Higher National Unit specification

General information

Unit title: Aircraft Avionics Principles (SCQF level 7)

Unit code: H94V 34

Superclass: XP

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Source: Scottish Qualifications Authority

Version: 01

Unit purpose

This Unit is designed to allow learners to acquire the knowledge and understanding of the theoretical principles that underpin modern aircraft avionics systems. The Unit concentrates on four core areas: Radio communications theory, Radar principles, navigation systems theory and automatic flight control principles.

This Unit is aimed at learners wishing to pursue a career in aircraft maintenance engineering and avionics systems design and manufacture. The knowledge elements provided by this Unit support understanding of the functionality and operation of typical aircraft avionics installations.

Outcomes

On successful completion of the Unit the learner will be able to:

1 Explain the theoretical concepts that support High Frequency (HF), Very High Frequency (VHF) and Ultra High Frequency (UHF) aircraft communications systems.
2 Explain the theoretical concepts that underpin aircraft radar installations.
3 Explain the theoretical concepts that underpin aircraft navigation systems.
4 Explain the theoretical concepts that underpin aircraft automatic flight control systems.

Credit points and level

1 Higher National Unit credit at SCQF level 7: (8 SCQF credit points at SCQF level 7)

Higher National Unit Specification: General information (cont)

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Recommended entry to the Unit

Entry is at the discretion of the centre. However it is recommended that learners have appropriate mathematical and science knowledge and understanding. This could be achieved through successful completion of Higher Mathematics or Physics (SCQF level 6).

Core Skills

Opportunities to develop aspects of Core Skills are highlighted in the Support Notes for this Unit specification.

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

Context for delivery

If this Unit is delivered as part of a Group Award, it is recommended that it should be taught and assessed within the subject area of the Group Award to which it contributes.

Equality and inclusion

This Unit specification has been designed to ensure that there are no unnecessary barriers to learning or assessment. The individual needs of learners should be taken into account when planning learning experiences, selecting assessment methods or considering alternative evidence.

Further advice can be found on our website **www.sqa.org.uk/assessmentarrangements**.

Higher 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.

Where evidence for Outcomes is assessed on a sample basis, the whole of the content listed in the Knowledge and/or Skills section must be taught and available for assessment. Learners should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Outcome 1

Explain the theoretical concepts that support High Frequency (HF), Very High Frequency (VHF) and Ultra High Frequency (UHF) aircraft communications systems.

Knowledge and/or Skills

- Propagation of radio waves
- Amplitude and frequency modulation
- Carrier Wave Transmitters
- Radio receivers and automatic frequency control
- Single sideband transmission
- Single sideband receivers
- Communication antenna principles

Outcome 2

Explain the theoretical concepts that underpin aircraft radar installations.

Knowledge and/or Skills

- Principles of primary radar operation
- Pulse modulated radar systems
- Superhetrodyne receiver operation
- Radar transmitter fundamentals
- Radar antenna systems and antenna stabilisation
- Principles of secondary radar operation

Outcome 3

Explain the theoretical concepts that underpin aircraft navigation systems.

Knowledge and/or Skills

- Aircraft synchro and servo systems
- Terrestrial magnetism and compass systems
- Gyroscopic and inertial navigation principles
- VHF Omni-directional Ranging (VOR) principles
- Distance Measuring Equipment (DME) underpinning theory
- Instrument Landing System (ILS) underpinning theory
- Air data system principles

Outcome 4

Explain the theoretical concepts that underpin aircraft automatic flight control systems.

Knowledge and/or Skills

- Autopilot demand signals, command signals and feedback signals
- Closed loop feedback systems
- Flight director principles
- Overview of autopilot modes and selection

Evidence Requirements for this Unit

The assessment for this Unit can be done on an Outcome by Outcome basis or as part of a combined assessment event. Learners are required to provide written or oral recorded evidence, generated under closed-book supervised conditions.

Evidence for the Knowledge and/or Skills in all four Outcomes will be generated through sampling. Any sampling process must be 'unseen' by the learner before the assessment. That is, learners are expected to fully prepare the range of Knowledge and Skills and not be able to predict a chosen sample.

In order to gain an assessment pass, learners will need to demonstrate that they have met the minimum Evidence Requirements by providing satisfactory responses to the sampled questions.

Higher National Unit specification: Statement of standards (cont)

Unit title: Aircraft Avionics Principles (SCQF level 7)

Outcome 1

Learners will need to provide written or oral recorded evidence, generated under closed-book supervised conditions, to demonstrate they can examine four of the seven Knowledge and/or Skills items by showing that they can:

- identify the properties of radio waves and explain their propagation.
- explain the characteristics of amplitude and frequency modulated waveforms.
- explain the principle of radio carrier waves and how they are generated and transmitted.
- identify the basic components of a radio receiver and the principle of operation.
- identify the reasons for automatic frequency control circuits and explain their basic operation.
- identify the reasons for using single sideband receivers and explain the basic concept of operation.

