National Unit specification: general information

Unit title: Engineering Systems: Test and Measurement (SCQF level 5)

Unit code: FN3L 11

Superclass: VE

Publication date: August 2011

Source: Scottish Qualifications Authority

Version: 02

Summary

This Unit will provide candidates with the necessary knowledge, understanding and use of test and measurement instrumentation at SCQF level 5. This will be done in the context of an integrative engineering system and assessed in a practical engineering environment.

This Unit is part of the Mandatory Core of the National Certificate in Engineering Systems (SCQF level 5) and can also be taken as a freestanding Unit.

The Unit is particularly suitable for those candidates wishing to embark upon a career in engineering or technology.

Outcomes

1 Use electrical test and measurement instrumentation correctly to carry out accurate measurements in electrical/electronic circuits.
2 Use mechanical test and measurement instrumentation correctly to carry out accurate measurements on mechanical systems.
3 Correctly measure performance parameters, for a given test specification, of a given electromechanical system.

Recommended entry

While entry is at the discretion of the centre, candidates would normally be expected to have attained a minimum of a general grade in one science, mathematics or technology based Standard Grade as well as a minimum of a general grade in Standard Grade English or relevant equivalent qualifications.

National Unit specification: general information (cont)

Unit title: Engineering Systems: Test and Measurement (SCQF level 5)

Credit points and level

1 National Unit 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.*

Core Skills

Achievement of this Unit gives automatic certification of the following Core Skills component:

- Critical Thinking at SCQF level 4

There are also opportunities to develop aspects of Core Skills which are highlighted in the Support Notes of this Unit specification.

National Unit specification: statement of standards

Unit title: Engineering Systems: Test and Measurement (SCQF level 5)

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 electrical test and measurement instrumentation correctly to carry out accurate measurements in electrical/electronic circuits.

Performance Criteria

(a) Selection of test and measurement instrumentation is appropriate for a given task.
(b) Connection of instrumentation to the circuit is correct.
(c) Measured values are recorded accurately.
(d) Measured values are correctly compared and contrasted against given expected values.
(e) Comply with all relevant safety regulations and safe working procedures and practices while undertaking practical work.

Outcome 2

Use mechanical test and measurement instrumentation correctly to carry out accurate measurements on mechanical systems.

Performance Criteria

(a) Selection of test and measurement instrumentation is appropriate for a given task.
(b) Connection of instrumentation to the system is correct.
(c) Measured values are recorded accurately.
(d) Measured values are correctly compared and contrasted against given expected values.
(e) Comply with all relevant safety regulations and safe working procedures and practices while undertaking practical work.

Outcome 3

Correctly measure performance parameters, for a given test specification, of a given electromechanical system.

Performance Criteria

(a) Selection of instrumentation is appropriate for a given task.
(b) Connection of instrumentation to the circuit is correct.
(c) Measured values are recorded accurately.
(d) Measured values are correctly compared and contrasted against given expected values.
(e) Comply with all relevant safety regulations and safe working procedures and practices while undertaking practical work.

National Unit specification: statement of standards (cont)

Unit title: Engineering Systems: Test and Measurement (SCQF level 5)

Evidence Requirements for this Unit

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

Performance evidence 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 should 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:

- Candidates have complied with relevant safety regulations and safe working procedures and practices whilst undertaking all practical activities.
- The candidate will be required to correctly discuss any three of the following relevant factors to their actual results for each outcome:
- Relevant factors: Accuracy, Range, Resolution, Sensitivity, Drift, Environment.

With regard to Outcome 1

- Voltage, current and resistance should be correctly measured (to within given tolerances), at three different points, within a direct current (dc) electrical circuit. The circuit should comprise of a resistor network with a minimum of 4 resistors with 2 resistors in series with a 2 resistor parallel arrangement.
- Amplitude and frequency should be correctly measured (to within given tolerances) within an alternating current (ac) circuit for three different frequencies and amplitudes. Typical circuits include rectifier circuits or single stage transistor amplifiers.

The candidate will be required to select appropriate instrumentation from a suitable range, correctly connect it to the given circuits, select the correct function/range and take measurements for each circuit.

