SCOTTISH QUALIFICATIONS AUTHORITY

National Unit Specification: general information

UNIT Applied Electronics (Higher)

NUMBER D186 12

COURSE Technological Studies (Higher)

SUMMARY

This unit is designed to enable candidates to develop the level of understanding of analogue and digital electronics introduced at Standard Grade and Intermediate 2.

OUTCOMES

1 Design and construct electronic systems to meet given specifications.
2 Design and construct electronic systems, based on operational amplifiers, to meet given specifications.
3 Design and construct combinational logic systems to meet given specifications.

RECOMMENDED ENTRY

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

- Standard Grade Technological Studies at grade 1 or 2
- Intermediate 2 Technological Studies or equivalent NC units.

CREDIT VALUE

1 credit at Higher.

Administrative Information

Superclass: XL

Publication date: December 1999

Source: Scottish Qualifications Authority

Version: 03

National Unit Specification: general information (cont)

UNIT Applied Electronics (Higher)

CORE SKILLS

This unit gives automatic certification of the following:

Complete core skills for the unit	Problem Solving	H
	Numeracy	H
Additional core skills components for the unit	None	

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 Applied Electronics (Higher)

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

Design and construct electronic systems to meet given specifications.

Performance criteria

(a) Components and sub systems are identified correctly, for given electronic systems.
(b) The operation of electronic sub systems is explained clearly.
(c) Calculations to verify the operation of sub systems are carried out correctly.
(d) An electronic system is evaluated correctly against a given specification, using computer simulation.
(e) An electronic system is constructed to meet a given specification.

Note on range for the outcome

Components: LDR, thermistor fixed resistor, variable resistor, strain gauge, bi-polar and MOSFET transistors, motor, relay, diode.

Electronic systems (including the following sub-systems):

input – potential divider
process – MOSFET, bi-polar configuration
output – any appropriate output.

Evidence requirements

Written and graphical evidence for PCs (a) to (c). Performance evidence for PCs (d) and (e).

OUTCOME 2

Design and construct electronic systems, based on operational amplifiers, to meet given specifications.

Performance criteria

(a) In selecting operational amplifier configurations from a data booklet, information is interpreted correctly and the configurations are represented graphically.
(b) The operation of electronic systems, based on operational amplifiers, is explained clearly.
(c) Calculations relating to operational amplifier based systems are carried out correctly.
(d) An operational amplifier system is evaluated correctly against a given specification, using computer simulation.
(e) An operational amplifier system is constructed to meet a given specification.

Note on range for the outcome

Operational amplifier configurations: non-inverting, inverting, difference and summing amplifiers, comparator, voltage follower.
Calculations: input voltage, output voltage, supply voltage, feedback resistance, input resistance, gain.

Evidence requirements

Written and graphical evidence for PCs (a) to (c). Performance evidence for PCs (d) and (e).

OUTCOME 3

Design and construct combinational logic systems to meet given specifications.

Performance criteria

(a) The operational characteristics of common integrated circuit logic families are described correctly.
(b) Data sheets are interpreted correctly in the selection of integrated circuits.
(c) Solutions to logic problems are developed successfully using truth tables, Boolean expressions, common logic gate diagrams and NAND-based equivalents.
(d) The graphical representation used in designing solutions to logic problems is in accordance with the data booklet.
(e) A logic circuit is evaluated correctly against a given specification, using computer simulation.
(f) A logic circuit is constructed to meet a given specification.

Evidence requirements

Written and graphical evidence for PCs (a) to (d). Performance evidence for PCs (e) and (f).

National Unit Specification: support notes

UNIT Applied Electronics (Higher)

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.

A data booklet will be issued by SQA for use in connection with this unit.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

Guidance for each outcome is given below.

Outcome 1

Principles of the voltage divider. Examples of potentiometer, fixed voltage divider. Use of variable resistors and analogue input transducers (LDR, thermistor, strain gauge) in voltage dividers.

Use input transducer characteristics from the data booklet to design a voltage divider to meet a given specification.

The n-p-n transistor as a switch (common emitter mode; switching circuits using transistors and voltage dividers. The need for circuit protection and associated techniques.

