

## Higher National Unit Specification

### General information for centres

**Unit title:** Aircraft Automatic Flight and Landing Systems

**Unit code:** F0M2 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 aircraft automatic flight and landing systems. It covers the knowledge about aircraft automatic flight and landing 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 Explain the signals, signal measurements and signal processing for automatic flight and landing systems.
- 2 Analyse aircraft stabilisation systems.
- 3 Analyse autopilots and flight directors.
- 4 Analyse flight management systems (FMS).

**Credit points and level:** 1 HN Credit at SCQF level 8: (8 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. However, it is recommended that candidates have completed 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 can be assessed either by two 45-minute assessments or by a single one-and-a-half-hour assessment. If two 45-minute assessments are used, the first assessment covers Outcomes 1 and 2, and the second assessment covers Outcomes 3 and 4. If a single one-and-a-half-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:** Aircraft Automatic Flight and Landing Systems

**Unit code:** F0M2 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

Explain the signals, signal measurements and signal processing for automatic flight and landing systems

#### Knowledge and/or skills

- ◆ Attitude, velocity and guidance signals and corresponding measurements
- ◆ Demand signals, command signals and feedback signals
- ◆ Signal conditioning and processing

#### 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 45 minutes or by a single one-and-a-half-hour assessment combining all four Outcomes, and carried out under supervised, closed-book, controlled conditions.

Where the knowledge is sampled, the sample should comprise two 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 attitude, velocity and guidance signals and corresponding measurements: pitch, roll, and yaw angles; angular velocities; air-data interface, airspeed, Mach speed, and vertical speed; heading, course, and beam; angle of attack and sideslip; altitude; engine speed.
- ◆ Explain demand signals, command signals and feedback signals: mode selectors; control and limiting; mode compatibility and command; override; engage interlocks; clutches and hardover protections.
- ◆ Explain signal conditioning and processing: filtering; limiting; modulation and demodulation; synchronising; summing, integration, gain scheduling; switching.

## **Higher National Unit specification: statement of standards (cont)**

**Unit title:** Aircraft Automatic Flight and Landing Systems

### **Assessment guidelines**

This Outcome can be assessed together with Outcome 2 by an examination taken as a single assessment lasting 45 minutes or by a single one-and-a-half-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 aircraft stabilisation systems

#### **Knowledge and/or skills**

- ◆ Yaw damper
- ◆ Pitch and roll stabilisation and control
- ◆ Trim
- ◆ Automatic stabilisation

#### **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 45 minutes or by a single one-and-a-half-hour assessment combining all four Outcomes, and carried out under supervised, closed-book, controlled conditions.

Where the knowledge is sampled, the sample should comprise at least 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:

- ◆ Analyse yaw damper: Dutch roll and Dutch roll control; conventional yaw damper; yaw damper build-in-test equipment (BITE).
- ◆ Analyse pitch and roll stabilisation and control: control surface actuation and feel; control panel; attitude stabilisation; rate signals and turn control; limiters and roll accelerometers; stall protection.
- ◆ Analyse trim control: aileron trim; stabiliser trim; rudder trim.
- ◆ Analyse automatic stabilisation: autostabiliser; stabilisation in fly-by-wire (FBW) systems.

## Higher National Unit specification: statement of standards (cont)

**Unit title:** Aircraft Automatic Flight and Landing Systems

### Assessment guidelines

This Outcome can be assessed together with Outcome 1 by an examination taken as a single assessment lasting 45 minutes or by a single one-and-a-half-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 autopilots and flight directors

#### Knowledge and/or skills

- ◆ Pitch channel modes and interface
- ◆ Lateral channel modes and interface
- ◆ Automatic landing

#### 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 45 minutes or by a single one-and-a-half-hour assessment combining all four Outcomes, and carried out under supervised, closed-book, controlled conditions.

Where the knowledge is sampled, the sample should comprise two 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 pitch channel modes and interface: autopilot/flight director interface; attitude hold; altitude pre-selection circuit; altitude capture and altitude hold; vertical speed; Mach and airspeed hold.
- ◆ Analyse lateral channel modes and interface: autopilot/flight director interface; beam sensing and capture; heading selection and heading changes.
- ◆ Analyse automatic landing: instrumental landing systems (ILS); localiser beam selection capture; glideslope capture; flare mode; go-around.

## **Higher National Unit specification: statement of standards (cont)**

**Unit title:** Aircraft Automatic Flight and Landing Systems

### **Assessment guidelines**

This Outcome can be assessed together with Outcome 4 by an examination taken as a single assessment lasting 45 minutes or by a single one-and-a-half-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 4**

Analyse flight management systems (FMS)

#### **Knowledge and/or skills**

- ◆ Flight profile and flight management panel
- ◆ Full authority engine control
- ◆ Flight management computer

#### **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 45 minutes or by a single one-and-a-half-hour assessment combining all four Outcomes, and carried out under supervised, closed-book, controlled conditions.

Where the knowledge is sampled, the sample should comprise at least two 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 flight profile and flight management panel: system block schematic; flight management modes; panel and display.
- ◆ Analyse full authority engine control: system block schematic; autothrottle; electronic engine control; BITE.
- ◆ Explain flight management computer: dual system communication; control display units and system interface.

