SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Practical Electronics (Intermediate 2)

NUMBER D181 11

COURSE Engineering Craft Skills (Intermediate 2)

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 Plan and construct an electronic circuit using stripboard.
3 Plan and 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. This may be evidenced by one of the following:

- Standard Grade Craft and Design
- Engineering Craft Skills at Intermediate 1 level

Administrative Information

Superclass: XL

Publication date: December 1999

Source: Scottish Qualifications Authority

Version: 03

National Unit Specification: general information (cont)

UNIT Practical Electronics (Intermediate 2)

CREDIT VALUE

1 credit at Intermediate 2.

CORE SKILLS

This unit gives automatic certification of the following:

Complete core skills for the unit	None
Core skills components for the unit	Planning and Organising Int 1

Additional information about core skills is published in *Automatic Certification of Core Skills in National Qualifications* (SQA, 1999).

National Unit Specification: statement of standards

UNIT Practical Electronics (Intermediate 2)

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 to demonstrate competence in the interpretation of a diagram, the selection of components and the construction of a working circuit using a prototype circuit board.

OUTCOME 2

Plan and construct an electronic circuit using stripboard.

Performance criteria

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

Evidence requirements

A practical exercise in interpreting a circuit diagram, planning a layout circuit, selecting and soldering components and constructing a working circuit on a stripboard to a given specification.

National Unit Specification: statement of standards (cont)

UNIT Practical Electronics (Intermediate 2)

OUTCOME 3

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

Performance criteria

(a) A layout diagram is drawn from the circuit diagram.
(b) The system is constructed correctly.
(c) Pre-power-up checks are carried out.
(d) The system operates to specification.

Evidence requirements

A practical exercise in interpreting a circuit diagram, planning a circuit layout, and constructing a working electronic system using a PCB.

National Unit Specification: support notes

UNIT Practical Electronics (Intermediate 2)

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 be mainly 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 and develop a knowledge of the functions of some electronic components. Artefacts produced should have a personal appeal to the client group, 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, protection and regulating devices, and output devices
- construction techniques: solderless prototype board (non-permanent); soldering, on stripboard (permanent); Printed Circuit Board (PCB)
- verification equipment: oscilloscope, multi-meter, logic probe

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

- reading and interpreting electronic-circuit and layout diagrams, creating a component listing and selecting components from stock
- assembling 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
- from a specification, developing a layout diagram and a component listing
- constructing a fully functioning electronic system and confirming its operation to specification, using test equipment
- adhering to safe working practices at all times

The range of electronic components is extensive but could include:

- Sensors such as — moisture, light, temperature; displacement, velocity
- Process devices such as — resistors, capacitors, transistors, amplifiers, logic gates, ICs
- Output devices such as — loudspeakers, buzzers, relays, motors, LEDs, lamps, LEDs and arrays, seven-segment displays
- Polarity-conscious devices — electrolytic capacitors, diodes, transistors, ICs
- Multi-pin devices — transistors, field-effect transistors (FETs), 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 and in a different workshop environment from that of the other areas of the course, preferably 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 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 prototype boards followed by soldering, on stripboard. 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 specification.

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. At this level, candidates are expected to develop an understanding of the functions of components and should develop their own layout diagrams and component lists from a clear and unambiguous written specification. The operation of the system should be verified using an oscilloscope, a multi-meter, or a logic probe, as appropriate.

Adhering to safe working practices at all times

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

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Approaches to assessment

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 for only this unit might be an alarm system with multiple sensor inputs, combinational logic processing to meet the performance specification and variable output tones, 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 2)* unit. Similarly, calibration dials or spindles and bearings could be turned on the lathe during the *Machine Processes – Metal (Int 2)* 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 and Certification Arrangements for Candidates with Special Needs/Candidates whose First Language is not English* (SQA, 1998).