Applied Practical Electronics
Intermediate 1

First edition – published February 2003

National Course Specification

APPLIED PRACTICAL ELECTRONICS (INTERMEDIATE 1)

COURSE NUMBER C119 10

COURSE STRUCTURE

The course has four mandatory units as follows.

D378 10	***Electronics (Int 1)***	***0.5 credit (20 hours)***
D181 10	***Practical Electronics (Int 1)***	***1 credit (40 hours)***
D9EP 10	***Wiring and Assembly Techniques (Int 1))***	***0.5 credit (20 hours)***
D9EN 10	***Electronic Simulation and Testing (Int 1)***	***1 credit (40 hours)***

All courses include a further 40 hours for induction and preparation for the external assessment. In effect up to 30 hours is allowed for the completion of the project and its associated tasks which leaves 10 hours for induction, consolidation of learning and any other support. Further information regarding the external assessment is contained in the course project specification.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have had some previous experience in Science and/or Technology. This may be evidenced by one of the following:

- Standard Grade Technological Studies at grades 4 or 5 or equivalent
- Standard Grade Science at grades 4, 5, 6 or equivalent
- 5 –14 Technology

Administrative Information

Publication date: February 2003

Source: Scottish Qualifications Authority

Version: 01

National Course Specifications: general information (cont)

COURSE Applied Practical Electronics (Intermediate 1)

CORE SKILLS

This course gives automatic certification of the following:

Complete core skills for the course	Problem Solving	Int 1
Additional core skills components for the course	Using Graphical Information	Int 1

For more information about the automatic certification of core skills for any individual unit in this course, please refer to the general information section at the beginning of the unit.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

PROGRESSION

This course or its component units may form part of one or more Scottish Group Awards and may provide progression in the following way:

- part of a Scottish Group Award at Intermediate 1 and an NC Group Award in Electronic Engineering or Electronic Engineering Practice
- progression to a Scottish Group Award in Engineering at Intermediate 2
- exit to employment at operator or semi-skilled level in electronic industries or placement on an industrial training course
- exit to employment at craft apprentice level in engineering or electronic industries.

National Course Specifications: course details

COURSE Applied Practical Electronics (Intermediate 1)

RATIONALE

Electronics continues to be a major contributor to the Scottish manufacturing economy. It also now contributes substantially to other sectors such as finance through telecommunications, raw material processing by the use of automated systems and services such as health through the application of a range of electronic products such as heart monitors. Within all of these fields there exists a wide range of job opportunities for people with electronic skills. Currently and for the immediate future growth in this sector may be restrained by an inadequately educated workforce.

Practical courses are increasingly in demand in Colleges of Further Education as local areas attempt to meet the needs of the labour market. High technology companies 'locating in Scotland', however, only continue to be attracted by the skilled and well-educated workforce. This course provides the opportunity to stress the high value of electronics in the Scottish economy and reflect the labour market demand.

Electronics at Intermediate 1 provides progression for school candidates who have developed a taste for the practical aspects of working with electronic components and systems in such subjects as 5 –14 Technology, Technological Studies and Science. Additionally this course allows for easier identification of progression routes to employment or Further Education.

The participants of this course may find that the interest stimulated by the practical work at Intermediate 1 is sufficient to encourage them to continue to Intermediate 2, a step they might not previously have considered. This will provide an opportunity for candidates seeking the rewards offered by the electronics sector.

Summary

The main points of the Intermediate 1 Electronics course are as follows:

- It enhances a valued and established provision in schools and FE.
- It offers curriculum flexibility for technology.
- It will have currency with candidates, parents, employers, lecturers and teachers.
- It will ease progression to Intermediate 2 Electronic and Electrical Fundamentals.
- It will complement the theoretical aspects of Intermediate 2 Electronic and Electrical Fundamentals
- It will offer progression beyond Intermediate 2 to Higher and Advanced Higher
- It will attract candidates who see value in Electronics.
- It will stimulate candidates to pursue the study of electronics further
- It offers a first rung on the Electronic Engineering ladder, which only exists at present in the form of various units. This course will consolidate specific and new units into a cohesive course.

National Course Specifications: course details (cont)

COURSE Applied Practical Electronics (Intermediate 1)

Course aims

This course aims to:

- foster practical skills in the field of electronics
- develop knowledge, understanding and skills of general aspects of electronics
- encourage independence and the ability to make choices
- highlight the importance of safety and encourage responsible attitudes in the electronics environment
- contribute to personal development, in particular to practical capability.

National Course Specifications: course details (cont)

COURSE Applied Practical Electronics (Intermediate 1)

COURSE CONTENT

The course consists of four mandatory units of either 20 or 40 hours. Three of the units (Electronics, Practical Electronics and Wiring and Assembly techniques) are very much hands on with candidates working with components and system units to construct electronic circuits and systems. The remaining unit, (Electronic Simulation and Testing) is based on simulating and testing circuits and systems. It is clear that circuits and systems constructed during the more practical units could be used in the latter unit. The course assessment is based on a project which integrates the knowledge, understanding and skills learned and practised across the units.

The course is focused on practical work and takes place in an electronics laboratory environment. Whenever a new skill is to be introduced, this should be demonstrated to candidates and accompanied by the underpinning knowledge and understanding. Content is prescribed, but the course is intended to be candidate-centred as opposed to being content-driven. For example, a candidate may be attracted to a particular project which requires experiences beyond the minimum competence and will require extended learning and teaching. While designing is neither a prescribed activity nor assessed, some centres may wish to encourage designing to motivate candidates and to personalise the work being undertaken. This approach should be used where it meets the needs and interests of a particular candidate or group of candidates. However, it should not inhibit the development of the practical electronics skills which is the key purpose of the course.

It is anticipated that particular candidates may require support throughout the course, in terms of planning and organisation of work and direct help with practical work.

Electronics (Intermediate 1)

This unit covers the use of a range of input, process and output subsystems. Candidates would normally build a range of systems using a modular systems kit which will enable quick construction of solutions to everyday problems. Candidates will gain experience in a range of subsystems through experience in building a number of systems. Towards the end of the unit the candidate must solve simple problems using the skills and knowledge developed through the early parts of the unit.

Area of study	Content
Electronics Systems	Input, process and output subsystems
Energy change	Input devices changing some form of energy into electrical energy
Behaviour of input devices	Microphone, thermistor, light dependent resistor (LDR), and switches
Use of ohmmeter (multimeter)	Measurement of resistance in thermistor and LDR
Use of output devices	Loudspeaker, buzzer, lamp, Light Emitting Diode (LED), and electric motor
Oscilloscope	Examine digital sound
Logic gates truth tables	NOT, AND and OR using LED as detector
Use of Logic gates	NOT, AND and OR using digital inputs in solving problems e.g. alarms, warning devices, etc.

National Course Specifications: course details (cont)

COURSE Applied Practical Electronics (Intermediate 1)

Practical Electronics (Intermediate 1)

This unit aims to provide experience of building a range of simple electronic circuits, by non-permanent and permanent methods. Through this experience of assembling circuits, candidates learn to recognise and gain knowledge of the function of a range of electronic components. At this level, candidates may work entirely from given layout diagrams. Completed circuits will undergo checking procedures for fault finding and, if necessary, rectification to ensure operation to specification. The culmination of this unit is the construction of an electronic system from a given circuit diagram.

