SQA Advanced Unit Specification

General information for centres

Unit title: Systems Integration

Unit code: HT1G 48

Unit purpose: This Unit is designed to enable candidates to gain a basic knowledge and understanding of the subject 'Systems Integration' as considered in Electronic Engineering. From the Unit candidates will learn how a system may be characterised using concepts such as 'Block Diagrams', 'Black Boxes', various 'Specifications' and various 'Descriptions'. Also candidates will gain an understanding of the people and processes that may be involved in Systems Integration. Note that while many of the concepts may apply to Systems Integration in any Engineering area, there is also consideration of specific issues that arise from the Electronic Engineering context.

On completion of the Unit the candidate should be able to:

1. Describe an electronic system using Black Box Specifications, Block Diagrams, Interface Specification and appropriate methodologies.
2. Describe key issues involved in System Integration tasks.
3. State the roles of additional factors that need considering when undertaking System Integration.

Credit value: 1 SQA Credit at SCQF level 8: (8 SCQF credit points at SCQF level 8*)

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

Recommended prior knowledge and skills: The normal entry qualification for this Unit would be a Higher in Electronic Engineering or an appropriate group of NQ Units at SCQF Level 6.

Core skills: There may be opportunities to gather evidence towards Core Skills in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Context for delivery: This Unit was originally designed to be included in the SQA Advanced Diploma in Electronics award. While much of the content has been written in generic terms there are some specialised aspects relating to Electronics Systems Integration. If this Unit is used in another group award(s), it is recommended that it should be taught and assessed within the context of the particular group award(s) to which it contributes.

Assessment: It is recommended that the assessment requirements for Outcomes 1, 2 and 3 are the subject of a combined mini-case study used to cover the sampled knowledge and/or skills items in the three Outcomes. It is expected that this Unit should be assessed using separate assessments for Outcomes 1, 2 and 3. The assessments should be based on an appropriate mini-case study which provides a threaded exercise and is of sufficient scope and breadth to cover all the required assessed areas. The overall assessment time should not exceed two hours and thirty minutes under supervised, controlled conditions. It may be possible that this Unit could be assessed using all the assessment papers at one single assessment event, though care should be taken that this does not disadvantage the candidate. It should be noted that candidates must achieve all of the minimum evidence specified for each Outcome, combination of Outcomes or for the Unit as a whole in order to pass the Unit.

SQA Advanced Unit Specification: Statement of standards

Unit title: Systems Integration

Unit code: HT1G 48

The sections of the Unit stating the Outcomes, knowledge and/or skills, and evidence requirements are mandatory.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the knowledge and/or skills section must be taught and available for assessment. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Describe an electronic system using Black Box Specifications, Block Diagrams, Interface Specification and appropriate methodologies

Knowledge and/or skills

- Know and understand the terms Black Box Specifications, Block Diagrams and Interface Specifications
- Identify a system's boundaries, inputs, outputs, control inputs, function
- Produce basic block diagrams from functional descriptions and/or circuit diagrams
- Produce basic interface specifications from functional descriptions and/or circuit diagrams
- Understand and describe the function of a basic system given a Black Box Specifications, Block Diagrams and Interface Specifications
- Understand the purpose and usage of specification methodologies including VHDL

Evidence requirements

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence should be presented as part of a report and/or responses to a specific question or questions. Such a report and/or questions should consist of a mini-case study which forms part of a threaded exercise linked with the other Outcomes. Each candidate will need to provide evidence that they can, with reference to a particular application, be able to understand the various ways of representing the information and carry out transformations between them based on a sample of the items shown above. The sample should be derived from a mini-case study which may be provided by the centre or based on an appropriate workplace application. In either case it must be checked that the mini-case study covers all items being sampled.

Where a workplace application is used, care should be taken to ensure that it would provide candidates with sufficient opportunity to meet the evidence requirements of this Unit. It may be appropriate for the lecturer or instructor concerned to ensure beforehand that a particular workplace application will allow candidates to generate sufficient and suitable evidence.

The application should consist of a fairly basic Electronic System and it should be accompanied with some appropriate background information. The candidate should then be asked to carry out tasks chosen to test a selection of the listed concepts. The candidate should be asked to carry out six tasks of which five should be completed correctly.

