

Higher National Unit Specification

General information for centres

Unit title: Communication and Navigation Systems for Aviation

Unit code: F0M3 35

Unit purpose: This Unit is designed to allow candidates to acquire the knowledge, understanding, and analysis skills of the principles, functions, operation and maintenance of aviation radio communication systems and navigation systems. The Unit covers the knowledge about aircraft communication and navigation systems required for EASA Part 66 B1 license (part of module 11 in EASA Part 66 requirements) or for EASA Part 66 B2 license (part of module 13 in EASA Part 66 requirements).

On completion of the Unit the candidate should be able to:

- 1 Analyse aviation radio communication systems.
- 2 Analyse air traffic control (ATC) transponder systems.
- 3 Analyse short range navigation and approach aids.
- 4 Analyse inertial navigation systems and global positioning systems (GPS).

Credit points and level: 2 HN Credits at SCQF level 8: (16 SCQF credit points at SCQF level 8*)

**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.*

Recommended prior knowledge and skills: Access to this Unit will be at the discretion of the centre. It is recommended that candidates have completed Higher National Units: DR0A 33 *Mathematics and Physics for Aviation*, DR06 34 *Electrical Fundamentals for Aviation*, DR07 34 *Electronic Fundamentals for Aviation* and DR05 34 *Avionics*.

Core Skills: There are opportunities to develop the Core Skill of Problem Solving: Critical Thinking at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

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.

General information for centres (cont)

Assessment: Candidates may be assessed either by two one hour assessments or by a single two-hour assessment. If two one hour assessments are used, the first assessment covers Outcomes 1 and 2, and the second assessment covers Outcomes 3 and 4. If a single two-hour assessment is used, the assessment covers all four Outcomes. The assessment papers could be composed of an appropriate balance of short answer, restricted response and structured questions. Assessment should be carried out on a sample basis and under supervised, closed-book, controlled conditions.

Accurate records should be made of the assessment instruments used showing how evidence is generated for each Outcome and giving marking schemes and/or checklists, etc. Records of candidates' achievements should be kept. These records will be available for external verification.

Higher National Unit specification: statement of standards

Unit title: Communication and Navigation Systems for Aviation

Unit code: F0M3 35

The sections of the Unit stating the Outcomes, knowledge and/or skills, and Evidence Requirements are mandatory.

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. Candidates 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

Analyse aviation radio communication systems

Knowledge and/or skills

- ◆ Radio waves
- ◆ Signal modulation
- ◆ Very-high-frequency (VHF) radio communication systems
- ◆ High-frequency (HF) radio communication systems
- ◆ Audio integrating systems
- ◆ Emergency location transmitters
- ◆ Cockpit voice recorder
- ◆ SELCAL (selective calling) systems

Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome together with that in Outcome 2 will be provided by an examination taken as a single assessment lasting one hour or by a single two-hour assessment combining all four Outcomes, and carried out under supervised, closed-book, controlled conditions.

Where the knowledge is sampled, the sample should comprise five bullet points listed under knowledge and/or skills. In order to ensure that candidates will not be able to foresee the sample, the whole of the content listed must be taught and available for assessment. Moreover, a different sample is required each time the Outcome is assessed, to which candidates must give a satisfactory response. The evidence may be presented in responses to specific questions. Each candidate will need to demonstrate that he/she can achieve at least 60% of the marks available in the assessment.