Area of study	Content
Reading and interpreting layout diagrams	Five different types of component to be included
Selection and insertion of common components	Sensors, signal-processing devices, and output devices
Using various construction techniques	Solderless prototype board (non-permanent); soldering, e.g. stripboard (permanent)
Inspection and testing	Multi-meter, logic probe

Wiring and Assembly Techniques (Intermediate 1)

This unit aims to provide experience in different types of cable and connectors in forming a cable loom. Candidates will learn to recognise and use different types of cable and connectors. The culmination of this unit is the construction and assembly of a cable loom from given layout diagrams. The completed loom will undergo a series of tests in function and continuity which will underpin the candidates' understanding. This testing will include fault-finding where necessary and subsequent rectification.

Area of study	Content
Cables	Three types: - multicore, solid wire and stranded wire
Circuit	Assembly and connection of a stripboard circuit
Connectors	Screw terminal, single connector crimp and wire solder connection
Connection methods	Crimping; clamped and soldering.
Cable looms	Tie wrap, spiral wrap, continuous sleeving and cable markers
Testing	Function, continuity, and low voltage using a non-ranging digital multimeter

Electronic Simulation and Testing (Intermediate 1)

This unit aims to provide experience of simulating a range of circuits and systems using computers and experience in electronic testing and measurement using a digital multimeter. The simulation focuses on circuit simulation and verification (testing) using discrete components and using modular sub-systems to simulate electronic systems. Candidates will be expected to become skilled in the operation of the different simulation software and their application using supplied diagrams and layouts. As well as testing within the simulation candidates will test a variety of different types of electronic circuits and record results and be expected to correctly connect a low voltage d.c. supply to circuits to enable meaningful testing to take place. It is not necessary for candidates to construct circuits for the activities as these can be provided or be constructed from work in other units.

National Course Specifications: course details (cont)

COURSE Applied Practical Electronics (Intermediate 1)

Area of study	Content
Circuit simulation software	Component based: - battery, buzzer, capacitor, diode, fuse, 8,14 or 16 pin integrated circuits, lamp, light dependent resistor, logic gate, loudspeaker, motor, resistor, switch, thermistor and bipolar transistor.
Circuit simulation verification	Voltage and current measurement. Operation of circuits
Electronics system simulation software	Modular input, process and output functions for electronic systems.
System inputs devices	Analogue sensors (light, temperature, sound and moisture, and digital sensors (push switch, reed and tilt switches)
Processes	Logic gates, delays, timers and output drivers
Outputs	Buzzers, lamps, loudspeakers, and motors
Multimeter set-up	Digital set-up for voltage, current and resistance
Use of multimeter	Digital attached to circuits to measure voltage, current and resistance
Low voltage d.c. supply	Setting up and use in conjunction with test equipment

Course organisation

All the units within the course can be delivered in isolation but the course lends itself to integration although some sequential teaching will be required. This is open to various models dependent on school/college organisation, facilities, timetable arrangements, resources and candidate experience. Generally one of the more practical units would be tackled first with the testing and simulation unit being integrated when and where appropriate or completed after all three more practical units.

Examples:

Model 1	
Electronic Simulation and Testing	Integrated into the following two units.
Electronics (Physics)	The system simulation (from the Electronic Simulation and Testing Unit) could be integrated with this unit by simulating the systems before building them.
Practical Electronics	The circuit simulation (from the Electronic Simulation and Testing Unit) and could be integrated with this unit by simulating some of the circuits before building them. Additionally some of the testing and measurement practice for the Electronic Testing and Measurement Unit could be established in this unit and some of the actual assessment.
Wiring and Assembly Techniques	The circuits required from this unit can be integrated with the work in the Practical Electronics unit i.e. the circuits can be the same ones, constructed in the Practical Electronics Unit.
Course Project	Some of the work done in the units could be taken forward into the course project work i.e. a circuit or loom could be adapted for use in the project.

National Course Specifications: course details (cont)

COURSE Applied Practical Electronics (Intermediate 1)

Model 2	
Wiring and Assembly Techniques	This unit could be a good introduction to Practical Electronics. It could establish good working practices introduce specific skills (ie soldering) and introduce simple testing (i.e. continuity).
Practical Electronics	This unit follows on naturally extending basic skills and practices into components. It also reinforces basic skills (i.e. soldering, wiring, and testing).
Electronic Simulation and Testing	This unit reinforces the theory of the early units and opens the world of simulation as a tool for project work and system testing. The two more practical units including the early work on testing would be excellent preparation for part of this unit. This unit could use some of the circuits made up previously and extend them into providing suitable ones for the work of this unit.
Electronics	This unit builds on the simulation of systems from the previous unit and could use some of the same systems.
Course Project	The course assessment/project will sample work from the units. This will integrate the activities to form a meaningful conclusion for the course. Typically it will involve some system circuit simulation followed by building a modular test system. Once this is proven a soldered permanent circuit will be built and connected to a real project using a wiring loom.

National Course Specifications: course details (cont)

COURSE Applied Practical Electronics (Intermediate 1)

ASSESSMENT

As this course is predominantly practical in nature, the majority of the features contained within the additional 40 hours must also be practical. Hence the course assessment is based entirely on a practical project. It is anticipated that this project will require between 20 and 30 hours and be tackled near the end of the course.

The project allows integration of the knowledge, understanding and skills gained in the units of the course. It is proposed that a project will be set that enables candidates to achieve any grade across the range. In time other projects may become available and this will allow selection from a range approved by the SQA. The single project provided allows selection across the range of degrees of difficulty so that each candidate tackles work at an appropriate level, i.e. to suit his/her performance in the units. In practice the final grade will be based on the practical performance of each candidate, i.e. there will be natural differentiation within each project set.

The project will be manufactured to given circuit and system diagrams and drawings. The role for the course project should be introduced at an early stage to allow candidates to develop and integrate their course experiences towards their final assessment.

Candidates will not be assessed on the ability to design a product, although designing should be encouraged and developed as part of effective learning and teaching and motivation.

The integrative nature of the final project has several advantages. Depth of understanding can be consolidated and there are opportunities for additional, integrated or applied learning. The additional time allowed for project work encourages more complex projects to be manufactured, hence an opportunity to achieve good-quality work and a useful product. In addition, the project is based on some earlier experience, so candidates will be able to plan their work with confidence.

As this is a practical course with visiting moderation/assessment, estimates and appeals are not valid.

Additional details are provided where appropriate, with the exemplar assessment materials. Further information on the key principles of assessment are provided in the document *Assessment* published in May 1996.

Details of the instrument of external assessment

External assessment will be based on the outcome of the Course Project. This Course Project is a practical activity in which the candidates plan, assemble and test an electronic system. The project integrates the knowledge, understanding and skills gained in the individual course units.

Assessment will be based on the outcome of the project. An overall grade (A, B or C) will be determined by assessment of each candidate's performance in producing the project. This assessment will be subject to external moderation. To gain the course award, the candidate must pass all four unit assessments, as well as the project assessment.

The Course Project is concerned primarily with practical activity in the creation of an electronic system and this is the main area of assessment. However, the project also includes basic skills relating to the planning and evaluation of the activity as well as its development. As an approach to design, candidates are asked to select between design options and give reasons for their choices. Simulation and test activities are also included.

