Arrangements for:

SQA Advanced Certificate Engineering Systems
(GM9P 47)

and

SQA Advanced Diploma Engineering Systems
(GM9N 48)

Date of publication: November 2017

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Acknowledgement

SQA acknowledges the valuable contribution that Scotland's colleges have made to the development of SQA Advanced Qualifications.

Further information

Call SQA's Customer Contact Centre on 44 (0) 141 500 5030 or 0345 0345 279 1000. Alternatively, complete our Centre Feedback Form.

History of changes

It is anticipated that changes will take place during the life of the qualification and this section will record these changes. Centres are advised to check SQA Connect 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
04	**Revision of Unit:** HV4M 47 Environmental Awareness (finish date 31/07/2023) has been replaced by J6M8 47 Environmental Awareness (start date 01/08/2022) on GM9N 48 framework only.	31/10/23
03	**Additional Unit:** HT7N 47: Engineering Skills has been added to optional section for GM9P 47 framework only	28/07/20
02	**Additional Units:** J1CH 47 Computer Programming and J1S1 47 Data Security has been added to both frameworks	15/04/19

Contents

1 Introduction

This is the Arrangements Document for the Group Awards in SQA Advanced Certificate in Engineering Systems and SQA Advanced Diploma in Engineering Systems. This document includes background information on the Group Award, its aims, details of the Group Award structure, and guidance on delivery.

2 Rationale for the awards

The SQA Advanced Certificate and SQA Advanced Diploma in Engineering Systems are designed to equip candidates with the knowledge, understanding and skills required for success in current and future employment or for progression to further academic and/or professional qualifications.

2.1 Purpose of the Awards

The SQA Advanced Certificate and SQA Advanced Diploma in Engineering Systems 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 SQA Advanced Certificate 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 SQA Advanced Certificate also has 5 credits of optional Units allowing centres greater flexibility to select Units in one or more engineering disciplines. In other SQA Advanced Certificate Engineering awards there is only 2 credits worth of Units in the optional section.

The SQA Advanced Diploma in Engineering Systems has 18 credits worth of mandatory Units which include all the Units from the mandatory section of the SQA Advanced Certificate in 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 SQA Advanced Diploma, compared with 7 credits in other SQA Advanced Diploma 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.

2.2 Market Research to support the SQA Advanced Certificate and SQA Advanced Diploma Engineering Systems Awards

2.2.1 Market Research

The development of the SQA Advanced Certificate and SQA Advanced Diploma 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.).
Delivery Centres	Two national seminars with workshop sessions were held and used to seek delivering centres' views on a range of issues relating to general SQA Advanced Engineering award developments. Draft Units and outlines of Graded Units were made available to centres.
Employers	Consultation took place through two questionnaire surveys, one for the SQA Advanced Certificate and the other for the SQA Advanced Diploma. Industrial contacts were consulted on the framework structure and Unit content.
Higher Education	Letters of support for articulation between the SQA Advanced Certificate and SQA Advanced Diploma in Engineering Systems and degree awards were received from a number of Higher Education institutions.
Professional Bodies	A representative of the Institution of Engineering and Technology (IET) advised on the status of the awards in relation to membership of the IET.
Candidates	While not consulted directly, details of candidate experience of the general SQA Advanced Certificates and SQA Advanced Diplomas in Engineering were provided.

Figure 2.2: Groups consulted on during the development of the SQA Advanced Qualifications in Engineering Systems

3 Aims of the awards

3.1 General Aims of the SQA Advanced Certificate and SQA Advanced Diploma in 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 SQA Advanced Certificate and SQA Advanced Diploma in Engineering Systems

Aims common to both the SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced Certificate in Engineering Systems only

3.2.5 develop an award that on successful completion will allow candidates to progress to SQA Advanced Diploma in Engineering Systems or another SQA Advanced Diploma 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 SQA Advanced Diploma in 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 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 SQA Advanced Certificate and SQA Advanced Diploma
3.1.1	Market research indicates that SQA Advanced Certificate and SQA Advanced Diploma Engineering awards are regarded as the minimum qualifications required by many organisations to work at engineering technician level.
3.1.2	Candidates in employment can take SQA Advanced Engineering awards on a part-time basis to increase their knowledge of engineering and enhance their career development. The SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced Certificate and SQA Advanced Diploma in Engineering Systems have been levelled at SCQF levels 6, 7 or 8. The two awards also conform to the SQA Design Principles levelling requirements for SQA Advanced Certificate and SQA Advanced Diploma awards.
3.1.4	The nature of the SQA Advanced Certificate and SQA Advanced Diploma in 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 for example 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 awards allow these important skills to be developed further both in the technical subjects and in the core Communication and Mathematics Units. In the SQA Advanced Diploma in Engineering Systems, analysis and synthesis skills are also developed in the Unit Business Awareness and Continuing Professional Development.

Aim No.	How they are met in the SQA Advanced Certificate and SQA Advanced Diploma
3.1.5	The SQA Advanced Certificate and SQA Advanced Diploma in Engineering Systems 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. 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 SQA Advanced Certificate and SQA Advanced Diploma 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.

3.4 How the Specific Aims are met in the 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 SQA Advanced Certificate and SQA Advanced Diploma
3.2.1	SQA Advanced Engineering awards have been recognised 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 SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced Certificate or SQA Advanced Diploma does not fully satisfy 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 SQA Advanced Certificate and SQA Advanced Diploma 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 market research information gathered through various consultations indicated that there is solid support for the inclusion of a distinct Communication Unit in the mandatory sections of both the SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced Certificate and SQA Advanced Diploma Engineering Systems awards. This was considered to be a more appropriate way to ensure that this Core Skill is included in the SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced Diploma in Engineering Systems.

Aim No.	How they are met in the SQA Advanced Certificate and SQA Advanced Diploma
3.2.4	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 SQA Advanced Certificate/1st Year SQA Advanced Diploma level by the SQA Advanced 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 Engineering Mathematics 1 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 focuses 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. The focus throughout the three Units is to provide an integrated programme of study covering a systems approach to the analysis of engineering processes and systems. As such every opportunity has been sought to combine the delivery and assessment of the four Units. To assist this process SQA 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. At 2nd Year SQA Advanced Diploma level studies in engineering systems are consolidated and enhanced by the following two SCQF level 8 SQA Advanced 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.

Aim No.	How they are met in the SQA Advanced Certificate and SQA Advanced Diploma
3.2.4 (cont.)	The Unit Engineering Mathematics 2 is also included in the mandatory section of the SQA Advanced Diploma in 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 SQA Advanced Diploma because a good understanding of the engineering design process is critical to the engineering systems approach.
3.2.5	It is strongly anticipated that progression routes will be developed between the SQA Advanced Certificate Engineering Systems award and degree courses. Progression arrangements between SQA Advanced Certificates, SQA Advanced Diplomas and degrees can only be strengthened with the full implementation of the SCQF.
3.2.6	The Communication Core Skill at SCQF Level 6 has been incorporated into the SQA Advanced Certificate in Engineering Systems through the mandatory Unit, Communication: Practical Skills. The Core Skill component Using Number at SCQF Level 6 is embedded within the mandatory Unit Engineering Mathematics 1. 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 SQCF level 6 if they take the optional Unit Information Technology: Applications Software 1 in the SQA Advanced Certificate.
3.2.7	In designing the SQA Advanced Certificate in 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 SQA Advanced Certificates: Electronics, Electrical Engineering, Fabrication, Welding and Inspection, Manufacturing Engineering, Mechanical Engineering and Mechatronics within the optional section of the SQA Advanced Certificate in Engineering Systems 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 SQA Advanced Certificate in Engineering Systems 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 SQA Advanced Certificate 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.

