



National Unit Specification: general information

UNIT Engineering Systems (SCQF level 6)

CODE F5FN 12

SUMMARY

This Unit may form part of a National Qualification Group Award or may be offered on a free standing basis.

This Unit is designed to provide candidates with opportunities to develop their knowledge and understanding of engineering systems. During the delivery of the Unit candidates will learn to represent engineering systems in block diagram form. They will also develop the knowledge, understanding and skills to describe and measure typical mechanical and electrical quantities present in engineering systems. Candidates will calculate different forms of mechanical and electrical energies, energy losses and efficiency in engineering systems. They will also investigate the performance of an electromechanical system.

The Unit is particularly suitable for those candidates training to be electrical, electronic, mechanical, manufacturing or multi-disciplinary engineering technicians.

OUTCOMES

- 1 Categorise engineering systems and represent such systems in block diagram format.
- 2 Describe and measure mechanical and electrical quantities present in engineering systems.
- 3 Identify different forms of energy present in engineering systems and calculate energies, energy losses and overall efficiency in a given engineering system.
- 4 Investigate the performance of a given electromechanical system.

Administrative Information

Superclass: VE

Publication date: March 2009

Source: Scottish Qualifications Authority

Version: 01

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National Unit Specification: general information (cont)

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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 Physics at credit level
- ◆ Intermediate 2 Physics
- ◆ Standard Grade Technological Studies at credit level

CREDIT VALUE

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

**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

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

The Unit provides opportunities for candidates to develop aspects of the following Core Skills:

- ◆ Communication (SCQF level 5)
- ◆ Numeracy (SCQF level 5)
- ◆ Problem Solving (SCQF level 5)

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

National Unit Specification: statement of standards

UNIT Engineering Systems (SCQF level 6)

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

Categorise engineering systems and represent such systems in block diagram format.

Performance Criteria

- (a) State correctly different types of engineering systems in terms of electrical, mechanical and electromechanical categories.
- (b) State correctly different types of engineering systems in terms of applications, physical size and power levels.
- (c) Draw correctly simple engineering systems in block diagram format showing all processes, inputs and outputs and using the correct terminology.

OUTCOME 2

Describe and measure mechanical and electrical quantities present in engineering systems.

Performance Criteria

- (a) Describe correctly mechanical engineering quantities found in engineering systems.
- (b) Describe correctly electrical engineering quantities found in engineering systems.
- (c) Measure accurately electrical and mechanical quantities.

OUTCOME 3

Identify different forms of energy present in engineering systems and calculate energies, energy losses and overall efficiency in a given engineering system.

Performance Criteria

- (a) State correctly mechanical energies present in engineering systems.
- (b) State correctly a form of electrical energy and power present in engineering systems.
- (c) Calculate accurately mechanical energies in a given engineering system.
- (d) Calculate accurately electrical power and energy in a given engineering system.
- (e) Calculate accurately electrical and mechanical energy losses in a given engineering system.
- (f) Calculate accurately the overall efficiency of a given engineering system.

National Unit Specification: statement of standards (cont)

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OUTCOME 4

Investigate the performance of a given electromechanical system.

Performance Criteria

- (a) Describe correctly the function of each element in a given electromechanical system and the overall function of the system.
- (b) Draw correctly a block diagram of the electromechanical system showing all processes, inputs and outputs and using the correct terminology.
- (c) Undertake accurately measurements on the electromechanical system to confirm its steady state performance.
- (d) Adjust correctly appropriate system parameters to alter the steady state output of the electromechanical system.
- (e) Comply with all relevant safety regulations and safe working procedures and practices while undertaking practical work on a given electromechanical system.

EVIDENCE REQUIREMENTS FOR THIS UNIT

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

Written and/or recorded oral and performance evidence supplemented with an assessor observation checklist(s) should be produced to demonstrate that the candidate has achieved all the Outcomes and Performance Criteria.

Outcomes may be assessed on an individual basis, as combinations of Outcomes (eg Outcomes 1, 2 and 3 together and Outcome 4 on its own) or as a single, holistic assessment covering all four Outcomes. Total assessment time for the Unit must not exceed 2 hours and 30 minutes.

Candidate evidence for Outcomes 1, 2 and 3 must be in the form of written and/or recorded oral evidence. Assessment of Outcomes 1, 2 and 3 except Outcome 2 performance criteria (c) must be conducted under supervised, closed-book conditions in which candidates may use reference materials provided by the centre but are not allowed to bring their own notes, handouts, textbooks or other materials into the assessment. Assessment of Outcome 2 performance criteria (c) must be conducted under supervised conditions. Candidates can use a scientific calculator during assessment.

Candidate evidence for Outcome 4 must be in the form of written and/or recorded oral and performance evidence. All practical activities undertaken as part of the assessment of Outcome 4 must be conducted under supervised conditions. 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 practical work on a given electromechanical system.