National Course Specifications: course details (cont)

COURSE Applied Practical Electronics (Intermediate 1)

Candidates are provided with a brief and are expected to demonstrate attainment relating to:

- planning the form and detail of the electronic system to be developed
- simulating the electronic system
- selecting and managing materials, techniques and resources
- building component parts of the electronic system
- assembling the electronic system
- testing the electronic system
- evaluating the outcome of the activity

Candidate evidence is required as follows

- planning of the electronic system
- simulation of the system
- the system hardware
- system test results
- evaluation

There are four aspects to be considered in determining the grade of award at Intermediate 1:

- the level of difficulty of the project undertaken
- the range of skills demonstrated
- independence of working and the amount of practical assistance required
- the level of skill and accuracy demonstrated

1 The level of difficulty of the project undertaken

The given project contains options at a range of difficulties to allow appropriate grading i.e. Grade A, B or C. The quality of performance in executing the project, using performance criteria is described in detail in the project specification document.

2 The range of skills demonstrated

Graded marks will be allocated during the project and will assess

- information read correctly from diagrams and drawings
- effective use of simulation tools
- appropriate selection of components
- appropriate selection of tools and equipment
- safety procedures and practices adhered to
- electronic components listed correctly, selected from stock and inserted in the circuit board
- pre-power-up procedures, fault finding and rectification carried out correctly
- project documentation

3 The degree of independence and the amount of practical assistance required

It is anticipated that most candidates will require some guidance to proceed with the project.
The three levels are:

- Project completed with a high degree of independent working with minimal assistance and advice.
- Project completed with areas of independent working with assistance and advice given regularly.
- Project completed with little independent work with much help and guidance.

4 The level of skill and accuracy demonstrated (in the practical activities)

Marking will be based on:

- accuracy and neatness of components placement and fixing
- quality of solder joints
- mechanical strength and electrical continuity of cable/wire terminations
- neatness of cable/harness layout
- quality of work in all areas of the project
- functionality of the project

To underpin this assessment system there are criteria to which marks are pegged, against which the candidate evidence from each of the three Course Project stages is assessed. The use of such mark categories linked to broad criteria allows for the aggregation of the various parts of the assessment which do not necessarily have the same weighting in the overall grade. The full details of the general criteria used to assess the candidates' evidence are given in the Course Project Specification. The overall grade for the Course Project is determined by the total mark. The table below gives the mark range relating to the grades.

% Mark range	Grade	Band (for estimates)
85 – 100	A (upper)	1
70 – 84.5	A (lower)	2
65 – 69.5	B (upper)	3
60 – 64.5	B (lower)	4
55 – 59.5	C (upper)	5
50 – 54.5	C (lower)	6
45 – 49.5	Fail (near miss)	7
40 – 44.5	Fail	8
less than 40	Fail	9

Although it is possible for candidates to be given bands 7, 8 and 9 which are described as 'fails', no such categories will appear on candidates' certificates. This information should help centres agree estimates of candidate performance and provide feedback to candidates for remediation purposes.

All National Courses are subject to external marking. External Markers, Visiting Examiners and Moderators will be trained by SQA to apply national standards. As candidate evidence becomes available exemplars will be issued to centres as guidance.

National Course Specifications: course details (cont)

COURSE Applied Practical Electronics (Intermediate 1)

Allocation of Marks

Course Project Stage	Assessment Evidence	Mark Allocation
Planning and simulation	Plan and simulation results	25
Construction and assembly	Candidate performance, the assembled system and associated diagrams and documentation.	150
Testing and evaluating	Test results and evaluation	25

These marks are broken down as follows:

PLANNING AND SIMULATION	
Evidence:	● Planning (10 marks) ● System/circuit simulation and/or test simulation (15 marks) (25 marks in total for this stage)
Conditions of assessment	Supervised
Who assesses it?	Internally centre marked and assessed: Externally moderated

CONSTRUCTION AND ASSEMBLY	
Evidence:	● Use of given information (10 marks) ● Selection of components (10 marks) ● Selection of tools and equipment (10 marks) ● Safe practices and procedures (10 marks) ● Accuracy and neatness of component placement and forming (15 marks) ● Quality of solder joints and other connections (15 marks) ● Neatness and structure of cable loom (15 marks) ● System documentation (system block diagram, circuit diagram, parts list, wiring schedule, layout drawing) (15 marks) ● Functionality of the project (20 marks) ● Value of the project (15 marks) ● Complexity of the project (15 marks) (150 marks in total for this stage)
Conditions of assessment	Supervised
Who assesses it?	Internally centre marked and assessed: Externally moderated

National Course Specifications: course details (cont)

COURSE Applied Practical Electronics (Intermediate 1)

Allocation of marks (cont.)

TESTING AND EVALUATING	
Evidence:	● test activity and results (15 marks) ● evaluation responses (10 marks) (25 marks)
Conditions of assessment	Centre-invigilated
Who assesses it?	Internally centre marked and assessed: Externally moderated

National Course Specifications: course details (cont)

COURSE Applied Practical Electronics (Intermediate 1)

Grade descriptions for a Course Project at Intermediate 1

Descriptions of each grade are given in the table below. These descriptors are to ensure that candidates have effectively integrated each stage of the Practical Assignment and that the overall grade is a fair reflection of the candidate's work. The grade descriptions are a touchstone against which grades can be checked.

Content and scope appropriate for Intermediate 1		
And looking at the evidence as a whole:	**And looking at the evidence as a whole:**	**And looking at the evidence as a whole:**
Course Project at Grade	**Course Project at Grade**	**Course Project at Grade**
A	**B**	**C**
● Produces high quality, complete, reliable, neat, well-organised, fully functional product evidence supported by neat, well-structured, logical documentary evidence	● produces good quality, sufficient, structured, workmanlike, functional product evidence supported by adequate documentary evidence	● Produces reasonable quality, adequate, functional product evidence supported by basic, fairly neat documentary evidence
● is an exercise in which candidates have demonstrated enthusiasm, imagination and initiative in fulfilling the Course Project brief.	● is an exercise in which candidates have demonstrated an accurate and fairly innovative and enthusiastic implementation of the Course Project brief.	● is an exercise in which candidates have brought an acceptable implementation of the Course Project brief.
● is completed with a high degree of independent working with minimal assistance and advice	● is completed with areas of independent working with assistance and advice given regularly	● is completed with little independent work with much help and guidance
● is tightly structured, relevant to the content of the Units and displays a high level of subject/occupational expertise	● is well structured, relevant to the content of the Units and displays a good level of subject/occupational expertise	● is reasonably well structured, relevant to the content of the Units and displays an adequate level of subject/occupational expertise
● applies, integrates and consolidates knowledge, understanding and skills effectively and consistently from the course Units.	● applies, integrates and consolidates knowledge, understanding and skills fairly effectively and consistently from the course Units.	● applies, integrates and consolidates knowledge, understanding and skills from the course Units with some lack of continuity and consistency.

Full mark ranges associated with each element at each grade is given in the Course Project Specification.

National Course Specifications: course details (cont)

COURSE Applied Practical Electronics (Intermediate 1)

APPROACHES TO LEARNING AND TEACHING

Where appropriate, arrangements should be made to ensure that there will be no artificial barriers to learning and assessment. The nature of a candidate's special needs should be taken into account when planning learning experiences and selecting assessment instruments. Alternative arrangements can be made as necessary.

Support notes on the following units have been developed and published by LTScotland.