Aim No.	How they are met in the SQA Advanced Diploma
3.2.8	As noted under 3.2.5 clear progression routes exist between SQA Advanced Engineering awards and degree courses. It is strongly anticipated that similar progression routes will be developed between the SQA Advanced Diploma Engineering Systems award and degree courses. Candidates may be able to enter degrees at advance stages.
3.2.9 and 3.2.10	It has been a tradition to deliver some form of Business Studies Unit in SQA Advanced Diploma Engineering awards looking at issues such as costing/pricing of products and services. However, the focus of the 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 globalisation 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 SQA Advanced Diploma in 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 SQA Advanced Diploma 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 SQA Advanced Diploma 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 SQA Advanced Diploma in 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 SQA Advanced Diploma Engineering Systems award, and as an option in the SQA Advanced Certificate 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 SQA Advanced Diploma
3.2.12	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 SQA Advanced Diploma in 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.
3.2.13	As was noted earlier, a critical aspect of award design was to produce SQA Advanced Certificate and SQA Advanced Diploma qualifications which allow centres flexibility in designing a single or multi–disciplinary engineering award. With regard to the SQA Advanced Diploma in Engineering Systems, flexibility has been achieved by incorporating all the mandatory and optional Units from the following SQA Advanced Certificate and SQA Advanced Diploma awards: Electronics, Electrical Engineering, Engineering Practice, Fabrication, Welding and Inspection, Manufacturing Engineering, Mechanical Engineering, Mechatronics and Petroleum Engineering within the optional section of the SQA Advanced Diploma in 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.

Aim No.	How it is met in the SQA Advanced Diploma
3.2.14	The Communication Core Skill at SCQF level 6 has been incorporated into the SQA Advanced Diploma in 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: Engineering Mathematics 1and Engineering Mathematics 2. The Core Skill of Problem Solving at SCQF level 6 is embedded in the Engineering Systems: Graded Unit 2. 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 SQA Advanced Diploma in 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 SQA Advanced Diploma Engineering Systems award. Opportunities to develop Core Skills and Core Skills components are signposted in all the Units in the SQA Advanced Diploma in Engineering Systems award.

3.5 Target Groups

Full-time SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced Certificate in Engineering Systems would normally be offered as the core part of a first year SQA Advanced Diploma Engineering Systems programme of study.

Alternatively, candidates at SQA Advanced Certificate and SQA Advanced Diploma Engineering Systems levels may already be in employment and will attend centres on a day-release or other part-time basis. The SQA Advanced Certificate Engineering Systems award structure is sufficiently flexible enough to allow centres to deliver the SQA Advanced Certificate award by various modes of delivery: for example, two-year day-release, evening attendance etc. The SQA Advanced Diploma represents a natural extension of studies at SQA Advanced Certificate level. The Units required for candidates to upgrade their SQA Advanced Certificate to an SQA Advanced Diploma 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 SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced Certificate and SQA Advanced Diploma in 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:

SQA Advanced Certificate and SQA Advanced Diploma

- one Higher from Physics, Technological Studies, Mechatronics or Mathematics and at least three Standard Grades 1–2/National 5 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 SQA Advanced Diploma

- An SQA Advanced Certificate in Engineering Systems*
- An SQA Advanced Certificate in Electronics, or Electrical Engineering, or Engineering Practice, or Fabrication, Welding and Inspection, or Manufacturing Engineering, or Mechanical Engineering or Mechatronics or SQA Advanced Certificate 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 SQA Advanced Diploma in Engineering Systems award (see Figure 5.1).*

4.2 Core Skills Entry Profile

The recommended Core Skills entry profile for both the SQA Advanced Certificate and SQA Advanced Diploma in Engineering Systems is as follows:

- Communication SCQF level 5
- Information and Technology SCQF level 5
- Numeracy SCQF level 5
- Problem Solving SCQF level 5
- Working with Others SCQF level 4

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 SQA Advanced Certificate and SQA Advanced Diploma in 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.

Ten SQA Advanced 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 SQA Advanced Certificate in Engineering Systems framework and all ten have been added as options to the SQA Advanced Diploma in Engineering Systems framework (See tables 5(a) and 5(b).

These Units 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.

5.1 SQA Advanced Certificate in Engineering Systems Award Structure

The structure of the SQA Advanced Certificate 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 SQA Advanced Certificate in Engineering Systems, as explained earlier, the SQA Advanced Certificate does **not** fit precisely into the overarching SQA Advanced Engineering award structure.

SQA Advanced Certificate and Diploma

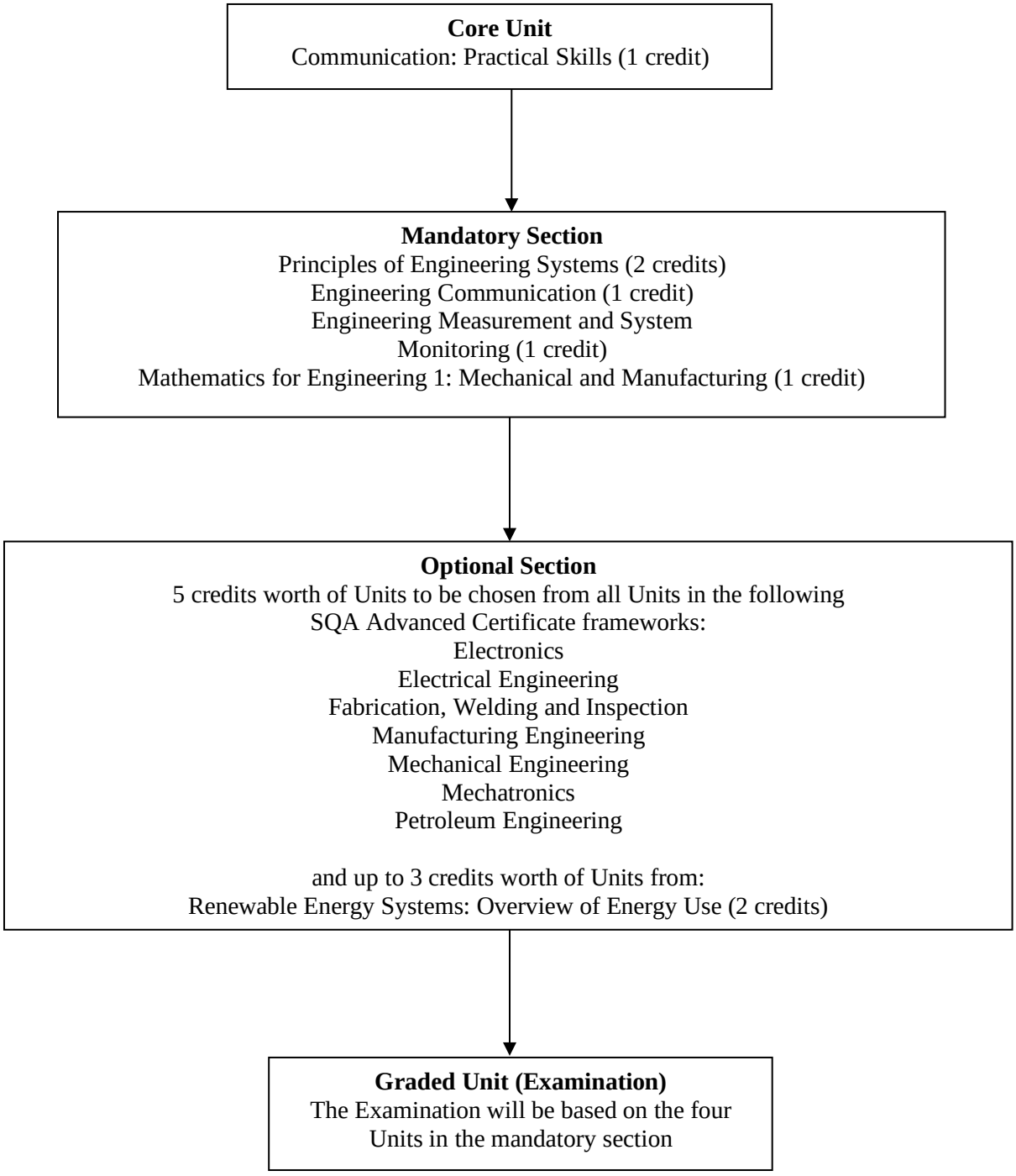


Figure 5.1 SQA Advanced Certificate in Engineering Systems Award Structure

5.2 SQA Advanced Diploma in 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 SQA Advanced Diploma in Engineering Systems award.

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

(1) The SQA Advanced Diploma builds on the engineering systems approach developed as part of the SQA Advanced Certificate in Engineering Systems. All SQA Advanced Certificate in Engineering Systems Units are included in the SQA Advanced Diploma framework.

