National Unit Specification: general information

UNIT Electrical Principles (SCQF level 5)

CODE F5HK 11

SUMMARY

This Unit has been designed to introduce candidates to electrical principles and provide opportunities to develop their knowledge and understanding of basic electrical concepts, magnetic and electromagnetic theory. Candidates will develop the skills to solve electrical quantities in direct current (dc) resistive networks and determine electromagnetic quantities. Candidates will be provided with the opportunity to describe the generation of an alternating voltage and plot and verify by measurement a sinusoidal waveform.

This Unit is suitable for candidates wishing to embark upon a career in electrical and/or electronic engineering. It is also suitable for candidates studying other branches of engineering, science or technology, requiring knowledge of electrical principles or who may be employed or seeking employment as electrical, mechanical or marine craft persons or technicians.

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

OUTCOMES

1 Describe basic electrical concepts and solve problems in dc resistive networks.
2 Sketch magnetic fields and determine mechanical force and electro-motive force (e.m.f.) quantities.
3 Describe and determine fundamental properties of a sinusoidal waveform.

Administrative Information

Superclass: XJ

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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 — General Level
- Standard Grade Technological Studies — General Level
- Standard Grade Science — General Level
- Standard Grade Mathematics — General Level

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.*

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:

- Problem Solving (SCQF level 5)
- Numeracy (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

Describe basic electrical concepts and solve problems in dc resistive networks.

Performance Criteria

(a) Describe correctly the electron theory of current flow in terms of electrical conductors and insulators.
(b) Describe correctly the quantities used in dc electrical circuits and state their correct units.
(c) Use correctly Ohm's law to dc circuits.
(d) Use correctly Kirchhoff's Current Law to a single node.
(e) Use correctly Kirchhoff's Voltage Law to a single loop in a network.
(f) Calculate correctly resistance, current, voltage, power and energy in a combined series-parallel resistive dc network.

OUTCOME 2

Sketch magnetic fields and determine mechanical force and e.m.f. quantities.

Performance Criteria

(a) Sketch correctly the magnetic field patterns for a permanent magnet and an electro-magnet.
(b) Determine correctly the magnitude and direction of the force on a straight current carrying conductor perpendicular to a uniform magnetic field.
(c) Calculate correctly the generated e.m.f. when a conductor is moved perpendicularly in a steady magnetic field.

OUTCOME 3

Describe and determine fundamental properties of a sinusoidal waveform.

Performance Criteria

(a) Describe correctly the generation of an alternating e.m.f. created by a single rotating coil in a uniform magnetic field.
(b) Plot correctly a sinusoidal voltage waveform.
(c) Determine correctly the quantities of a sinusoidal waveform.
(d) Carry out measurements to verify accurately the r.m.s. value and frequency of a displayed sinusoidal waveform.

National Unit Specification: statement of standards

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EVIDENCE REQUIREMENTS FOR THIS UNIT

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

Written and/or recorded oral evidence and performance evidence is required which demonstrates that the candidate has achieved Outcomes 1, 2, and 3 to the standards specified in the Outcomes and Performance Criteria.

Performance evidence supplemented with an assessor observation checklist, and written and/or recorded oral evidence is required which demonstrates that the candidate has achieved Outcome 3 to the standards specified in the Outcome and Performance Criteria.

Outcomes may be assessed on an individual basis or as combinations of Outcomes (eg Outcomes 1 and 2 together and Outcome 3 as stand-alone). Regardless of which approach is taken total assessment time should not exceed two hours.

Assessment(s) should be conducted under controlled, supervised, closed-book conditions in which candidates should not be allowed to bring any notes, handouts, textbooks or any other relevant materials into the assessment. Candidates may use a scientific calculator during assessment(s).