Name	Number
DET Electronics (Intermediate 1)	7527
DET Practical Electronics (Intermediate 1)	7531
Wiring and Assembly Techniques (Intermediate 1)	9032
Electronic Circuit and System Simulation	9031

Although changes have been made in most of the units the support materials are still useful and valid. Checks should be made against the most recent arrangements before setting out on delivery of this course.

These documents will give further advice and information on:

- support materials for each course
- appropriate learning and teaching approaches
- assessment

Induction

The course could commence with some time from the additional 40 hours, being spent on setting the scene for the course, including:

- an industrial visit to see electronics in action
- a tour of the centre's workshop facilities and equipment
- matters of general safety and expectations of conduct and attitudes in an electronics environment
- the structure of the course
- how the course relates to previous experiences
- an outline of the course content and the units
- the assessment requirements for the course
- advice for candidates on how to access knowledge for themselves
- progression available beyond successful completion.

Appropriate videos to introduce electronic processes and safety aspects might be useful at this stage.

As shown earlier, several different models for unit delivery can be used. However centres must consider which model to use carefully making sure that practical skills are built up in a logical progression towards the completion of the course project. Similarly this type of progression would be followed for knowledge and understanding.

In the earlier parts of the course or at specific times in each unit it would be preferable that all candidates would work on the same tasks. This will allow more direct teaching/instruction and help to embed skills, knowledge and understanding. As the course progresses it is envisaged that candidates may be working on different tasks as their experience and available resources dictate.

Each new operation, process or stage will need to be demonstrated or discussed, possibly with reference to video material, on a need-to-know basis. This should enable candidates to proceed with some confidence and safety. Teaching inputs should be kept as brief as possible to allow the main activity of 'hands-on' practical work. Likewise assessment should be kept as brief as possible, mainly by noting successful achievement on checklists.

Candidates need to be made aware that their performance throughout the course will determine the level of difficulty of their prescribed project and hence influence their final grade. They should be encouraged to aim high in this respect. Within the course, from the additional 40 hours, there is time and opportunity for additional learning and practice of skills to try to achieve enhanced grades.

Candidates should be thinking at an early stage about the demands that the project will make, and relating their course experiences to what will be expected in the project.

SPECIAL NEEDS

This course specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, 2001).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Electronics (Intermediate 1)

NUMBER D378 10

COURSES Physics (Intermediate 1)
Applied Practical Electronics (Intermediate 1)

SUMMARY

The unit seeks to develop the candidate's knowledge and understanding of simple concepts and facts related to electronics. It also provides an opportunity for developing the ability to apply this knowledge and understanding in the analysis of simple problems.

OUTCOMES

1 Demonstrate knowledge and understanding related to electronics.
2 Solve problems related to electronics.
3 Use a systems approach to produce a practical solution to a simple, real-life problem.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates will normally be expected to have attained the following.

- Standard Grade Physics at grade 5, 6 or 7

or

- Standard Grade Biology, Chemistry or Science at grade 4, 5, 6 or 7

or

- appropriate Access units

CREDIT VALUE

0.5 credit at Intermediate 1

Administrative Information

Superclass: RC

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Source: Scottish Qualifications Authority

Version: 04

National Unit Specification: general information (cont)

UNIT Electronics (Intermediate 1)

CORE SKILLS

This unit gives automatic certification of the following:

Complete core skills for the unit	Problem Solving	Int 1
Additional core skills components for the unit	Using Graphical Information	Int 1

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

National Unit Specification: statement of standards

UNIT Electronics (Intermediate 1)

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1

Demonstrate knowledge and understanding related to electronics.

Performance criteria

(a) Methods are described correctly in relation to electronics.
(b) Facts are used correctly in relation to electronics.
(c) Symbols are described correctly in relation to electronics.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria. The test must sample the Content Statements, given in the National Course Specification: course details, in each of the following areas:

- Input, process and output
- Digital logic gates.

OUTCOME 2

Solve problems related to electronics.

Performance criteria

(a) Relevant information is selected and presented appropriately.
(b) Conclusions drawn are valid, and explanations given are supported by evidence.

Evidence requirements

Evidence of an appropriate level of achievement must be generated from a closed book test with items covering all the above performance criteria. The test must sample the areas shown below.

- Input, process and output
- Digital logic gates.

National Unit Specification: statement of standards (cont)

UNIT Electronics (Intermediate 1)

OUTCOME 3

Use a systems approach to produce a practical solution to a simple, real-life problem.

Performance criteria

(a) Selected sub-systems are appropriate for a specific function.
(b) Justification for choice of each sub-system is correctly made.
(c) Sub-systems are correctly assembled.
(d) System provides a solution to the problem.

Evidence requirements

One report, based on a given structure, of a practical solution to a real-life problem related to electronics and covering the above performance criteria is required. The teacher/lecturer responsible must attest that the report is the individual work of the candidate derived from active participation in problem solving activities involving the candidate in planning the activities; deciding how the activities are to be managed; identifying and obtaining the necessary resources; carrying out the activities. The report must contain a block diagram of the system and a written justification of the choice of sub-systems. An explanation of how the system functions in terms of the sub-systems selected must also be included.

National Unit Specification: support notes

UNIT Electronics (Intermediate 1)

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

While the time allocated to this unit is at the discretion of the centre, the notional design length is 20 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

The content and suggested contexts, applications, illustrations and activities for this unit are given in the National Course Specification: course details. The subheadings in the tables in the course details correspond to the areas mentioned in the evidence requirements for Outcome 1 and Outcome 2. The practical activities chosen for Outcome 3 must relate to the content of the unit and must allow opportunity for all the performance criteria for this outcome to be achieved within any single report.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The learning and teaching of this unit are most effective when the concepts, principles and theories are set in a relevant context, eg by making reference to applications of physics and to real-world situations. The use of the suggested contexts, applications, illustrations and activities is recommended. It is suggested that emphasis is given to practical activities and that the associated knowledge and understanding are developed during these activities. Practical activities also provide opportunities to develop a wide range of skills associated with scientific enquiry. Suitable approaches to learning and teaching are given in the National Course Specification.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Outcomes 1 and 2

It is recommended that a holistic approach is taken for assessment of Outcomes 1 and 2. These outcomes can be assessed by an end of unit test with questions covering all of the associated performance criteria. Within one question, assessment of knowledge and understanding and problem solving can occur. Each question can assess achievement of a number of performance criteria from either Outcome 1 or 2. Assessment items are available from the National Assessment Bank.

Outcome 3

The teacher/lecturer should ensure that the activities undertaken in connection with the assessment of Outcome 3 present a practical real-life problem. The activities must relate to the unit content and be at an appropriate level of demand. Candidates should be provided with an outline structure of a report.

In relation to PC (c) the teacher/lecturer should check by observation that the system is assembled correctly.

In relation to PCs (a), (b) and (d), the following provides an indication of what may be included in a candidate's report.

National Unit Specification: support notes (cont)

UNIT Electronics (Intermediate 1)

PC (a)
Comments should be provided on the selected sub-systems with:

- a description of the problem to be solved
- a statement of the name of the input device
- a statement of the name of the output device
- a statement of the name of the processor.

PC (b)
The choice of each sub-system should be justified by:

- a clear sentence indicating why the input device was chosen
- a clear sentence indicating why the output device was chosen
- a clear sentence indicating why the processor was chosen.

PC (d)
A few concise sentences describing how the system works should be provided.

