



Arrangements for:
HNC Engineering Systems
(Award Number: G85G 15)

Validation date: December 2005

and

HND Engineering Systems
(Award Code: G8G5 16)

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Acknowledgement

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

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
13	Revision of Unit: F43J 34 Process Safety Engineering has been replaced by HE3F 34 and finishes on 31/07/2018	02/06/16
12	Revision of Unit: DE1K 33 Workplace Communication in English has been revised by H8T2 33 and finishes on 31/07/2016.	08/05/15
11	Removal of finish date from unit DG4P 35 <i>Mathematics for Engineering 3</i> . Addition of Credit Transfer Table <i>see Page 40</i> .	15/01/15
10	Revision of Units: D77G 34 <i>Communication: Practical Skills</i> revised by H7MB 34. DT5X 33 <i>Mathematics for Engineering 1: Mechanical and Manufacturing</i> revised by H7K0 33 <i>Engineering Mathematics 1</i> DG4L 34 <i>Mathematics for Engineering 2</i> revised by H7K1 34 <i>Engineering Mathematics 2</i> on HNC and HND frameworks finishing 31/07/2016. DG4H 33 <i>Mathematics for Engineering 1: Electronics and Electrical</i> revised by H7K0 33 <i>Engineering Mathematics 1</i> on HND framework finishing 31/07/2016.	21/10/14
09	<i>Engineering Mathematics 3</i> (H7K2 34), <i>Engineering Mathematics 4</i> (H7K3 35) and <i>Engineering Mathematics 5</i> (H7K4 35) added as optional Units to HND framework.	20/08/14
08	Addition of optional Units: <i>Energy Overview</i> (H4J5 34) and <i>Energy Technologies</i> (H4J6 35)	09/08/13
07	Change to code: <i>Engineering Systems: Graded Unit 1</i> from DW11 34 (<i>lapse date 31/07/2012, finish date 31/07/2014</i>) to H2VY 34. <i>Production Planning and Control</i> from DT63 35 (<i>lapse date 31/07/2012, finish date 31/07/2014</i>) to H1KS 35. Change to code and title: <i>Process and Equipment Selection</i> from DT62 35 (<i>lapse date 31/07/2012, finish date 31/07/2014</i>) to <i>Manufacturing: Process and Equipment Selection</i> H292 35.	06/11/12
06	Due to the HN Review the following Units have been amended and recoded: DN4F 35, DN48 33, DN4L 34, DN4J 34, DN42 34, DG2X 34 and DG54 34.	20/03/12
05	As a result of the 2010 HN Review the HNC Petroleum has been included for direct entry to the HND Engineering Systems. Unit F1BX 33 <i>Engineering Practical Skills</i> has been added to the optional section of the HNC to allow candidates to develop skills such as fitting, turning, milling, sheet metal work or welding.	13/10/11
04	Unit FJ3D 35 <i>Energy: Nuclear Power and the Environment</i> has been	25/05/11

	added to the Optional section of the HND.	
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03	Unit F1NH 34 Project Management: An Introduction has been added to the optional section of the HNC and HND as it is the recommended entry for the HND core Unit DV5J 35 Project Management: Managing the Implementation of a Project and will ease access for full-time students. Unit DV5H 35 Project Management: Project Justification and Planning has also been added to the optional section of the HND as it is part of the PDA in Project Management.	08/01/10
02	Amendments regarding Renewable Energy	03/01/08

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1 Introduction

This is the combined Arrangements Document for the HNC and HND Engineering Systems awards. The HNC was validated in December 2005 and the HND in February 2007. This Arrangements Document supersedes the previous HNC Engineering Systems Arrangements Document which was first published in May 2006.

This Arrangements Document has been written in order to assist centres in preparing for the delivery of the HNC and HND Engineering Systems and maintaining these awards thereafter. These awards were developed under the new SQA HN Design Principles and replace the existing HNC and HND Engineering awards.

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

2 Rationale for the revision of the awards

2.1 Purpose of the Awards

The HNC and HND Engineering Systems awards comprise 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 are also optional sections where centres have opportunities to select Units in one or more engineering disciplines to meet their own local client needs. In designing the two awards this way, flexibility has been built into both core and optional Units by allowing centres to examine different types of engineering systems depending on their areas of interest while allowing centres to specialise in an area, or areas, of engineering via the optional Units.

In the HNC Engineering Systems award there are 7 credits of core Units which focus strongly on an engineering systems approach with equal emphasis being given to mechanical and electrical engineering. The HNC also has 5 credits of optional Units allowing centres greater flexibility to select Units in one or more engineering disciplines. In other HNC Engineering awards there is only 2 credits worth of Units in the optional section.

The HND Engineering Systems has 18 credits worth of mandatory Units which include all the Units from the mandatory section of the HNC Engineering Systems. These 18 credits continue to place a strong focus on an engineering systems approach to the solution of engineering problems. There are 12 credits of optional Units in the HND, compared with 7 credits in other HND Engineering awards. This provides centres with greater scope to select Units from one or more areas of engineering to meet candidates' educational and career aspirations and local employer needs.

As the award embraces studies in a number of engineering areas it was felt that HNC Engineering Systems was an appropriate title. The choice of this title also reflects the fact that the current broad based Higher National Engineering award has a similar title and therefore, has recognition among stakeholders of the award. Exactly the same reasoning was applied to the HND and so it was given the name HND Engineering Systems.

2.2 History and Market Research to support the HNC and HND Engineering Systems Awards

2.2.1 History

SCOTVEC awarded the syllabus based 114 HNC in Multidisciplinary Engineering for a number of year in the eighties and nineties. In 1996 SCOVEC introduced broad based HNC and HND Engineering awards as part of a major SCOTVEC national development which saw the introduction of an overarching HN Engineering Framework. The new awards presented in this Document represent a further development of general Higher National Engineering awards in as much as they have a particular focus on a systems approach to the delivery and assessment of engineering and take account fully of 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 and HND Engineering Systems awards 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 FutureSkills Scotland, SEMTA — Science, Engineering Manufacturing Technologies Alliance, ECITB — Engineering Construction Industry Training Board etc.).

Stakeholder	Method
Delivery Centres	<p>Two national seminars with workshop sessions were held and used to seek delivering centres' views on a range of issues relating to general HN Engineering award developments.</p> <p>Draft Units and outlines of Graded Units were made available to centres.</p>
Employers	<p>Consultation took place through two questionnaire surveys, one for the HNC and the other for the HND. Industrial contacts were consulted on the framework structure and Unit content.</p>
Higher Education	<p>Letters of support for articulation between the HNC and HND Engineering Systems and degree awards were received from a number of Higher Education institutions.</p>
Professional Bodies	<p>A representative of the Institution of Engineering and Technology (IET) advised on the status of the awards in relation to membership of the IET.</p>
Candidates	<p>While not consulted directly details of candidate experience of the current general HNC and HND Engineering awards were provided by centre staff involved in the delivery of the current awards. These experiences were fully taken into account in the design of the new awards.</p>

Figure 2.2: Groups consulted on HN Engineering Systems developments

3 Aims of the award

3.1 General Aims of the HNC and HND Engineering Systems

The general aims of the awards 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 and HND Engineering Systems

Aims common to both the HNC and HND Engineering Systems awards

- 3.2.1 provide awards that will allow candidates to work now, or in the future, at technician level or following further learning contribute towards the achievement of incorporated engineer level
- 3.2.2 provide awards that create routes towards meeting the academic requirements for Incorporated Engineer status
- 3.2.3 develop a range of communication knowledge and skills relevant to the needs of engineering technicians or incorporated engineers
- 3.2.4 develop applications of knowledge, understanding and skills in an engineering systems approach

Aims specific to the HNC Engineering Systems only

- 3.2.5 develop an award that on successful completion will allow candidates to progress to HND Engineering Systems or another HND in an engineering discipline or a degree in engineering or related subject discipline area
- 3.2.6 on successful completion of the award, achieve the Core Skill Communication at SCQF level 6 and the Using Number Core Skill component also at SCQF level 6. Candidates will also be provided with opportunities to develop the following Core Skills: Information Technology, Using Graphical information, Problem Solving and Working with Others
- 3.2.7 achieve a degree of specialisation in one or more of the following areas: Electronics, Electrical Engineering, Mechatronics, Mechanical Engineering, Manufacturing Engineering and Fabrication, Welding and Inspection.

Aims specific to the HND Engineering Systems only

- 3.2.8 provide an award that on successful completion will allow candidates to progress to a degree in engineering or a related subject discipline area
- 3.2.9 develop knowledge and understanding of the external and internal factors that influence the performance of modern engineering companies
- 3.2.10 recognise the important role Continuing Professional Development plays in career development
- 3.2.11 develop a range of practical skills in two of the following: fitting, turning, milling, sheet metalwork or welding, and in electrical installation and electronics
- 3.2.12 develop a range of project management skills
- 3.2.13 allow opportunities for specialisation within one or more of the following engineering disciplines: Electronics, Electrical Engineering, Engineering Practice, Fabrication and Welding, Manufacturing Engineering, Mechanical Engineering, Mechatronics and or Petroleum Engineering.
- 3.2.14 on successful completion of the award, achieve the Core Skills of Communication and Problem Solving and the Using Number Core Skill component all at SCQF level 6. Provide candidates with opportunities to develop the following Core Skills: Information Technology, Working with Others and Using Graphical Information

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

The reader may wish to have the appropriate framework information in Sections 5.1, 5.2, 5.3 and 5.4 available when reading the comments in the Table below.

Aim No.	How they are met in the HNC and HND
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 HNC and HND Engineering Systems awards both contain a balance of core engineering systems principles and up to date knowledge and skills across a wide range of engineering disciplines which lend themselves to the Continuous Professional Development and career development of candidates working at engineering technician and following further learning contribute towards incorporated engineer level.
3.1.3	All Units within the HNC and HND Engineering Systems awards have been levelled at SCQF levels 6, 7 or 8. The two awards also conform to the SQA Design Principles levelling requirements for HNC and HND awards.
3.1.4	The nature of the HNC and HND Engineering Systems awards, with their emphasis on an engineering systems approach, lend themselves 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. In the HND Engineering Systems award analysis and synthesis skills are also developed in the Unit Business Awareness and Continuing Professional Development.

Aim No.	How they are met in the HNC and HND
3.1.5	<p>The HNC and HND Engineering Systems awards provide centres with opportunities to enhance learning skills not least by creating circumstances where candidates can 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 the learning that has taken place 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 and HND Engineering Systems awards where candidates, for example, have to transfer their knowledge and understanding 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 since it is recognised that a good level of competence in these is essential in the work of an engineering technician and incorporated engineer.</p>

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

The reader may wish to have the appropriate framework information in Sections 5.1, 5.2, 5.3 and 5.4 available when reading the comments in the Table below.