National Unit Specification: statement of standards (cont)

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With regard to Outcome 1

- ◆ two types of electrical, mechanical and electromechanical systems should be stated
- ◆ three types of systems should be stated in terms of their applications, physical size and power levels
- ◆ two block diagrams of two different engineering systems should be drawn

With regard to Outcome 2

- ◆ three mechanical quantities should be correctly described from the following list: mass, length, force, pressure, temperature, flow, heat or friction
- ◆ two electrical quantities should be correctly described from the following list: charge, emf, voltage, current or resistance
- ◆ two electrical and two mechanical quantities should be measured from the following list: emf, voltage, current, resistance, mass, length, force, pressure, temperature, flow or heat

With regard to Outcome 3

- ◆ two forms of mechanical energy should be stated from the following list: potential, kinetic, heat/thermal or flow
- ◆ electrical energy and power should be limited to dc electrical energy and power only
- ◆ a minimum of two different forms of mechanical energy should be calculated from the following list: potential, kinetic or heat/thermal
- ◆ a minimum of two energy losses in an engineering system should be calculated

With regard to Outcome 4

- ◆ the electromechanical system should contain a minimum of four sub-systems and may contain feedback
- ◆ a minimum of two different parameters should be measured in an electromechanical system to confirm the steady state performance of the system

National Unit Specification: support notes

UNIT Engineering Systems (SCQF level 6)

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 Manufacturing and Mechanical Engineering at SCQF level 6, but may also be offered on a free standing basis.

This Unit provides a very good basis of knowledge and understanding for candidates wishing to proceed to the HNC Engineering Systems.

The aim of this Unit is to provide candidates with an introduction to an engineering systems approach to solving engineering problems. The Unit has been designed to provide an equal treatment to mechanical and electrical engineering quantities and energies as applied within the context of engineering systems.

On successful completion of the Unit candidates will have learnt to represent engineering systems in block diagram form. They will also have developed the knowledge, understanding and skills to describe and measure typical mechanical and electrical quantities present in engineering systems. Candidates will also be able to calculate different forms of mechanical and electrical energies, energy losses and overall efficiency in an engineering system. They will also be capable of undertaking investigations into the performance of electromechanical systems.

Centres may use this Unit in their programmes of study to provide candidates with an overview of engineering systems before getting candidates to focus on subject specific material covered in the Group Award. Alternatively, centres may use the Unit in their programme of study as a vehicle for 'bringing things together' once candidates have studied subject specific units.

The following lists are not intended to be exhaustive.

Typical mechanical systems that may be considered as part of this Unit may include: bicycle, fan pumps, valves, motor vehicle sub-systems (eg clutch, brakes, gearbox), hydraulic and pneumatics systems, compressors, turbines or steam plant.

Typical electrical systems that may be considered as part of this Unit may include: electrical lighting circuits, electrical power circuits, transformer, rectifying circuit, electric luminaries or electric oven.

Typical electromechanical systems that may be considered as part of this Unit may include: electrical relays, electric lawn mower, domestic appliances, electric motor with load plus starting and braking, position control system, air conditioning system, central heating system, conveyor belt systems, material handling systems, vacuum pumps, refrigeration systems or diesel/petrol engines.

National Unit Specification: support notes (cont)

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GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

It is recommended that the Unit is delivered in the same sequence the Outcomes are presented in the National Unit Specification: statement of standards section of the Unit. This Unit may be delivered by a combination of lectures, tutorial work, investigations using paper based and electronic sources and practical exercises which may include candidates disassembling engineering systems, or sub-systems, to study their constructional features and principle of operation. Centres may also wish to allow candidates to perform experiments on engineering systems, or sub-systems, to investigate some of their performance characteristics.

It should be noted that the Internet contains a rich source of information on engineering systems.

Well annotated wall charts of the layout and constructional features of engineering systems, or their sub-systems, can also act as an important source of learning.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

The Reading Communication Core Skill component at SCQF level 5 may be developed in all four Outcomes while candidates are reading materials on aspects of engineering systems from paper based and electronic sources.

The Written Communication Core Skill component at SCQF level 5 may be developed in all four Outcomes while candidates are preparing written responses to formative and summative assessments.

The Using Graphical Information Core Skill component at SCQF level 5 may be developed in Outcome 1 while candidates represent engineering systems in block diagram form.

The Critical Thinking Core Skill component at SCQF 5 may be developed in Outcomes 1 and 4 while candidates consider how to represent engineering systems in block diagram format and when investigating the performance of an electromechanical system.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Formative assessment exercises involving candidates in producing block diagrams of engineering systems, describing electrical and mechanical quantities and energies, performing calculations on energies, energy losses and efficiency in engineering systems and while undertaking practical experimental work will play a particularly important role in building candidate knowledge, understanding and confidence of Unit content.

Outcomes 1–3

(except Outcome 2 pc (c)) Assessment may consist of an assessment paper comprising a balance of short two and three answer, restricted response and structured questions. It is recommended that the assessment paper is taken at a single assessment event lasting 1 hour and 30 minutes.

National Unit Specification: support notes (cont)

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Outcome 2 pc (c) Assessment may comprise a series of practical exercises involving the measurement of mechanical and electrical quantities. Candidates may record results on forms provided by the centre.

Outcome 4 — Assessment may comprise a practical exercise involving an investigation into the steady state performance of an electromechanical system. Candidates should prepare a report based on the practical investigation. It is recommended that this report is between 600–750 words in length plus diagrams. The report may be prepared in the candidate's own time. Centres should make every reasonable effort to ensure that the report is the candidate's own work. Where copying or plagiarism is suspected candidates may be interviewed to check their knowledge and understanding of the subject matter. A checklist may be used to record oral evidence of the candidate's knowledge and understanding.

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)*.

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