The references under each performance criterion give an indication of what should be provided as evidence in order to achieve the criterion. These references are intended to assist the teacher/lecturer in making a judgement of the candidate's achievement against the performance criteria. It is appropriate to give limited support to candidates in producing their reports. Re-drafting of reports after necessary supportive criticism is to be encouraged both as part of the learning and teaching process and to produce evidence for assessment.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, 2001).

SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Practical Electronics (Intermediate 1)

NUMBER D181 10

COURSE Engineering Craft Skills (Intermediate 1)
Applied Practical Electronics (Intermediate 1)

SUMMARY

The purpose of this unit is to recognise electronic components, and how they are assembled into electronic circuits. Electronic construction in this context would be aimed at integrating with an engineering construction to provide a working electronics device.

OUTCOMES

1 Construct an electronic circuit using a prototype circuit board.
2 Construct an electronic circuit using stripboard.
3 Construct an electronic system using a Printed Circuit Board (PCB) from a given specification and using individual components.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have had some experience in reading and interpreting working drawings, as well as some experience in using hand tools.

CREDIT VALUE

1 credit at Intermediate 1.

Administrative Information

Superclass: XL

Publication date: December 1999

Source: Scottish Qualifications Authority

Version: 03

National Unit Specification: general information (cont)

UNIT Practical Electronics (Intermediate 1)

CORE SKILLS

There is no automatic certification of core skills or core skills components in this unit.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

National Unit Specification: statement of standards

UNIT Practical Electronics (Intermediate 1)

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1

Construct an electronic circuit using a prototype circuit board.

Performance criteria

(a) The components are selected correctly from stock.
(b) The circuit is constructed correctly to given layout diagram.
(c) The circuit diagram is interpreted correctly.
(d) Pre-power-up checks are carried out.
(e) The circuit is verified to operate to a given specification.

Evidence requirements

A practical exercise in interpreting a diagram, selecting components and constructing a working circuit using a prototype circuit board.

OUTCOME 2

Construct an electronic circuit using stripboard.

Performance criteria

(a) The components are selected correctly from stock.
(b) The components (including connections) are soldered into position neatly and to layout diagram.
(c) The circuit diagram is interpreted correctly.
(d) Pre-power-up checks are carried out.
(e) The circuit is verified to operate to a given specification.

Evidence requirements

A practical exercise in interpreting a diagram, selecting and soldering of components on a strip board and producing a working circuit.

National Unit Specification: statement of standards (cont)

UNIT Practical Electronics (Intermediate 1)

OUTCOME 3

Construct an electronic system using a Printed Circuit Board (PCB) from a given specification and using individual components.

Performance criteria

(a) The system is constructed correctly.
(b) Pre-power-up checks are carried out.
(c) The system operates to specification.

Evidence requirements

A practical exercise in interpreting a diagram, selecting components and constructing a working electronic system using a PCB.

National Unit Specification: support notes

UNIT Practical Electronics (Intermediate 1)

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

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

The purpose of this unit is to branch out into an associated area of engineering practical work: electronic-circuit construction.

Candidates attempting this unit will mainly be in post-16 education, although it may also be undertaken by some adult returners and perhaps some candidates in the 14 to 16 curriculum.

Candidates require little prior experience, but will be expected to produce good practical work. Artefacts produced should have personal appeal to the candidates, but must provide challenge and stimulation.

Apart from developing basic electronic manufacturing hand skills, this unit should emphasise the need for safe working practices and a disciplined approach to achieving quality work. As part of a course in the post-16 curriculum, the candidates should be required to act and perform as adults and, accordingly, the tasks set should be challenging to the candidates at the level at which they are working. As the course develops, the candidates will be required to operate machinery and equipment to a code of practice, with a degree of independence, and it is essential that ground rules for acceptable standards are set and applied throughout this unit.

GUIDANCE ON CONTENT AND CONTEXT FOR THE UNIT

Content:

- simple diagrams: electronic circuit diagrams, layouts and connection lists
- common components: sensors, signal-processing devices, and output devices
- construction techniques: solderless prototype board (non-permanent); soldering, on stripboard (permanent); printed circuit board (PCB)

This unit is practical in nature and requires the candidate to develop skills in:

- reading and interpreting simple electronic-circuit and layout diagrams and selecting components from a listing
- assembling simple electronic circuits while taking into account component pin connections and polarity
- applying pre-power-up checks and fault-finding techniques and taking appropriate remedial action
- constructing a fully functioning electronic system and confirming its operation to specifications
- adhering to safe working practices at all times

National Unit Specification: support notes (cont)

UNIT Practical Electronics (Intermediate 1)

The range of electronic components is extensive but could include:

- Sensors such as moisture, light, temperature
- Process devices such as resistors, capacitors, transistors, ICs
- Output devices such as loudspeakers, buzzers, relays, motors, LEDs, lamps
- Polarity-conscious devices electrolytic capacitors, diodes, transistors, ICs
- Multi-pin devices transistors, ICs, relays, variable resistors, thyristors

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

There is a progressive learning process in this unit, and this is best achieved in a concentrated manner, preferably in a laboratory. The recommended approach is that outcomes would be addressed entirely through the building of circuits. Candidates should start by practising on simple circuits containing only a few components, by a range of methods, before attempting more demanding circuits. Candidates should be directed to consider the circuit as being interfaced with metalwork structures or simple mechanisms to provide an operational system in the project.

Reading and interpreting circuit diagrams and selecting components

Candidates should be introduced to colour coding of resistors, and know how to recognise values of other components such as capacitors. Identification of components in the initial stages would be aided greatly by suitable, clearly marked storage systems, for example small drawer units.

Assembling simple electronic circuits, while taking into account component pin connections and polarity

Candidates with no experience of electronic circuit construction should initially be provided with layout diagrams having only a few components, and should build circuits from these, starting with a prototype board followed by soldering on stripboard and wire wrapping. In the early stages, candidates could be guided as to which technique would be appropriate for a particular circuit.

Applying pre-power-up checks and fault-finding techniques and taking appropriate remedial action

An important routine in building circuits is the pre-power-up checking, fault-finding and rectification procedures, before testing for operation to specifications.

Constructing a fully functioning electronic system and confirming its operation to specification

A full electronic 'system' should be constructed from a given circuit diagram or series of diagrams, using a permanent construction technique. More demanding work is envisaged at this time, and this aspect of the course provides ample opportunity to integrate other areas of the course.

Adhering to safe working practices at all times

Electronics and soldering have their own safety practices and procedures, including safety wear, ventilation, equipment checks and work holding. These should be fully covered and firmly enforced.

National Unit Specification: support notes (cont)

UNIT Practical Electronics (Intermediate 1)

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Whenever possible, the dynamic nature of this course should not be hindered by overburdening assessment of the candidate.

The candidate should be aware that certain performances are being monitored constantly and recorded on an observation checklist, and that finished artefacts will be tested against the stated criteria for accuracy and quality. Lengthy written tests are not required for tool, process or equipment recognition and use. Short-answer tests that are mainly of a visual nature will be provided. Another technique would be to display the tools and equipment, and ask the candidates to write or state their names and uses.

Approaches to generating evidence

Examples of artefacts that could be produced only for this unit might be an alarm system where all aspects of the artefact are electronic. An example of an integrative artefact dealing with areas from elsewhere in the course might be an electronic system housed in a sheet-metal enclosure manufactured during the *Bench Skills – Metal (Int 1)* unit. Similarly, calibration dials or spindles and bearings could be turned on the lathe during the *Machine Processes – Metal (Int 1)* unit and used in the integrative artefact.

