: Mechanical and Manufacturing	<p>O.1 — Single test lasting 40 minutes.</p> <p>O.2 — Single test lasting 30 minutes.</p> <p>O.3 — Single test lasting 30 minutes.</p>	<p>Single assessment lasting 1 hour and 40 minutes covering the work of the three Outcomes.</p>

Figure 6.2 — Assessment details for the 4 Principles/Technology Units

Assessment Exemplar Materials

Assessment exemplar packs are in the process of being produced for all Principles/Technology Units and the Graded Unit in the HNC Engineering Systems award. With regard to the Principles/Technology Units it is intended to produce two sets of assessment exemplars for each Unit. One set will focus on a renewable energy/sustainable energy theme while the other set will have a more conventional engineering theme.

Formative Assessment

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

6.3 Open and Distance Learning

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 be required 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 involves 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.

6.4 Credit Transfer Arrangements

Credit Transfer arrangements between Units in the mandatory section of the HNC Engineering Systems and Units in the current HN Engineering award frameworks are shown in Table 6.4.

New Unit Number	New Unit Title	Existing Unit Number	Existing Unit Title	Level of Credit Transfer
D77G 34	Communication: Practical Skills	D5P3 04	Communication: Presenting Complex Communication for Vocational Purposes	100%
DV9R 34	Principles of Engineering Systems		No comparable Unit in current HN Engineering award framework	0%

New Unit Number	New Unit Title	Existing Unit Number	Existing Unit Title	Level of Credit Transfer
DV9N 34	Engineering Communication		No comparable Unit in current HN Engineering award framework	0%
DV9P 34	Engineering Measurement and System Monitoring		No comparable Unit in current HN Engineering award framework	0%
DT5X 33	Mathematics for Engineering 1: Mechanical and Manufacturing	D4JB 04	Introductory Mathematics for Engineering (may require some additional assessment on demand)	100% at the centre's discretion

Table 6.4 Credit Transfer Arrangements

Centres should refer to the Arrangement Documents for the HNC/D Electronics, Electrical Engineering, Mechanical/Manufacturing Engineering, Mechatronics or HNC Fabrication and Welding to find out what level of credit transfer is available between individual optional Units in the new and current HN Engineering award frameworks.

7 General information for centres

Candidates with disabilities and/or additional support needs

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs (www.sqa.org.uk).

Internal and external moderation

All instruments of assessment used within this Group Award should be internally moderated, using the appropriate policy within the centre and the guidelines set by SQA.

External moderation 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 moderation can be found in SQA's Guide to Assessment and Quality Assurance for Colleges of Further Education (www.sqa.org.uk).

8 General information for candidates

The new HNC award has been designed by an expert team of educators and industrialists with a view to allowing you to meet the educational requirements to work as an engineering technician or incorporated engineer. The new qualification contains up-to-date and relevant engineering subject content and skills and has also been designed to satisfy the new SQA Higher National Design Principles.

The SQA Qualification Design Team has designed the new award so that you will have opportunities to learn and understand about mechanical and electrical engineering concepts and principles and about an engineering systems approach to analysing and solving an engineering system. Such an approach is somewhat different from that taken in other engineering awards where candidates tend to specialise more in one area of engineering. The approach taken in the HNC Engineering Systems will allow you to analyse a wide range of engineering systems from both an electrical and mechanical perspective and thus solve a diverse range of engineering problems. Such a wide and flexible approach to problem solving is very attractive to many employers. In addition the HNC Engineering Systems allows you to specialise in one or more areas of Engineering in the five credit optional section.

As well as studying Engineering subjects you will also take a Communication Unit. Communication skills are essential to understanding technical material, and when communicating with others whether on an individual basis or when working as part of a team.

Opportunities to develop Information Technology knowledge and skills are available in a number of Units in the HNC, but an optional Unit on Information Technology Applications is also available if you wish to consolidate your skills in this area.

While taking the HNC Engineering Systems you can anticipate that the teaching and learning approaches adopted by your lecturers will include the following: lecturing, group work, practical engineering work, measurement and testing, computer simulation and project work. Industrial visits may also be included to allow you to see 'real life' engineering systems in action.

The Qualification Design Team has ensured that assessment in the award meets national standards. The award has been designed to optimise assessment so that sufficient time is available for you to learn the mechanical and electrical concepts and principles and engineering systems approaches that are essential to being a good engineering technician and/or incorporated engineer.

You can expect to do assessment at individual Unit level and at qualification level. At Unit level assessments will normally consist of written tests and practical exercises and computer simulations which will include the preparation of reports. 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 3 hour examination. The examination has been designed to allow you to demonstrate your ability to integrate knowledge, understanding and skills learnt throughout the award as a whole.