Example tasks could be:

- produce a Black Box specification for a design
- from a circuit or block diagram, identify the inputs (or same for outputs)
- identify the function of a design
- produce a Block Diagram from a Circuit Diagram
- produce a Block Diagram from a System Functional Description
- identify interfaces to a design (or within a design)
- produce basic Input Interface specifications for a design (or same for output)
- describe the purpose and usage of specification methodologies (including VHDL)

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of six items of knowledge and/or skills items is required each time the Outcome is assessed. The basic Electronic System used in the assessment should also be different each time. Candidates must provide a satisfactory response to five items out of the six.

Where an item is sampled, a candidate's response can be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- identify evidence of knowledge of the terms used: Black Box Specifications, Block Diagrams or Interface Specifications
- identify a system's boundaries, inputs, outputs, control inputs or function
- produce basic block diagrams from functional descriptions and/or circuit diagrams
- produce basic interface specifications from functional descriptions and/or circuit diagrams
- demonstrate an understanding of the function of a basic system from a given Black Box Specifications, Block Diagrams or Interface Specifications
- demonstrate an understanding of the purpose and usage of specification methodologies including VHDL

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Candidates should be given a copy of the mini-case study at least seven days before the assessment takes place. Where the mini-case study is to be based on an appropriate workplace application provided by the candidate then the candidate should provide a workplace mini-case study report to the centre at least twenty one days before the assessment date. This workplace mini-case study report should provide a minimum of similar levels of information to the centre provided mini-case studies and a centre provided template or checklist may prove useful to assist the candidate in preparation of the report. Note this workplace mini-case study report is not itself assessed as part of the assessment but is used to provide contextual background. In all cases it must be checked that the mini-case study covers all items being sampled.

Where a workplace application is used, care should be taken to ensure that it would provide candidates with sufficient opportunity to meet the evidence requirements of the Unit. It may be appropriate for the lecturer or instructor concerned to ensure beforehand that a particular workplace application will allow candidates to generate sufficient and suitable evidence.

Candidates will be allowed to bring to the assessment a copy of the mini-case study and notes they have prepared personally. They may not bring textbooks, handouts or other materials not prepared by themselves. All notes should be handed in at the end of the assessment.

Assessment guidelines

The scope of the assessment should cover all the required sampled aspects. If there are a few areas not sufficiently covered by the particular mini-case study then these can be tested by means of a short supplementary paper or oral questioning with checklists which cover only those aspects. In such a case then the overall time allocation should be adjusted appropriately for each paper.

Outcome 2

Describe key issues involved in System Integration tasks

Knowledge and/or skills

- Know the purpose of different type of system descriptions/specifications: Market, User, Functional, Technical, Design
- Know the key trade-offs that shape specifications: Performance/Appearance, Price/Cost
- Know how issues of Availability and IPR (Intellectual Property Rights) affects specification
- Describe the role of different stakeholders: End-user, Customer, Manufacturer, Designer
- Compare and contrast incremental and step-function innovation
- Describe the characteristics of the specification status: Idea, Concept, Draft, Issued
- Describe the function and operation of specification Change Control
- Describe the benefits of a Mechatronic/Holistic Approach to System Design and Realisation
- Discuss the relative merits of Technology Choices – digital and/or analogue, discrete and/or integrated, buy and/or make, through hole and/or surface mount, System on Silicon, ASICs, Logic/Gate Arrays, hardware/firmware/software
- Describe Design Approaches: Top down/Bottom up, System, Sub-System, Circuit, Performance, Interfacing, Protocols, Design for X, Use of Libraries of designs or functions

Evidence requirements

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence should be presented as part of a report and/or responses to a specific question or questions. Such a report and/or questions should consist of a mini-case study which forms part of a threaded exercise linked with the other Outcomes. Each candidate will need to provide evidence that they can, with reference to a particular application, be able to describe

the key issues related to Systems Integration based on a sample of the items shown above. The sample should be derived from a mini-case study which may be provided by the centre or based on an appropriate workplace application. In either case it must be checked that the mini-case study covers all items being sampled.

