National Unit specification: general information

Unit title: Engineering Systems: Principles (SCQF level 5)

Unit code: FN3J 11

Superclass: VE

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Version: 02

Summary

This Unit will provide candidates with the necessary knowledge and understanding of mechanical, electrical and electronic engineering principles at SCQF level 5. These principles will be in the context of an engineering system and predominately delivered in a practical engineering environment to support the essential theory required.

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 Demonstrate by investigation and measurement, electrical quantities present in engineering systems.
2 Demonstrate by investigation and measurement, mechanical quantities present in engineering systems.
3 Verify by investigation and measurement, the performance 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: Principles (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:

- Using Number 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: Principles (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

Demonstrate by investigation and measurement, electrical quantities present in engineering systems.

Performance Criteria

(a) Demonstrate direct current (dc) quantities found in engineering systems by investigation and measurement.
(b) Demonstrate alternating current (ac) quantities found in engineering systems by investigation and measurement.
(c) Simulate accurately electrical quantities found in engineering systems.
(d) Comply with all relevant safety regulations and safe working procedures and practices while undertaking practical work.

Outcome 2

Demonstrate by investigation and measurement, mechanical quantities present in engineering systems.

Performance Criteria

(a) Demonstrate mechanical quantities found in engineering systems by investigation and measurement.
(b) Demonstrate mechanical energies found in engineering systems by investigation and measurement.
(c) Simulate accurately mechanical quantities found in engineering systems.
(d) Comply with all relevant safety regulations and safe working procedures and practices while undertaking practical work.

Outcome 3

Verify by investigation and measurement, the performance of a given electromechanical system.

Performance Criteria

(a) Measure correctly mechanical and electrical parameters, from a given test specification, on an electromechanical system to confirm its steady state performance.
(b) Draw correctly a block diagram of the electromechanical system showing all processes, inputs and outputs, accurately labelled and using the correct terminology
(c) Describe correctly the function of each element within the block diagram of the electromechanical system and the overall function of the system.
(d) Comply with all relevant safety regulations and safe working procedures and practices while undertaking practical work.

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 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:

With regard to Outcome 1

- Voltage, current and resistance should be correctly measured (to within given tolerances) and described with respect to unit of measurement, basic properties and fundamental relationships established within a dc electrical circuit. The circuit should comprise of a resistor network with a minimum of four resistors with two resistors in series with a two resistor parallel arrangement. The fundamental relationships to be measured, established (verified) and described are Ohm's, Kirchhoff's Current and Voltage Laws.
- Amplitude (peak to peak and root mean square (rms)) and frequency should be correctly measured (to within given tolerances) and described with respect to unit of measurement and fundamental relationships within an ac circuit. The fundamental relationships to be measured, established (verified) and described are the relationship between peak and rms amplitude and the relationship between frequency and time. Typical circuits include rectifier circuits or single stage transistor amplifiers.
- All measurements carried out in either Performance Criteria (a) or (b) must be established and confirmed using a suitable software simulation package.

With regard to Outcome 2

- Three mechanical quantities (mass, length, force, pressure, temperature, flow, heat or friction) should be correctly measured (to within given tolerances) and described with respect to unit of measurement, basic properties and fundamental relationships established (verified) within a mechanical system.
- Two forms of mechanical energy (potential, kinetic or heat/thermal) should be correctly measured (either directly or indirectly to within given tolerances) and described with respect to unit of measurement, basic properties and fundamental relationships established (verified) within a mechanical system.
- All measurements carried out in either Performance Criteria (a) or (b) must be established and confirmed using a suitable software simulation package.

National Unit specification: statement of standards (cont)

Unit title: Engineering Systems: Principles (SCQF level 5)

With regard to Outcome 3

- The electromechanical system must contain a minimum of four sub-systems and may contain feedback. Candidates will be issued with all relevant documentation for the system including the test specification that they must implement.
- A minimum of two different electrical and two different mechanical parameters should be measured, either directly or indirectly, to confirm the steady state performance of the system. 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 block diagram must be accurately and neatly constructed with all blocks clearly labelled with regard to input, function and output.
- Each element within the block diagram should be accurately described with regard to function within the electromechanical system.

National Unit specification: support notes

Unit title: Engineering Systems: Principles (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 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 the fundamental engineering principles that may be employed within an engineering system and has been designed to provide an equal treatment to 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 representing engineering systems in block diagram form.

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: Test and Measurement 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: Principles (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 mechanical, electrical and electronic engineering principles.

Candidates will:

- complete reports
- draw engineering diagrams
- carry out investigations
- take measurements

This Unit has the Numeracy component of Using Number embedded in it, so when candidates achieve this Unit their Core Skills profile will be updated to show they have achieved Using Number at SCQF Level 4. In addition, as candidates are doing this Unit they will be developing aspects of the Core Skills in Communication.

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 Components Using Number at SCQF level 4 embedded.	08/08/2011