National Unit Specification: general information

UNIT Electronic Simulation and Testing (SCQF level 5)

CODE F5HS 11

SUMMARY

This Unit is designed primarily for those candidates who wish to develop their skills, knowledge and understanding of electronic simulation and testing of electronic circuits with a view to supporting and underpinning their studies in an engineering discipline. This Unit is suitable for candidates wishing to embark upon a career in electrical and/or electronic engineering. It is also relevant to candidates studying other branches of engineering, science or technology. The candidate will use application software to model electronic systems and electronic circuits down to component level and they will also use a range of electronic test equipment to make test measurements on electronic circuits. This Unit may form part of a National Qualification Group Award or may be offered on a free standing basis.

OUTCOMES

1 Use a computer to simulate electronic systems.
2 Use a computer to simulate electronic circuits and measure and record circuit parameters.
3 Use electronic test equipment to test, record and compare electronic circuits.

RECOMMENDED ENTRY

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

- Standard Grade in a Science or Technology subject — General Level

Administrative Information

Superclass: XL

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CREDIT VALUE

1 credit at SCQF level 5 (6 SCQF credit points at SCQF level 5*).

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

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CORE SKILLS

There is no automatic certification of Core Skills in this Unit.

This Unit provides opportunities for candidates to develop aspects of the following Core Skill:

- Information Technology (SCQF level 5)
- Working with Others (SCQF level 5)

These opportunities are highlighted in the Support Notes of this Unit Specification.

National Unit Specification: statement of standards

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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 SQA.

OUTCOME 1

Use a computer to simulate electronic systems.

Performance Criteria

(a) Describe the key stages in electronic systems correctly.
(b) Identify system functions correctly.
(c) Create and simulate electronic systems to specified design criteria correctly.

OUTCOME 2

Use a computer to simulate electronic circuits and measure and record circuit parameters.

Performance Criteria

(a) Identify the symbols of the circuit components correctly.
(b) Create and simulate electronic circuits to specified design criteria correctly.
(c) Measure and record circuit parameters correctly.

OUTCOME 3

Use electronic test equipment to test, record and compare electronic circuits.

Performance Criteria

(a) Demonstrate the correct use of a digital multi-meter to measure voltage, current and resistance on pre-contructed circuits.
(b) Demonstrate the correct use of an oscilloscope to measure the amplitude, period and frequency on pre-constructed circuits.
(c) Demonstrate the correct use of a direct current (dc) power supply on pre-constructed circuits
(d) Demonstrate the correct use of an alternating current (ac) signal generator on a pre constructed circuit
(e) Demonstrate the correct use of a logic probe on a pre constructed circuit
(f) Record the test results from pre-constructed circuits correctly and compare the practical and simulated results correctly

National Unit Specification: statement of standards (cont)

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EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria.

Performance evidence supplemented with an assessor observation checklist as well as written and/or recorded oral evidence is required which demonstrates that the candidate has achieved all Outcomes to the standards specified in the Outcome and Performance Criteria.

This evidence will be produced under supervised, controlled conditions at appropriate points throughout the Unit either on an Outcome by Outcome basis or as integrated assessments. All calculations and measurements should be given using the relevant SI units of measurement.

The required evidence, for all Outcomes, is as follows:

Outcome 1

Satisfactory achievement to be demonstrated by the candidate showing the correct system function in terms of:

- input
- process
- driver
- output
- the system to be simulated must use a minimum of two inputs and contain a processing block, a driver block and an appropriate output device

Outcome 2

Satisfactory achievement to be demonstrated by the candidate showing the correct circuit operation in terms of:

- correct symbolic representation of components
- correctly simulated circuit design
- correctly simulated test results involving the measurement of voltage at a minimum of four test points, current in a minimum of three branches and resistance of a minimum of three components
- the circuits used must be mixed mode, with a minimum of one logic gate, one transistor, one sensor, a switch, three passive components and an appropriate output device

National Unit Specification: statement of standards (cont)

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Outcome 3

Satisfactory achievement to be demonstrated by the candidate showing the correct test procedures on pre-constructed circuits and will involve the setting up of a dc power supply correctly in terms of voltage level, current limit level and circuit connection and the setting up of an ac signal generator correctly in terms of amplitude, frequency, and waveform function and circuit connection for a minimum of two separate waveforms. The candidate will also demonstrate the use of a digital multi-meter to measure resistance of a minimum of three components, voltage at a minimum of three test-points and current in a minimum of three branches correctly in terms of parameter selection, range setting and lead/circuit connection. The candidate will also demonstrate the use of an oscilloscope to measure the period, frequency correctly in terms of amplitude sensitivity, time-base sensitivity, coupling, triggering, and circuit connection on a minimum of two separate waveforms. The candidate will also demonstrate the use of a logic probe to determine a minimum of four logic signals correctly in terms of high states, low states, and indeterminate states.

A candidate's responses can be judged to be satisfactory by observation of the correct use of the equipment and by recording the results correctly on the pro forma provided.

The candidate will also be asked to make a comparison between the measurements obtained from a simulated (computer modelled) circuit and the measurements obtained from an actual pre-constructed circuit and to comment on the effectiveness of the simulation.

A candidate's responses can be judged to be satisfactory where the evidence provided demonstrates the candidate is able to:

- produce a written/oral report that includes:
  - a table of the measurements obtained from the simulated circuit
  - a table of the measurements obtained from the actual pre-constructed circuit
  - an explanation of the circuit operation
  - a comparison of the results between the simulated circuit and the actual circuit and an explanation of any differences between the two circuits
  - a conclusion of the effectiveness of the simulation process

The Assessment Support Pack for this Unit provides sample assessment material. Centres wishing to develop their own assessments should refer to the Assessment Support Pack to ensure a comparable standard.