Where a workplace application is used, care should be taken to ensure that it would provide candidates with sufficient opportunity to meet the evidence requirements of this Unit. It may be appropriate for the lecturer or instructor concerned to ensure beforehand that a particular workplace application will allow candidates to generate sufficient and suitable evidence.

In discussion of the issues for this Outcome, care should be taken to ensure the aspect of Electronic System Integration should be suitably present and emphasised. While many aspects are generic to many industry sectors yet the prevalent timescales, modes of operation and priorities should be highlighted in exploring the background. The candidate should then be asked to carry out a selection of tasks. The tasks should be chosen to test a selection of the listed concepts. The candidate should be asked to carry out twelve of which ten should be completed correctly.

Example tasks could be:

- state the purpose of Market system descriptions/specifications
- state the purpose of User system description/specifications
- state the purpose of Functional system descriptions/specifications
- state the purpose of Technical system descriptions/specifications
- state the purpose of System Design descriptions/specifications
- briefly describe key trade-offs between Performance/Appearance, Price/Cost
- briefly describe how issues of Availability and IPR (Intellectual Property Rights) could affect specification
- availability
- briefly describe the role of different stakeholders: End-user, Customer, Manufacturer, Designer
- briefly compare and contrast incremental and step-function innovation
- briefly describe the characteristics of the specification status: Idea, Concept, Draft, Issued
- briefly describe the function and operation of specification Change Control
- briefly describe the benefits of a Mechatronic/Holistic Approach to System Design and Realisation
- briefly discuss the relative merits of Technology Choices: digital and/or analogue
- briefly discuss the relative merits of Technology Choices: discrete and/or integrated
- briefly discuss the relative merits of Technology Choices: make and/or buy
- briefly discuss the relative merits of Technology Choices: through hole and/or surface mount
- briefly discuss the relative merits of Technology Choices: System on Silicon, ASICs, Logic/Gate Arrays
- briefly discuss the relative merits of Technology Choices: hardware/firmware/software

- briefly describe Design Approaches: Top down/Bottom up
- briefly describe Design Approaches: Interfaces and Protocols
- briefly describe Design Approach: Design for X
- briefly describe Design Approach: Use of Libraries of designs or functions

In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of twelve items of knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to ten items out of the twelve.

Where an item is sampled, a candidate's response can be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:-

- identify evidence of knowledge of the purpose of different type of system descriptions/specifications: Market, User, Functional, Technical, Design
- identify evidence of knowledge of the key trade-offs that shape specifications: Performance/Appearance, Price/Cost
- identify evidence of knowledge of how issues of Availability and IPR (Intellectual Property Rights) affects specification
- provide descriptions of the role of different stakeholders: End-user, Customer, Manufacturer, Designer
- compare and contrast incremental and step-function innovation
- describe the characteristics of the specification status: Idea, Concept, Draft, Issued
- describe the function and operation of specification Change Control
- describe the benefits of a Mechatronic/Holistic Approach to System Design and Realisation
- discuss the relative merits of Technology Choices – digital and/or analogue, discrete and/or integrated, buy and/or make, through hole and/or surface mount, System on Silicon, ASICs, Logic/Gate Arrays, hardware/firmware/software
- describe Design Approaches: Top down/Bottom up, System, Sub-system, Circuit, Performance, Interfacing, Protocols, Design for X, Use of Libraries of designs or functions

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Candidates should be given a copy of the mini-case study at least seven days before the assessment takes place. Where the mini-case study is to be based on an appropriate workplace application provided by the candidate then the candidate should provide a workplace mini-case study report to the centre at least twenty one days before the assessment date. This workplace mini-case study report should provide a minimum of similar levels of information to the centre provided mini-case studies and a centre provided template or checklist may prove useful to assist the candidate in preparation of the report. Note this workplace mini-case study report is not itself assessed as part of the assessment but is used to provide contextual background. In all cases it must be checked that the mini-case study covers all items being sampled.

Where a workplace application is used, care should be taken to ensure that it would provide candidates with sufficient opportunity to meet the evidence requirements of the Unit. It may be appropriate for the lecturer or instructor concerned to ensure beforehand that a particular workplace application will allow candidates to generate sufficient and suitable evidence. Candidates will be allowed to bring to the assessment a copy of the case study and notes they have prepared personally. They may not bring textbooks, handouts or other materials not prepared by themselves. All notes should be handed in at the end of the assessment.