Aim No.	How they are met in the HNC and HND
3.2.1	HN 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 level and with further learning contribute to incorporated engineer level. Market research indicates that there is still a demand for people with technician level skills in engineering especially as companies increasingly automate their processes. Thus, it is confidently anticipated that those achieving HNC and HND Engineering Systems awards will find employment as engineering technicians and with further learning contribute to incorporated engineering status in a wide range of small, medium and large companies.
3.2.2	An HNC or HND no longer satisfies fully the academic requirements for incorporated engineer status. The minimum qualification for incorporated engineer is a Bachelors degree. The Institution of Engineering and Technology (IET) has advised that the HNC and HND Engineering Systems awards partially meet the academic requirements for registration as an incorporated engineer and meet the academic underpinning requirements for registration as an engineering technician.
3.2.3	The current HNC and HND Engineering awards contain a separate Communication Unit within their mandatory sections. 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 sections of both the HNC and HND Engineering Systems awards. The benefit of having a separate Communication Unit is that it significantly improves the prospect of sufficient attention being given to the teaching and development of this crucial Core Skill area for engineering candidates. A separate Unit also makes it possible to ensure that the Communication Core Skill at SCQF level 6 is fully embedded within the HNC and HND Engineering Systems awards. This was considered to be a more appropriate way to ensure that this Core Skill is included in the HNC and HND 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 both awards. Other opportunities for application and development of Communication skills are embedded in the Engineering Systems: Graded Unit 2 project Unit in the HND Engineering Systems.

Aim No.	How they are met in the HNC and HND
3.2.4	<p>As noted earlier, in order to ensure a measure of consistency across various engineering disciplines a common engineering systems approach has been adopted. This common approach is achieved at HNC/1st Year HND level by developing three new HN Units; Principles of Engineering Systems, Engineering Communication and Engineering Measurement and System Monitoring. The Unit 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 Unit Engineering Communication has been developed to allow candidates to develop knowledge, understanding and skills in communicating and analysing a wide range of engineering information. The Unit Engineering Measurement and System Monitoring introduces candidates to measurement of electrical and mechanical quantities, transducer operations and typical responses produced by different engineering systems. The Unit Mathematics for Engineering 1: Mechanical and Manufacturing 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 is very useful in supporting, for example, the work on electrical ac waveforms and power within the Principles of Engineering Systems Unit.</p> <p>The focus throughout the three Units and the Mathematics for Engineering 1: Mechanical and Manufacturing core Unit 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 has developed a range of assessment exemplar materials for the four Units and is in the process of developing teaching and learning materials for these Units.</p> <p>At 2nd Year HND level studies in engineering systems are consolidated and enhanced by the introduction of the following two SCQF level 8 HN Units; Engineering Systems Analysis: System Modelling and Control and Principles of Safe Engineering Systems. The single credit Unit, Engineering Systems Analysis: System Modelling and Control introduces candidates to engineering systems modelling and control using a non-mathematical, software based approach. The single credit Unit Principles of Safe Engineering Systems introduces candidates to some of the ways in which safety can be designed into an engineering system. Such engineering systems safety considerations are examined from both a hardware and software perspective.</p>

Aim No.	How it is met in the HNC and HND
3.2.4 (cont.)	The Unit Mathematics for Engineering 2 is also included in the mandatory section of the HND Engineering Systems to provide candidates with knowledge and understanding of Calculus which will support their studies of other Units in both the mandatory and optional sections of the award. The Unit Design for Manufacture has also been included in the mandatory core of the HND because a good understanding of the engineering design process is critical to the engineering systems approach.

Aim No.	How they are met in the HNC
3.2.5	<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 HNC Engineering Systems and degree programmes.</p>
3.2.6	<p>The Communication Core Skill at SCQF Level 6 has been incorporated into the HNC Engineering Systems award through the mandatory Unit, Communication: Practical Skills. The Core Skill component Using Number at SCQF Level 6 is embedded within the mandatory Unit Mathematics for Engineering 1: Mechanical and Manufacturing or Mathematics for Engineering 1: Electronics and Electrical.</p> <p>Opportunities to develop the Core Skills Information Technology, Using Graphical Information, Problem Solving and Working with Others are signposted within individual Unit specifications. Candidates may achieve the Information Technology Core Skill at Higher level if they take the optional Unit Information Technology: Applications Software 1 in the HNC.</p>
3.2.7	<p>In designing the HNC Engineering Systems it was important that centres had flexibility in designing a single or multi-disciplinary award. This flexibility has been achieved by incorporating all the mandatory and optional Units from the following HNCs: Electronics, Electrical Engineering, Fabrication, Welding and Inspection, 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 this optional section. Therefore, a centre could choose to focus on one area of Engineering, say, by choosing 5 credits worth of Mechanical Engineering Units in the optional section of the HNC Engineering Systems award or it could choose to focus on a multi-disciplinary award by, say, selecting 3 credits worth of Electrical Engineering Units and 2 credits worth of Mechanical Engineering Units from the optional section of the HNC award. The precise choice of Units a centre makes will be dictated in large measure by the demands of its local employment market and the educational and career aspirations of its candidates.</p>

Aim No.	How they are met in the HND
3.2.8	As noted under 3.2.5 clear progression routes exist between HN Engineering awards and degree courses. It is strongly anticipated that similar progression routes will be developed between the HND Engineering Systems award and degree courses. Scottish universities have been consulted about articulation arrangements between the new HND Engineering Systems and degree programmes and they have indicated that candidates may be able to enter degrees at advance stages.
3.2.9 & 3.2.10	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, looking as it does at the changing industrial environment in which engineering technicians and incorporated engineers have to work in today. This environment is characterised by globalization of the market place leading to world-wide marketing opportunities and competitive business pressures; greater use of advanced technologies and the predominance of small and medium sized enterprises in the British economy. It is important that HND Engineering Systems candidates are suitably prepared to work in this ever-changing employment environment. The Business Awareness and Continuing Professional Development 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 now increasingly play in helping candidates to obtain sustainable and rewarding employment. Consultation with the FE sector and other interested stakeholders of HND Engineering awards has shown a strong measure of support for the Unit Business Awareness and Continuing Professional Development.
3.2.11	It has been the practice in some HND Engineering awards to include one or more practical skills Units to meet the Engineering applications needs of candidates (eg candidates coming directly from school) who have little, or no, practical skills. Given the multi-disciplinary nature of the HND Engineering Systems award, it is important that candidates develop practical skills in a range of engineering disciplines. Thus, a 2 credit Unit, Engineering: Practical Skills has been included in the HND Engineering Systems award, and as an option in the HNC Engineering Systems to allow candidates to develop any two of the following five mechanical based skills: fitting, turning, milling, sheet metalwork or welding. Candidates will also develop practical skills in electrical and electronics. Candidates who have some or all of the skills specified in the Unit may seek credit for part, or all, of the Unit using credit transfer or centre based APL or assessment on demand arrangements.

Aim No.	How they are met in the HND
3.2.12	<p>Many engineering technicians and incorporated engineers are increasingly involved in some capacity in large scale project work. Evidence from market research indicates that candidates lack critical planning and organisational skills which are central to the effective management and operation of a project. It has been recognised that there is a need to develop these skills by including in the mandatory section of the HND Engineering Systems a 2 credit Unit entitled Project Management: Managing the Implementation of a Project (the development of these skills will, of course, also take place when candidates do the Engineering Systems: Graded Unit 2 Project). The Project Management Unit contains Outcomes in managing project relationships, controlling a project budget, monitoring and controlling a project, managing risks and evaluating and closing a project.</p>
3.2.13	<p>As was noted earlier, a critical aspect of award design was to produce HNC and HND qualifications which allow centres flexibility in designing a single or multi-disciplinary engineering award. With regard to the HND Engineering Systems, flexibility has been achieved by incorporating all the mandatory and optional Units from the following HNC and HND awards: Electronics, Electrical Engineering, Engineering Practice, Fabrication, Welding and Inspection, Manufacturing Engineering, Mechanical Engineering, Mechatronics and Petroleum Engineering within the optional section of the HND Engineering Systems award and allowing centres to choose any twelve credits of Units from this optional section. Therefore, a centre could choose to focus on one area of Engineering, say, by choosing 12 credits of Mechanical Engineering Units or it could choose to deliver a multi-disciplinary award by, say, selecting 5 credits of Electrical Engineering Units, 5 credits of Mechanical Engineering Units, a 1 credit Electronics Unit and a 1 credit Fabrication, Welding and Inspection Unit. The precise choice of Units a centre makes will be dictated in large by the demands of its local employment market and the educational and career aspirations of its candidates.</p>

Aim No.	How it is met in the HND
3.2.14	<p>The Communication Core Skill at SCQF level 6 has been incorporated into the HND Engineering Systems award through the mandatory Unit, Communication: Practical Skills. The Core Skill component Using Number at SCQF level 6 is embedded within the mandatory core Units: Mathematics for Engineering 1: Mechanical and Manufacturing, Mathematics for Engineering 1: Electronics and Electrical and Mathematics for Engineering 2. The Core Skill of Problem Solving at SCQF level 6 is embedded in the Engineering Systems: Graded Unit 2.</p> <p>The opportunity to achieve the Core Skill Information Technology at SCQF level 6 is available if candidates take the Unit Information Technology: Applications Software 1 in the optional section of the HND Engineering Systems award. Likewise the opportunity to achieve the Core Skill Working with Others is available if candidates take the Unit, Employment Experience 2 within the optional section of the HND Engineering Systems award.</p> <p>Opportunities to develop Core Skills and Core Skills components are signed posted in all the Units in the HND Engineering Systems award.</p>

3.5 Target Groups

Full-time HNC and HND 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 or re-entering the job market. The HNC Engineering Systems would normally be offered as the core part of a first year HND Engineering Systems programme of study.

Alternatively, candidates at HNC and HND Engineering Systems levels 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 HND represents a natural extension of studies at HNC level. The Units required for candidates to upgrade their HNC to an HND Engineering Systems may also be studied on a part-time basis by a number of different modes of delivery: for example, day-release, block-release, evening attendance etc.

Employed candidates may choose the types of engineering systems studied as part of the core and optional Units in both the HNC and HND to reflect the branch of industry in which they are employed or, alternatively, the engineering systems may be chosen to allow candidates 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 and HND awards to gain entry to the advanced stages of degree level programmes.

3.6 Employment Opportunities

For information on employment opportunities please see Aims 3.1.1 in Section 3.3 and Aim 3.2.1 in Section 3.4.

4 Access to awards

4.1 Access requirements

Admission to the HNC and HND Engineering Systems awards 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. 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 one of the following:

HNC and HND

- ◆ one Higher from Physics, Technological Studies, Mechatronics or Mathematics and at least three Standard Grades 1–2/Intermediate 2 passes including Mathematics, Physics/Technological Studies and English.
- ◆ a National Certificate Group Award in Engineering, Electrical Engineering, Electronic Engineering or Fabrication and Welding
- ◆ qualifications 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

Direct entry to the HND

- ◆ An HNC Engineering Systems*
- ◆ An HNC in Electronics, or Electrical Engineering, or Engineering Practice, or Fabrication, Welding and Inspection, or Manufacturing Engineering, or Mechanical Engineering or Mechatronics or HNC Petroleum Engineering *. Candidates coming through one of these award routes will be best served by having studied the Units, Principles of Engineering Systems, Engineering Communication and Engineering Measurement and System Monitoring together with a suitable breadth of mathematics at SCQF level 6 (see also Figure 5.2 (a)).