### **Assessment guidelines**

This Outcome can be assessed together with Outcome 3 by an examination taken as a single assessment lasting 45 minutes or by a single one-and-a-half-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:** Aircraft Automatic Flight and Landing Systems

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:** F0M2 35

**Unit title:** Aircraft Automatic Flight and Landing Systems

**Superclass category:** XP

**Original date of publication:** August 2006

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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: Aircraft Automatic Flight and Landing Systems

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

Corresponding to Outcomes:

#### 1 Explain the signals, signal measurements and signal processing for automatic flight and landing systems.

- ◆ Attitude, velocity and guidance signals and corresponding measurements:
  - Pitch, roll, and yaw angles
  - Angular velocities
  - Air-data interface, airspeed, Mach speed and vertical speed
  - Heading, course, and beam
  - Angle of attack and sideslip
  - Altitude; engine speed
  
- ◆ Demand signals, command signals and feedback signals:
  - Mode selectors
  - Control and limiting
  - Mode compatibility and command
  - Override; engage interlocks
  - Clutches and hardover protections
  
- ◆ Signal conditioning and processing:
  - Filtering
  - Limiting
  - Modulation and demodulation
  - Synchronising
  - Summing, integration, gain scheduling
  - Switching

#### 2 Analyse aircraft stabilisation systems.

- ◆ Yaw damper:
  - Dutch roll and Dutch roll control
  - Conventional yaw damper
  - Yaw damper build-in-test equipment (BITE)

## Higher National Unit specification: support notes (cont)

### Unit title: Aircraft Automatic Flight and Landing Systems

- ◆ Pitch and roll stabilisation and control:
  - Control surface actuation and feel
  - Control panel
  - Attitude stabilisation
  - Rate signals and turn control
  - Limiters and roll accelerometers
  - Stall protection
  
- ◆ Trim:
  - Aileron trim
  - Stabiliser trim
  - Rudder trim
  
- ◆ Automatic stabilisation:
  - Autostabiliser
  - Stabilisation in fly-by-wire (FBW) systems

### 3 Analyse autopilots and flight directors.

- ◆ Pitch channel modes and interface:
  - Autopilot/flight director interface
  - Attitude hold
  - Altitude pre-selection circuit
  - Altitude capture and altitude hold
  - Vertical speed
  - Mach and airspeed hold
  
- ◆ Lateral channel modes and interface:
  - Autopilot/flight director interface
  - Beam sensing and capture
  - Heading selection and heading changes
  
- ◆ Automatic landing:
  - Instrumental landing systems (ILS)
  - Localiser beam selection capture
  - Glideslope capture
  - Flare mode
  - Go-around

## Higher National Unit specification: support notes (cont)

**Unit title:** Aircraft Automatic Flight and Landing Systems

### 4 Analyse flight management systems (FMS).

- ◆ Flight profile and flight management panel:
  - System block schematic
  - Flight management modes:
    - Take-off mode
    - In-flight mode
    - Speed mode
    - Vertical navigation (VNAV) mode
    - Area navigation (RNAV) mode
    - Thrust limit mode
  - Panel and display
  
- ◆ Full authority engine control:
  - System block schematic
  - Autothrottle
  - Electronic engine control
  - BITE
  
- ◆ Flight management computer:
  - Dual system communication
  - Control display units and system interface

### 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 skill 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.

Candidates are assessed either by two 45-minute assessments or by a single one-and-a-half-hour assessment. If two 45-minute assessments are used, the first assessment covers Outcomes 1 and 2, and the second assessment covers Outcomes 3 and 4. If a single one-and-a-half-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. Assessments should be carried out on a sample basis and under supervised, closed-book, controlled conditions.

#### *Opportunities for developing Core Skills*

Candidates will have 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 effects of different signals in flight control systems, the operating principles of autopilots.

## **Higher National Unit specification: support notes (cont)**

### **Unit title:** Aircraft Automatic Flight and Landing Systems

In Outcome 1, candidates would be encouraged to analyse the different signals for flight control systems and the effects of different interferences on the systems and they will summarise the needs for different kinds of signal conditioning and processing measures. This should help candidates to achieve a better understanding of the principles and configurations of automatic flight control and landing systems.

There would be no formal assessments for certification of Core Skills in this Unit.

### **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](http://www.sqa.org.uk).

## General information for candidates

### Unit title: Aircraft Automatic Flight and Landing System

In this Unit you will acquire the knowledge, understanding, and analysis skills in relation to the principles, functions, operation and maintenance of aircraft automatic flight and landing systems. It covers the knowledge about aircraft instrument 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:

- ◆ explain the signals, signal measurements and signal processing for automatic flight and landing systems
- ◆ analyse aircraft stabilisation systems
- ◆ analyse autopilots and flight directors
- ◆ analyse flight management systems (FMS)

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 45-minute assessments or by a single one-and-a-half-hour assessment. If two 45-minute assessments are used, the first assessment covers Outcomes 1 and 2, and the second assessment covers Outcomes 3 and 4. If a single one-and-a-half-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. Assessments 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.