The Qualification Design Team does not wish to place any artificial barriers in the way of potential candidates wanting to study the HNC Engineering Systems award. However, it would be unfair to enrol a candidate into the HNC who did not have a realistic chance of successfully achieving the award. The Qualification Design Team

would therefore recommend that a candidate had one of the following qualifications before entering the HNC Engineering Systems:

- (1) One Higher from Physics, Technological Studies, Mechatronics or Mathematics and at least three Standard Grades 1-2/ Intermediate two passes including Mathematics, Physics/Technological Studies and English.
- (2) A National Certificate in Engineering.
- (3) Equivalent qualifications or experience to those shown in (1) and (2).

An HNC Engineering Systems no longer satisfies the full academic requirements to become an incorporated engineer (a degree is now required). However, the new HNC Engineering Systems awards provide a very solid platform for candidates to precede to a degree programmes in an Engineering area. Ask your lecturer about progression arrangements your college has with any universities.

The Institution of Engineering and Technology has advised that the HNC Engineering Systems award partially meets the academic requirements for registration as an Incorporated Engineer (a degree is normally required to meet the requirements fully) and meets the academic underpinning requirements for registration as an Engineering Technician.

Universities have advised that the HNC Engineering Systems award may allow entry into the second year of a degree in engineering where an appropriate level of Mathematics has been achieved, otherwise entry will be into the first year of a degree. You should ask your lecturer about any articulation arrangements your centre has with any universities regarding the HNC Engineering Systems.

9 Glossary of terms

SCQF: This stands for the Scottish Credit and Qualification Framework, which is a new way of speaking about qualifications and how they inter-relate. We use SCQF terminology throughout this guide to refer to credits and levels. For further information on the SCQF visit the SCQF website at www.scqf.org.uk.

SCQF credits: 1 HN credit is equivalent to 8 SCQF credit points. This applies to all HN Units, irrespective of their level.

SCQF levels: The SCQF covers 12 levels of learning. HN Units will normally be at levels 6–9. Graded Units will be at level 7 and 8.

Subject Unit: Subject Units contain vocational/subject content and are designed to test a specific set of knowledge and skills.

Graded Unit: Graded Units assess candidates' ability to integrate what they have learned while working towards the Units of the Group Award. Their purpose is to add value to the Group Award, making it more than the sum of its parts, and to encourage candidates to retain and adapt their skills and knowledge.

Dedicated Core Skill Unit: This is a Unit that is written to cover one or more particular Core Skills, eg HN Units in Information Technology or Communications.

Embedded Core Skills: This is where the development of a Core Skill is incorporated into the Unit and where the Unit assessment also covers the requirements of Core Skill assessment at a particular level.

Signposted Core Skills: This refers to the opportunities to develop a particular Core Skill at a specified level that lie outwith automatic certification.

Qualification Design Team: The QDT works in conjunction with a Qualification Manager/Development Manager to steer the development of the HNC/D from its inception/revision through to validation. The group is made up of key stakeholders representing the interests of centres, employers, universities and other relevant organisations.

Consortium-devised HNCs and HNDs are those developments or revisions undertaken by a group of centres in partnership with SQA.

Specialist single centre and specialist collaborative devised HNCs and HNDs are those developments or revisions led by a single centre or small group of centres who provide knowledge and skills in a specialist area. Like consortium-devised HNCs and HNDs, these developments or revisions will also be supported by SQA.

10 Appendices

See following pages for appendices.

Page 33: Appendix 1: Graded Unit Specification — Examination

Page 40: Appendix 2: Sample Teaching Timetable

Appendix 1

Graded Unit — Examination Specification

Higher National Graded Unit Specification

General Information for Centres

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

Graded Unit Title: Engineering Systems: Graded Unit 1

Graded Unit Code: DW11 34

Type of Graded Unit: Examination

Assessment Instrument: Examination

Credit points and level: 1 HN Credit(s) at SCQF level 7: (8 SCQF credit points at SCQF level 7)

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

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

- ◆ Develop knowledge, understanding and skills in an engineering systems approach to the study of Engineering
- ◆ Develop candidates' ability to apply analysis and synthesis skills to the solution of engineering problems
- ◆ Develop learning and transferable skills (including Core Skills)

Recommended Prior Knowledge and Skills: It is recommended that the candidate should have completed or be in the process of completing the following Units relating to these specific aims prior to undertaking this Graded Unit:

- ◆ Communication: Practical Skills
- ◆ Principles of Engineering Systems
- ◆ Engineering Communication
- ◆ Engineering Measurement and System Monitoring
- ◆ Mathematics for Engineering 1: Mechanical and Manufacturing

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

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

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

Administrative Information

Graded Unit Code: DW11 34

Graded Unit Title: Engineering Systems: Graded Unit 1

Date of publication: May 2006

Source: SQA

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Additional copies of this Graded Unit specification (if sourced by the Scottish Qualifications Authority), can be purchased from the Scottish Qualifications Authority. Please contact the Customer Contact Centre for further details, telephone 0845 279 1000.