**Candidates would already have 12 Unit credits towards the HND Engineering Systems award (see Figure 5.1).*

4.2 Core Skills Entry Profile

The recommended Core Skills entry profile for both the HNC and HND 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) |

4.3 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.

4.4 Candidates who have English as an additional language

A Unit, Workplace Communication in English has been included in the optional section of both the HNC and HND Engineering Systems awards to support those candidates for whom English is an additional language.

5 Award structures

Renewable Energy Systems options

Introduction

Most experts believe that the gases released when fossil fuels are burnt to produce energy are contributing towards changes in world climate and global warming. One way of reducing dependency on fossil fuels is to make greater use of Renewable Energy Systems technologies such as wind farms, hydroelectric schemes, wave and tidal barriers and solar energy conversion. Such technologies are certainly making a greater contribution to energy production across the world and particularly in Scotland.

A PDA in Renewable Energy Systems comprising of ten Higher National Units in Renewable Energy Systems have been designed to provide candidates with knowledge and understanding of current and future trends in energy production, sustainability and energy conservation issues and the role that Renewable Energy Systems technologies may play in meeting energy demands and in limiting global environmental damage. Two of these Units have been added as options to the HNC Engineering Systems framework and all ten have been added as options to the HND Engineering Systems framework (See tables 5(a) and 5(b).

These Units and the PDA award will allow candidates to gain a broad knowledge and understanding of the physics and engineering of many Renewable Energy Systems technologies so that they can make accurate, valid comparisons between renewable technologies when solving energy related problems. Candidates will also be able to specialise in more depth in at least two specialist areas of Renewable Energy Systems by studying from optional Units in Biomass, Geothermal Energy, Hydroelectricity, Hydrogen, Microgeneration, Solar, Wave and Tidal Power or Wind Power.

Technological context

Some renewable technologies are now well established (although new innovations are still being introduced into these technologies) whereas others are still under active research and development (eg hydrogen/fuel cell technology, wave and tidal systems etc). This has been taken into account in the writing of the Renewable energy Systems Units. The Units will have to be kept under regular review to take account of technological developments and the changing political, economic and social context.

Social-Economic context

Social-economic aspects of Renewable Energy Systems have been considered in the Units. For example, in the Unit Renewable Energy Systems: Overview of Energy Use candidates are encouraged to investigate the social economic consequences of current energy supplies and trends (with, for example, the quantity of fossil fuels predicted to drop over the next century) not matching demand. They will also be able to analyse how alternative, clean, sustainable sources of energy can be used to meet a significant part of the demand for energy while contributing to the reduction in climate change and global warming. The Unit Renewable Energy Systems: Hydroelectricity includes a consideration of the social and economic benefits of existing hydroelectric schemes including job creation and leisure opportunities. There is also scope to consider the benefits of Renewable Energy Systems generation in small communities. For example, the formal assessment task for the Unit Renewable Energy Systems: Microgeneration may be applied to a small community building.

Structure changes

Table 5(a) Optional Units added to HNC Engineering Systems

Credit value	SCQF level	Product code	Product title
2	7	F1YL 34	Renewable Energy Systems: Overview of Energy Use
1	7	F1YK 34	Renewable Energy Systems: Microgeneration Systems

Table 5(b) Optional Units added to HND Engineering Systems

Credit value	SCQF level	Product code	Product title
2	7	F1YL 34	Renewable Energy Systems: Overview of Energy Use
2	8	F1YN 35	Renewable Energy Systems: Technology
1	8	F1YG 35	Renewable Energy Systems: Biomass
1	8	F1YH 35	Renewable Energy Systems: Geothermal Energy
1	8	F1YJ 35	Renewable Energy Systems: Hydroelectricity
1	8	F1YF 35	Renewable Energy Store: Hydrogen
1	7	F1YK 34	Renewable Energy Systems: Microgeneration Systems

Credit value	SCQF level	Product code	Product title
1	8	F1YM 35	Renewable Energy Systems: Solar
1	8	F1YP 35	Renewable Energy Systems: Wave and Tidal Energy
1	8	F1YR 35	Renewable Energy Systems: Wind Power

Progression

The PDA in Renewable Energy Systems (G8LP 48) is comprised of the ten Renewable Energy Systems Units in table 5(b) above. While completion of the HNC or HND in Engineering Systems is one of the recommended entry routes to the PDA in Renewable Energy Systems, completion of the two PDA mandatory Units — Renewable Energy Systems: Overview of Energy Use and Renewable Energy Systems: Technology — or any two of the optional Units would contribute directly to the completion of the PDA.

For further details of the PDA in Renewable Energy Systems (G8LP 48) please see the post validation document which is available on the SQA website www.sqa.org.uk.

5.1 HNC Engineering Systems Award Structure

The structure of the HNC 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, as explained earlier, the HNC does **not** fit precisely into the overarching HN Engineering award structure.

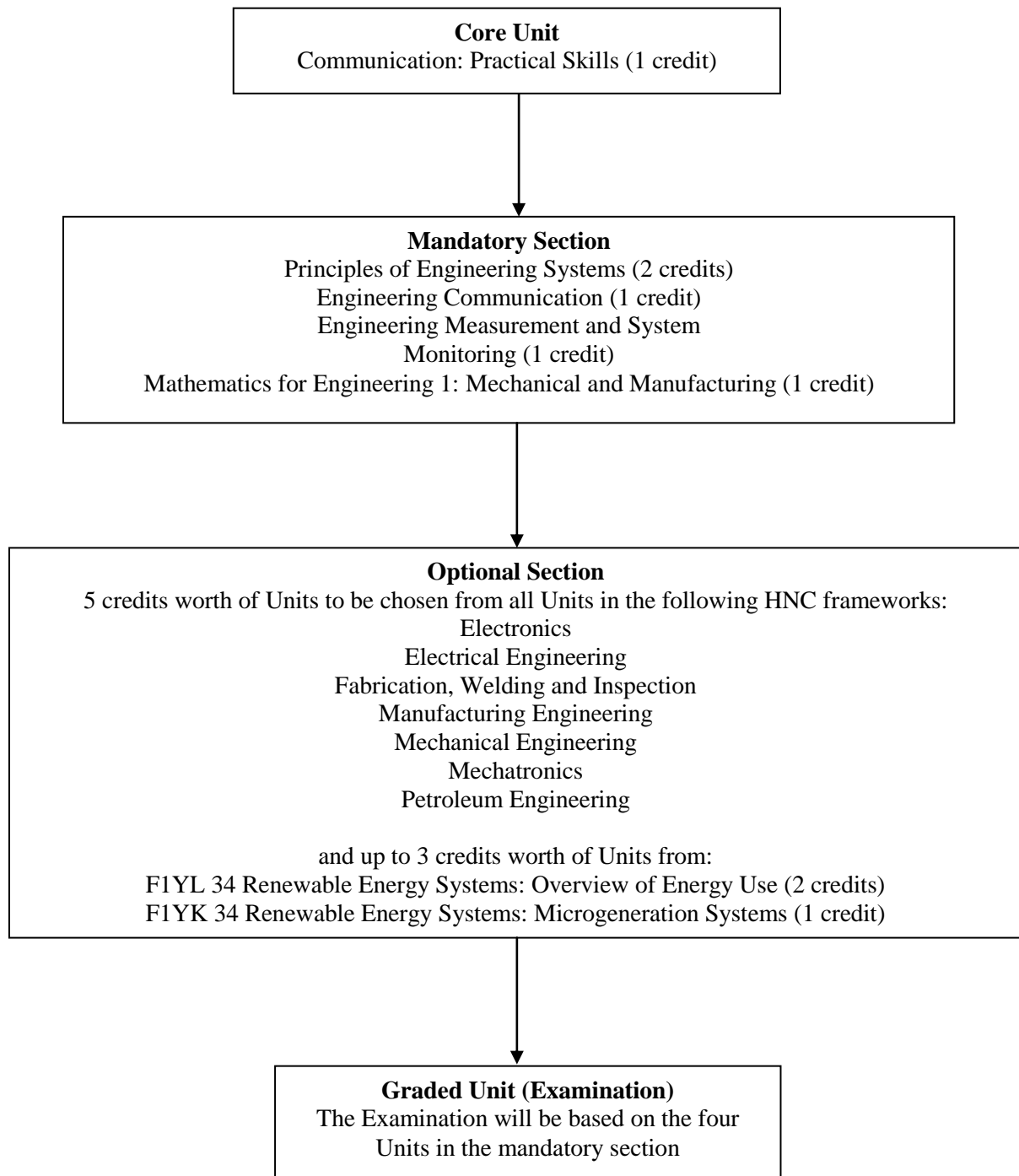


Figure 5.1 HNC Engineering Systems Award Structure

5.2 HND Engineering Systems Award Structure

The reader may find it helpful to study Figure 5.2 (a) on the following page in order to understand the structure of the HND Engineering Systems award.

With regard to Figure 5.2 (a) the following should be noted.

- (1) The HND builds on the engineering systems approach developed as part of the HNC Engineering Systems. All HNC Engineering Systems Units are included in the HND framework.
- (2) Entry to the HND can be either via the HNC Engineering Systems award or by any of the HNC Engineering awards shown on the left-hand side of the diagram in Figure 5.2 (a). It is advised that any candidate pursuing the latter award route should have the bridging Units and level of mathematics shown in Figure 5.2 (b).
- (3) A centre delivering the HNC Engineering Systems followed by the HND Engineering Systems will be able to select 12 optional Unit credits from the mandatory and optional sections of the following individual HNC and HND Engineering awards: Electronics, Electrical Engineering, Engineering Practice, Fabrication, Welding and Inspection, Manufacturing Engineering, Mechanical Engineering and Mechatronics, Petroleum Engineering (see Figure 5.2 (c)).
- (4) A centre that decides to allow its candidates to progress from one or more of the HNC Engineering awards on the left-hand side of the diagram in Figure 5.2 (a) will be able to follow the award route shown below:
 - (a) 12 Unit credits from the HNC Engineering award achieved.
 - (b) 16 Unit credits from the HND mandatory section. The number of Unit credits is only 16 because Communication: Practical Skills is included in all HNC Engineering awards and the Graded Unit 1 Examination in any of the HNC Engineering awards will be regarded as equivalent to the Engineering Systems: Graded Unit 1 Examination. The number of HND mandatory Units a candidate has to study is illustrated in the following example. A candidate who has successfully achieved an HNC Mechanical Engineering will have passed the following Units in the HND mandatory section: Communication Practical Skills, the Mechanical Engineering: Graded Unit 1 and Mathematics for Engineering 1: Mechanical and Manufacturing Thus, the candidate will only have to take 15 Unit credits in the HND Engineering Systems mandatory section.
 - (c) 2 optional Unit credits plus any of the Unit credits in the HND that have already been achieved in the HNC in (a). In the case of the HNC Mechanical Engineering the candidate will be able to study three optional Unit credits.