Outcome 2

Learners will need to provide written or oral recorded evidence, generated under closed-book supervised conditions, to demonstrate they can examine three of the six Knowledge and/or Skills items by showing that they can:

- explain the principles of primary and secondary radars and identify their fundamental differences, including the basic transmitter and receiver channels.
- explain the basic principles of pulse modulated radar systems and the generation of their transmitted waves.
- explain the basic operation of a typical superhetrodyne receiver including the main receiver channel and automatic frequency control.
- identify the different types of radar antennae and explain the need for antenna stabilisation.

Outcome 3

Learners will need to provide written or oral recorded evidence, generated under closed-book supervised conditions, to demonstrate they can examine four of the seven Knowledge and/or Skills items by showing that they can:

- explain the basic operation of synchro and servo Units and their use in aircraft systems.
- explain the concepts of terrestrial magnetism and how it is used in basic compass systems.
- explain the principles of gyroscope based inertial navigation and its limitations in providing accurate global aircraft navigation.
- explain the underpinning theory that supports the operation of VOR navigation aids.
- explain the underpinning theory that supports the operation of DME navigation aids.
- explain the underpinning theory that supports the operation of ILS navigation systems.
- explain the principles that underpin the operation of aircraft air data systems.

Higher National Unit specification: Statement of standards (cont)

Unit title: Aircraft Avionics Principles (SCQF level 7)

Outcome 4

Learners will need to provide written or oral recorded evidence, generated under closed-book supervised conditions, to demonstrate they can examine two of the four Knowledge and/or Skills items by showing that they can:

- identify the differences between autopilot demand signals, command signals and feedback signals.
- identify the reasons for using closed loop feedback in automatic flight control systems and explain their basic operation.
- explain the principles of operation of a typical aircraft flight director system.
- identify the key autopilot control modes and explain their basic operation in terms of aircraft attitude and control.

Higher National Unit Support Notes

Unit title: Aircraft Avionics Principles (SCQF level 7)

Unit Support Notes are offered as guidance and 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 is an optional Unit within the HNC and HND Aircraft Engineering Group Awards. The Unit is intended to provide the learner with an in-depth knowledge of the theoretical principles that underpin modern aircraft avionics equipment installations.

This Unit provides learners with the underpinning theory and knowledge that will enable them to undertake related avionic systems Units that focus on aircraft equipment installations and their operation. This Unit links to the Semta National Occupational Standard (NOS) — carrying out fault diagnosis on aircraft avionics components or systems (SEMAE3120).

The Unit is broken down into four Outcomes that include the key areas of radio communications, aircraft radar, navigation systems and automatic flight control. Additional information and context is provided as follows:

Outcome 1

The content of this Outcome focusses on the underpinning theory that supports the design, manufacture and operation of aircraft radio communications installations. The knowledge is restricted to High Frequency (HF), Very High Frequency (VHF) and Ultra High Frequency (UHF) aircraft systems. Basic radio waveforms and their propagation are introduced to learners prior to addressing techniques used to transfer audio signals between ground and airborne installations. This includes the concept of carrier waves and how they can be modulated with audio data by the transmitting station, and demodulated by the receiving station. The functionality of basic radio systems are considered by providing knowledge on the key components of radio transmitter and receiver channels.

Outcome 2

The content of this Outcome focusses on the underpinning theory that supports the design, manufacture and operation of aircraft radar installations. The Unit introduces the learner to primary and secondary radar concepts and the systems they are applied to. Additional focus is provided that examines the transmitter and receiver channels of aircraft radar systems as well as introducing the concepts of radar modes of operation. Learners are also introduced to radar antenna systems and the need for radar scanner stabilisation and feedback.

Higher National Unit Support Notes (cont)

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Outcome 3

The content of this Outcome focusses on the underpinning theory that supports the design, manufacture and operation of aircraft navigation installations. Learners are introduced to theoretical concepts of terrestrial magnetism, compass applications and synchros and servos that underpin key aircraft navigation systems. Theoretical principles of common aircraft navigation aids are also examined and include VHF Omni-Directional Ranging (VOR), Distance Measuring Equipment (DME) and Instrument Landing System (ILS). Leaners will also study the principles of air data and how they are used in aircraft air data systems.

Outcome 4

The content of this Outcome focusses on the underpinning theory that supports the design, manufacture and operation of aircraft automatic flight control installations. Learners are introduced to the different signals that are key to the operation of aircraft autopilot systems; these include command, demand and feedback signals. The use of these signals by autopilot systems are explored further including an introduction to closed loop feedback within and autopilot system. Aircraft flight director concepts are also introduced including their integration within autopilot systems. To conclude, basic autopilot modes of operation are examined, including how they affect the control of an aircraft attitude and its powerplant.