This approach could serve any or all of the following three purposes:

- as a rehearsal for the course assignment project, during which the candidate is expected to work with a degree of independence
- as a means of re-testing certain performances from other areas of the course
- as a means of employing a holistic approach to assessment, whereby much of the evidence for the other two units of the course could be found in the artefact as it is described

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, 2001).

National Unit Specification: general information

UNIT Wiring and Assembly Techniques (Intermediate 1)

NUMBER D9EP 10

COURSE Applied Practical Electronics (Intermediate 1)

SUMMARY
The purpose of this unit is to introduce and develop skills in connecting and assembling electrical and electronic systems

OUTCOMES
1 Prepare and connect conductors (wire/cable/stripboard).
2 Form a cable loom.
3 Assemble and test an electronic system.

RECOMMENDED ENTRY
While entry is at the discretion of the centre, candidates would normally be expected to have attained some previous experience in the use of hand tools in a technical context.

CREDIT VALUE
0.5 credits at Intermediate 1. (3 SCOTCAT Points at SCQF level 4).

*SCOTCAT 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 SCOTCAT points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.

Administrative Information

Superclass: XJ

Publication date: January 2003

Source: Scottish Qualifications Authority

Version: 01

National Unit Specification: general information (cont)

UNIT Wiring and Assembly Techniques (Intermediate 1)

CORE SKILLS

There is no automatic certification of core skills or core skills components in this unit.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

National Unit Specification: statement of standards

UNIT Wiring and Assembly Techniques (Intermediate 1)

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1
Prepare and connect conductors (wire/cable/stripboard).

Performance criteria
a) The preparation of a range of cable types is correct.
b) The connections to a range of connectors are applied correctly.
c) A stripboard circuit is assembled correctly.
d) Work methods and activities are in accordance with recognised procedures and safe practices.

Evidence requirements
A practical exercise in preparing and terminating wires and a cable from assembly instructions and wire lists.

A practical exercise in assembling a stripboard circuit from assembly instructions, a circuit diagram and a layout diagram.

OUTCOME 2
Form a cable loom.

Performance criteria
a) The formation of cables is correct in accordance with given interconnection schedules.
b) The loom is constructed correctly to given requirements.
c) The loom is completed using fixing methods correctly.
d) The stripboard circuit is connected to the loom correctly.

Evidence requirements
A practical exercise in forming a cable loom from assembly instructions and a layout diagram.

OUTCOME 3
Assemble and test an electronic system.

Performance criteria
a) The terminations of the system are neat and correct according to a given system layout.
b) Tests with a power supply and a digital non-auto-ranging multimeter are used to check the given layout and connections.
c) System faults are analysed and connected.
d) Work methods and activities are in accordance with recognised procedures and safe practices.

National Unit Specification: statement of standards (cont)

UNIT Wiring and Assembly Techniques (Intermediate 1)

Evidence requirements

A practical exercise in testing a cable loom and correcting faults. A checklist should be completed indicating that the:

- testing has been conducted safely
- system assembly is accurate to the given layout
- system has been fully tested and any faults corrected
- test equipment has been used correctly

National Unit Specification: support notes

UNIT Wiring and Assembly Techniques (Intermediate 1)

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 20 hours.

The purpose of this unit is to introduce and develop skills in connecting and assembling electrical and electronic systems.

Candidates attempting this unit will mainly be in post-16 education, although it may also be undertaken by some adult returners and perhaps some candidates in the 14 to 16 curriculum.

Candidates require little prior experience, but will be expected to produce good practical work.

The electronic system produced should appeal to the candidates and provide challenge and stimulation as they work with methods and procedures common throughout electronics probably for the first time.

Apart from developing basic electronic manufacturing hand skills, this unit should emphasise the need for safe working practices and a disciplined approach to achieving quality work. As part of a course in the post-16 curriculum, the candidates should be required to act and perform as adults and, accordingly, the tasks set should be challenging to the candidates at the level at which they are working. As the course develops, the candidates will be required to use hand tools and equipment, with a degree of independence, and it is essential that ground rules for acceptable standards are set and applied throughout this unit.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

Content:

- cable assembly: parts lists, tool lists, assembly instructions, wire lists, test instructions
- wire types: solid conductor, stranded conductor
- construction techniques: wire stripping, crimping, soldering, stripboard track cutting, wire identification, tie wrapping, spiral wrapping
- component identification: wires, terminals, stripboard, resistors, Light Emitting Diodes (LEDs), transistors, 4 mm plugs
- testing: continuity, resistance, voltage, current
- using test equipment: digital non-auto-ranging multimeter, low voltage dc power supply

This unit is practical in nature and requires the candidate to develop skills in:

- adhering to safe working practices at all times
- reading and interpreting parts lists, tool lists, assembly instructions, wire lists, circuit diagrams, layout diagrams and test instructions
- wire stripping and soldering
- using hand tools such as wire strippers, soldering irons, solder suckers, pointed nosed pliers, electricians' pliers, crimping tools, craft knives and screwdrivers
- assembling simple electronic circuits while taking into account component pin connections
- testing and fault-finding and taking appropriate remedial action
- constructing a fully functioning electronic system and confirming its operation to a specification

National Unit Specification: support notes (cont)

UNIT Wiring and Assembly Techniques (Intermediate 1)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

The Practical Activities
This is a practical unit. It is probable that the allocated time of 20 hours will be taken up by three main areas of activity:

1. staff demonstrations of techniques such as soldering, crimping and wire stripping (approximately 10% of available time)
2. candidate practice in unfamiliar techniques (10% of available time)
3. candidate activity making cables, harnesses and testing (80% of time available)

As can be seen from the outcomes there are three stages to the candidate activity:

- making cable assemblies
- forming the cable assemblies into a loom or harness
- testing the completed loom or harness.

Since the cable types are the same for Outcomes 1 and 2 it is entirely practical to use the cables made for Outcome 1 in the loom for Outcome 2. This loom can then be used as the basis for the system test of Outcome 3. This is the integrative approach taken in this unit. It has the advantage that candidates have one clear overall objective and a clear result for their efforts.

Before delivering the unit, the main issues to be addressed are:
- the provision of tools and materials
- the secure retention of the evidence, particularly whilst the unit is underway.

The individual cable assemblies may be made in any order. Where tooling is limited, it may be desirable for groups of candidates to be engaged on different activities at the same time, though note that not all the cables take the same amount of time to make.

Outcome 1
Cable: solid wire; stranded wire.
Stripboard circuit: resistors; diodes; transistor; pins.
Connectors: screw terminal: 4mm plug; terminal block.
Single connector crimp: ring terminal; blade terminal and receptacle.
Discrete wire solder connection: solder pad.
Methods: wire stripping; crimping; clamping; soldering.

Outcome 2
Cables: solid wire; stranded wire.
Methods: tie wrap; spiral wrap; continuous sleeving; cable markers.
Requirements: three breakouts; one bend; three cables.

Outcome 3
System: low voltage power supplies; the loom; the stripboard circuit.
Test: continuity; voltage; current; function.

National Unit Specification: support notes (cont)

UNIT Wiring and Assembly Techniques (Intermediate 1)

When checking the candidates' work, make sure that:
- all the conductor strands are present in the crimp - no strands have been cut in the stripping of the insulation
- the crimp has crimped on the insulation as well as the conductor
- the crimp pins are held in the housing by the retaining spring

Note that it is not essential that you use a specific connector system provided that crimp terminations are employed. You may already have an alternative crimping tool.