Assessment guidelines

The scope of the assessment should cover all the required sampled aspects. If there are a few areas not sufficiently covered by the particular mini-case study then these can be tested by means of a short supplementary paper or oral questioning with checklists which cover only those aspects. In such a case then the overall time allocation should be adjusted appropriately for each paper.

Outcome 3

State the roles of additional factors that need considering when undertaking System Integration

Knowledge and/or skills

- State the roles of Technical factors, Technology, Cost, Time and Resources when carrying out Feasibility Studies
- State the roles of Tasks, Resources, Scheduling and Dependencies in Project Planning
- State possible reasons for doing Fast prototyping, prototyping critical aspects of a system, and prototyping Human Computer interfaces
- State the roles of Simulation & Modelling, Schematic capture, Design check, Layout and Realisation, Programmable Logic, System on Silicon, Emulation in the system integration process
- State the reasons for carrying types of testing during systems integration: Functional test, Component test, Performance test, sub-system test, Integration test
- State the role of Configuration Control in systems integration: Issue Status, Signoff, Changes, Upgrades, Fault Reporting, Migration Strategies

Evidence requirements

Evidence for the knowledge and/or skills in this Outcome will be provided on a sample basis. The evidence should be presented as part of a report and/or responses to a specific question or questions. Such a report and/or questions should consist of a mini-case study which forms part of a threaded exercise linked with the other Outcomes. Each candidate will need to provide evidence that they can, with reference to a particular application, be able to state the roles of the additional factors that need considering when undertaking System Integration based on a sample of the items shown above. The sample should be derived from a mini-case study which may be provided by the centre or based on an appropriate workplace application. In either case it must be checked that the mini-case study covers all items being sampled.

Where a workplace application is used, care should be taken to ensure that it would provide candidates with sufficient opportunity to meet the evidence requirements of this Unit. It may

be appropriate for the lecturer or instructor concerned to ensure beforehand that a particular workplace application will allow candidates to generate sufficient and suitable evidence.

The application should consist of a fairly basic Electronic System and it should be accompanied with some appropriate background information. The candidate should then be asked to carry out tasks chosen to test a selection of the listed concepts. In order to ensure that candidates will not be able to foresee what items they will be questioned on, a different sample of six knowledge and/or skills items is required each time the Outcome is assessed. Candidates must provide a satisfactory response to five out of the six items.

Where sampling takes place, a candidate's response can be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate is able to:

- state the roles of Technical factors, Technology, Cost, Time and Resources when carrying out Feasibility Studies
- state the roles of Tasks, Resources, Scheduling and Dependencies in Project Planning
- state possible reasons for doing Fast prototyping, prototyping critical aspects of a system, and prototyping Human Computer interfaces
- state the roles of Simulation & Modelling, Schematic capture, Design check, Layout and Realisation, Programmable Logic, System on Silicon, ASICs, Logic/Gate Arrays, Emulation in the system integration process
- state the reasons for carrying types of testing during systems integration: Functional test, Component test, Performance test, sub-system test, Integration test
- state the role of Configuration Control in systems integration: Issue Status, Signoff, Changes, Upgrades, Fault Reporting, Migration Strategies

Evidence should be generated through assessment undertaken in controlled, supervised conditions. Candidates should be given a copy of the mini-case study at least seven days before the assessment takes place. Where the mini-case study is to be based on an appropriate workplace application provided by the candidate then the candidate should provide a workplace mini-case study report to the centre at least twenty one days before the assessment date. This workplace mini-case study report should provide a minimum of similar levels of information to the centre provided mini-case studies and a centre provided template or checklist may prove useful to assist the candidate in preparation of the report. Note this workplace mini-case study report is not itself assessed as part of the assessment but is used to provide contextual background. In all cases it must be checked that the mini-case study covers all items being sampled.

Where a workplace application is used, care should be taken to ensure that it would provide candidates with sufficient opportunity to meet the evidence requirements of the Unit. It may be appropriate for the lecturer or instructor concerned to ensure beforehand that a particular workplace application will allow candidates to generate sufficient and suitable evidence. Candidates will be allowed to bring to the assessment a copy of the mini-case study and notes they have prepared personally. They may not bring textbooks, handouts or other materials not prepared by themselves. All notes should be handed in at the end of the assessment.