Guidance on approaches to delivery of this Unit

This Unit forms part of the HNC and HND Aircraft Engineering Group Awards and is designed to provide learners with the underpinning theory that determines the design, manufacture and operation of modern aircraft avionics installations. This Unit directly supports higher level Units that may be taken at a later stage.

If being delivered as part of the HNC/HND Aircraft Engineering, it is recommend that this Unit is delivered following the mandatory Engineering Mathematics and Physics for Aviation Units. It is logical to deliver this Unit sequentially by Outcome in the order presented in this specification. Throughout delivery of this Unit learners should have a good appreciation of how the theoretical concepts presented support the operation of aircraft avionic installations.

The theoretical nature of this Unit naturally lends itself to classroom delivery, but opportunities including practical demonstrations and use of computer simulations should be considered to support learner interaction and participative approaches.

Higher National Unit Support Notes (cont)

Unit title: Aircraft Avionics Principles (SCQF level 7)

Guidance on approaches to assessment of this Unit

Evidence can be generated using different types of assessment. The following are suggestions only. There may be other methods that would be more suitable to learners.

Centres are reminded that prior verification of centre-devised assessments would help to ensure that the national standard is being met. Where learners experience a range of assessment methods, this helps them to develop different skills that should be transferable to work or further and higher education.

Assessment for this Unit could be done on an Outcome by Outcome basis or as part of a combined assessment event. As an example, two combined assessments could take place, the first covering Outcomes 1 and 2 and the second Outcomes 3 and 4, each lasting one hour and carried out under closed-book supervised conditions. In this example, each assessment could comprise two distinctive parts such as, the first containing a selection of multiple-choice response questions and the second part containing restricted response questions. Alternatively, centres may choose to use a single assessment that covers all four Outcomes, lasting two hours and carried out under closed-book supervised conditions.

Irrespective of which assessment strategy is adopted, assessments should contain a sample of the Knowledge and/or Skills requirements for each Outcome as detailed in the Statement of Standards.

In order to achieve this Unit, learners are required to pass all assessments by presenting sufficient evidence that they have met the minimum Evidence Requirements, giving satisfactory response to the sampled questions.

Accurate records should be made of the assessment instruments used showing how evidence is generated for each assessment and providing marking schemes and/or check lists. Records of learners evidence should be kept and made available for verification as required.

Opportunities for 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 social software. Centres which wish to use e-assessment must ensure that the national standard is applied to all learner evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. The most up-to-date guidance on the use of e-assessment to support SQA's qualifications is available at **www.sqa.org.uk/e-assessment**.

Higher National Unit Support Notes (cont)

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Opportunities for developing Core and other essential skills

Learners will have opportunities to develop the Core Skills component of *Communication* (Written Communication) at SCQF level 5 in this Unit throughout all Outcomes. This could be achieved through accurate written answers to formative and summative assessment questions.

History of changes to Unit

Version	Description of change	Date

General information for learners

Unit title: Aircraft Avionics Principles (SCQF level 7)

This section will help you decide whether this is the Unit for you by explaining what the Unit is about, what you should know or be able to do before you start, what you will need to do during the Unit and opportunities for further learning and employment.

This Unit is designed to allow you to acquire the knowledge, understanding and analysis skills of the theoretical principles that underpin modern aircraft avionics systems. This Unit is aimed at those wishing to pursue a career in aircraft maintenance engineering and avionics systems design and manufacture. The knowledge elements provided by this Unit support understanding of the functionality and operation of typical aircraft avionics installations.

The Unit is broken down into four Outcomes that cover the key avionics disciplines of radio communications, aircraft radar, navigation systems and automatic flight control. Additional information and context for each Outcome is provided as follows:

Outcome 1: In this Outcome you will become familiar with the underpinning theory that supports the design, manufacture and operation of aircraft radio communications installations.

Outcome 2: The content of this Outcome focusses on the underpinning theory that supports the design, manufacture and operation of aircraft Radar installations.

Outcome 3: The content of this Outcome focusses on the underpinning theory that supports the design, manufacture and operation of aircraft navigation installations.

Outcome 4: The content of this Outcome focusses on the underpinning theory that supports the design, manufacture and operation of aircraft automatic flight control installations.

You will be assessed on aspects of all four Outcomes of this Unit under closed-book and supervised conditions. To complete the Unit successfully you will have to achieve a satisfactory level of performance in the assessment event(s).

You will also have opportunities to develop the Core Skills component of *Communication* (Written Communication) at SCQF level 5 in this Unit throughout all Outcomes. This could be achieved through accurate written answers to formative and summative assessment extended response questions.