A candidate's response can be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate has correct understanding or skills to:

Higher National Unit specification: statement of standards (cont)

Unit title: Communication and Navigation Systems for Aviation

- ◆ Explain radiation of electromagnetic waves; wave propagation; velocity and wavelength; electromagnetic spectrum; aerials; double-sideband amplitude modulation; modulation factor; single-sideband suppressed-carrier amplitude modulation; frequency modulation; bandwidth required for an FM wave; phase modulation; pulse modulation.
- ◆ Analyse Very High Frequency (VHF) communication: basic principles; block diagram operation; interface, control, test and operation; practical aircraft installation; system maintenance.
- ◆ Analyse High Frequency (HF) communication: basic principles; block diagram operation; interface, control, test and operation; practical aircraft installation; system maintenance.
- ◆ Analyse audio integrating systems: block diagram operation; interface, control and operation; typical aircraft installation.
- ◆ Analyse emergency location transmitters and cockpit voice recorder: basic principles; practical aircraft installation; system maintenance.
- ◆ Analyse SELCAL: basic principles; block diagram operation; interface, control, test and operation; system maintenance.

Assessment guidelines

This Outcome can be assessed together with Outcome 2 by an examination taken as a single assessment lasting one hour or by a single two-hour assessment combining all four Outcomes, and carried out under supervised, closed-book, controlled conditions.

Questions used to elicit candidate evidence may take the form of an appropriate balance of short answer, restricted response and structured questions.

Outcome 2

Analyse air traffic control (ATC) transponder systems

Knowledge and/or skills

- ◆ Directional aerial
- ◆ Secondary radar
- ◆ Air traffic control transponder
- ◆ ARINC communication addressing and reporting systems
- ◆ Traffic alert and collision avoidance systems

Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome together with that in Outcome 1 will be provided by an examination taken as a single assessment lasting one hour or by a single two-hour assessment combining all four Outcomes, and carried out under supervised, closed-book, controlled conditions.

Higher National Unit specification: statement of standards (cont)

Unit title: Communication and Navigation Systems for Aviation

Where the knowledge is sampled, the sample should comprise three bullet points listed under knowledge and/or skills. In order to ensure that candidates will not be able to foresee the sample, the whole of the content listed must be taught and available for assessment. Moreover, a different sample is required each time the Outcome is assessed, to which candidates must give a satisfactory response. The evidence may be presented in responses to specific questions. Each candidate will need to demonstrate that he/she can achieve at least 60% of the marks available in the assessment.

A candidate's response can be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate has correct understanding or skills to:

- ◆ Explain directional aerial: principles of directional radio waves, loop aerial and its polar diagram; parabolic dish aerial; beam-width; principle of primary surveillance radar (PSR).
- ◆ Analyse secondary surveillance radar (SSR) and air traffic control transponder: basic principles; block diagram operation; interrogation and reply; coding; false target; side lobe suppression; installation.
- ◆ Analyse ARINC communication addressing and reporting systems: basic principles; block diagram operation; interface with other systems; practical aircraft installation; system maintenance.
- ◆ Analyse traffic alert and collision avoidance systems: principles; block diagram operation; interface, control, test and operation; practical aircraft installation; system maintenance.

Assessment guidelines

This Outcome can be assessed together with Outcome 1 by an examination taken as a single assessment lasting one hour or by a single two-hour assessment combining all four Outcomes, and carried out under supervised, closed-book, controlled conditions.

Questions used to elicit candidate evidence may take the form of an appropriate balance of short answer, restricted response and structured questions.

Outcome 3

Analyse short range navigation and approach aids

Knowledge and/or skills

- ◆ Very-high-frequency omnidirectional range (VOR)
- ◆ Distance measuring equipment (DME) system
- ◆ Automatic direction finding (ADF)
- ◆ Instrument landing system (ILS)
- ◆ Microwave landing system (MLS)
- ◆ Flight director systems and area navigation

Higher National Unit specification: statement of standards (cont)

Unit title: Communication and Navigation Systems for Aviation

Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome together with that in Outcome 4 will be provided by an examination taken as a single assessment lasting one hour or by a single two-hour assessment combining all four Outcomes, and carried out under supervised, closed-book, controlled conditions.

