National Unit Specification: general information

UNIT Aeronautical Electrical Technology (SCQF level 5)

CODE F5D2 11

SUMMARY

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

This Unit is designed to provide candidates with knowledge, understanding and skills in aeronautical electrical technology. During the delivery of the Unit candidates will develop the knowledge and understanding to solve dc circuit problems. They will also learn to draw single and three phase ac waveforms and determine key parameters of such waveforms. Candidates will also learn to measure and record quantities in electrical circuits supplied from dc and ac voltage sources. They will also develop the knowledge and understanding to explain the construction, operation and applications of ac and dc generators.

This Unit is suitable for candidates who:

- are undertaking the study of this subject for the first time
- wish to gain a basic knowledge, understanding and skills in aeronautical electrical technology
- are considering a career in the aviation industry and wish to gain a basic knowledge, understanding and skills in aeronautical electrical technology

OUTCOMES

1 Solve problems involving dc circuits.
2 Draw single and three phase ac waveforms and interpret key parameters associated with these waveforms.
3 Measure and record quantities in electrical circuits supplied from dc and ac sources.
4 Describe the construction, operation and applications of ac and dc generators.

Administrative Information

Superclass: XP

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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 General level
- Standard Grade Technological Studies at 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:

- 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 (cont)

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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

Solve problems involving dc circuits.

Performance Criteria

(a) State correctly the meaning of terms commonly used in solving dc circuit problems.
(b) State correctly the purpose of a battery in a dc circuit and state typical battery voltages used in aircraft systems.
(c) Solve correctly problems involving Kirchhoff's Current and Voltage Laws.
(d) Solve correctly problems involving a series — parallel network connected to a dc source.
(e) Calculate accurately a power and an energy quantity in a series — parallel network connected to a dc voltage source.

OUTCOME 2

Draw single and three phase ac waveforms and interpret key parameters associated with these waveforms.

Performance Criteria

(a) Determine correctly the maximum value and direction of electromotive force (emf) acting on a current carrying conductor located in a uniform magnetic field.
(b) Plot accurately the emf waveform of a current carrying conductor which is rotating in a magnetic field.
(c) Determine correctly, for a given sinusoidal waveform, key parameters of that waveform.
(d) Sketch accurately a three phase ac voltage waveform and identify correctly key parameters associated with this waveform.

OUTCOME 3

Measure and record quantities in electrical networks supplied from dc and ac sources.

Performance Criteria

(a) Measure and record accurately voltage and current measurements in a series — parallel resistance network supplied from a dc voltage source.
(b) Measure and record accurately voltage and current measurements in a series — parallel resistance network supplied from an ac voltage source.
(c) Measure and record accurately the measurement of resistances in an electrical circuit using the ammeter-voltmeter method.
(d) Describe correctly any sources of error that may arise as a result of making voltage and current measurements in electrical circuits.
(e) Undertake all wiring and measurements in a safe manner.

National Unit Specification: statement of standards (cont)

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OUTCOME 4

Describe the construction, operation and applications of ac and dc electrical generators.

Performance Criteria

(a) Identify correctly the main constructional features of an ac electrical generator.
(b) Describe correctly the principle of operation of an ac electrical generator.
(c) Identify correctly the main constructional features of a dc electrical generator.
(d) Describe correctly the principle of operation of a dc electrical generator.
(e) State correctly one application of an ac generator and one application of a dc generator in an aircraft.
(f) Describe correctly the function of a busbar in an aircraft.

EVIDENCE REQUIREMENTS FOR THIS UNIT

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

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

Outcomes 1, 2 and 4 may be assessed on an individual basis, as combinations of Outcomes (eg Outcomes 1 and 2 together and Outcome 4 on its own) or as a single assessment covering all three Outcomes. Assessment (s) of Outcomes 1, 2 and 4 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. The total time to assess Outcomes 1, 2 and 4 must not exceed 2 hours. Candidates may use a scientific calculator during assessment.

Outcome 3 must be assessed under supervised, open-book conditions.

With regard to Outcome 1

- candidates must state two terms from the following list: charge, current, emf, potential difference or resistance.
- Kirchhoff's Current Law should be applied to one node only and Kirchhoff's Voltage Law should be applied to one mesh only.
- the series — parallel network used for assessment purposes must contain a minimum of four resistances. Candidates must calculate, as a minimum, the total resistance of the network, the supply current, one volt drop and one branch current.

National Unit Specification: statement of standards (cont)

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With regard to Outcome 2

- candidates must determine any three parameters, for either a voltage or current sinusoidal waveform, from the following list:
  - — peak value
  - — peak to peak value
  - — rms value
  - — average value
  - — frequency
  - — periodic time
- candidates must determine any two parameters from the following list:
  - — peak voltage per phase
  - — rms voltage per phase
  - — phase differences between phases
  - — frequency of supply

With regard to Outcome 3

- candidates must measure and record a minimum of two voltages and two current measurements in an electrical circuit supplied by a dc voltage source
- candidates must measure and record a minimum of two voltages and two current measurements in an electrical circuit supplied by an ac voltage source
- candidates must use the ammeter-voltmeter method to determine the value of two resistors in an electrical network

With regard to Outcome 4

- candidates can either be asked to sketch and label a diagram of the constructional features of an ac and dc generator or can be provided with a diagram of each generator and be asked to label the main parts

National Unit Specification: support notes

UNIT Aeronautical Electrical Technology (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 Award in Aeronautical Engineering at SCQF level 6, but may also be offered on a free standing basis.