Figure 5.2 (a): Block Diagram of the HND Engineering Systems Framework

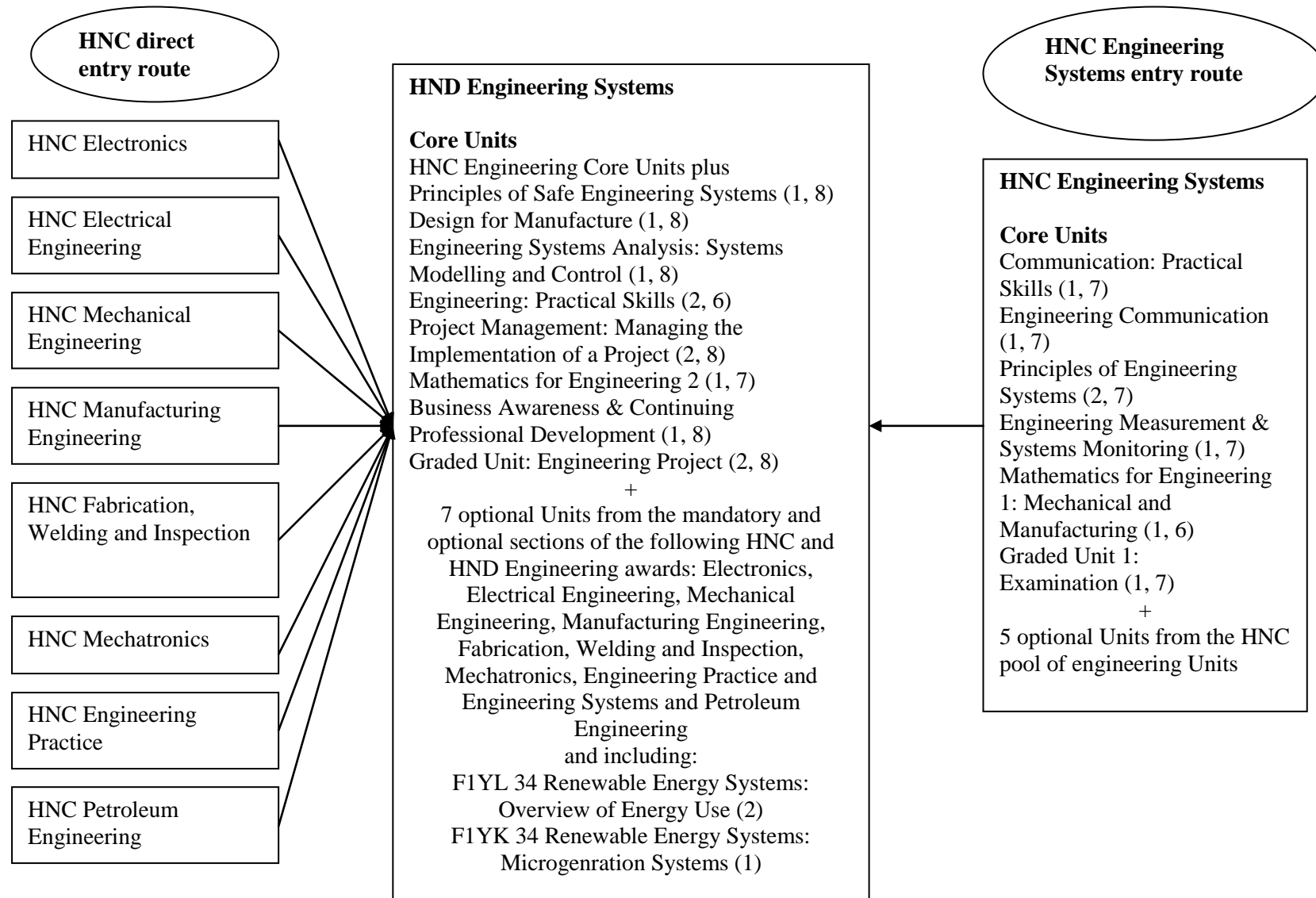


Figure 5.2 (b): Block Diagram of the HND Engineering Systems Framework — Bridging Units

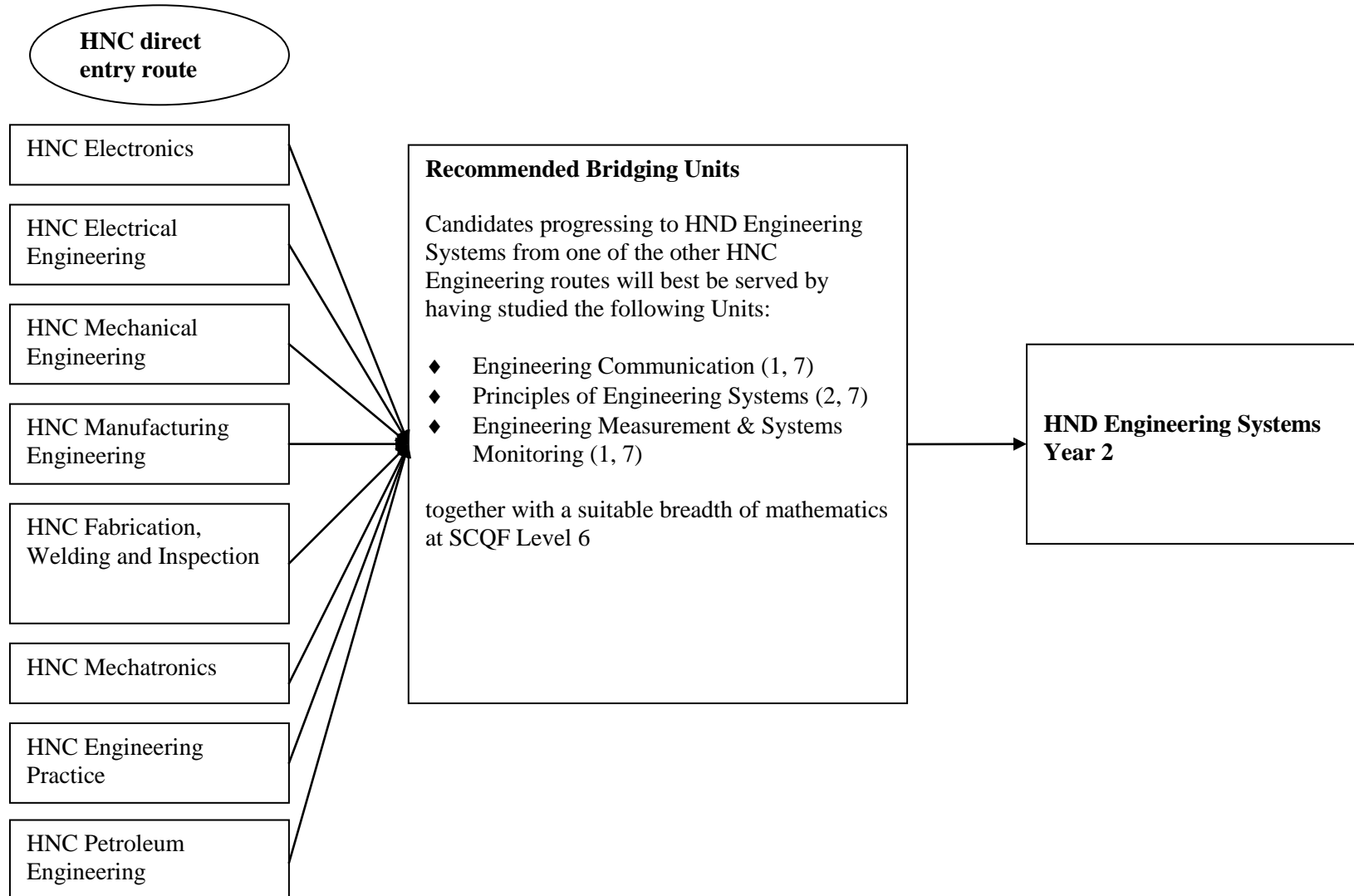
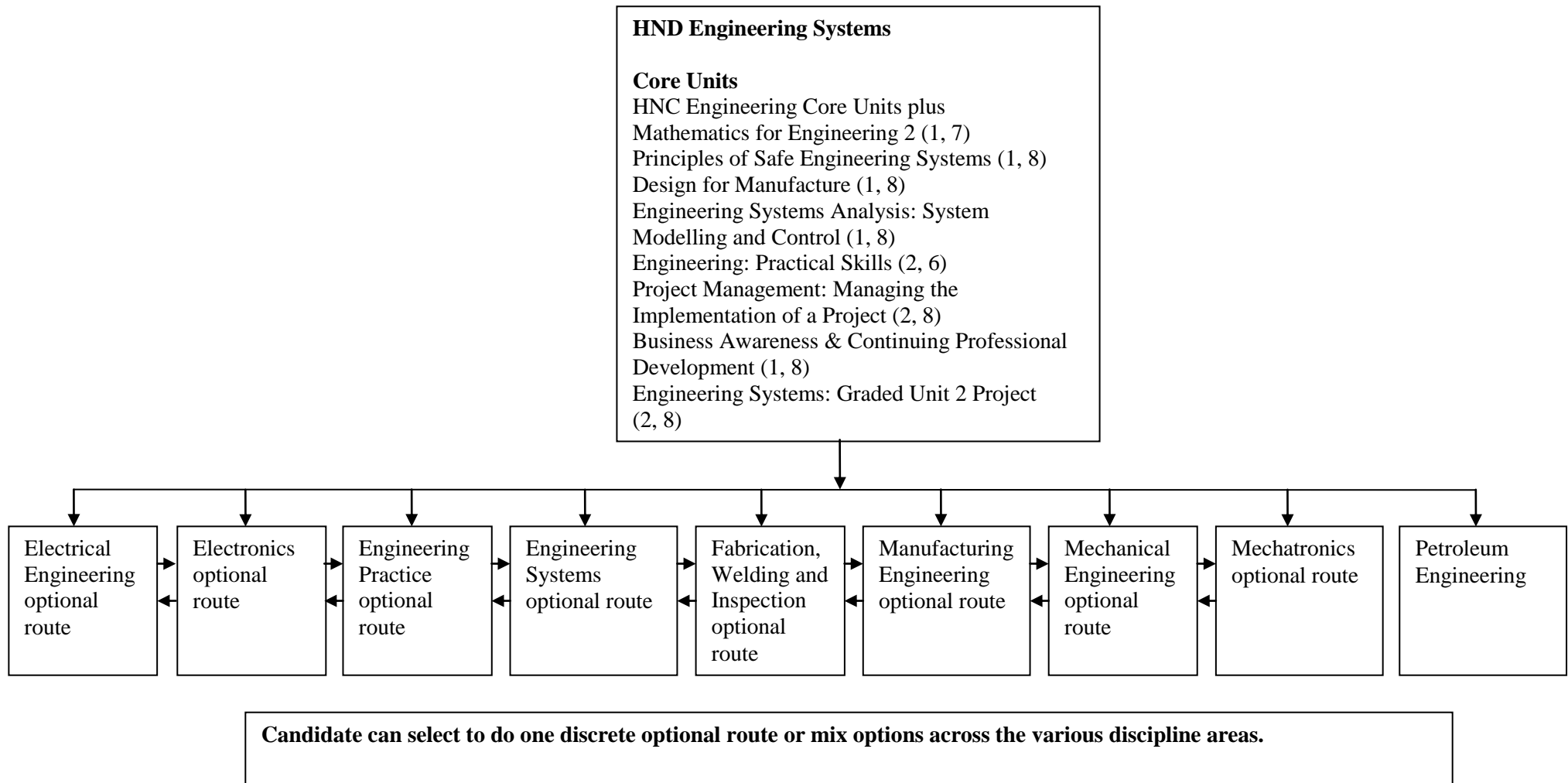