Assessment guidelines

The scope of the assessment should cover all the required sampled aspects. If there are a few areas not sufficiently covered by the particular mini-case study then these can be tested by means of a short supplementary paper or oral questioning with checklist which cover only those aspects. In such a case then the overall time allocation should be adjusted appropriately for each paper.

Administrative information

Unit code: HT1G 48

Unit title: Systems Integration

Superclass category: XL

Date of publication: August 2017

Version: 01

Source: SQA

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 279 1000. Alternatively, complete our Centre Feedback Form.

SQA Advanced Unit Specification: Support notes

Unit title: Systems Integration

This part of the Unit specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

Guidance on the content and context for this Unit

This Unit has been written to allow candidates to gain and develop an understanding of a System's Approach to Electronic Engineering. It has been written as part of a group of Units associated with the SQA Advanced Diploma in Electronics.

The modern Electronics practitioner needs to not only gain knowledge, understanding and practice of basic circuits/devices/principles and applications but also to recognise the importance of the overall design and realisation of a system to perform a function. The function may be derived from not only technical needs but may come from many other factors and influences. The choices made to use analogue and/or digital, integrated and/or discrete, fixed and/or programmable, etc. will depend on many issues and is liable to vary between realisations and almost certainly could be achieved by many mixtures and combinations.

Considering a topic at a 'systems level' is often (rightly) considered to be a higher order task or discipline than considerations at more basic levels. In some respects, the Unit here seeks to identify and discuss systems aspects as a way of simplification or gaining clarity rather than dealing with more complex aspects. In many cases, engineering topics are often approached as a system or black box before the details are explored and examined. Examples might include the bipolar transistor or a 555 timer. It is expected that candidates will already have a basic understanding of many other areas at SCQF level 7 and maybe some at SCQF level 8 before this Unit is approached. Having completed this Unit, candidates should have greater confidence to face technologies, devices and sub-systems which are novel to them and to use them in basic applications while then learn more and explore.

The subject is split into the three areas.

The first, "Describe an electronic system using Black Box Specifications, Block Diagrams, Interface Specification and appropriate methodologies" seeks to show different ways of considering a system and how these help in understanding and defining functionality and linkages. By the end candidates should be able to freely convert between these forms and verbal descriptions of systems and subsystems. It should also be recognised that ‘systems’ are not just ‘products’ but are increasingly a combination of both ‘products and services’ which together provide, or contribute towards, a solution for purchasers and end users.

The second "Describe key issues involved in System Integration tasks" introduces some of the main factors and people that strongly influence system designs. By studying these, candidates should gain an awareness of the 'bigger picture' that often enables, governs or constrains detailed design, realisation or use.

The third, "State the roles of additional factors that need considering when undertaking System Integration" is to help candidates gain an overview of the process of Systems Integration. Much of Systems Integration is generic to disciplines other than Electronic Engineering. But some is specific to Electronic Engineering and some aspects are very specific to particular technology routes. All require careful consideration of the interrelationships and timing.

It is not expected that a candidate would become an expert practitioner as Systems Integrator by the end of the Unit, but more that they acquire a basic knowledge and understanding of the issues and situations that will often surround their particular area of specialism. This will enable them to ask more appropriate questions and respond to those questions asked of themselves more appropriately

Because of the generic nature of much of the content, lecturers and candidates should find many opportunities to shape the placing of the Unit within their areas of particular interest or employment. Similarly background information from case studies and articles should be easily found and used. This Unit covers many of the key topics in this area but lecturers should be sensitive to new technologies, development methodologies and industry fashion which may suggest additional associated topics which would add value.

A list of topics are given below. Lecturers are advised to study this list of topics in conjunction with the assessment exemplar information for this Unit so they can get a clear indication of the standard of achievement expected of candidates taking this Unit.