(2) Entry to the SQA Advanced Diploma can be either via the SQA Advanced Certificate in Engineering Systems award or by any of the SQA Advanced Certificate in 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 SQA Advanced Certificate in Engineering Systems followed by the SQA Advanced Diploma in Engineering Systems will be able to select 12 optional Unit credits from the mandatory and optional sections of the following individual SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced Certificate in 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 SQA Advanced Certificate in Engineering award achieved.

   (b) 16 Unit credits from the SQA Advanced Diploma mandatory section. The number of Unit credits is only 16 because Communication: Practical Skills is included in all SQA Advanced Certificate Engineering awards and the Graded Unit 1 Examination in any of the SQA Advanced Certificate in Engineering awards will be regarded as equivalent to the Engineering Systems: Graded Unit 1 Examination. The number of SQA Advanced Diploma mandatory Units a candidate has to study is illustrated in the following example. A candidate who has successfully achieved an SQA Advanced Certificate in Mechanical Engineering will have passed the following Units in the SQA Advanced Diploma mandatory section: Communication Practical Skills, the Mechanical Engineering: Graded Unit 1 and Engineering Mathematics 1. Thus, the candidate will only have to take 15 Unit credits in the SQA Advanced Diploma in Engineering Systems mandatory section.

(c) 2 optional Unit credits plus any of the Unit credits in the SQA Advanced Diploma that have already been achieved in the SQA Advanced Certificate in (a). In the case of the SQA Advanced Certificate in Mechanical Engineering the candidate will be able to study three optional Unit credits.

Figure 5.2 (a): Block Diagram of the SQA Advanced Diploma in Engineering Systems Framework

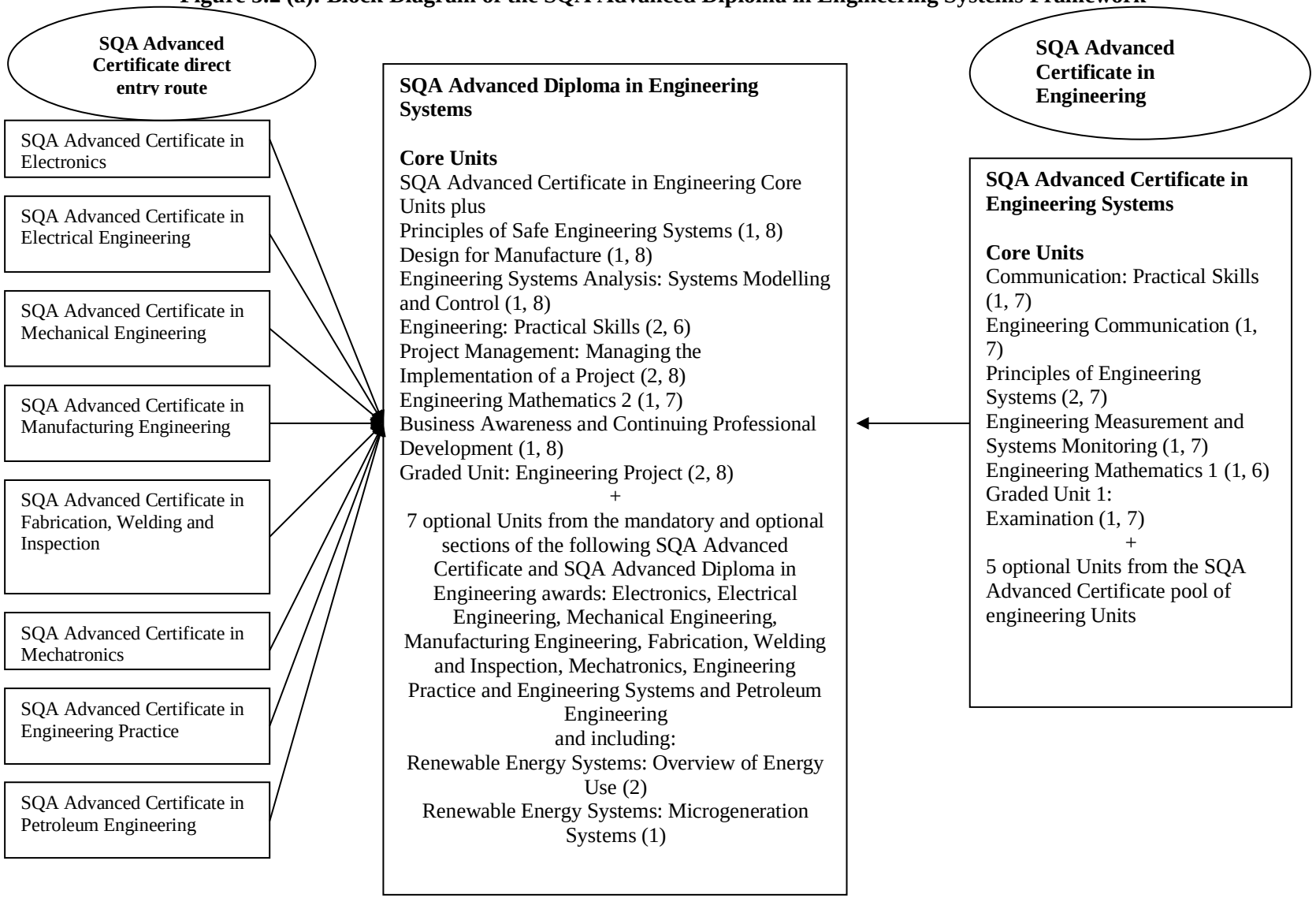


Figure 5.2 (b): Block Diagram of the SQA Advanced Diploma in Engineering Systems Framework — Bridging Units