Figure 5.2 (c): Block Diagram of the HND Engineering Systems framework showing optional routes



5.3 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	H7MB 34*	Communication: Practical Skills
Mandatory (5 Credits)	1	6	H7K0 33*	Engineering Mathematics 1
	2	7	DV9R 34	Principles of Engineering Systems
	1	7	DV9N 34	Engineering Communication
	1	7	DV9P 34	Engineering Measurement and Systems Monitoring

Graded Unit (1 Mandatory Credit)

Credit value	SCQF level	Product code	Product title
1	7	H2VY 34*	Engineering Systems: Graded Unit 1

*Refer to History of Changes for revision changes.

Optional Units (maximum of 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	Materials Selection
1	7	H7K1 34*	Engineering Mathematics 2
1	7	DG59 34	MCU/MPU Assembly Language Programming
1	7	DT9X 34	Pneumatics and Hydraulics
2	8	H292 35*	Manufacturing: 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	(finishes 31/07/2013) FY9E 34	OR DC and AC Principles
1	7	DR1T 34	Statics and Strength of Materials
1	7	DE3R 34	Personal Development Planning

Credit value	SCQF level	Product code	Product title
1	7	H8T2 33*	Workplace Communication in English
2	7	F1YL 34	Renewable Energy Systems: Overview of Energy Use
1	7	F1YK 34	Renewable Energy Systems: Microgeneration Systems
1	7	H4J5 34*	Energy Overview

*Refer to History of Changes for new revision changes.

Credit value	SCQF level	Product code	Product title
Electrical			
2	6	F1BX 33 <i>(finishes 31/07/2013)</i>	Engineering Practical Skills OR
2	6	H0ET 33	Engineering Practical Skills
1	6	DN48 33 <i>(finishes 31/07/2013)</i>	Application of Electrical and Electronic Instruments OR
1	6	H03B 33	Application of Electrical and Electronic Instruments
1	7	DN4H 34	Electrical Installation Skills
2	7	DN4J 34 <i>(finishes 31/07/2013)</i>	Electrical Machine Principles OR
2	7	H01T 34	Electrical Machine Principles
1	7	DN4L 34 <i>(finishes 31/07/2013)</i>	Electrical Safety OR
1	7	H01V 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	FINH 34	Project Management: An Introduction
1	7	DN41 34	Inspection and Testing of Low Voltage Electrical Installations
1	7	DN42 34 <i>(finishes 31/07/2013)</i>	Power Electronics OR
1	7	FY9R 34	Power Electronics
1	8	DN45 35	Three Phase Induction Motors
1	7	DN47 34	Three Phase Systems
Electronics			
2	7	DG2X 34 <i>(finishes 31/07/2013)</i>	Analogue Electronic Principles OR
2	7	FY9T 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

Credit value	SCQF level	Product code	Product title
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	DT6I 34	Plastic Component Manufacture
1	7	DT9P 34	Thermofluids
Mechatronics			
1	7	DW8T 34	Mechatronic Systems Elements
1	8	DW8R 35	Mechatronic Systems
1	7	DW8P 34	Interfacing Electronics
1	6	DW6W 33	Electrical Engineering Principles 1
1	8	DT9W 35	Applied Industrial Plant Maintenance
1	7	DW8W 34	Robotics and Animatronics: An Introduction

5.4 HND Engineering Systems Award Table

Group Award: G8G5 16

30 Unit credits

Mandatory Units (15 Credits)

Section	Credit value	SCQF level	Product code	Product title
Common Core	1	7	H7MB 34*	Communication: Practical Skills
	1	8	DG3D 35	Business Awareness and Continuing Professional Development
Mandatory Section (13 Credits)	1	6	H7K0 33*	Engineering Mathematics 1
	1	7	H7K1 34*	Engineering Mathematics 2
	2	7	DV9R 34	Principles of Engineering Systems
	1	7	DV9N 34	Engineering Communication
	1	7	DV9P 34	Engineering Measurement and System Monitoring
	1	8	F1BY 35	Principles of Safe Engineering Systems
	1	8	DR3M 35	Design for Manufacture
	1	8	F1BV 35	Engineering Systems Analysis: System Modelling and Control
	2	6	F1BX 33 <i>(finishes 31/07/2013)</i>	Engineering Practical Skills
	2	6	H0ET 33	OR Engineering Practical Skills
2	8	DV5J 35	Project Management: Managing the Implementation of a Project	

*Refer to History of Changes for new revision changes.

Graded Unit (3 Mandatory Credits)

Credit value	SCQF level	Product code	Product title
1	7	H2VY 34* OR DG2T 34 OR DN3V 34 OR DW92 34 OR DR37 34 OR DV13 34 OR DV11 34 OR DX3H 34 OR F546 34	Engineering Systems: Graded Unit 1 OR Electronics: Graded Unit 1 OR Electrical Engineering: Graded Unit 1 OR Engineering Practice: Graded Unit 1 OR Fabrication, Welding and Inspection: Graded Unit 1 OR Manufacturing Engineering: Graded Unit 1 OR Mechanical Engineering: Graded Unit 1 OR Mechatronics: Graded Unit 1 OR Petroleum Engineering: Graded Unit 1
2	8	F1E8 35	Engineering Systems: Graded Unit 2

Optional Units (maximum of 12 Credits)

Credit value	SCQF level	Product code	Product title
Cross-Discipline			
1	6	DN46 33	Analogue Electronics: An Introduction
1	8	DT9W 35	Applied Industrial Plant Maintenance
1	6	DN48 33 <i>(finishes 31/07/2013)</i>	Applications of Electrical and Electronic Instruments OR
1	6	H03B 33	Applications of Electrical and Electronic Instruments
1	7	DG31 34	Applications of Programmable Logic Controllers
1	7	DR1X 34	Computer Aided Draughting for Engineers
1	7	DT5P 34	CNC
1	7	DR23 34	Containers: Design and Manufacture
1	8	DN4D 35	Control Systems Behaviour
1	7	DN4E 34	Digital Electronics
1	7	DT9T 34	Dynamics
1	7	DT5R 34	Economics of Manufacture
1	6	DW6W 33	Electrical Engineering Principles 1
1	7	DW6X 34	Electrical Engineering Principles 2
2	7	DN4J 34 <i>(finishes 31/07/2013)</i>	Electrical Machine Principles OR
2	7	H01T 34	Electrical Machine Principles
1	8	DN4K 35	Electrical Motor Drive Systems
1	7	DG3G 34	Electrical Networks and Resonance
1	7	DN4L 34 <i>(finishes 31/07/2013)</i>	Electrical Safety OR
1	7	H01V 34	Electrical Safety

Optional Units (maximum of 12 Credits)

Credit value	SCQF level	Product code	Product title
Cross-Discipline (continued)			
1	7	DG3N 34	Electronic Testing Skills
1	7	D77H 34	Employment Experience 2
1	7	DR1W 34	Engineering Drawing
1	7	DT9R 34	Engineering Measurement
1	7	DR3L 34	Engineering Principles
2	7	DR1V 34	Engineering Skills
1	7	DW8N 34	Engineering Systems Interfaced with Programmable Logic Controllers
1	7	DR2C 34	Fabrication: Preparation, Joining and Assembly
1	7	DN3Y 34	Fundamentals of Control Systems and Transducers
1	7	DG58 34	High Level Engineering Software
1	8	DG5A 35	High Level Language: External I/O Transfer
1	7	DG40 34	Implementing Small Local Area Networks
1	7	DN40 34	Industrial Plant Maintenance
1	8	DT5V 35	Industrial Systems
1	7	D75X 34	Information Technology: Applications Software 1
1	7	DN41 34	Inspection and Testing of Low Voltage Electrical Installations
1	7	DR26 34	Inspection Systems
1	7	DT46 34	Material Selection
2	8	DG4P 35	Mathematics for Engineering 3
1	7	DG59 34	MCU/MPU Assembly Language Programming
1	8	DG5C 35	MCU/MPU I/O Hardware Control
1	7	DT5Y 34	Metal Component Manufacture
1	8	DG4X 35	Microprocessor and Microcontroller Technology
1	7	DE3R 34	Personal Development Planning
1	7	DT61 34	Plastic Component Manufacture
1	7	DT9X 34	Pneumatics and Hydraulics
1	7	DN42 34	Power Electronics
1	7	<i>(finishes 31/07/2013)</i> FY9R 34	OR Power Electronics
2	8	H292 35*	Manufacturing: Process and Equipment Selection
1	8	H1KS 35*	Production Planning and Control
1	7	A6AX 34	Project Management
1	7	F1NH 34	Project Management: An Introduction
1	8	DV5H 35	Project Management: Project Justification and Planning
1	7	DT8Y 34	Quality Management: An Introduction
1	8	DT9Y 35	Robotic Systems
1	7	DR2D 34	Safety Engineering and the Environment

*Refer to History of Changes for new revision changes.