National Unit Specification: support notes

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

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

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

This is a restricted core Unit within the National Certificate in Electronic Engineering at SCQF level 5. It can also be delivered as a free-standing Unit. The Unit is of a practical nature and will develop the candidate's skills in the following areas:

- computer construction and simulation of electronic systems using input, process, driver and output system stages. This can be achieved by means of appropriate application software
- computer construction and simulation of electronic circuits at component level. This can be achieved by means of appropriate application software.
- set-up and use of various types of digital multimeters (non auto ranging) to measure resistance, dc and ac currents and dc and ac voltages.
- set-up and use of oscilloscopes to measure dc and ac voltages and frequency. Emphasis could be placed on setting up the oscilloscope prior to making measurements, eg sensitivity, calibration and triggering settings. Mention could also be made of how to measure current using 'sniffer' resistors or a current probe.
- set-up and use low voltage dc power. Emphasis should be placed on pre-adjustment and checking of dc levels prior to circuit connection.
- set-up and use of a logic probe to measure logic levels.
- reading and interpreting electronic systems/circuit diagrams.
- adherence to Health and Safety guidelines regarding the use of electrical/electronic equipment.
- the accurate recording and documentation of test results.
- fault-finding in electronic circuits

The range of electronic devices/components could include:

Outcome 1

Inputs:

Switches — Push-button, Latching, Relays
Sensors — Sensor processing units, temperature, light and moisture sensors
Process — Logic gates, delays, latches, comparators
Drivers — Transistors, thyristors, transducers
Outputs — LED's, bulbs, buzzers, motors
Measurement — voltmeters, ammeters and oscilloscope

National Unit Specification: support notes (cont)

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Outcome 2

Component/devices:

Resistors, capacitors, diodes, avalanche diodes, bridge rectifiers, transistors, ICs, dc power supplies, ac signal generators, transformers.

Measurement:

Multimeter, voltmeters, ammeters and oscilloscope.

Outcome 3

Component/devices:

Resistors, capacitors, diodes, avalanche diodes, bridge rectifiers, transistors, ICs, dc power supplies, ac signal generators, logic probe

Measurement:

Multimeters (non-auto ranging) and oscilloscope.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

This Unit has been written with an emphasis on progressive learning through the **real** design sequence from system level conceptualisation through circuit simulation prototyping to hardware circuit prototyping. Each Outcome will allow the candidate to develop their skills in the use of the software and the hardware to be used. In order to achieve this Unit, the candidate will require access to a computing resource and to an Electronics Laboratory.

Simulation

It must be ensured that candidates have the necessary basic IT skills to undertake this Unit. This could involve an induction session that will allow the candidates to develop the necessary keyboard, mouse and file management skills. It is likely that some/most of the candidates will not have encountered system/circuit simulation packages before and it is therefore advisable to choose application software package that provides good induction/tutorial material that will allow the candidates to build up an expertise on the features and function of the system to be used.

Testing

The range of experience may vary widely amongst the candidates depending on their starting point, ranging from those who will already have a good knowledge of testing circuits through to candidates with very limited experience. For Outcome 3, it is likely that centres will have in-house materials that can be adapted to suit the specific requirements of this Unit.

National Unit Specification: support notes (cont)

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OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

An induction session to introduce *Information Technology* basics may be useful for some candidates. The use of application software packages that provide tutorial material would support understanding of the features and function of the system to be used. As candidates make use of a computer to simulate electronic systems and circuits they should be provided with the support needed to learn through practical experience. Security and consideration for other users should be routine.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by information and communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003), SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

Candidates work could be assessed against an assessment checklist, which could be included in the Instrument of Assessment. Centres could consider combining Outcomes 1 and 2. Outcome 3 could involve a comparison of the practical results against the theoretically simulated results. Evidence could be in the form of practical assignments and a report (containing electronic file references and hard-copy of computer simulations where appropriate) for all Outcomes.

Outcome 1

A practical assignment involving the use of system simulation software. The candidate could be asked to create a system to meet a given specification.

Satisfactory achievement to be demonstrated by the candidate showing the correct system function and by means of a written or oral report.

Outcome 2

A practical assignment involving the use of circuit simulation software. The candidate could be asked to create a circuit that meets the specification given in Outcome 1.

Satisfactory achievement to be demonstrated by the candidate showing the correct circuit operation and by means of a written or oral report.

The Instrument of Assessment for Outcomes 1 and 2 could consist of a candidate being asked to simulate, using appropriate System Simulation software, a dashboard indicator in a car that indicates when there is a likelihood of icing outside and is activated by the combined effect of the *ignition* switch and a *heat* sensor. Once they have achieved a suitable system design they would then go on to construct and test a component level circuit using appropriate Circuit Simulation software. It is not necessary that the actual Circuit Simulation software has temperature controlled components provided the delivering staff make it clear that such components are simply variable resistors whose resistance varies with temperature rather than by mechanical adjustment.

Outcome 3

A practical assignment involving the use of electronic test equipment on pre-constructed electronic circuits to measure logic levels, voltage, current, resistance and frequency and to compare readings with those obtained in Outcomes 1 and 2.

Satisfactory achievement will be demonstrated by observation of the candidate's use of the test equipment and by means of a written or oral report.

The Instrument of Assessment for Outcomes 3 could involve the use of a pre-constructed circuit whose function is similar to that used in Outcomes 1 and 2

DISABLED CANDIDATES AND/OR THOSE WITH ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering whether any reasonable adjustments may be required. Further advice can be found on our website **www.sqa.org.uk/assessmentarrangements**