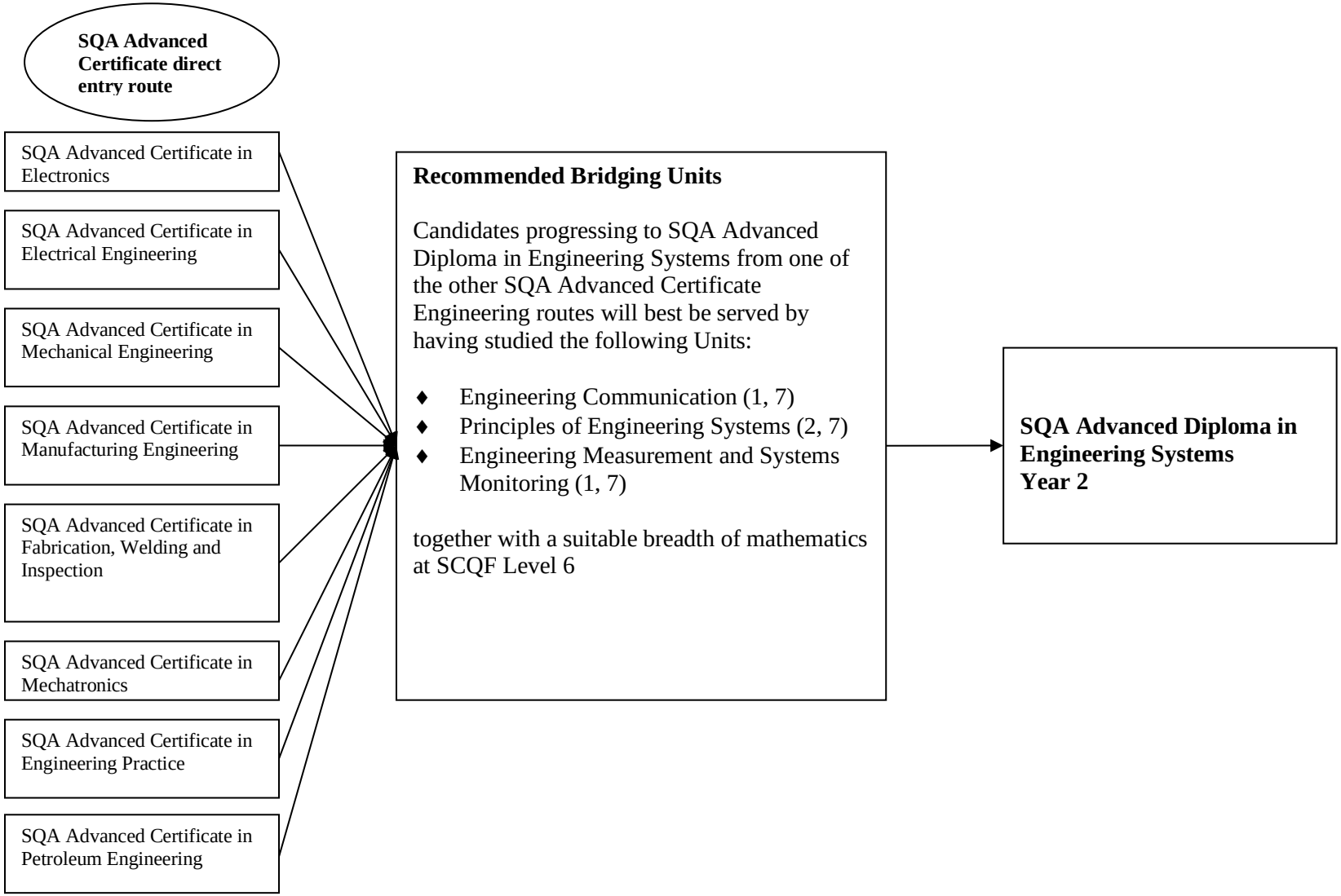
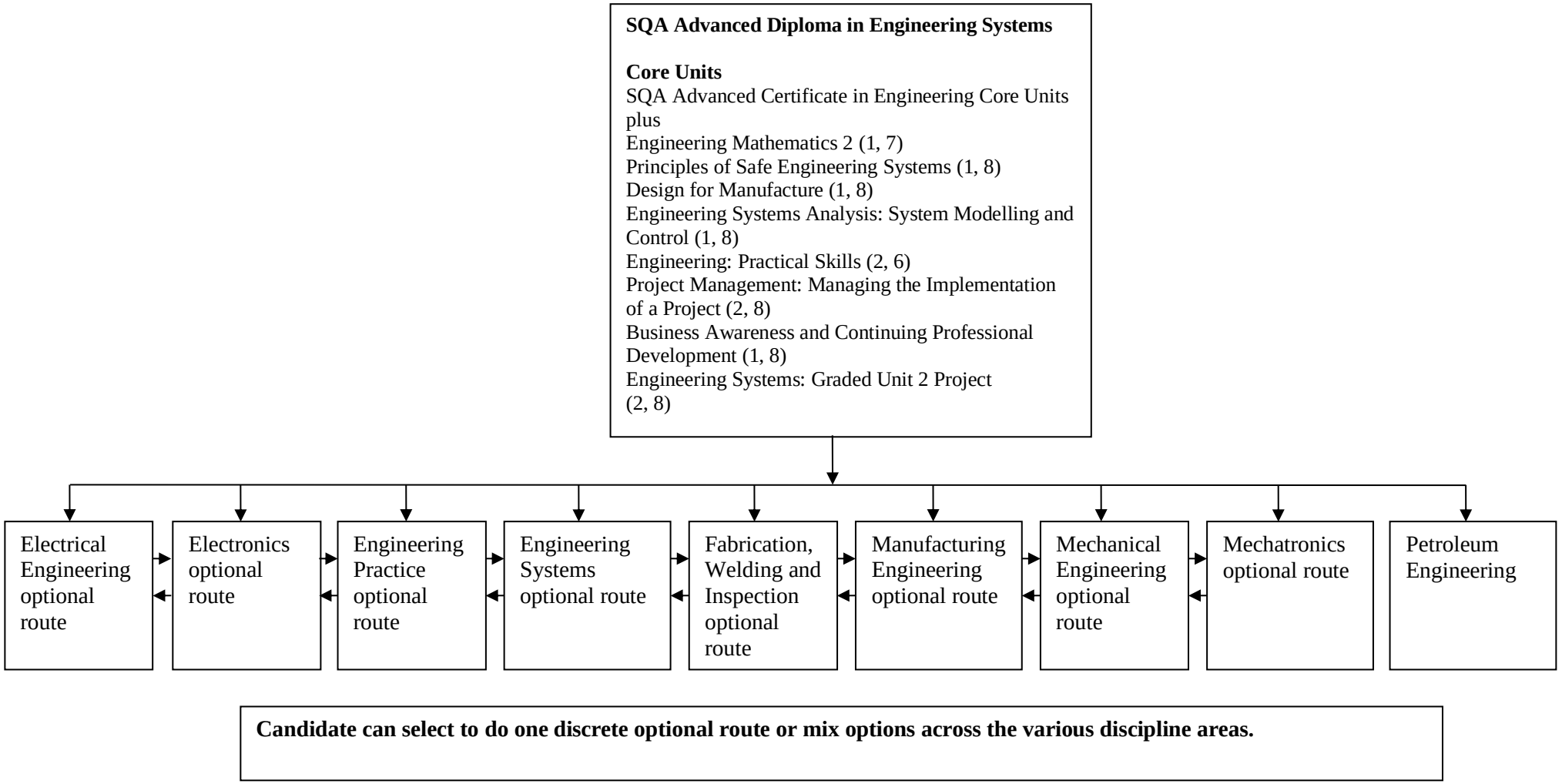


Figure 5.2 (c): Block Diagram of the SQA Advanced Diploma in Engineering Systems framework showing optional routes



5.3 SQA Advanced Certificate in Engineering Systems Award Table

Group Award: GM9P 47 **12 Unit credits**

Mandatory Units (6 credits)

Section	Credit value	SCQF level	Product code	Product title
Common Core	1	7	HP4A 47	Communication: Practical Skills
Mandatory (5 Credits)	1	6	HP48 46	Engineering Mathematics 1
	2	7	HV44 47	Principles of Engineering Systems
	1	7	HV42 47	Engineering Communication
	1	7	HV43 47	Engineering Measurement and Systems Monitoring

Graded Unit (1 Mandatory Credit)

Credit value	SCQF level	Product code	Product title
1	7	HV3C 47	Engineering Systems: Graded Unit 1

Optional Units (maximum of 5 credits)

Credit value	SCQF level	Product code	Product title
Cross-Discipline			
1	7	HT1K 47	Applications of Programmable Logic Controllers
1	7	HT73 47	Computer Aided Draughting for Engineers
1	7	HT77 47	CNC
1	7	J1CH 47*	Computer Programming
1	7	J1S1 47*	Data Security
1	8	HT75 48	Design for Manufacture
1	7	HT78 47	Economics of Manufacture
1	7	HP3J 47	Electrical Networks and Resonance
1	7	HT72 47	Engineering Drawing
1	7	HT7D 47	Engineering Measurement
1	7	HT74 47	Engineering Principles
1	7	HT7N 47*	Engineering Skills
1	7	HT1R 47	Fundamentals of Control Systems and Transducers
1	7	HP41 47	High Level Engineering Software
1	8	HT79 48	Industrial Systems
1	7	HP6L 47	Information Technology: Applications Software 1
1	8	HV3H 48	Jig and Fixture Design
1	7	HT76 47	Materials Selection
1	7	HP49 47	Engineering Mathematics 2
1	7	HP42 47	MCU/MPU Assembly Language Programming
1	7	HT7F 47	Pneumatics and Hydraulics
2	8	HT84 48	Manufacturing: Process and Equipment Selection
1	7	HT7A 47	Quality Management: An Introduction
1	7	HT7P 47	Safety Engineering and the Environment
1	7	HP46 47	DC and AC Principles
1	7	HT71 47	Statics and Strength of Materials
1	7	HP6M 47	Personal Development Planning
1	7	HR1C 46	Workplace Communication in English
2	7	HV48 47	Renewable Energy Systems: Overview of Energy Use

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Credit value	SCQF level	Product code	Product title
1	7	HR49 47	Renewable Energy Systems: Microgeneration Systems
1	7	HT1Y 47	Energy Overview