Credit value	SCQF level	Product code	Product title
Cross-Discipline (continued)			
1	7	DG54 34 <i>(finishes 31/07/2013)</i>	Single Phase AC Circuits
1	7	FY9E 34	OR DC and AC Principles
1	7	DR1T 34	Statics and Strength of Materials
1	7	DN47 34	Three Phase Systems
1	8	DG57 35	Transmission Lines and Complex Waves
1	7	DR2G 34	Welding: Principles and Applications 1
1	7	DR24 34	Welding Procedures: Specification, Qualification and Testing
1	6	H8T2 33*	Workplace Communication in English
3	7	DG6E 34	Work Role Effectiveness (2003)
3	8	DG6G 35	OR Work Role Effectiveness (2003)
1	8	DG50 35	Power Supply Circuits
1	8	F1YF 35	Renewable Energy Store: Hydrogen
1	8	F1YG 35	Renewable Energy Systems: Biomass
1	8	F1YH 35	Renewable Energy Systems: Geothermal Energy
1	8	F1YJ 35	Renewable Energy Systems: Hydroelectricity
1	7	F1YK 34	Renewable Energy Systems: Microgeneration Systems
2	7	F1YL 34	Renewable Energy Systems: Overview of Energy Use
1	8	F1YM 35	Renewable Energy Systems: Solar
2	8	F1YN 35	Renewable Energy Systems: Technology
1	8	F1YP 35	Renewable Energy Systems: Wave and Tidal Energy
1	8	F1YR 35	Renewable Energy Systems: Wind Power
1	8	FJ3D 35	Energy: Nuclear Power and the Environment
1	7	H4J5 34*	Energy Overview
1	8	H4J6 35*	Energy Technologies
1	7	H7K2 34*	Engineering Mathematics 3
1	8	H7K3 35*	Engineering Mathematics 4
1	8	H7K4 35*	Engineering Mathematics 5
Electrical Engineering			
1	8	DN4C 35	Applications of Power Electronics in Electrical Motor Drive Systems
1	8	DN4F 35 <i>(finishes 31/07/2013)</i>	Electrical Installation Design
1	8	FY7L 35	OR Electrical Installation Design
1	8	DN4G 35	Electrical Installation Design: Computer Aided
1	7	DN4H 34	Electrical Installation Skills
1	8	DN4M 35	Electrical Standby Systems
1	7	DN3T 34	Electrical Systems in Potentially Explosive and Gas Hazardous Environments
1	7	DN3W 34	Electricity Power Systems
1	8	DN43 35	Switchgear and Protection of High Voltage Systems
1	8	DN44 35	Synchronous Machines
1	8	DN45 35	Three Phase Induction Motors
1	8	DN49 35	Transformers
1	8	DN4A 35	Utilisation of Electrical Energy in Buildings

*Refer to History of Changes for revision changes.

Credit value	SCQF level	Product code	Product title
Electronics			
1	8	DG2W 35	Active Electronic Circuits
2	7	DG2X 34	Analogue Electronic Principles
2	7	<i>(finishes 31/07/2013)</i> FY9T 34	OR Analogue Electronic Principles
1	8	DG35 35	Applications of Signal Processing and Conditioning
1	7	DG3C 34	Combinational Logic
1	7	DG3H 34	Electronic Construction Skills
1	8	DG3J 35	Electronic Fault Finding
1	8	DG3P 35	Field Programmable Gate Arrays
1	8	DG4Y 35	MSI Devices
1	7	DG51 34	Printed Circuit Board Design, Manufacture and Test
1	8	DG52 35	Programmable Logic Devices
1	7	DG53 34	Sequential Logic
1	8	DG55 35	Systems Integration
1	8	DG56 35	Telecommunications Fundamentals
Engineering Practice			
1	6	DV9H 33	Advanced Pattern Development: An Introduction
1	7	DW6V 34	Alternative Machining Operations
1	7	DW8G 34	Computer Integrated Manufacture
1	7	DV9J 34	Electrical Design Systems: An Introduction
1	7	DV9K 34	Electrical Installation Design (Computer Aided): An Introduction
1	7	DV9M 34	Electrical Motors and Motor Starting
1	7	DW7R 34	Engineering Supervision: Staff and Budget Issues
1	7	DW7I 34	Engineering Supervision: Teamworking and Continuing Professional Development
1	6	DW8F 33	Fundamental Electronic Components, Devices and Applications
1	7	DV9L 34	Lighting Design in Buildings
1	7	DV9G 34	Mechanical Engineering Principles
1	7	DW7M 34	Plant Systems: Services
1	7	DW7N 34	Plant Systems: Utilities
1	7	DW7K 34	Value Engineering
Engineering Systems			
1	8	F1BW 35	Engineering Systems Analysis: Non-Linearities and Control Strategies

Credit value	SCQF level	Product code	Product title
Fabrication, Welding and Inspection			
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	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	DR1Y 34	Welding: Principles and Applications 2
Manufacturing			
2	8	DR1R 35	Computer Aided Engineering (CAE) and Prototyping
1	8	DT5N 35	Facilities Layout and Analysis
1	8	D7CY 35	Information Technology: Applications Software 2
1	8	DT5W 35	Jig and Fixture Design
1	8	DV00 35	Simulation of Advanced Manufacturing Systems
1	8	DT64 35	Tool Design
Mechanical			
1	8	DT5T 35	Heat Transfer and Fluid Mechanics
1	8	DT9V 35	Heating, Ventilation and Air Conditioning Practice and Design
2	8	DT60 35	Plant Systems
1	8	DV01 35	Strength of Materials: Advanced
1	7	DT9P 34	Thermofluids
Mechatronics			
1	8	DW8M 35	Engineering Design Process: Mechatronics
1	7	DW8T 34	Mechatronic Systems Elements
1	8	DW8R 35	Mechatronic Systems
1	7	DW8P 34	Interfacing Electronics
1	7	DW8W 34	Robotics and Animatronics: An Introduction
1	8	DW8V 35	Robotics and Animatronics
Petroleum			
1	7	DP9M 34	Science Industry: Key Issues
1	7	F52Y 34	Petroleum Engineering: Physics, Mathematics and Chemistry
1	7	F530 34	Petroleum Geology and Geophysics: An Introduction
1	7	F533 34	Petroleum Reservoir Engineering: An Introduction
1	7	F52X 34	Oilfield Drilling Techniques and Operations: An Introduction
1	6	DX29 33	Fundamental Chemistry: An Introduction
2	7	DH2K 34	Fundamental Chemistry: Theory and Practice
1	7	DX49 34	Engineering Science Principles
1	7	HE3F 34*	Process Safety Engineering
1	7	F2G8 34	Environmental Awareness
1	7	DX4A 34	Fire and Gas Detection
1	8	F52T 35	Oil Well Management
1	8	F531 35	Petroleum Production Processes

*Please refer to History of Changes

5.5 Conditions of the Award

5.5.1 HNC Engineering Systems

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 table shown in Section 5.3. More specifically the HNC award structure requires that candidates achieve the following:

- ◆ the 1 Unit credit Communication: Practical Skills
- ◆ the 5 Unit credits from the mandatory section of the award structure table shown in Section 5.3
- ◆ 5 Unit credits from the optional section of the award structure table shown in Section 5.3
- ◆ Engineering Systems: Graded Unit 1

5.5.2 HND Engineering Systems

The conditions of award for HND Engineering Systems qualifications are as follows:

A candidate will be awarded an HND Engineering Systems on successful completion of 27 Unit credits plus 3 Graded Unit credits based on the HND Engineering Systems award table shown in Section 5.4. More specifically the HND award structure requires that candidates achieve the following:

- ◆ the 15 Unit credits from the mandatory section of the award structure table shown in Section 5.4
- ◆ 12 Unit credits from the optional section of the award structure table shown in Section 5.4
- ◆ the 1-credit Engineering Systems: Graded Unit 1 or any of the other Engineering Graded Unit 1 shown in the award structure in Section 5.4
- ◆ the 2-credit Engineering Systems: Graded Unit 2

5.6 Core Skills Exit Profile

5.6.1 Core Skills Exit Profile

HNC Engineering Systems

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)

5.6.2 HND Engineering Systems

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

- ◆ Communication SCQF level 6
(fully embedded in the Unit, Communication: Practical Skills)
- ◆ Using Number SCQF level 6
(fully embedded in the Units Mathematics for Engineering 1: Mechanical and Manufacturing, Mathematics for Engineering 1: Electronics and Electrical, Mathematics for Engineering 2)
- ◆ Problem Solving SCQF level 6
(fully embedded in the Unit, Engineering Systems: Graded Unit 2)

Unit writers have also identified within the individual core HNC and HND Engineering Systems Units opportunities to develop Core Skills. These development opportunities are summarised in Table 5.6.

5.7 Mapping Information

Information on the way in which individual Units map into the aims of the awards can be found in the tables in Sections 3.3 and 3.4.

Table 5.6 HNC and HND Engineering Systems Core Engineering Units — Core Skills Development Opportunities

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

	Communication			Numeracy		Using Information Technology	Problem Solving			Working with Others
Unit Title	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	SCQF level 6		SCQF level 5		SCQF level 5	SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 5
Engineering Communication			SCQF level 6		SCQF level 6	SCQF level 6	SCQF level 6			
Engineering Measurement and System Monitoring		SCQF level 6				SCQF level 6	SCQF level 6			
Design for Manufacture		SCQF level 6	SCQF level 6				SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6

	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
Unit Title	Read	Write	Oral	Using Number	Using Graphical Info.	Using Information Technology	CT	P&O	R&E	Working with Others
Principles of Safe Engineering Systems	SCQF level 6	SCQF level 6		SCQF level 5		SCQF level 5	SCQF level 6	SCQF level 6	SCQF level 6	
Engineering Systems Analysis: System Modelling and Control						SCQF level 6	SCQF level 6			
Engineering: Practical Skills					SCQF level 6		SCQF level 6		SCQF level 6	SCQF level 5
Project Management: Managing the Implementation of a Project	SCQF level 6	SCQF level 6	SCQF level 6				SCQF level 6	SCQF level 6	SCQF level 6	SCQF level 6

	Communication			Numeracy		Information Technology	Problem Solving			Working with Others
Unit Title	Read	Write	Oral	Using Number	Using Graphical Info.	Using Information Technology	CT	P&O	R&E	Working with Others
Engineering Systems: Graded Unit 2	SCQF level 6	SCQF level 6	SCQF level 6				Embedded	Embedded	Embedded	SCQF level 6

5.8 Articulation, professional recognition and credit transfer

5.8.1 Articulation

A number of universities in Scotland were contacted regarding possible articulation routes between the HNC and HND Engineering Systems and various degree courses offered by these universities. In general terms, successful HNC and HND candidates can enter degree programmes at an advanced stage subject to individual centre/university articulation arrangements. Mathematics Units are available in the HNC and HND frameworks to support progression to university.

5.8.2 Professional Body Recognition

The Institution of Engineering and Technology (IET) was consulted about the status of the HNC and HND Engineering Systems awards with regard to future membership of the IET. The IET has advised that the HNC and HND Engineering Systems awards partially meet the academic requirements for registration as an Incorporated Engineer and meet the academic underpinning requirements for registration as an Engineering Technician.

5.8.3 Credit Transfer

The following Units are new in concept and have no equivalent in the current HN Engineering or Management frameworks: Engineering Communication, Principles of Engineering Systems, Engineering Measurement and System Monitoring, Principles of Safe Engineering Systems, Engineering Systems Analysis: System Modelling and Control and Project Management: Managing the Implementation of a Project.

A candidate can achieve partial credit for the Communication: Practical Skills Unit if she/he possesses the Unit Communication: Presenting Complex Communication for Vocational Purposes (or equivalent). (Please note that the latter Unit embeds only the **Oral Communication** component of the Communication Core Skill.

A candidate may achieve partial or full credit transfer for the Unit Mathematics for Engineering 1: Mechanical and Manufacturing or the Unit Mathematics for Engineering 1: Electronic and Electrical depending on which HN Mathematics Unit(s) she/he possesses.