With regard to Outcome 1:

- candidates to state correctly the atomic structure of material as protons, neutrons and electrons
- candidates to describe correctly the **relative** movement of electrons in electrical conductors and insulators and distinguish between electron flow and conventional current direction
- candidates to describe correctly the meaning of **three** terms from Resistance, Current, Voltage (Electromotive Force e.m.f. and Potential Difference p.d.) Power and Energy including their relevant **Unit** of measurement
- candidates to solve correctly **two** problems in a combined series-parallel dc resistive network, using a total of four resistors, from the following $V = IR$, $P = VI$, $P = I^2R$, $P = V^2/R$ *and* $P = W/t$

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With regard to Outcome 3:

- candidates to plot correctly, on given scaled axes, a sinusoidal voltage waveform 0 to 360º using a waveform displayed on an oscilloscope or from given values from a table
- candidates to determine three quantities from: peak value, peak-to-peak value, average value, r.m.s. value, frequency and periodic time

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

UNIT Electrical 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 is a mandatory Unit within the National Certificate in Electrical Engineering at SCQF level 5. This Unit can also be delivered on a free-standing basis.

The Unit is one of a series of Units in the area of Electrical Principles. Other Units in this series include:

- *Circuit Element Devices* at SCQF level 5
- *Electrical Fundamentals* at SCQF level 6
- *Electrostatics and Electromagnetics* at SCQF level 6
- *Electronic Network Analysis* at SCQF level 6
- *Single Phase and Three Phase Principles* at SCQF level 6
- *Circuit Element Principles* at SCQF level 6

This Unit provides the opportunity for candidates to develop their knowledge of basic electrical, magnetic, electromagnetic and the properties of sinusoidal waveforms to prepare for further engineering studies or employment.

This Unit is particularly suitable for candidates who are embarking on a career in Electrical and/or Electronic Engineering. It is also suitable for candidates studying other branches of engineering, science or technology, requiring knowledge of electrical principles.

Successful completion of this Unit enhances the employability skills for candidates to gain employment in the Electrical and/or Electronic Engineering and other related industries.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

This Unit should be delivered in a practical electrical environment by a combination of lectures, demonstrations and practical exercises. It is recommended that the Outcomes are delivered in the sequence outlined in the statement of standards.

For Outcome 1 it would be beneficial to candidates to undertake laboratory exercises to measure accurately expected values of supply current, branch currents and voltage to compare with calculated values to reinforce learning of the principles and laws of dc resistive networks. Lecturers could also make reference to conventional and electron flow when discussing dc resistive circuits.

Physical examination of circuit components such as resistors and capacitors and practice in the use of measuring instruments is recommended.

For Outcome 3 guidance and practice in the use of an oscilloscope will be beneficial to the candidates in achieving the Performance Criteria for this Outcome.

It is recommended that candidates use interactive software packages available to developing the skills further their knowledge of basic electrical concepts and principles.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

Problem Solving skills, that is, critical thinking, planning and organising, reviewing and evaluating, will be developed and enhanced as candidates undertake calculations solving problems in dc resistive networks and determining electromagnetic quantities as well as practical work to verify sinusoidal waveforms.

The numerical work of Outcomes 1 and 2 and also the creation of graphical information in Outcome 3 may provide candidates with opportunities to develop aspects of the Core Skill *Numeracy* at SCQF level 5.

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).*

Outcome 1 and 2 require written and/or recorded oral evidence and can be individually set or combined in the form of a short answer, multiple choice and/or on-line assessment to give the candidate an opportunity to display knowledge of basic electrical, electromagnetic concepts and the opportunity to solve associated problems.

Outcome 3 requires performance, written and/or recorded oral evidence and should take the form of a practical exercise and a short answer question paper to demonstrate the measurement of electrical quantities and to give the candidate the opportunity to display knowledge of the fundamental properties of sinusoidal waveforms.

Outcomes may be assessed on an individual basis, as combinations of Outcomes (eg Outcomes 1 and 2 together and Outcome 3 as stand-alone). Regardless of which approach is taken total assessment time should not exceed two hours.

National Unit Specification: support notes (cont)

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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**