Credit value	SCQF level	Product code	Product title
Electrical			
2	6	HV3F 46	Engineering Practical Skills
1	6	HV2H 46	Application of Electrical and Electronic Instruments
1	7	HV3M 47	Electrical Installation Skills
2	7	HT83 47	Electrical Machine Principles
1	7	HV3A 47	Electrical Safety
1	7	HV3K 47	Electrical Systems in Potentially Explosive and Gas Hazardous Environments
1	7	HV3L 47	Electricity Power Systems
1	7	HR0W 47	Project Management: An Introduction
1	7	HV2L 47	Inspection and Testing of Low Voltage Electrical Installations
1	7	HT1W 47	Power Electronics
1	8	HV3G 48	Three Phase Induction Motors
1	7	HT7K 47	Three Phase Systems
Electronics			
2	7	HP47 47	Analogue Electronic Principles
1	7	HP3G 47	Combinational Logic
1	7	HP3K 47	Electronic Construction Skills
1	7	HP3M 47	Electronic Testing Skills
1	7	HR1D 47	Employment Experience 2
1	7	HP3P 47	Implementing Small Local Area Networks
1	7	HP3V 47	Printed Circuit Board Design, Manufacture and Test
1	7	HP3Y 47	Sequential Logic

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Credit value	SCQF level	Product code	Product title
Fabrication and Welding			
1	7	HV2M 47	Containers: Design and Manufacture
1	7	HV3T 47	Design Analysis: Fabrication and Welding
1	7	HV3R 47	Destructive Testing
1	7	HV3P 47	Engineering Project
1	7	HV41 47	Fabrication and Welding Materials
1	7	HV3V 47	Fabrication Forming Processes
1	7	HV2R 47	Fabrication: Preparation, Joining and Assembly
1	7	HV2P 47	Inspection Systems
1	6	HV3D 46	Performing Liquid Penetrant Inspection
1	6	HV3E 46	Performing Magnetic Particle Inspection
1	7	HV3W 47	Pipework 1: Construction and Site Installation
1	7	HV3X 47	Pipework 2: Pipe Bending and Pipe System Design
1	7	HV3Y 47	Shipbuilding Principles: Advanced Hull and Associated Technologies
1	7	HV40 47	Shipbuilding Principles: Planning, Production and Assembly
1	7	HV2N 47	Welding Procedures: Specification, Qualification and Testing
1	7	HV2T 47	Welding Principles and Applications 1
1	7	HV3N 47	Welding Principles and Applications 2
Mechanical and Manufacturing			
1	7	HT7E 47	Dynamics
1	7	HT7T 47	Metal Component Manufacture
1	7	HT7W 47	Plastic Component Manufacture
1	7	HT7C 47	Thermofluids
Mechatronics			
1	7	HV46 47	Mechatronic Systems Elements
1	8	HV3J 48	Mechatronic Systems
1	7	HV45 47	Interfacing Electronics
1	6	HV2F 46	Electrical Engineering Principles 1
1	8	HT7Y 48	Applied Industrial Plant Maintenance
1	7	HV47 47	Robotics and Animatronics: An Introduction

5.4 SQA Advanced Diploma in Engineering Systems Award Table

Group Award: GM9N 48 **30 Unit credits**

Mandatory Units (15 Credits)

Section	Credit value	SCQF level	Product code	Product title
Common Core	1	7	HP4A 47	Communication: Practical Skills
	1	8	HP3H 48	Business Awareness and Continuing Professional Development
Mandatory Section (13 Credits)	1	6	HP48 46	Engineering Mathematics 1
	1	7	HP49 47	Engineering Mathematics 2
	2	7	HV44 47	Principles of Engineering Systems
	1	7	HV42 47	Engineering Communication
	1	7	HV43 47	Engineering Measurement and System Monitoring
	1	8	HV5G 48	Principles of Safe Engineering Systems
	1	8	HT75 48	Design for Manufacture
	1	8	HV5E 48	Engineering Systems Analysis: System Modelling and Control
	2	6	HV3F 46	Engineering Practical Skills
	2	8	HR0T 48	Project Management: Managing the Implementation of a Project

Graded Unit (3 Mandatory Credits)

Credit value	SCQF level	Product code	Product title
1	7	HV3C 47 **OR** HT15 47 **OR** HV4C 47 **OR** HV2D 47 **OR** HV4D 47 **OR** HV4E 47 **OR** HT7G 47 **OR** HV4F 47 **OR** HV4G 47	Engineering Systems: Graded Unit 1 **OR** Electronics: Graded Unit 1 **OR** Electrical Engineering: Graded Unit1 **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	HV4A 48	Engineering Systems: Graded Unit 2

Optional Units (maximum of 12 Credits)

Credit value	SCQF level	Product code	Product title
Cross-Discipline			
1	6	HT7J 46	Analogue Electronics: An Introduction
1	8	HT7Y 48	Applied Industrial Plant Maintenance
1	6	HV2H 46	Applications of Electrical and Electronic Instruments
1	7	HT1K 47	Applications of Programmable Logic Controllers
1	7	HT73 47	Computer Aided Draughting for Engineers
1	7	HT77 47	CNC
1	7	J1CH 47*	Computer Programming
1	7	J1S1 47*	Data Security
1	7	HV2M 47	Containers: Design and Manufacture
1	8	HV51 48	Control Systems Behaviour
1	7	HT7L 47	Digital Electronics
1	7	HT7E 47	Dynamics
1	7	HT78 47	Economics of Manufacture
1	6	HV2F 46	Electrical Engineering Principles 1
1	7	HV32 47	Electrical Engineering Principles 2
2	7	HT83 47	Electrical Machine Principles
1	8	HT7M 48	Electrical Motor Drive Systems
1	7	HP3J 47	Electrical Networks and Resonance
1	7	HV3A 47	Electrical Safety

Optional Units (maximum of 12 Credits)

Credit value	SCQF level	Product code	Product title
Cross-Discipline (continued)			
1	7	HP3M 47	Electronic Testing Skills
1	7	HR1D 47	Employment Experience 2
1	7	HT72 47	Engineering Drawing
1	7	HT7D 47	Engineering Measurement
1	7	HT74 47	Engineering Principles
2	7	HT7N 47	Engineering Skills
1	7	HV39 47	Engineering Systems Interfaced with Programmable Logic Controllers
1	7	HV2R 47	Fabrication: Preparation, Joining and Assembly
1	7	HT1R 47	Fundamentals of Control Systems and Transducers
1	7	HP41 47	High Level Engineering Software
1	8	HP43 48	High Level Language: External I/O Transfer
1	7	HP3P 47	Implementing Small Local Area Networks
1	7	HV2K 47	Industrial Plant Maintenance
1	8	HT79 48	Industrial Systems
1	7	HP6L 47	Information Technology: Applications Software 1
1	7	HV2L 47	Inspection and Testing of Low Voltage Electrical Installations
1	7	HV2P 47	Inspection Systems
1	7	HT76 47	Material Selection
2	8	HT1E 48	Mathematics for Engineering 3
1	7	HP42 47	MCU/MPU Assembly Language Programming
1	8	HT1J 48	MCU/MPU I/O Hardware Control
1	7	HT7T 47	Metal Component Manufacture
1	8	HT1F 48	Microprocessor and Microcontroller Technology
1	7	HP6M 47	Personal Development Planning
1	7	HT7W 47	Plastic Component Manufacture
1	7	HT7F 47	Pneumatics and Hydraulics
1	7	HT1W 47	Power Electronics
2	8	HT84 48	Manufacturing: Process and Equipment Selection
1	8	HV2J 48	Production Planning and Control
1	7	HT7H 47	Project Management
1	7	HR0W 47	Project Management: An Introduction
1	8	HV58 48	Project Management: Project Justification and Planning
1	7	HT7A 47	Quality Management: An Introduction
1	8	HT80 48	Robotic Systems
1	7	HT7P 47	Safety Engineering and the Environment