It is possible that a candidate may achieve partial credit transfer, but is unlikely to achieve full credit transfer for the Unit Engineering: Practical Skills because this Unit covers a number of distinct engineering practical skill areas and most candidates are unlikely to have studied all of these areas. For example, a candidate may have specialised in mechanical fitting and turning but may not have done any practical work in electrical installation or electronics. Such a candidate may be given credit transfer for Outcomes 1 in the Engineering: Practical Skills Unit. A candidate with electrical installation or electronics practical skills may be given credit transfer for part of Outcome 2.

New Unit Title	New Unit Code	Old Unit Title	Old Unit Code	Credit Transfer Conditions
Engineering Mathematics 1	H7K033	Mathematics for Engineering 1:Electronics and Electrical	DG4H33	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	H7K033	Mathematics for Engineering 1:Mechanical and Manufacturing	DT5X33	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	H7K134	Mathematics for Engineering 2	DG4L34	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.

6 Approaches to delivery and assessment

6.1 Content and Context

As noted in previous sections, the main purpose of the mandatory sections in both the HNC and HND Engineering Systems awards 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 in both awards. Centres are encouraged to expose candidates to a range of engineering systems so that they get an idea of the range, scale and complexity of engineering systems available in the modern world. Centres can contextualise the HNC and HND Engineering Systems awards 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 1: Mechanical and Manufacturing is included in the mandatory core of both the HNC and HND Engineering Systems awards to support and underpin the delivery and assessment of the 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 a number of the 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 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 Unit Principles of Engineering Systems.

In the HND Engineering Systems award candidates may take the Unit Mathematics for Engineering 1: Electronics and Electrical as an alternative to the Unit Mathematics for Engineering 1: Mechanical and Manufacturing. The only difference between these two Units is that in Outcome 2 of the Mathematics for Engineering 1: Electronics and Electrical the focus is on complex numbers rather than vectors as is the case in the Mathematics for Engineering 1: Mechanical and Manufacturing Unit. The mandatory section of the HND also contains the Unit Mathematics for Engineering 2 to allow candidates to study Calculus in some depth.

Centres have a large measure of flexibility in choosing Units from the optional sections of the HNC and HND Engineering Systems, thus allowing them opportunities to develop their own discreet HNC and HND programmes 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 e.g. 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 HNC Engineering Systems electronics programme and a multi-disciplinary HNC Engineering Systems electro-mechanical programme are shown in Tables 6.1.1 and 6.1.2 respectively.

Likewise, examples of a single discipline HND Engineering Systems electrical Engineering programme and an HND Engineering Systems multi-disciplinary engineering programme are shown below in Figures 6.1.3 and 6.1.4

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 (finishes 31/07/3013)	Analogue Electronic Principles OR	7	2
FY9T 34	Analogue Electronic Principles	7	2
DG3C 34	Combinational Logic	7	1
DG53 34	Sequential Logic	7	1
DG54 34 (finishes 31/07/2013)	Single Phase AC Circuits OR	7	1
FY9E 34	DC and AC Principles	7	1
H2VY 34 (starts 31/07/2014)	Engineering Systems: Graded Unit 1	7	1
Total			12

Table 6.1.1: HNC Engineering Systems — 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 (finishes 31/07/2013)	Single Phase AC Circuits OR	7	1
FY9E 34	DC and AC Principles	7	1
DN47 34	Three Phase Systems	7	1
DN45 35	Three Phase Induction Motors	8	1
DR3L 34	Engineering Principles	7	1
DT9X 34	Pneumatics and Hydraulics	7	1
H2VY 34 (starts 31/07/2014)	Engineering Systems: Graded Unit 1	7	1
Total			12

Table 6.1.2: HNC Engineering Systems — multi-disciplinary electro-mechanical programme

**HND Engineering Systems Mandatory and Graded Unit Sections
(18 credits worth of Units)**

PLUS

Optional Units (12 credits worth of Units)

Unit Number	Unit title	SCQF level	Credit value
DG54 34 (<i>finishes 31/07/2013</i>)	Single Phase AC Circuits	7	1
	OR		
FY9E 34	DC and AC Principles	7	1
DG3G 34	Electrical Networks and Resonance	7	1
DN47 34	Three Phase Systems	7	1
DN3W 34	Electricity Power Systems	7	1
DN4J 34 (<i>finishes 31/07/2013</i>)	Electrical Machine Principles	7	2
	OR		
H01T 34	Electrical Machine Principles	7	2
DG31 34	Applications of Programmable Controllers	7	1
DN40 34	Industrial Plant Maintenance	7	1
DN4K 35	Electrical Motor Drive Systems	8	1
DN45 35	Three Phase Induction Motors	8	1
DG4P 35	Mathematics for Engineering 3	8	2

Figure 6.1.3: HND Engineering Systems — single discipline electrical engineering programme

**HND Engineering Systems Mandatory and Graded Unit Sections
(18 credits worth of Units)**

PLUS

Optional Units (12 credits worth of Units)

Unit Number	Unit title	SCQF level	Credit value
DR1T 34	Statics and Strength of Materials	7	1
DT9T 34	Dynamics	7	1
DT60 35	Plant Systems	8	2
DT9W 35	Applied Industrial Plant Maintenance	8	1
DG54 34 <i>(finishes 31/07/2013)</i>	Single Phase AC Circuits OR	7	1
FY9E 34	DC and AC principles	7	1
DN47 34	Three Phase Systems	7	1
DN4J 34 <i>(finishes 31/07/2013)</i>	Electrical Machine Principles OR	7	2
H01T 34	Electrical Machine Principles	7	2
DN4K 35	Electrical Motor Drive Systems	8	1
DN45 35	Three Phase Induction Motors	8	1
DW8N 34	Engineering Systems Interfaced with Programmable Logic Controllers	7	1

Figure 6.1.4: HND Engineering Systems — multi-disciplinary engineering programme

6.2 Delivery

The 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 also been offered on a full-time basis for school leavers, adult returners etc.

As with the HNC, the HND Engineering Systems award can be delivered by a range of different delivery modes. Traditionally most HND Engineering awards have been offered on a full-time basis. However, in recent years HND Engineering awards have also been offered on a part-time day or evening class basis to meet, for example, the needs of people in employment who wish to progress from HNC to HND level.

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 and HND Engineering Systems awards.

The SQA is currently in the process of developing learning and teaching materials to support the delivery of the four Units in the mandatory section of the HNC Engineering award. It is anticipated that these learning and teaching materials will be available from August 2007.

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

- ◆ 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 (eg 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 HNC Engineering Systems award, centre staff should consider whether they wish to adopt one of the following three approaches to delivering the HNC 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 1.

The choice of approach to timetabling the HNC will influence how the 2nd year HND Engineering Systems is timetabled. An example of how the HND Engineering Systems may be timetabled assuming a top down approach has been taken to the HNC Engineering Systems/1st Year HND Engineering Systems is shown in Appendix 2.

The Units in the mandatory sections of both the HNC and HND Engineering Systems have been designed to be delivered as an integrated engineering systems programme. As already noted, SQA are in the process of preparing learning/teaching materials for the four Units: Engineering Communication, Principles of Engineering Systems, Engineering Measurement and System Monitoring and Mathematics for Engineering 1: Mechanical and Manufacturing to assist in integrating an engineering systems approach. Centres may also wish to consider a team teaching approach to the delivery of some of the Units so that, for example, a mechanical and electrical engineering lecturer share the delivery of a Unit such as Principles of Engineering Systems. Centres are strongly encouraged to make every reasonable effort to ensure that the delivery and assessment of the mandatory engineering systems Units are integrated.

Centres 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, it is recommended that the Engineering Systems Analysis: System Modelling and Control Unit in the HND mandatory section is not delivered until the Engineering Communication, Principles of Engineering Systems and Engineering Measurement and System Monitoring Units have been taught. Particular regard should be taken to the Recommended Prior Knowledge and Skills statements in Units when sequencing the delivery of optional Units.

An attempt 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 HND Engineering Systems award. These may include lecturing, group work, laboratory and practical work, computer simulation (using appropriate software packages), investigative work (including the use of the Internet), 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 , but not be limited to, the following:

Communication	<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 Units Engineering Communication and Engineering Systems: Graded Unit 2 project ◆ Developing complex, vocationally specific reading skills (eg Communication: Practical Skills, Principles of Safe Engineering Systems etc.) ◆ Developing report writing skills in a number of Units (eg Principles of Engineering Systems, Engineering Systems: Graded Unit 2 etc.) ◆ Allowing candidates to develop their communication skills in group work activities (eg Communication: Practical Skills, Principles of Engineering Systems)
Numeracy	<ul style="list-style-type: none"> ◆ Reinforcing numeracy and mathematical skills when teaching mechanical or electrical engineering principles (eg Mathematics for Engineering 1: Mechanical and Manufacturing or Mathematics for Engineering 1: Electronics and Electrical etc.) ◆ Reinforcing using graphical information skills by use of a range of graphical representations (eg Engineering Communication, Engineering: Practical Skills etc.)
Information Technology	<ul style="list-style-type: none"> ◆ Develop information technology skills through the application of IT within engineering systems approaches (eg Engineering Communication, Engineering Measurement and Systems Monitoring, Engineering Systems Analysis: System Modelling and Control)
Problem Solving Skills	<ul style="list-style-type: none"> ◆ Develop problem solving skills by applying engineering systems concepts and principles to solution of engineering problems (Engineering Communication, Principles of Safe Engineering Systems, Engineering: Practical Skills and Project Management: Managing the Implementation of a Project etc.)
Working with Others	<ul style="list-style-type: none"> ◆ Develop working with others skills through group work on the solution to engineering problems (eg Communication: Practical Skills, Principles of Engineering Systems and Project Management: Managing the Implementation of a Project)

6.3 Assessment

6.3.1 Assessment Strategy

From the outset of developments, the need to have an appropriate assessment strategy in place for both the HNC and HND Engineering Systems awards was recognised. 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 candidates and staff is sensible and that assessment does not unduly detract from teaching and learning.
- (3) As far as possible reliable and rigorous verification 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 mandatory Units within the HNC and HND Engineering Systems awards.
- (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 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 a specimen paper for the HNC Graded Unit 1 to show the standards expected in such a paper.
- (5) Actively encourage centres to work in partnership in producing Graded Unit assessment materials, which meet nationally agreed standards reducing, in turn, the workload on staff in individual centres.
- (6) Ensure that consistent and rigorous internal and external verification 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.

With regard to the HNC Engineering Systems Table 6.3.1 shows a summary of the details of assessment and opportunities for the integration of assessment for the four Units in the mandatory 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.' This means 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 Unit Principles of Engineering Systems.</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 Unit Principles of Engineering Systems.</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 assessment lasting 1 hour and 30 minutes 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>

Table 6.3.1 — Assessment details for the four mandatory Units

6.3.2 Graded Units

The purpose of the Graded Units within the HNC and HND Engineering Systems award structures 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 while HND candidates will undertake the 1 credit Graded Unit at SCQF level 7 and a 2 credit Graded Unit at SCQF level 8. The level 7 Graded Unit is a 3 hour written examination and the level 8 Graded Unit is a project.