Outcome 1
Describe an electronic system using Black Box Specifications, Block Diagrams, Interface Specification and appropriate methodologies (10 hours)

- What is a system? It’s boundaries, function and form
- Black Box Specifications: Input, Function or Action, Output, Parameters, Block Diagrams: Functional blocks, logical blocks, physical blocks, interfaces. specification methodologies

Outcome 2
Describe key issues involved in System Integration tasks (18 hours)

- Descriptions and Specifications: Market, User, Functional, Technical, Design
- Specifications trade-offs: Performance/Appearance, Price/Cost
- Availability and IPR (Intellectual Property Rights) issues
- Stakeholders: End-user, Customer, Manufacturer, Designer

- Innovation Routes: Incremental v Step Function
- Stages and Aspects of Specification: Idea, Concept, Draft, Issued, Change Control
- System Design and Realisation Choices: Mechatronic/Holistic Approach
- Technology Choices – digital and/or analogue, discrete and/or integrated, buy and/or make, through hole and/or surface mount, System on Silicon, ASICs, Logic/Gate Arrays, hardware/firmware/software
- Design Approaches: Top down/Bottom up, System, Sub-System, Circuit, Performance, Interfacing, Protocols, Design for X, Use of Libraries of designs or functions

Outcome 3
State the roles of additional factors that need considering when undertaking System Integration (12 hours)

- Feasibility: Technical, Technology, Cost, Time, Resources
- Project Planning: Tasks, Resources, Scheduling, Dependencies
- Prototypes: Fast prototyping, critical aspects, Human Computer Interfacing
- Tools and environments: Simulation and Modelling, Schematic capture, Design check, Layout and Realisation, Programmable Logic, System on Silicon, ASICs, Logic/Gate Arrays, Emulation
- Testing: Functional, Component, Performance, Sub-System, Integration
- Configuration Control: Issue Status, Signoff, Changes, Upgrades, Fault Reporting, Migration Strategies

Assessment (2 hours 30 minutes)

It is recommended that a mini-case study be used to assess this Unit. A fairly basic Electronic Design can be provided with some background information. The candidate can then be asked to carry out a selection of tasks.

Tasks such as are required to cover Outcome 1, for example, sketching the design as a Block Diagram, Identifying Interfaces, etc. would typically be assessed in 45 minutes following a prior discussion of the case study material.

Responses that could cover the key issues involved in Outcome 2, for example, discussion of Tradeoffs in Specification, Stakeholder's interests, Realisation Choices, Design Approaches, etc. would typically be assessed in 60 minutes following a prior discussion of the case study material.

Responses that could cover the additional factors involved in Systems Integration, for example, listing certain ones of these factors/issues would typically be assessed in 45 minutes following a prior discussion of the case study material.

Guidance on the delivery and assessment of this Unit

This Unit is an optional Unit within the SQA Advanced Diploma in Electronics award. This Unit provides a good overview of Systems Integration issues and should be delivered in the context of Electronic Engineering as experienced in the modern business environment. Given the content of this Unit, particularly that relating to learning and future career planning, it is recommended that this Unit be delivered towards the middle or end of the SQA Advanced Diploma in Engineering award when the student has already developed some understanding of the technical terms and issues.

This Unit has been designed to promote the development of research, analytical and critical thinking skills. It is important that candidates are provided with the appropriate support to develop these skills. This support may come in the form of individual or group support from the lecturer or instructor delivering this Unit, through group activities, or with reference to appropriate textbooks, reports or papers or from some other source(s) of information or knowledge. The technical press is a particular good source of information and lecturers should look out for appropriate material which may benefit the learners. Many reports, papers and other sources of information may be accessed via a number of different web sites operated by the following: Scottish Executive, Scottish Enterprise, United Kingdom Government, Labour Market Research Organisations, Sector Skills Councils relating to the occupational area or Professional Bodies relating to the occupational area. It is important that the information on these web sites is checked regularly as new information on such areas as new technologies, process tools and innovations, testing and integration tools, etc. becomes available all the time.

Because of the systems nature of this Unit, a bank of exemplar materials should be accumulated for the student to handle and discuss. This might include Product Descriptions, Product Specifications, Interface Specifications, Block Diagrams, Products, Case studies, Engineering documentation, Planning Charts, Test Procedures, etc. This could be introduced at appropriate points in the coverage to help the candidate get a feel for these and their scope. Lecturers should be alert to opportunities to use the students' own knowledge and experiences to inform particular topics and the subject area in general.