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Credit value	SCQF level	Product code	Product title
Cross-Discipline (continued)			
1	7	HP46 47	DC and AC Principles
1	7	HT71 47	Statics and Strength of Materials
1	7	HT7K 47	Three Phase Systems
1	8	HT1H 48	Transmission Lines and Complex Waves
1	7	HV2T 47	Welding: Principles and Applications 1
1	7	HV2N 47	Welding Procedures: Specification, Qualification and Testing
1	6	HR1C 46	Workplace Communication in English
3	7	HR0M 47	Work Role Effectiveness (2003)
			OR
3	8	HR0P 48	Work Role Effectiveness (2003)
1	8	HP3T 48	Power Supply Circuits
1	8	HV5H 48	Renewable Energy Store: Hydrogen
1	8	HV5J 48	Renewable Energy Systems: Biomass
1	8	HV5K 48	Renewable Energy Systems: Geothermal Energy
1	8	HV5L 48	Renewable Energy Systems: Hydroelectricity
1	7	HR49 47	Renewable Energy Systems: Microgeneration Systems
2	7	HV48 47	Renewable Energy Systems: Overview of Energy Use
1	8	HV5M 48	Renewable Energy Systems: Solar
2	8	HV5N 48	Renewable Energy Systems: Technology
1	8	HV5P 48	Renewable Energy Systems: Wave and Tidal Energy
1	8	HV5R 48	Renewable Energy Systems: Wind Power
1	8	HV5W 48	Energy: Nuclear Power and the Environment
1	7	HT1Y 47	Energy Overview
1	8	HT1L 48	Energy Technologies
1	7	HT1M 47	Engineering Mathematics 3
1	8	HT03 48	Engineering Mathematics 4
1	8	HT1N 48	Engineering Mathematics 5
Electrical Engineering			
1	8	HV50 48	Applications of Power Electronics in Electrical Motor Drive Systems
1	8	HV5X 48	Electrical Installation Design
1	8	HV52 48	Electrical Installation Design: Computer Aided
1	7	HV3M 47	Electrical Installation Skills
1	8	HV53 48	Electrical Standby Systems
1	7	HV3K 47	Electrical Systems in Potentially Explosive and Gas Hazardous Environments
1	7	HV3L 47	Electricity Power Systems
1	8	HV4V 48	Switchgear and Protection of High Voltage Systems
1	8	HV4W 48	Synchronous Machines
1	8	HV3G 48	Three Phase Induction Motors
1	8	HV4X 48	Transformers
1	8	HV4Y 48	Utilisation of Electrical Energy in Buildings

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Credit value	SCQF level	Product code	Product title
Electronics			
1	8	HP3D 48	Active Electronic Circuits
2	7	HP47 47	Analogue Electronic Principles
1	8	HP3F 48	Applications of Signal Processing and Conditioning
1	7	HP3G 47	Combinational Logic
1	7	HP3K 47	Electronic Construction Skills
1	8	HP3L 48	Electronic Fault Finding
1	8	HP3N 48	Field Programmable Gate Arrays
1	8	HP3R 48	MSI Devices
1	7	HP3V 47	Printed Circuit Board Design, Manufacture and Test
1	8	HP3W 48	Programmable Logic Devices
1	7	HP3Y 47	Sequential Logic
1	8	HT1G 48	Systems Integration
1	8	HP40 48	Telecommunications Fundamentals
Engineering Practice			
1	6	HV2E 46	Advanced Pattern Development: An Introduction
1	7	HV31 47	Alternative Machining Operations
1	7	HV38 47	Computer Integrated Manufacture
1	7	HV2W 47	Electrical Design Systems: An Introduction
1	7	HV2X 47	Electrical Installation Design (Computer Aided): An Introduction
1	7	HV30 47	Electrical Motors and Motor Starting
1	7	HV37 47	Engineering Supervision: Staff and Budget Issues
1	7	HV33 47	Engineering Supervision: Teamworking and Continuing Professional Development
1	6	HV2G 46	Fundamental Electronic Components, Devices and Applications
1	7	HV2Y 47	Lighting Design in Buildings
1	7	HV2V 47	Mechanical Engineering Principles
1	7	HV35 47	Plant Systems: Services
1	7	HV36 47	Plant Systems: Utilities
1	7	HV34 47	Value Engineering
Engineering Systems			
1	8	HV5F 48	Engineering Systems Analysis: Non-Linearities and Control Strategies

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Credit value	SCQF level	Product code	Product title
Fabrication, Welding and Inspection			
1	7	HV3T 47	Design Analysis: Fabrication and Welding
1	7	HV3R 47	Destructive Testing
1	7	HV3P 47	Engineering Project
1	7	HV41 47	Fabrication and Welding Materials
1	7	HV3V 47	Fabrication Forming Processes
1	6	HV3D 46	Performing Liquid Penetrant Inspection
1	6	HV3E 46	Performing Magnetic Particle Inspection
1	7	HV3W 47	Pipework 1: Construction and Site Installation
1	7	HV3X 47	Pipework 2: Pipe Bending and Pipe System Design
1	7	HV3Y 47	Shipbuilding Principles: Advanced Hull and Associated Technologies
1	7	HV40 47	Shipbuilding Principles: Planning, Production and Assembly
1	7	HV3N 47	Welding: Principles and Applications 2
Manufacturing			
2	8	HV54 48	Computer Aided Engineering (CAE) and Prototyping
1	8	HV55 48	Facilities Layout and Analysis
1	8	HP12 48	Information Technology: Applications Software 2
1	8	HV3H 48	Jig and Fixture Design
1	8	HV57 48	Simulation of Advanced Manufacturing Systems
1	8	HV56 48	Tool Design
Mechanical			
1	8	HT7R 48	Heat Transfer and Fluid Mechanics
1	8	HT7X 48	Heating, Ventilation and Air Conditioning Practice and Design
2	8	HT7V 48	Plant Systems
1	8	HT81 48	Strength of Materials: Advanced
1	7	HT7C 47	Thermofluids
Mechatronics			
1	8	HV5A 48	Engineering Design Process: Mechatronics
1	7	HV46 47	Mechatronic Systems Elements
1	8	HV3J 48	Mechatronic Systems
1	7	HV45 47	Interfacing Electronics
1	7	HV47 47	Robotics and Animatronics: An Introduction
1	8	HV5C 48	Robotics and Animatronics
Petroleum			
1	7	HV4J 47	Science Industry: Key Issues
1	7	HV4P 47	Petroleum Engineering: Physics, Mathematics and Chemistry
1	7	HV4R 47	Petroleum Geology and Geophysics: An Introduction
1	7	HV4T 47	Petroleum Reservoir Engineering: An Introduction
1	7	HV4N 47	Oilfield Drilling Techniques and Operations: An Introduction
1	6	HV49 46	Fundamental Chemistry: An Introduction
2	7	HV4H 47	Fundamental Chemistry: Theory and Practice
1	7	HV4K 47	Engineering Science Principles
1	7	HV0C 47	Process Safety Engineering
1	7	J6M8 47*	Environmental Awareness
1	7	HV4L 47	Fire and Gas Detection
1	8	HV5T 48	Oil Well Management
1	8	HV5V 48	Petroleum Production Processes

5.5 Conditions of the Award

5.5.1 SQA Advanced Certificate in Engineering Systems

The conditions of award for the SQA Advanced Certificate in Engineering Systems qualification are as follows:

A candidate will be awarded the SQA Advanced Certificate in Engineering Systems on successful completion of 11 Unit credits plus 1 Graded Unit based on the SQA Advanced Certificate in Engineering Systems award table shown in Section 5.3. More specifically the SQA Advanced Certificate 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 SQA Advanced Diploma in Engineering Systems

The conditions of award for SQA Advanced Diploma in Engineering Systems qualifications are as follows:

A candidate will be awarded an SQA Advanced Diploma in Engineering Systems on successful completion of 27 Unit credits plus 3 Graded Unit credits based on the SQA Advanced Diploma in Engineering Systems award table shown in Section 5.4. More specifically the SQA Advanced Diploma 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

SQA Advanced Certificate in Engineering Systems

A candidate who successfully achieves an SQA Advanced Certificate in 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 Engineering Mathematics 1 Unit)

5.6.2 SQA Advanced Diploma in Engineering Systems

A candidate who successfully achieves an SQA Advanced Diploma in 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 Engineering Mathematics 1 and Engineering Mathematics 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 SQA Advanced Certificate and SQA Advanced Diploma in 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 SQA Advanced Certificate and SQA Advanced Diploma in 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 and professional recognition

5.8.1 Articulation

Articulation arrangements exist between a number of Scottish, UK and international universities where SQA Advanced Certificates and Diplomas will be accepted as advanced entry to either the second or third year of a related degree programme. Depending on the specific degree programme, certain units may be required as part of the SQA Advanced Certificate/Diploma. The optional section of the framework is sufficiently broad to ensure that centres are able to comply with reasonable articulation requests. A high proportion of our candidates have articulated to degree programmes and successfully completed them

5.8.2 Professional Body Recognition

SQA Advanced Certificates and Diplomas are recognised by many professional bodies. Candidates achieving an SQA Advanced Certificate/Diploma may meet the professional body entry requirements. Candidates may also gain partial and full exemptions to professional body exams.