Cable 1 - LED driver cable

One problem with this cable is the crimping tool for the specified connector. Cheap hand tools are available. However, an easier and more reliable crimp is made with the more expensive ratchet tool since the crimps are made on the wire and on the insulation at the same time.

Cable 2 - Ring terminal cable

Note that when fitting cable markers to cables, the convention is that the more significant digit is always towards the end of the cable. To bring home this fact, a two digit marker is specified, whereas one would be quite sufficient for four wires.

When checking the candidates' work, make sure that:
- all the conductor strands are present in the crimp - no strands have been cut in the stripping of the insulation
- the crimp has crimped on the insulation as well as the conductor
- the correct markers are the right way round

Cable 3 - Solid conductors

This is the simplest set of cables to make up. At this stage, no soldering or special tooling is required, just wire strippers and a small screwdriver.

Continuous Sleeving- cable 2

It is not possible to push the wires through the continuous sleeving with the cable markers attached. Candidates will firstly need to insert the wires into the sleeving, then to buzz through the wires to identify which is which, then lastly to apply the cable markers.

Tie-wraps and Spiral wrap - cables 1, 2 and 3

There are no special considerations to be addressed in this activity.

Assemble and test the system

The system should be assembled using the skills developed within this unit. It should be tested using the skills developed in the Electronic Simulation and Testing (Intermediate 1) unit.

National Unit Specification: support notes (cont)

UNIT Wiring and Assembly Techniques (Intermediate 1)

It is intended that the completion of a working system is the end product of the unit. This provides a target for the candidates, helps with motivation and delivers a reward in the form of the completed task. If centre circumstances permit it may be helpful to release candidates from the activity once they have completed it satisfactorily. This has been found, with similar units, to yield the combined benefits of a reward for the candidates and more time for the lecturer/teacher to work with those remaining in the class.

Material, tool, test instrument and exercise management
Materials are best stored in shallow trays or drawers. These should be easy to access at the start of a lesson and easy to put away at the end. Secure storage should be considered as much of the material can be desirable to candidates for day-to-day electronic repair and construction work. Trays should be loaded with adequate material cut to size as appropriate for current class use bearing in mind the inevitable wastage. Bulk supplies such as reels of wire or bags of terminals should not be made available to candidates as this tends to result in high wastage and damage to the materials. Similarly items such as solder should be dispensed on demand.

Tools are attractive to most people and tend to be desirable items particularly for anyone who is interested in the skills delivered by this unit. Similarly test equipment such as multimeters are frequently seen as an attractive addition to a candidate's personal possessions. This inevitably results in there being a constant security problem with both tools and test equipment. Normal tool management disciplines, however, can be applied to this as follows:

- warn candidates of likely disciplinary action if tools or test equipment are removed from the workshop
- keep tools and test equipment in sets or on marked boards
- check all tools and test equipment at the conclusion of every class

The management of the exercises is very dependent on the type of candidate, the class size and the prevalent attendance cultures in the centre. In general group teaching can be used for unit induction, safety training and initial tool use demonstrations. One or two exercises may then be demonstrated and the candidates encouraged to proceed at their own pace. This should enable the teacher/lecturer to devote time to systematically moving around the workshop advising candidates and checking connection quality. Care should be taken to cultivate a "self help" culture amongst the candidates who should also be encouraged to await the teacher/lecturer's arrival to have their work reviewed. This is necessary to ensure that adequate attention is devoted to all of the candidates.

As ability and motivation will vary within candidate groups it is generally unhelpful to attempt to keep all candidates working on the same exercises at the same time. Inevitably some candidates will complete exercises before others. This should be encouraged and their completed and checked work labelled with their name and either stored in individual boxes or in the original material tray bearing in mind the need for security. If possible the more able candidates should be allowed to proceed to the loom construction and system testing stage as fast as they can without jeopardising practising their skills or the quality of their work. This will spread the load on scarce resources such as special tools and teacher/lecturer attention. Early finishers can be motivated by their success and released from the activity. Normally this will free teaching and equipment resources to be concentrated on the remaining candidates.

National Unit Specification: support notes (cont)

UNIT Wiring and Assembly Techniques (Intermediate 1)

There is a progressive learning process in this unit, and this is best achieved in a laboratory or workshop environment. The recommended approach is that outcomes are addressed entirely through the building of the electronic system consisting of a wire loom and stripboard circuit. If necessary candidates should start by practising with simple exercises containing only a few components, by a range of methods, before attempting more demanding circuits.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Whenever possible, the dynamic nature of this unit should not be hindered by overburdening assessment of the candidate.

The candidate should be aware that certain performances are being monitored constantly and recorded on an observation checklist, and that the finished electronic system will be tested against the stated criteria for accuracy and quality.

Candidates must work alone so that the work produced is the result of the candidate's own efforts. It is expected, however, that discussions will take place between candidates regarding working methods which may extend in some situations to a skill being demonstrated.

Evidence for the unit assessment is provided by the completed electronic system including the loom and the stripboard circuit and a checklist of test results.

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, publication code AA0645).

National Unit Specification: general information

UNIT Electronic Simulation and Testing (Intermediate 1)

NUMBER D9EN 10

COURSE Applied Practical Electronics (Intermediate 1)

SUMMARY

To introduce and develop skills in:

- computer simulation of electronic systems and circuits
- the use of non-ranging multimeters and d.c. power supplies

OUTCOMES

1 Use a computer to simulate electronic systems.
2 Use a computer to simulate electronic circuits.
3 Set-up and use multimeters to measure resistance, d.c. voltage and d.c. current.
4 Use a low voltage d.c. supply when testing circuits.

RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained some previous experience in science and/or technology. This may be evidenced by possession of the following:

- Standard Grade Science (including discrete subjects) at 4, 5 and 6
- Standard Grade Technological Studies at 4 and 5
- Electronics (Physics) Intermediate 1

Administrative Information

Superclass: XL

Publication date: January 2003

Source: Scottish Qualifications Authority

Version: 01

National Unit Specification: general information (cont)

UNIT Electronic Simulation and Testing (Intermediate 1)

CREDIT VALUE
1 credit at Intermediate 1 (6 SCOTCAT Points at SCQF level 4).

*SCOTCAT 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 SCOTCAT points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.

CORE SKILLS
There is no automatic certification of core skills or core skills components in this unit.

Additional information about core skills is published in the *Catalogue of Core Skills in National Qualifications* (SQA, 2001).

National Unit Specification: statement of standards

UNIT Electronic Simulation and Testing (Intermediate 1)

Acceptable performance in this unit will be the satisfactory achievement of the standards set out in this part of the unit specification. All sections of the statement of standards are mandatory and cannot be altered without reference to the Scottish Qualifications Authority.

OUTCOME 1
Use a computer to simulate electronic systems.

Performance criteria
a) An electronic system simulation package is accessed correctly.
b) Electronic circuit functions are chosen correctly.
c) Electronic systems are correctly simulated.
d) System functions are adequately tested.

Evidence requirements
Electronic file copy or hard copy of simulated electronic systems which contain input process and outputs in the range.

OUTCOME 2
Use a computer to simulate electronic circuits.