Where the knowledge is sampled, the sample should comprise four bullet points listed under knowledge and/or skills. In order to ensure that candidates will not be able to foresee the sample, the whole of the content listed must be taught and available for assessment. Moreover, a different sample is required each time the Outcome is assessed, to which candidates must give a satisfactory response. The evidence may be presented in responses to specific questions. Each candidate will need to demonstrate that he/she can achieve at least 60% of the marks available in the assessment.

A candidate's response can be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate has correct understanding or skills to:

- ◆ Analyse very-high-frequency omnidirectional range (VOR)/distance measuring equipment (DME) system: VOR signals; operational principles of VOR/DME system; aircraft installation; control and operation; maintenance.
- ◆ Analyse automatic direction finding (ADF): principles of ADF; ADF receiver; loop and sense aerials; installation and installation errors; maintenance.
- ◆ Analyse instrument landing system (ILS): principles and configuration of ILS; localiser; glide-slope; marker beacons; system installation; control and operation.
- ◆ Explain microwave landing system (MLS): principles; block diagram operation.
- ◆ Explain flight director systems and area navigation: attitude direction indicator (ADI); horizontal situation indicator (HSI); area navigation and RNAV systems.

Assessment guidelines

This Outcome can be assessed together with Outcome 4 by an examination taken as a single assessment lasting one hour or by a single two-hour assessment combining all four Outcomes, and carried out under supervised, closed-book, controlled conditions.

Questions used to elicit candidate evidence may take the form of an appropriate balance of short answer, restricted response and structured questions.

Higher National Unit specification: statement of standards (cont)

Unit title: Communication and Navigation Systems for Aviation

Outcome 4

Analyse inertial navigation systems and global positioning systems (GPS)

Knowledge and/or skills

- ◆ Gyroscope and accelerometer
- ◆ Laser gyro
- ◆ Platform inertial navigation system
- ◆ Transport rate and earth rate compensation
- ◆ Strap-down inertial navigation system and analytic platform
- ◆ GPS systems
- ◆ GPS signal structure

Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome together with that in Outcome 3 will be provided by an examination taken as a single assessment lasting one hour or by a single two-hour assessment combining all four Outcomes, and carried out under supervised, closed-book, controlled conditions.

Where the knowledge is sampled, the sample should comprise four bullet points listed under knowledge and/or skills. In order to ensure that candidates will not be able to foresee the sample, the whole of the content listed must be taught and available for assessment. Moreover, a different sample is required each time the Outcome is assessed, to which candidates must give a satisfactory response. The evidence may be presented in responses to specific questions. Each candidate will need to demonstrate that he/she can achieve at least 60% of the marks available in the assessment.

A candidate's response can be judged to be satisfactory where the evidence provided is sufficient to meet the requirements for each item by showing that the candidate has correct understanding or skills to:

- ◆ Analyse gyroscope and accelerometer: operational principles; configuration.
- ◆ Explain Laser gyro: operational principles; configuration.
- ◆ Analyse platform inertial navigation system: Gyro-stabilised platform (inertial platform); Schuler tuning; Accelerometer output; Position computation.
- ◆ Explain transport rate and earth rate compensation.
- ◆ Analyse strap-down inertial navigation system and analytic platform.
- ◆ Explain global positioning system (GPS): Intersection of three spheres for positioning; System configuration; GPS satellite constellation and coverage; GPS control segment.
- ◆ Explain GPS signal structure: Signal modulation; Almanac.

Assessment guidelines

This Outcome can be assessed together with Outcome 3 by an examination taken as a single assessment lasting one hour or by a single two-hour assessment combining all four Outcomes, and carried out under supervised, closed-book, controlled conditions.

Questions used to elicit candidate evidence may take the form of an appropriate balance of short answer, restricted response and structured questions.

Administrative Information

Unit code:	F0M3 35
Unit title:	Communication and Navigation Systems for Aviation
Superclass category:	XP
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History of Changes:

Version	Description of change	Date

Source: SQA

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Higher National Unit specification: support notes

Unit title: Communication and Navigation Systems for Aviation

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 80 hours.