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

Graded Unit Title: Engineering Systems: Graded Unit 1

Conditions of Assessment

The assessment is based on an examination lasting three hours.

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

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

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

The Examination Paper should comprise of a Case Study of an engineering system or systems. The Examination paper should have the following two sections: Section A, comprising of between 8 and 12 short answer and restricted response questions based on the Case Study and covering topics across all units in the Principles/Technology section of the HNC Engineering award. Candidates should answer all questions in this Section and be able to score a maximum of 50%. The Paper should also have a Section B comprising of three 25 mark question. Each of the three questions, while covering topics within the units in the Principles/Technology section of the HNC Engineering award, should have a particular engineering bias (eg electrical/electronics, mechanical /manufacture/fabrication or mechatronics) to reflect to some degree the candidates specialisation in the optional units. Candidates should be able to score a maximum of 50% from Section B.

Candidates should be given a copy of the Case Study only 14-days before they sit the Examination.

The examination should be conducted under closed book, supervised conditions with candidates only being allowed to use a maximum of three sides of A4 notes they have prepared on the Case Study. These notes **must** be handed in to the invigilator at the end of the examination.

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

The examination paper should be unseen prior to the assessment event which should be conducted under controlled and invigilated condition.

Instructions for designing the assessment task:

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

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

Graded Unit Title: Engineering Systems: Graded Unit 1

Topic	Level of knowledge/ understanding	Weighting/ Mark Allocation
Apply mathematical techniques in the context of Engineering	Apply algebraic and vector techniques to solve problems commonly found in Engineering	5%
Block diagram representation of engineering systems	Represent mechanical, electrical and electromechanical systems in block diagram format	10%
Sketch engineering component and system layout	Accurate neat and annotated sketches of component and layout	10%
Description and comparison of engineering quantities	Explain a minimum of four electrical and four mechanical quantities given in Principles of Engineering Systems unit and compare and contrast these mechanical and electrical quantities	15%
Energy calculations and audit	Perform energy calculations involving at least two mechanical and two electrical energy/power forms. Undertake an energy audit of a system where appropriate	15%
Material properties	Identify key properties of materials used in engineering system and suggest possible alternatives	10%
Engineering system responses and corrective actions	Draw typical engineering responses and recommended corrective action for a system operating out with its normal range	15%
Sensor/Transducer operation and applications	Describe the operation and application of at least one electrical and one mechanical transducer	20%

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

Graded Unit Title: Engineering Systems: Graded Unit 1

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

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

Candidates with Additional Support Needs

This Graded Unit specification is intended to ensure that there are no artificial barriers to learning or assessment. The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative assessment arrangements. For information on these, please refer to the SQA document *Guidance on Alternative Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs*, which is available on SQA's website: www.sqa.org.uk.

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

Graded Unit Title: Engineering Systems: Graded Unit 1

Guidance to Centres

Centres are encouraged to study this Engineering Systems: Graded Unit 1 specification and the associated Assessment Exemplar paper carefully before embarking on the writing of any HNC Engineering Systems Examination paper.

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

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

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

Sample Teaching Timetable

- 1 **Full-Time HNC Engineering Systems Timetable —
Top-Down, Bottom-Up and Parallel Approaches**

1 – Year, Full-Time HNC Engineering Systems Timetable — Top-Down Approach

First Year, First Semester

Mathematics for Engineering 1: Mechanical & Manufacturing	Communication: Practical Skills	Engineering Communication	Principles of Engineering Systems	Principles of Engineering Systems	Engineering Measurement and System Monitoring
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First Year, Second Semester

Option 1	Option 2	Option 3	Option 4	Option 5	Engineering Systems: Graded Unit 1: Examination
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Centres may include additional optional Units in the programme if they wish.

1 – Year, Full-Time HNC Engineering Systems Timetable — Bottom-Up Approach

First Year, First Semester

Mathematics for Engineering 1: Mechanical & Manufacturing	Option 1	Option 2	Option 3	Option 4	Option 5
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First Year, Second Semester

Communication: Practical Skills	Engineering Communication	Principles of Engineering Systems	Principles of Engineering Systems	Engineering Measurement and System Monitoring	Engineering Systems: Graded Unit 1: Examination
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Centres may include additional optional Units in the programme if they wish.

1 – Year, Full-Time HNC Engineering Systems Timetable — Parallel Approach

First Year, First Semester

Mathematics for Engineering 1: Mechanical & Manufacturing	Communication: Practical Skills	Engineering Communication	Principles of Engineering Systems	Option 1	Option 2
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First Year, Second Semester

Option 3	Option 4	Option 5	Principles of Engineering Systems	Engineering Measurement and System Monitoring	Engineering Systems: Graded Unit 1: Examination
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Centres may include additional optional Units in the programme if they wish.