The aim of this Unit is to allow candidates to develop knowledge, understanding and skills in aeronautical electrical technology. On successful completion of the Unit candidates will be able to solve dc circuit problems. They will also have learnt how to draw single and three phase ac waveforms and will be able to determine key parameters of such waveforms. Candidates will also be capable of measuring accurately and safely quantities in electrical networks supplied from dc and ac voltage sources and recording their results. Candidates will also be able to explain the construction, operation and applications of ac and dc generators.

The list below shows a suggested range of topics which may be delivered to candidates to support and underpin the requirements set out in the Outcomes, Performance Criteria and Evidence Requirements.

1 **Solve problems involving dc circuits**

- charge, current, emf, voltage and resistance
- batteries (28 V in aircraft)
- concept of circuit
- Ohm's Law
- Kirchhoff's Laws
- resistance in series
- resistance in parallel
- series/parallel resistance combinations
- circuit reduction techniques
- calculations of currents and voltages in dc circuits
- energy and power in dc circuits

2 **Draw single and three phase ac waveforms and interpret key parameters associated with these waveforms**

- fields associated with magnets
- field associated with a current carrying conductor
- field associated with a current carrying conductor in a magnetic field
- Corkscrew rule
- induced emf
- magnitude of emf (e = Blv)
- direction of emf (Fleming's Right-Hand Rule)

- generation of single phase voltage waveform from a conductor rotating in a magnetic field
- sketch typical waveform using e = Blv sin Ø
- current waveform associated with resistive load
- key parameters of single phase waveforms: peak value, peak to peak, rms value, average value, frequency, periodic time
- typical voltages and frequencies of ac waveforms in aircraft systems
- concept of three-phase waveforms by sketching such waveforms
- key parameters of three phase waveforms: Emax per phase, rms value per phase, phase differences between phases and frequency of supply

3 **Measure and record quantities in electrical circuits supplied from dc and ac sources**

- correct and safe use of voltmeters and ammeters
- sources of error in using ammeters and voltmeters
- circuit and wiring diagrams
- practice in wiring up circuits
- measuring and recording currents and voltages in electrical circuits supplied from dc voltage sources
- measuring and recording currents and voltages in electrical circuits supplied from ac voltage sources
- explanation of the ammeter-voltmeter method of determining resistance
- using the ammeter-voltmeter method to determine resistance in electrical circuits

4 Describe the construction, operation and applications of ac and dc generators

- frequency wild and frequency fixed
- basic constructional features of an ac generator
- principle of operation of an ac generator
- basic constructional features of a dc generator
- principle of operation of a dc generator
- applications of ac and dc generators in aircraft
- concept of supplying electrical power to a busbar to supply electrical loads in aircraft systems

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. The Unit may be delivered by a combination of lectures, tutorial work, investigations using paper based and electronic sources and laboratory exercises.

Laboratory work should play a particularly important role in reinforcing learning in the classroom. For example, with regard to dc circuits candidates should be encouraged to calculate current, voltage and resistance values in circuits and then confirm these by measurements. Centres may also wish to allow candidates to perform experiments on ac and dc generators to investigate some of their performance characteristics.

Candidates should be taught correct and safe wiring and measurement techniques prior to commencing any experimental work.

Candidates should be encouraged to disassemble ac and dc generators to study their constructional features.

It should be noted that the internet contains a rich source of information on electrical principles and ac and dc generators.

Well annotated wall charts on basic electrical concepts and principles and on ac and dc generator constructional features can also act as important sources of learning.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

The Reading Communication Core Skill component at SCQF level 5 may be developed in Outcome 4 while candidates undertake paper based and electronic investigations into the constructional features, principles of operation, and applications of ac and dc generators.

The Writing Communication Core Skill component at SCQF level 5 may be developed in Outcome 4 while candidates write answers to both formative and summative assessment questions.

The Using Number Core Skill component at SCQF level 5 may be developed in Outcomes 1 and 2 while candidates solve problems involving dc circuits and while determining single phase ac waveform parameters.

The Using Graphical Information Core Skill component at SCQF level 5 may be developed in all four Outcomes while candidates interpret and apply various graphical representations in dc and ac circuits, single and three phase waveforms and ac and dc generators.

The Critical Thinking Core Skill component at SCQF level 5 may be developed in Outcome 1 while candidates solve dc circuit problems.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Formative assessment exercises should be used to develop candidates' knowledge, understanding, skills and confidence in solving dc circuit problems, drawing single and three phase waveforms and interpreting information from these waveforms and when measuring and recording quantities in dc and ac electrical circuits. Formative assessment may also be used to develop candidates' knowledge and understanding of the construction, operation and applications of ac and dc generators.

Outcomes 1 and 2 may be assessed using a single assessment paper taken at a single assessment event lasting 1 hour and 15 minutes. Likewise Outcome 4 may be assessed by a single assessment paper taken at a single assessment event lasting 45 minutes. Both assessment papers may comprise a suitable balance of short answer, restricted response and structured questions.

Outcome 3 may be assessed by a series of practical laboratory exercises. It is strongly recommended that lecturers check that all candidates' circuits are correctly wired prior to such circuits being energised. An observation checklist should be used to record if candidates have wired up circuits and taken measurements of electrical quantities safely or not. Centres may wish to provide candidates with a suitable form (s) to record their results and comments on any sources of error in taking electrical measurements.

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 WITH DISABILITIES AND/OR ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* **(www.sqa.org.uk)**.