The candidate will be required to record all measurements to the relevant degree of accuracy on the test specification worksheet provided and correctly compare and contrast measured values with given expected values. The comparison with expected values must focus on the accuracy of the instrumentation selected (relevant factors: Accuracy, Range, Resolution, Sensitivity, Drift, Environment) and not the theory of the given circuits as this is out with the scope of this unit.

National Unit Specification: statement of standards (cont)

UNIT: Engineering Systems: Test and Measurement (SCQF level 5)

With regard to Outcome 2

- Three mechanical quantities (mass, length, force, pressure, temperature, flow, heat or friction) should be correctly measured, either directly or indirectly, to within given tolerances.

The candidate will be required to select appropriate instrumentation from a suitable range, correctly connect it to the given mechanical system, select appropriate function/range and take measurements of the selected quantities.

The candidate will be required to record all measurements to the relevant degree of accuracy on the test specification worksheet provided and correctly compare and contrast measured values with given expected values. The comparison with expected values must focus on the accuracy of the instrumentation selected (relevant factors: Accuracy, Range, Resolution, Sensitivity, Drift, Environment) and not the theory of the given system as this is out with the scope of this Unit.

With regard to Outcome 3

- A minimum of two different electrical and two different mechanical parameters should be correctly measured to confirm the steady state performance of the system.

The candidate will be required to select appropriate instrumentation, connect it to the given electromechanical system, select appropriate function/range and take measurements of the selected parameters. The justification of instrument selection must be appropriate. The number of measurements to be taken may vary with respect to different conditions and/or different points in time but must be sufficient to confirm the performance of the system.

The candidate will be required to record all measurements to the relevant degree of accuracy on the test specification worksheet provided and correctly compare and contrast measured values with given expected values. The comparison with expected values must focus on the accuracy of the instrumentation selected (relevant factors: Accuracy, Range, Resolution, Sensitivity, Drift, Environment) and not the theory of the given electromechanical system as this is out with the scope of this Unit.

National Unit specification: support notes

Unit title: Engineering Systems: Test and Measurement (SCQF level 5)

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

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

Guidance on the content and context for this Unit

This Unit forms part of the Mandatory Core of the National Qualification Group Awards (NQGA) in Engineering Systems at SCQF level 5, but may also be offered on a free standing basis.

The aim of this Unit is to provide candidates with an introduction to test and measurement techniques that may be employed within an engineering system and has been designed to provide an equal treatment to measuring mechanical and electrical quantities.

On successful completion of the Unit candidates will have developed the knowledge, understanding and skills to measure typical mechanical and electrical quantities present in engineering systems as well as selecting the most appropriate instrument and account for inaccuracies in instrumentation readings.

Centres may choose to employ one engineering system throughout the delivery of this unit or may wish to employ several different systems dependent upon centre resources and other course content.

Guidance on learning and teaching approaches for this Unit

It is recommended that the Unit is by a series of investigations developed from the statement of standards section of the Unit. This will include candidates investigating engineering systems, or sub-systems, to study their principles of operation by investigation and measurement. If appropriate, centres may wish to allow candidates to perform experiments on engineering systems, or sub-systems, by integrating the evidence requirements for this Unit with the evidence requirements for the following two Units:

Engineering Systems: Principles at SCQF level 5
Engineering Systems: Applications at SCQF level 5

Guidance on approaches to assessment for this Unit

The evidence requirements necessitate each candidate submitting a portfolio of accurate results from experiments and investigations. Centres will need to issue candidates with suitable logbooks containing relevant information with regard to equipment choices, health and safety requirements and any other essential information.
An assessor observation checklist must be used to record evidence that candidates have complied with relevant safety regulations and safe working procedures and practices while undertaking all practical activities.

National Unit specification: support notes (cont)

Unit title: Engineering Systems: Test and Measurement (SCQF level 5)

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 Communication 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)*.

Opportunities for developing Core Skills

In this Unit candidates will learn about test and measurement instrumentation.

Candidates will:

- complete reports
- carry out investigations
- take measurements to within given tolerances

This Unit has the Problem Solving component of Critical Thinking embedded in it, so when candidates achieve this Unit their Core Skills profile will be updated to show they have achieved Critical Thinking at SCQF Level 4. In addition, as candidates are doing this Unit they will be developing aspects of the Core Skills in communication and numeracy.

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**

History of changes to Unit

Version	Description of change	Date
02	Core Skills Component Critical Thinking at SCQF level 4 embedded.	08/08/2011