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 SQA Advanced Certificate and SQA Advanced Diploma in 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 SQA Advanced Certificate and SQA Advanced Diploma in 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 Engineering Mathematics 1 is included in the mandatory core of both the SQA Advanced Certificate and SQA Advanced Diploma in 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. The Mathematics Unit concentrates on the development of these very important skills. For example, Outcome 1 in the Mathematics Unit covers trigonometrical functions and their graphs which is very useful in supporting the work on electrical ac waveforms and power within the Unit Principles of Engineering Systems. Outcome 3 in the Mathematics Unit focuses on vectors in two dimensions which supports the work on engineering quantities in the core engineering Units.

The mandatory section of the SQA Advanced Diploma also contains the Unit Engineering Mathematics 2, which allows candidates to study Calculus in some depth.

Centres have a large measure of flexibility in choosing Units from the optional sections of the SQA Advanced Certificate and SQA Advanced Diploma in Engineering Systems, thus allowing them opportunities to develop their own discreet SQA Advanced Certificate and SQA Advanced Diploma 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 eg does it meet a particular local or national employment need, does it aid candidates to progress to more advanced studies etc? Programmes should not be introduced without any clear rationale and simply to satisfy timetabling constraints. Examples of a single discipline SQA Advanced Certificate Engineering Systems electronics programme and a multi-disciplinary SQA Advanced Certificate Engineering Systems electro-mechanical programme are shown in Tables 6.1.1 and 6.1.2 respectively.

Likewise, examples of a single discipline SQA Advanced Diploma Engineering Systems Electrical Engineering programme and an SQA Advanced Diploma in Engineering Systems multi-disciplinary engineering programme are shown below in Figures 6.1.3 and 6.1.4

Unit code	Unit title	SCQF level	Credit value
HP4A 47	Communication: Practical Skills	7	1
HP48 46	Engineering Mathematics 1	6	1
HV44 47	Principles of Engineering Systems	7	2
HV42 47	Engineering Communication	7	1
HV43 47	Engineering Measurement and System Monitoring	7	1
HP47 47	Analogue Electronic Principles	7	2
HP3G 47	Combinational Logic	7	1
HP3Y 47	Sequential Logic	7	1
HP46 47	DC and AC Principles	7	1
HV3C 47	Engineering Systems: Graded Unit 1	7	1
	Total		**12**

Table 6.1.1: SQA Advanced Certificate in Engineering Systems — single discipline electronics programme

Unit code	Unit title	SCQF level	Credit value
HP4A 47	Communication: Practical Skills	7	1
HP48 46	Engineering Mathematics 1	6	1
HV44 47	Principles of Engineering Systems	7	2
HV42 47	Engineering Communication	7	1
HV43 47	Engineering Measurement and System Monitoring	7	1
HP46 47	DC and AC Principles	7	1
HT7K 47	Three Phase Systems	7	1
HV3G 48	Three Phase Induction Motors	8	1
HT74 47	Engineering Principles	7	1
HT7F 47	Pneumatics and Hydraulics	7	1
HV3C 47	Engineering Systems: Graded Unit 1	7	1
	Total		**12**

Table 6.1.2: SQA Advanced Certificate in Engineering Systems — multi-disciplinary electro-mechanical programme

SQA Advanced Diploma in Engineering Systems Mandatory and Graded Unit Sections (18 credits worth of Units)

PLUS

Optional Units (12 credits worth of Units)

Unit code	Unit title	SCQF level	Credit value
HP46 47	DC and AC Principles	7	1
HP3J 47	Electrical Networks and Resonance	7	1
HT7K 47	Three Phase Systems	7	1
HV3L 47	Electricity Power Systems	7	1
HT83 47	Electrical Machine Principles	7	2
HT1K 47	Applications of Programmable Controllers	7	1
HV2K 47	Industrial Plant Maintenance	7	1
HT7M 48	Electrical Motor Drive Systems	8	1
HV3G 48	Three Phase Induction Motors	8	1
HT1E 48	Mathematics for Engineering 3	8	2

Figure 6.1.3: SQA Advanced Diploma in Engineering Systems — single discipline electrical engineering programme

SQA Advanced Diploma in Engineering Systems Mandatory and Graded Unit Sections (18 credits worth of Units)

PLUS

Optional Units (12 credits worth of Units)

Unit code	Unit title	SCQF level	Credit value
HT71 47	Statics and Strength of Materials	7	1
HT7E 47	Dynamics	7	1
HT7V 48	Plant Systems	8	2
HT7Y 48	Applied Industrial Plant Maintenance	8	1
HP46 47	DC and AC principles	7	1
HT7K 47	Three Phase Systems	7	1
HT83 47	Electrical Machine Principles	7	2
HT7M 48	Electrical Motor Drive Systems	8	1
HV3G 48	Three Phase Induction Motors	8	1
HV39 47	Engineering Systems Interfaced with Programmable Logic Controllers	7	1

Figure 6.1.4: SQA Advanced Diploma in Engineering Systems — multi-disciplinary engineering programme

6.2 Delivery

The SQA Advanced Certificate in Engineering Systems award can be delivered on a full-time, block-release, part-time day or part-time evening basis. Traditionally most SQA Advanced Certificate in Engineering awards have been offered on a day-release and evening class basis to candidates in employment. However, in recent years SQA Advanced Certificate in Engineering awards have also been offered on a full-time basis for school leavers, adult returners etc.

As with the SQA Advanced Certificate, the SQA Advanced Diploma in Engineering Systems can be delivered by a range of different delivery modes. Traditionally most SQA Advanced Diploma Engineering awards have been offered on a full-time basis. However, in recent years SQA Advanced Diploma 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 SQA Advanced Certificate to SQA Advanced Diploma 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 SQA Advanced Certificate and SQA Advanced Diploma Engineering Systems awards.

Centres, working on their own or in partnership, might also wish to consider the following approaches to delivering the SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced Certificate Engineering Systems award, centre staff should consider whether they wish to adopt one of the following three approaches to delivering the SQA Advanced Certificate 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 SQA Advanced Certificate 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 SQA Advanced Certificate will influence how the 2nd year SQA Advanced Diploma in Engineering Systems is timetabled. An example of how the SQA Advanced Diploma in Engineering Systems may be timetabled assuming a top down approach has been taken to the SQA Advanced

Certificate in Engineering Systems/1st Year SQA Advanced Diploma in Engineering Systems is shown in Appendix 2.

The Units in the mandatory sections of both the SQA Advanced Certificate and SQA Advanced Diploma in Engineering Systems have been designed to be delivered as an integrated engineering systems programme. SQA has produced learning/teaching materials for the four Units: Engineering Communication, Principles of Engineering Systems, Engineering Measurement and System Monitoring and Engineering Mathematics 1 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 SQA Advanced Diploma 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 SQA Advanced Diploma in 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	♦ 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	♦ Reinforcing numeracy and mathematical skills when teaching mechanical or electrical engineering principles (eg Engineering Mathematics 1.) ♦ Reinforcing using graphical information skills by use of a range of graphical representations (eg Engineering Communication, Engineering: Practical Skills etc.)
Information and Communication Technology	♦ 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	♦ 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	♦ 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 SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced 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 SQA Advanced 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 SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced 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 SQA Advanced Unit, over assessment should be avoided if the following guidelines are adopted for the maximum time spent on SQA Advanced Unit assessment:

(i) One and a half hours per Unit credit for SQA Advanced Units at SCQF levels 6 and level 7.

(ii) Two hours per Unit credit for SQA Advanced Units at SCQF level 8.

(iii) Two and a half hours per Unit credit for SQA Advanced Units at SCQF level 9.