Types of Graded Unit

Engineering Systems: Graded Unit 1 — Examination

The specifications for the Engineering Systems: Graded Unit 1 can be found on the SQA website (www.sqa.org.uk). The Graded Unit draws on Outcomes in the mandatory sections of the HNC Engineering Systems/1st year HND Engineering Systems awards which are studied by all candidates irrespective of what specialist Units they study in the optional section.

It is recommended that candidates do not sit the Graded Unit Examination until the end of the HNC/1st year of the HND Engineering Systems given the range of Units that the Graded Unit draws on.

Engineering Systems: Graded Unit 2 — Project

The specification for Engineering Systems: Graded Unit 2 can also be found on the SQA website. The nature of the project activity detailed in the specification is such that it is likely that centres will wish their candidates to embark on the project from the start of the second year of the HND Engineering Systems programme. Those centres that deliver the HNC Engineering Systems as part of the first year of the HND Engineering Systems programme are advised that their candidates should have completed all HNC Engineering Systems Units, including the Engineering Systems: Graded Unit, 1 before commencing the project.

6.3.3 Assessment Exemplar Materials

Assessment exemplar packs have been produced for some of the mandatory Units in the HNC and HND Engineering Systems awards and are in the process of being produced for all other Units in the mandatory sections of the two awards. The exact status of assessment exemplar packs for the mandatory Units and Graded Units in the HNC and HND Engineering Systems awards is shown in Table 6.3.3.

Unit Title	Assessment exemplar status
Communication: Practical Skills	An assessment exemplar contextualized for the HND Electronics is available
Engineering Communication	Available
Principles of Engineering Systems	Available
Engineering Measurement and System Monitoring	Available
Mathematics for Engineering 1: Mechanical and Manufacturing	Available
Mathematics for Engineering 1: Electronics and Electrical	Available
Business Awareness and Continuing Professional Development	Available
Principles of Safe Engineering Systems	Available
Engineering Systems Analysis: System Modelling and Control	Available
Engineering: Practical Skills	Available
Project Management: Managing the Implementation of a Project	To be confirmed
Engineering Systems Graded Unit 1	Specimen paper available
Engineering Systems Graded Unit 2	An assessment exemplar contextualised for HND Electronics is available
Mathematics for Engineering 2	Available
Design for Manufacture	Available

Table 6.3.3 — Assessment Exemplar Material

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 Resources

Practical Resources

Centre staff are advised to read individual Unit specifications carefully to identify the consumables, equipment and/or software requirements to deliver Units. Some Units have specific requirements. For example, the Units Engineering Systems Analysis: System Modelling and Control and Engineering Systems Analysis: Non-Linearities and Control Strategies require a specialist mathematics software package. Other Units, such as Computer Aided Draughting in Engineering and Electrical Installation Design (Computer Aided): An Introduction requires candidates to use industrial specific software. The Unit Computer Integrated Manufacture (CIM) requires candidates to be able to access CNC equipment.

While not all Units require practical resources some definitely do. For example, the Unit Engineering: Practical Skills will require that candidates are able to access some of the following workshops: mechanical fitting, machine tool (for turning and/or milling), sheet metalwork, welding, electrical installation and electronics. Even where access to a laboratory and/or workshop is not essential to the delivery of a Unit it is nevertheless a good idea if candidates can observe the facilities in such areas so that they have an opportunity to relate the theory they have been taught in the classroom to practice.

When teaching subjects such as pumps, fans, electrical motors etc. centres should allow candidates to view disassembled equipment so that they can gain a greater appreciation of the construction of these items of plant. A good chart or other visual aid showing the various features of an item of plant, a machine tool etc. can also be a very good teaching aid.

The use of simulation software is strongly recommended to support teaching and learning. However, such software should not be used at the expense of practical workshops and laboratory activities. Practical activities represent the best way for candidates to relate the theory they learn in the classroom to practical engineering systems.

There is a very rich and varied range of teaching and learning resources available to deliver individual HNC and HND Engineering Systems Units. Such learning resources include textbooks, reports, papers, standards, CDs, DVDs and numerous sites on the Internets. Some centres may already have good learning resources in their learning libraries/Virtual Learning Environments. It is anticipated that the Qualification Support Team (QST) for the HNC and HND Engineering Systems will provide a useful forum for the identification and sharing of learning resources.

Continuing Professional Development

Active staff continuing professional development (CPD) is essential if the delivery and assessment of individual HNC and HND Engineering Systems Units are to be kept up to date, relevant and interesting. Staff CPD activities could be in subject areas such as the following (the list is not intended to be exhaustive):

- Learning to use specialist software including industrial standard software
- Modern manufacturing technologies and practices
- New or revised standards and regulations
- Design of safe engineering systems
- Project management (particularly as applied in an engineering context)
- Issues relating to health and safety
- Quality Control and Assurance
- New teaching and assessment methodologies
- e-learning

6.5 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 an 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.

7 General information for centres

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.

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).

8 General information for candidates

Introduction

The new HNC and HND Engineering Systems awards have been designed with a view to allowing you to meet the educational requirements to work as an engineering technician or incorporated engineer. The new qualifications contain up to date and relevant engineering subject content and skills and have also been designed to satisfy the SQA Higher National Design Principles.

Award Content

The HNC and HND Engineering Systems awards have been designed 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 engineering problems. Such an approach is somewhat different from that taken in other engineering awards where candidates tend to specialise in one area of engineering. The approach taken in the HNC and HND 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 and HND Engineering Systems will allow you to specialise in one or more areas of engineering in the five credit optional section of the HNC or the twelve credit optional section of the HND.

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.

Within the HND Engineering Systems mandatory section there is a Unit entitled Business Awareness and Continuing Professional Development. This Unit will provide you with an awareness of the business pressures on modern engineering companies and what strategies they are adopting to meet these pressures. This Unit will also give you an opportunity to develop your own career and education action plan for the next five years or so.

The HND Engineering Systems award also includes a Unit on Project Management. Engineering technicians and incorporated engineers are frequently asked to get involved in project work. Such work in industry is much more than simply designing and manufacturing a product. It begins with understanding the customer requirements and translating these into a detailed tender document. Following contract award, this document will be used to identify a number of project deliverables with associated resources. The resources and timescale for a project will determine the logic behind a project programme. A 'baseline' is identified from this programme to monitor progress against. Progress monitoring is essential throughout a project, as is implementing a number of controls ie cost, quality and change control. A final commissioning stage is vital on any project to ensure the client's requirements have been met. From this you can see that running even a small project in industry can be a complex business requiring good planning and organisational skills.

Opportunities to develop Information Technology knowledge and skills are available in a number of Units in the HNC and HND, but one Unit on Information Technology in the optional section of the HNC and two Units on Information Technology in the optional section of the HND are available if you wish to consolidate your knowledge and skills in this area.

Teaching

While taking the HNC and HND Engineering Systems awards 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, investigations and project work. Industrial visits may also be included to allow you to experience 'real life' engineering systems in action.

Assessment

Assessment in the HNC and HND Engineering Systems awards has been designed to meet national standards. The awards have 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.

Candidates can expect to do assessment at individual Unit level and at qualification level. At Unit level, assessments will normally consist of written tests, practical exercises and computer simulations which may include the preparation of reports. Your lecturers should tell you at the start of the Unit what form the Unit assessment will take. In addition to the Unit assessments there will also be a 3 hour examination which is normally sat at the end of the HNC/1st year of the HND and a major project activity you will do during the 2nd year of the HND. The examination has been designed to allow you to demonstrate your ability to integrate knowledge, understanding and skills learnt throughout the HNC/1st year of the HND. A satisfactory pass in the core Units in the 1st year of the HND and the 3 hour Graded Unit 1 examination will mean you would be eligible to achieve an HNC Engineering Systems.

In the HND Graded Unit 2 project you will be provided with opportunities to develop not only technical skills but also very important non-technical skills such as planning and organisation, time management, oral and written communication skills, team working and evaluation skills. Both the examination and the project are graded as follows: A, B, C pass and no award.

Entry requirements

No artificial barriers have been placed in the way of candidates wanting to study the HNC and HND Engineering Systems awards. However, it would be unfair to enroll you into an award which you did not have a realistic chance of successfully achieving. Candidates are, therefore, recommended to have one of the following qualifications before entering the HNC and HND Engineering Systems:

HNC and HND

- ◆ one Higher from Physics, Technological Studies, Mechatronics or Mathematics and at least three Standard Grades 1–2/Intermediate 2 passes including Mathematics, Physics/Technological Studies and English.
- ◆ a National Certificate Group Award in Engineering, Electrical Engineering, Electronic Engineering or Fabrication and Welding
- ◆ qualifications 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

Direct entry to the HND

- ◆ An HNC Engineering Systems*
- ◆ An HNC in Electronics, or Electrical Engineering, or Engineering Practice, or Fabrication, Welding and Inspection, or Manufacturing Engineering, or Mechanical Engineering or Mechatronics or Petroleum Engineering*. Candidates coming through one of these award routes will be best served by having studied the Units, Principles of Engineering Systems, Engineering Communication and Engineering Measurement and System Monitoring together with a suitable breadth of mathematics at SCQF level 6 (see also Figure 5.2 (a)).

* *Candidates would already have 12 Unit credits towards the HND Engineering Systems award.*

Progression

The HNC and HND Engineering Systems awards only partially satisfy the academic requirements to become an incorporated engineer (a degree is now required). However, both the HNC and HND Engineering Systems awards provide a solid platform for you to proceed to a degree programme in an engineering area with advanced standing. Information should be available from your centre on any progression arrangements that exist between the centre and any university.

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.

Appendix 1: Sample HNC Teaching Timetable — Page 58

Appendix 2: Sample HND Teaching Timetable — Page 62

Sample HNC 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.

Sample HND Teaching Timetable

1. Full — time HND Engineering Systems Timetable

2 Year, Full — Time HND Engineering Systems/HNC Engineering Systems Timetable

First Year, First Semester

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

Option 2	Engineering Communication	Option 3	Option 4	Option 5	Option 6	Engineering: Practical Skills	Engineering Systems: Graded Unit 1 Examination
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2 Year, Full —Time HND Engineering Systems Timetable

Second Year, First Semester

Business Awareness and Continuing Professional Development	Engineering Systems Analysis: System Modelling & Control	Principles of Safe Engineering Systems	Project Management: Managing the Implementation of a Project	Mathematics for Engineering 2	Option 7	Engineering Systems: Graded Unit 2 Project
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Second Year, Second Semester

Design for Manufacture	Option 8	Option 9	Project Management: Managing the Implementation of a Project	Option 10	Option 11	Option 12	Engineering Systems: Graded Unit 2 Project
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