Performance criteria
a) An electronic circuit simulation package is accessed correctly.
b) Electronic and electrical component circuit symbols and representations are chosen correctly.
c) Electronic circuits are correctly simulated.
d) Circuit voltages and currents are correctly tested.

Evidence requirements
Electronic file copy or hard copy of simulated circuits which contain the range of components.

OUTCOME 3
Set-up and use multimeters to measure resistance, d.c. voltage and d.c. current.

Performance criteria
a) A multimeter is set-up to read resistance, current and voltage.
b) The correct range is selected for measuring resistance, current and voltage.
c) The connections to the test circuits are correct.
d) The results of tests are taken and recorded accurately.

Evidence requirements
- completed test results
- observational evidence on the use of a digital non-auto-ranging multimeter.

National Unit Specification: statement of standards (cont)

UNIT Electronics Simulation and Testing (Intermediate 1)

OUTCOME 4
Use a low voltage d.c. supply when testing circuits.

Performance criteria
a) The low voltage d.c. power supply is set-up correctly.
b) The low voltage d.c. power supply is connected correctly to the circuits.
c) The low voltage d.c. power supply is used correctly in conjunction with simple test equipment.

Evidence requirements
- completed exercises record
- observational evidence on use of equipment.

National Unit Specification: support notes

UNIT Electronic Simulation and Testing (Intermediate 1)

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.

The purpose of this unit is to enable candidates to build knowledge and practice of computer simulation and testing followed by physical setting up and use of digital non-ranging multimeters. This will be applied to circuits and systems which candidates are intending to build, to specific circuits built as part of this unit or ones built as part of other units.

Candidates attempting this unit will mainly be in post-16 education, although it may also be undertaken by some adult returners and perhaps some candidates in the 14 to 16 curriculum.

In the simulation activities, candidates require little prior experience, but will be expected to produce good organised computer output either electronically or as physical output. In the real testing activities candidate will require some previous experience in building and testing circuits or will require instructions and practice with real circuits before assessment.

As part of a course in the post-16 curriculum, the candidates should be required to act and perform as adults and, accordingly, the tasks set should be challenging to the candidates at the level at which they are working. Apart from developing skills and techniques, this unit should emphasise the need for a disciplined approach to achieving safe and quality work. The use of testing equipment and d.c. power supplies will require discipline in use and more importantly adherence to Health and Safety guidelines and regulations. With regard to the use of computers, candidates operate under an agreed acceptable use policy and this should be applied consistently in accordance with the maturity demanded at this level.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

Content

- Computer construction, connection and simulation of electronic systems using input, process and output system blocks or boards.
- Computer construction, connection and simulation of component electronic circuits
- Set-up and use of digital non-ranging multimeter to measure resistance, d.c. current and d.c. voltage and setting-up and use of a low voltage d.c. supply.

This unit is practical in nature and requires the candidate to develop skills in:

- reading and interpreting simple electronic systems and circuits
- drawing/assembling computer based circuits and systems using simulation software taking into account component pin connections and polarity
- applying fault-finding techniques and taking appropriate remedial action in both simulation and actual circuits
- simulating electronic systems and circuits and confirming their operation to specifications
- use of digital multimeters
- use of d.c. voltage supplies
- adherence to Health and Safety procedures, guidelines and regulations
- adhering to acceptable use policy in terms of computer usage

UNIT Electronic Simulation and Testing (Intermediate 1)

The range of electronic components is extensive but could include:

- Sensors such as moisture, light, temperature
- Process devices, such as resistors, capacitors, transistors, ICs
- Output devices such as loudspeakers, buzzers, relays, motors, LEDs, lamps
- Polarity-conscious devices, electrolytic capacitors, diodes, transistors, ICs
- Multi-pin devices, transistors, ICs, relays, variable resistors, thyristors

Outcome 1
Modular input: process and output functions for electronic systems.
Analogue sensors: light; temperature; sound and moisture; digital sensors (push switch, reed and tilt switches); voltage inputs; logic gates; delays; timers; output drivers; and outputs (buzzers, lamps, loudspeakers, and motors).
System functions: desired output for a range of inputs.

Outcome 2
Component circuit symbols: battery; buzzer; capacitor; diode; fuse; 8; 14; or 16 pin integrated circuits; lamp; light dependent resistor; logic gate; loudspeaker; motor; resistor; switch; thermistor; bipolar transistor.
Voltage and current testing: d.c. voltage 0v to 25v, d.c. current 0 mA to 500 mA.

Outcome 3
Digital non-auto-ranging multimeter.
Measuring resistance; 0 Ω to M Ω.
Measuring d.c. voltage; 0v to 25v
Measuring d.c. current; 0 mA to 500 mA.

Outcome 4
Low voltage power supplies; digital non-auto-ranging multimeters.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

There is a progressive learning process in this unit, and this is best achieved in a concentrated manner on each type of activity. This will allow each individual candidate to build expertise in the software and hardware (including multimeters and d.c voltage supplies) being used.

Simulation

In almost all cases candidates will have experience in using computer software and will have built up some level of skills - this will be an advantage. Candidates may also have some experience of the computer packages used and may require only limited guidance. Most simulation software packages have some type of induction or tutorial exercises or programmes and these can be used to build up expertise and confidence.

Testing

The experience of candidates will vary before beginning this part of the unit. Where little or no experience exists, candidates will need to be given practice and instruction in the set-up and use of suitable digital multimeters and d.c. voltage supplies. Where candidates have built up much experience through other units or at standard grade, suitable revision may suffice before attempting this part of the unit and subsequent assessment.

National Unit Specification: support notes (cont)

UNIT Electronic Simulation and Testing (Intermediate 1)

General

Support materials (already produced by LTScotland) and commercial or in-house tutorial materials should be used either as whole class teaching, in small groups or on an individual need/support basis. Once candidates have built up enough expertise in the use of the software and hardware, they can either complete the outcomes in a unit approach, where they work through the support exercises and go on to complete the assessment, or alternatively, the unit may be integrated into other units within the course (notably Electronic (Physics) and Practical Electronics). This can be matched as follows: -

System Simulation	Electronics (Physics) Intermediate 1
Circuit Simulation	Practical Electronics Intermediate 1
Testing	Practical Electronics Intermediate 1 Wiring and Assembly Techniques Intermediate 1

After completion of each task, either simulated or testing activities, the candidate's work should be verified as satisfying the operational specifications in the NAB. This should then be recorded on the assessment checklists and should be stored as hard copy and kept as evidence.

Examples of the systems and circuits for the assessment of this unit are given in the NAB. These circuits can be used in certain areas of other units in this course: -

- Electronics (Physics)
- Practical Electronics

This approach could serve any or all of the following three purposes:

- as a rehearsal for part of the course project, during which the candidate is expected to work with a degree of independence
- as a means of re-testing certain performances from other areas of the course
- as a means of reinforcing areas of knowledge and understanding of concepts within other areas of the course.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Whenever possible, the dynamic nature of this course should not be hindered by overburdening assessment of the candidate.

The candidate should be aware that certain performances are being monitored constantly and recorded on an observation checklist. Physical assessment and moderation evidence will be in the form of: -

- hard copy of simulated systems and circuits
- records of testing and measurement results

SPECIAL NEEDS

This unit specification is intended to ensure that there are no artificial barriers to learning or assessment. Special needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments or considering special alternative outcomes for units. For information on these, please refer to the SQA document *Guidance on Special Assessment Arrangements* (SQA, publication code AA0645).