Current gain of an n-p-n transistor.

Calculations based on the load being connected to the collector. All calculations assume that the transistor is at the point of 'saturation' (assume $I_e \simeq I_c$).

Use of Darlington Pair and associated calculations.

Push-pull driver circuit – use of the p-n-p/n-p-n configuration to provide negative and positive output voltages. (No calculations are required on p-n-p transistors.)

The *n-channel* MOSFET (in enhancement mode) as a switch and as an output driver. Simple switching circuit with MOSFET and voltage divider.

Calculations associated with MOSFETs for a given gate voltage. Use of a relay in a transistor circuit to switch a separate (high voltage or high current) circuit.

Use of computer simulation to evaluate electronic systems. Constructing electronic systems to meet given specifications.

Outcome 2

Introduction to the use of a 741 IC as a building block for a range of op-amp configurations; pin-out diagram for a 741 IC.

Basic theory of operational amplifiers as devices for amplifying voltage signals.

Relationships between input voltages (to inverting and non-inverting inputs) and output voltage for different op-amp configurations. Calculations involving input voltage, output voltage and gain.

National Unit Specification: support notes (cont)

UNIT Applied Electronics (Higher)

Outcome 2 (cont)	Op-amp configurations: inverting, non-inverting, comparator, difference amplifier, summing amplifier, voltage follower. Basic theory of operation and use. Use of data booklet in selection and representation of op-amp configurations. Use of computer simulation to evaluate electronic systems, based on op-amps. Construction of electronic systems, based on op-amps, to meet given specifications.
Outcome 3	Logic functions and their associated truth tables: AND, OR, NOT, NAND, NOR. Use of NAND based equivalents. Truth tables – maximum of three inputs. Development of Boolean expressions from truth tables or circuit specifications. Construction of truth tables for combinational logic diagrams. Production of combinational logic diagrams from truth tables using any gates or NAND based equivalents. Construction of truth tables and logic diagrams from written specifications. Use of data sheets in selecting logic ICs. Graphical representations of solutions to combinational logic problems. Use of logic ICs and pin-out diagrams. Comparison of TTL and CMOS families of ICs (in terms of operational characteristics). Use of computer simulation (and construction) to evaluate combinational logic systems.

Candidates are required to develop an understanding of the function and operation of electronic devices and to carry out calculations to verify the operation of electronic systems. The main areas of study are the potential divider, transistor driver, operational amplifier and combinational logic. In addition, candidates are required to develop practical capabilities in simulating and constructing electronic systems.

National Unit Specification: support notes (cont)

UNIT Applied Electronics (Higher)

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Where appropriate, opportunities should be taken to ensure that learning and teaching is contextualised in industrial/commercial applications. Candidates are expected to design and construct systems to meet given specifications. Such systems should be based on transistor control and operational amplifier and combinational logic applications.

This unit deals with concepts which are applied in other units and thus offers opportunities for integration of content. In presenting this unit, teachers and lecturers should ensure that there is a balance between direct teaching and practical activities.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

National Assessment Bank materials have been created specifically to assess knowledge and understanding for each outcome. Assessments can take place either at the completion of an outcome or as an end of unit test. Centres must ensure that tests are conducted under appropriate conditions. Candidates should be allowed to use the Technological Studies data booklet. Candidates should be issued with clean copies of this booklet for use during tests.

All three outcomes require candidates to simulate, construct and evaluate systems to given specifications. It is the responsibility of the centre to ensure that evidence of candidate performance is recorded in an appropriate way. All evidence of performance must be retained by the centre. The assessment of this unit is subject to central moderation by the SQA.

Candidates generate evidence by means of their response to written tests, proficiency in practical activities and systems evaluation.

In order to gain success in the written test for an outcome, each candidate must achieve at least the cut-off score for that outcome. In order to succeed in practical activities, the candidate must simulate, construct and evaluate a system to meet a given specification. Evidence of performance must be recorded in an appropriate manner. Simulation and construction performance must be observed directly. Candidates' evaluation of a system can be in the form of either a written or oral report. Details should be recorded of the particular system(s) dealt with by each candidate.

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).