(4) Produce a specimen paper for the SQA Advanced Certificate 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 SQA Advanced 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 SQA Advanced Certificate in 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 SQA Advanced Certificate 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
HV42 47	Engineering Communication	O.1 — Portfolio of sketches covering systems layouts and component level representation. Portfolio developed in candidate's own time. 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. O.3 — Presentation lasting 10 minutes plus 5 minutes Question and Answer session.	Centres may combine the block diagram aspects of this assessment with the assessment for O.1 in the Unit Principles of Engineering Systems. The presentation may be based on the engineering systems studied in O.2.

Unit Number	Unit title	Assessment details	Opportunities or integrating assessment
HV43 47	Engineering Measurement and System Monitoring	O.1 — Practical exercises involving the measurement of engineering quantities and production of short report. Report should be produced in candidate's own time. 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. 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.	The delivery and assessment of this Outcome may be linked to O.8 in the Unit Principles of Engineering Systems.

Unit Number	Unit title	Assessment details	Opportunities or integrating assessment
HV44 47	Principles of Engineering Systems	O.1, O.2, O.3 and O.7 — assessed as four separate assignments plus 4 reports. O.4, O.5 and O.8 — assessed by three separate 30 minute tests. 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.	Single assignment plus single report based on the same electromechanical system covering the work of the four Outcomes. Single assessment lasting 1 hour and 30 minutes covering the work in all three Outcomes.
HP48 46	Engineering Mathematics 1	O.1 — Single test lasting 40 minutes. O.2 — Single test lasting 30 minutes. O.3 — Single test lasting 30 minutes.	Single assessment lasting 1 hour and 40 minutes covering the work of the three Outcomes.

Table 6.3.1 — Assessment details for the four mandatory Units

6.3.2 Graded Units

The purpose of the Graded Units within the SQA Advanced Certificate and SQA Advanced Diploma in 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.

SQA Advanced Certificate in Engineering Systems candidates will undertake a 1 credit Graded Unit at SCQF level 7 while SQA Advanced Diploma 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 SQA Advanced Certificate in Engineering Systems/1st year SQA Advanced Diploma in 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 SQA Advanced Certificate/1st year of the SQA Advanced Diploma 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 SQA Advanced Diploma in Engineering Systems programme. Those centres that deliver the SQA Advanced Certificate in Engineering Systems as part of the first year of the SQA Advanced Diploma Engineering Systems programme are advised that their candidates should have completed all SQA Advanced Certificate 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 SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced Certificate and SQA Advanced Diploma Engineering Systems awards is shown in Table 6.3.3.

Unit Title	Assessment exemplar status
Communication: Practical Skills	An assessment exemplar contextualised for the SQA Advanced Diploma 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
Engineering Systems Graded Unit 1	Specimen paper available
Engineering Systems Graded Unit 2	An assessment exemplar contextualised for SQA Advanced Diploma Electronics is available
Engineering Mathematics 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 SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced Certificate and SQA Advanced Diploma 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

Equality and inclusion

This unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

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 SQA Advanced Certificate and SQA Advanced Diploma in 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 Advanced Design Principles.

Award Content

The SQA Advanced Certificate and SQA Advanced Diploma in 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 SQA Advanced Certificate and SQA Advanced Diploma in 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 SQA Advanced Certificate and SQA Advanced Diploma in Engineering Systems will allow you to specialise in one or more areas of engineering in the five credit optional section of the SQA Advanced Certificate or the twelve credit optional section of the SQA Advanced Diploma.

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 SQA Advanced Diploma in 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 SQA Advanced Diploma in 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 SQA Advanced Certificate and SQA Advanced Diploma, but one Unit on Information Technology in the optional section of the SQA Advanced Certificate and two Units on Information Technology in the optional section of the SQA Advanced Diploma are available if you wish to consolidate your knowledge and skills in this area.

Teaching

While taking the SQA Advanced Certificate and SQA Advanced Diploma in 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 SQA Advanced Certificate and SQA Advanced Diploma in 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 SQA Advanced Certificate/1st year of the SQA Advanced Diploma and a major project activity you will do during the 2nd year of the SQA Advanced Diploma. The examination has been designed to allow you to demonstrate your ability to integrate knowledge, understanding and skills learnt throughout the SQA Advanced Certificate/1st year of the SQA Advanced Diploma. A satisfactory pass in the core Units in the 1st year of the SQA Advanced Diploma and the 3 hour Graded Unit 1 examination will mean you would be eligible to achieve an SQA Advanced Certificate Engineering Systems.

In the SQA Advanced Diploma 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 SQA Advanced Certificate and SQA Advanced Diploma 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 SQA Advanced Certificate and SQA Advanced Diploma Engineering Systems:

SQA Advanced Certificate and SQA Advanced Diploma

- one Higher from Physics, Technological Studies, Mechatronics or Mathematics and at least three Standard Grades 1–2/National 5 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 SQA Advanced Diploma

- An SQA Advanced Certificate in Engineering Systems*
- An SQA Advanced Certificate 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 SQA Advanced Diploma Engineering Systems award.*

Progression

The SQA Advanced Certificate and SQA Advanced Diploma Engineering Systems awards only partially satisfy the academic requirements to become an incorporated engineer (a degree is now required). However, both the SQA Advanced Certificate and SQA Advanced Diploma in 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 SQA AdvancedSQA Credit is equivalent to 8 SCQF credit points. This applies to all SQA Advanced Units, irrespective of their level.

SCQF levels: The SCQF covers 12 levels of learning. SQA Advanced 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 SQA Advanced 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 SQA Advanced CertificateSQA Advanced Certificate/Diploma 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 SQA Advanced Certificates and SQA Advanced Diplomas are those developments or revisions undertaken by a group of centres in partnership with SQA.

Specialist single centre and specialist collaborative devised SQA Advanced Certificates and SQA Advanced Diplomas 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 SQA Advanced Certificates and SQA Advanced Diplomas, these developments or revisions will also be supported by SQA.

10 Appendices

See following pages for appendices.

Appendix 1: Sample SQA Advanced Certificate Teaching Timetable
Appendix 2: Sample SQA Advanced Diploma Teaching Timetable

Appendix 1

Sample SQA Advanced Certificate Teaching Timetable

Full-Time SQA Advanced Certificate in Engineering Systems Timetable — Top-Down, Bottom-Up and Parallel Approaches

1 – Year, Full-Time SQA Advanced Certificate in Engineering Systems Timetable — Top-Down Approach

First Year, First Semester

Engineering Mathematics 1	Communication: Practical Skills	Engineering Communication	Principles of Engineering Systems	Principles of Engineering Systems	Engineering Measurement and System Monitoring

First Year, Second Semester

Option 1	Option 2	Option 3	Option 4	Option 5	Engineering Systems: Graded Unit 1 Examination

Centres may include additional optional Units in the programme if they wish.

1 – Year, Full-Time SQA Advanced Certificate in Engineering Systems Timetable — Bottom-Up Approach

First Year, First Semester

Engineering Mathematics 1	Option 1	Option 2	Option 3	Option 4	Option 5

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

Centres may include additional optional Units in the programme if they wish.

1 – Year, Full-Time SQA Advanced Certificate in Engineering Systems Timetable — Parallel Approach

First Year, First Semester

Engineering Mathematics 1	Communication: Practical Skills	Engineering Communication	Principles of Engineering Systems	Option 1	Option 2

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

Centres may include additional optional Units in the programme if they wish.

Appendix 2

Sample SQA Advanced Diploma Teaching Timetable

Full-time SQA Advanced Diploma in Engineering Systems Timetable

2 Year, Full-Time SQA Advanced Diploma in Engineering Systems/SQA Advanced Certificate in Engineering Systems Timetable

First Year, First Semester

Engineering Mathematics 1	Communication: Practical Skills	Principles of Engineering Systems	Principles of Engineering Systems	Engineering Measurement and System Monitoring	Engineering: Practical Skills	Option 1

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

2 Year, Full-Time SQA Advanced Diploma in Engineering Systems Timetable

Second Year, First Semester

Business Awareness and Continuing Professional Development	Engineering Systems Analysis: System Modelling andControl	Principles of Safe Engineering Systems	Project Management: Managing the Implementation of a Project	Engineering Mathematics 2	Option 7	Engineering Systems: Graded Unit 2 Project

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