Details on approaches to assessment are given under Evidence requirements and Assessment guidelines under each Outcome in the SQA Advanced Unit specification: statement of standards section. It is recommended that these sections be read carefully before proceeding with assessment of candidates. With many Units, lecturers will generally expect to receive back responses which correspond to the communicated information from the lecturer. However, owing to the systems nature of this topic, lecturers should remain alert to accept other valid responses which students may provide. This may flow from the student's personal knowledge, reading or experience although they have not been covered to such depth by the Unit.

Open learning

This Unit could be delivered by distance learning, which may incorporate some degree of on-line support and interaction. However, with regard to assessment, planning would be required by the centre concerned to ensure the sufficiency and authenticity of candidate evidence. Arrangement would be required to be put in place to ensure that assessment whether done at a single or at multiple events was conducted under controlled, supervised conditions.

To keep administrative arrangements to a minimum, it is recommended that a single assessment paper (taken by candidates at a single assessment event) be used for distance learning candidates provided this does not disadvantage the candidates.

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

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.

General information for candidates

Unit title: Systems Integration

This Unit has been designed to allow you to learn about a systems approach to Electronics. While there can be much skill and satisfaction in designing, building and testing specific designs and circuits, there often is a need to combine your work with other practitioners. This Unit aims to help you understand how systems are described and specified and the sub-systems identified.

As many students eventually work in industry or research centres, such an appreciation is a very useful perspective. Often your first experience in industry is not as working at a "systems level" but this may come later as your experience has grown and your career progresses. But, from 'day one' in industry you may be working as part of a team with others who are working at the systems level and integrating electronic designs. You need to learn the language (terms) and appreciate the processes so you can be more at ease when others discuss it. Also, if you progress to supervisory roles where you may be in charge of others, this Unit should help you to be able to better direct and guide them.

This Unit starts with terms used to describe or specify systems. Next, it progresses to cover may key processes and things that happen in a systems integration process. Much of what is included is generic (i.e. it is roughly the same if you were trained in Mechanical, Computing, Mechatronics, etc.). But other parts are more likely to occur in the Electronics area. The third section briefly introduces additional factors that may occur or require attention.
It will become increasingly necessary for you to develop new knowledge and skills if you are to keep in employment and develop your career when working in such a rapidly changing business environment. Thus, this Unit also allows you the opportunity to examine the processes and reasons for ways of working. Learning this new knowledge and skills will help you remain active in your learning and career development beyond your SQA Advanced course.

It is likely that during the teaching of this Unit you will be provided with, or have to obtain through research, significant amounts of information relevant to modern business practices and learning. You will be required to analyse this information and judge its value in supporting any views you wish to put forward. Thus, another benefit of taking the Unit is that you will be encouraged to develop or enhance new skills in research, analysis and critical thinking. There is no single right way to apply a systems approach so you need to develop judgement as to which may be the most appropriate in practice and for a particular situation.

You should not be concerned if you have little or no knowledge of how modern electronics companies operate yet. During this Unit, you will be provided with case study and background materials to illustrate how these companies work. If you do have previous experience, or are currently in employment, your lecturer or instructor may encourage you to use this knowledge to set in context the information you receive during the teaching of this Unit. They may also ask you to share this knowledge with the rest of your class so that others can benefit from your experiences.

By the end of this Unit you will be expected to have a clearer understanding of the factors involved in System Integration in Electronics and a number of key issues which you may face.

The precise form that assessment will take will depend on the centre where you are taking the Unit. This Unit could be assessed at three assessment events or it may be possible to be assessed completely at one assessment event. Assessment will take place towards the end of the associated learning and will take place under supervised, controlled conditions. You are likely to be required to produce a report or respond to questions though you will have been provided with appropriate mini-case study information prior to the actual assessment event. Please ask your lecturer or instructor to explain precisely what form assessment will take and the precise timetable.

You will be provided with details of the assessment a period before it is due to take place so that you have time to prepare properly for it. You will be allowed to bring a copy of relevant notes (and learning style questionnaires) you have made personally to the assessment event. However, you will not be permitted to bring textbooks, handouts and other materials you have not prepared yourself.