Guidance on the content and context for this Unit

This Unit is designed to allow candidates to acquire the knowledge and understanding of principles, functions, operation and maintenance of aviation radio communication systems, radar and radio altimeters, inertial navigation systems and GPS systems.

Corresponding to Outcomes:

1 Analyse aviation radio communication systems.

- ◆ Radio waves and signal modulation:
 - Velocity and wavelength
 - Electromagnetic spectrum and propagation
 - Airborne radio frequency utilisation
 - Radiation of electro-magnetic waves, dipole and unipole aerials:
 - Standing wave and voltage standing wave ratio
 - Aerial coupler

- ◆ Double-sideband amplitude modulation:
 - Combining signals of different frequency
 - Spectrum of amplitude modulation and sidebands
 - Modulation factor
 - Modulation depth
 - Single-sideband suppressed-carrier amplitude modulation
 - Frequency modulation:
 - Spectrum of frequency modulation
 - Bandwidth required for an FM wave
 - Phase modulation
 - Pulse modulation

- ◆ Very High Frequency (VHF) communication:
 - Operational principles
 - Block diagram
 - Interface, control, test and operation
 - Practical aircraft installation
 - System maintenance

Higher National Unit specification: support notes (cont)

Unit title: Communication and Navigation Systems for Aviation

- ◆ High Frequency (HF) communication:
 - Basic principles
 - Block diagram operation
 - Interface, control, test and operation
 - Practical aircraft installation
 - System maintenance.
- ◆ Audio integrating systems:
 - Block diagram operation
 - Interface, control and operation
 - Typical aircraft installation
- ◆ Emergency location transmitters and cockpit voice recorder:
 - Basic principles
 - Practical aircraft installation
 - System maintenance
- ◆ SELCAL:
 - Operational principles and block diagram
 - System interface, control, test and operation
 - Aircraft installation and maintenance

2 Analyse air traffic control (ATC) transponder systems.

- ◆ Basic principles of secondary radar:
 - Operational principles and block diagram:
 - Primary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR)
 - Interrogation and reply
 - Coding and altitude encoding
 - False target
 - Side lobe suppression
 - System interface and controls
 - Aircraft installation and maintenance
- ◆ ARINC communication addressing and reporting systems
 - Principles
 - Block diagram operation
 - Interface with other systems
 - Practical aircraft installation
 - System maintenance

Higher National Unit specification: support notes (cont)

Unit title: Communication and Navigation Systems for Aviation

- ◆ Traffic alert and collision avoidance systems
 - Principles
 - Block diagram operation
 - Interface, control, test and operation
 - Practical aircraft installation
 - System maintenance

3 Analyse short range navigation and approach aids.

- ◆ Very-high-frequency omnidirectional range (VOR) / distance measuring equipment (DME) system:
 - Operational principles of VOR/DME system and block diagram:
 - Very-high-frequency omni-range (VOR)
 - VOR signals
 - Distance measuring equipment (DME):
 - Slant range
 - Aircraft installation
 - Control and operation
 - Maintenance
- ◆ Automatic direction finding (ADF):
 - Principles of ADF
 - ADF receiver
 - Loop and sense aerials
 - Installation and installation errors
 - Maintenance.
- ◆ Basic principles of instrument landing system (ILS):
 - Block diagram and construction:
 - Localiser
 - Glide-slope
 - Marker beacons
 - ILS system installation
 - Control and operation
- ◆ Microwave landing system (MLS):
 - Principles
 - Block diagram operation
- ◆ Flight director systems and area navigation:
 - Attitude direction indicator (ADI) displays
 - Horizontal situation indicator (HSI)
 - Area navigation and RNAV systems Display

Higher National Unit specification: support notes (cont)

Unit title: Communication and Navigation Systems for Aviation

4 Analyse inertial navigation systems and global positioning systems (GPS).

- ◆ Gyro-stabilised platform (inertial platform) and Schuler tuning
- ◆ Accelerometer output and position computation
- ◆ Transport rate and earth rate compensation
- ◆ Construction of a gimballed platform
- ◆ Strap-down inertial navigation system and analytic platform

- ◆ Laser gyro:
 - Operational principles and construction

- ◆ Basic principles for GPS:
 - Intersection of three spheres for positioning

- ◆ System configuration:
 - Space segment
 - Control segment
 - User segment

- ◆ GPS satellite constellation and coverage:
 - Satellites
 - Satellite orbit structure
 - Coverage
 - Requirements for accurate positioning

- ◆ GPS control segment:
 - CS configuration
 - Performance requirements

- ◆ GPS signal structure:
 - Signal modulation:
 - Pseudo-random noise
 - C/A code
 - P code

- ◆ Almanac

Guidance on the delivery and assessment of this Unit

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. Candidates should not know in advance the items on which they will be assessed and different items should be sampled on each assessment occasion.

Higher National Unit specification: support notes

Unit title: Communication and Navigation Systems for Aviation

Assessment: Candidates are assessed either by two one hour assessments or by a single two-hour assessment. If two one hour assessments are used, the first assessment covers Outcomes 1 and 2, and the second assessment covers Outcomes 3 and 4. If a single two-hour assessment is used, the assessment covers all four Outcomes. The assessment papers could be composed of an appropriate balance of short answer, restricted response and structured questions. Assessment should be carried out on a sample basis and under supervised, closed-book, controlled conditions. The candidate should achieve a minimum of 60% pass rate for the Evidence Requirements.

Opportunities for developing Core Skills

There are opportunities to develop the Core Skill of Problem Solving: Critical Thinking at SCQF level 6 in this Unit, although there is no automatic certification of Core Skills or Core Skills components.

Candidates can achieve this by demonstrating that they can analyse and evaluate complex issues such as the performance data for short range navigation and approach aids, the working principles of radio communication systems.

The teaching and learning activities would contribute to the Core Skill: Critical Thinking. In Outcomes 1 and 3, candidates would be encouraged to analyse the effects of different factors on radio wave propagation and summarise the advantages and disadvantages of different types of radio communication and navigation systems. This would help candidates to achieve a better understanding of the principles of the aviation communication and navigation systems.

Open learning

If this Unit is delivered by open or distance learning methods, additional planning and resources may be required for candidate support, assessment and quality assurance. The evidence for Outcomes could be held in a portfolio and sent to the assessor.

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. For information on these, please refer to the SQA document *Guidance on Alternative Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs*, which is available on SQA's website: www.sqa.org.uk.

General information for candidates

Unit title: Communication and Navigation Systems for Aviation

In this Unit you will acquire the knowledge, understanding, and analysis skills of the principles, functions, operation and maintenance of aviation radio communication systems, and navigation systems. It covers the knowledge about aircraft communication and navigation systems required for EASA Part 66 B1 license (part of module 11 in EASA Part 66 requirements) or EASA Part 66 B2 license (part of module 13 in EASA Part 66 requirements). There are four Outcomes:

This Unit is designed to allow you to:

- ◆ analyse aviation radio communication systems
- ◆ analyse air traffic control (ATC) transponder systems
- ◆ analyse short range navigation and approach aids
- ◆ analyse inertial navigation systems and global positioning systems (GPS)

This Unit will be beneficial if you are interested in aircraft engineering or are doing an aircraft engineering course.

You will be assessed either by two one hour assessments or by a single two-hour assessment. If two one hour assessments are used, the first assessment covers Outcome 1 and 2, and the second assessment covers Outcome 3 and 4. If a single two-hour assessment is used, the assessment covers all four Outcomes. The assessment papers could be composed of an appropriate balance of short answer, restricted response and structured questions. Assessment should be carried out on a sample basis and under supervised, closed-book, controlled conditions. You have to achieve a minimum of 60% pass rate for the Evidence Requirements.