

Higher National Unit Specification

General information for centres

Unit title: Aircraft Servo Control Systems

Unit code: F0M1 35

Unit purpose: This Unit is designed to give candidates an introduction to the use of embedded control and servomechanisms as used in many systems onboard an aircraft.

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

- 1 Investigate the features of embedded control in aircraft systems.
- 2 Investigate the uses of embedded control in aircraft systems.
- 3 Analyse the characteristics and properties of servomechanisms in aircraft systems.
- 4 Investigate the applications of servomechanisms in aircraft systems.

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. The Unit has no mandatory prerequisites, however it is recommended that candidates have completed the following HN Units: DR0A 33 *Mathematics and Physics for Aviation* and DR07 34 *Electronic Fundamentals for Aviation*.

Core Skills: There are opportunities to develop the Core Skill of Problem Solving 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.

Assessment: Candidates should be assessed on an Outcome by Outcome basis.

Outcome 1 should be assessed by means of a case study or investigation report. Candidates should be required to write a report on their investigations, analyses and practical activities.

Outcome 2 should be assessed by a closed-book examination lasting 40 minutes and a practical task. The examination may be composed of an appropriate balance of short answer, restricted response and structured questions. Performance of the practical task should be confirmed by the completion of a checklist.

General information for centres (cont)

Outcome 3 should be assessed by a closed-book examination lasting 40 minutes. The assessment may be composed of an appropriate balance of short answer, restricted response and structured questions. Assessment of Outcome 3 should be carried out under closed-book, supervised, controlled conditions.

Outcome 4 should be assessed by means of a case study or investigation report. Candidates should be required to write a report on their investigations, analyses and practical activities.

Higher National Unit specification: statement of standards

Unit title: Aircraft Servo Control Systems

Unit code: F0M1 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

Investigate the features of embedded control in aircraft systems

Knowledge and/or skills

- ◆ Comparison of embedded control with hardwired control
- ◆ Types of embedded control – microcontroller, application specific integrated circuit (ASIC)
- ◆ Block diagram of microcontroller
- ◆ Pin-out diagram for microcontroller from manufacturer's data sheet

Evidence Requirements

This Outcome should be assessed by means of a case study or investigation report. The report should cover all points in the knowledge and/or skills of this Outcome.

Candidates will need to provide evidence to demonstrate their knowledge and/or skills by showing that they can:

- ◆ describe and compare the features and characteristics of hardwired and embedded electronic control
- ◆ describe and compare the features and characteristics of microcontrollers and ASICs
- ◆ explain the basic principles of operation of a microcontroller with reference to a block diagram
- ◆ describe the features of a typical microcontroller with reference to a manufacturer's data sheet

Assessment guidelines

Candidates may be provided with a report outline that describes the areas to be investigated and the expected content of the report.

Higher National Unit specification: statement of standards (cont)

Unit title: Aircraft Servo Control Systems

Outcome 2

Investigate the uses of embedded control in aircraft systems

Knowledge and/or skills

- ◆ Types of transducer and actuator used in aircraft servo systems
- ◆ Applications of embedded control in aircraft systems
- ◆ Editing, downloading and running a program on a microcontroller

Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome will be provided by an examination taken as a single assessment event lasting forty minutes carried out under supervised, closed-book, controlled conditions.

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 in:

- ◆ describing the operation of at least two transducers and one actuator
- ◆ describing at least three applications of embedded control in aircraft systems

In addition, evidence of satisfactory completion of a practical task will be required. This includes:

- ◆ editing a program to modify it to carry out a specified task
- ◆ downloading the modified program to a microcontroller
- ◆ executing the modified program and confirming the task has been carried out

Evidence may be provided by a checklist.

Assessment guidelines

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

A suitable practical activity would be using a microcontroller to switch on an electric motor in forward or reverse for specified times.

Higher National Unit specification: statement of standards (cont)

Unit title: Aircraft Servo Control Systems

Outcome 3

Analyse the characteristics and properties of servomechanisms in aircraft systems

Knowledge and/or skills

- ◆ Open/closed loop systems
- ◆ Feedback
- ◆ Follow-up
- ◆ Transducers
- ◆ Null, damping, deadband

Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome will be provided by an examination taken as a single assessment event lasting forty minutes carried out under supervised, closed-book, controlled conditions.

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 in:

- ◆ the properties of open loop and closed loop systems
- ◆ the effects of positive and negative feedback
- ◆ analysing the operational principles of a variety of transducers found in aircraft systems
- ◆ investigating the effects of proportional, integral and derivative control in closed loop systems

Assessment guidelines

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: Aircraft Servo Control Systems

Outcome 4

Investigate the applications of servomechanisms in aircraft systems

Knowledge and/or skills

- ◆ Aircraft synchro systems
- ◆ Common servomechanism defects

Evidence Requirements

Evidence for the knowledge and/or skills in this Outcome will be provided by an open-book report. Evidence that the candidate has carried out the practical activities is also required. Such evidence could include computer simulation printouts and checklists completed by the assessor.

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 in:

- ◆ the features and components of synchro systems: resolvers, differential control and torque, transformers, inductance and capacitance transmitters, synchronous transmitters
- ◆ some common servomechanism defects found on aircraft

Assessment guidelines

Candidates may be provided with a report outline that describes the areas to be investigated and the expected content of the report.

Administrative Information

Unit code: F0M1 35
Unit title: Aircraft Servo Control Systems
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: Aircraft Servo Control 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 is an optional Unit devised for the principles and technology section of the HNC/HND Aircraft Engineering Group Award. This Unit is intended to give candidates an in-depth knowledge of some of the range of electronic devices (in particular embedded systems, transducers and actuators) likely to be encountered on an aircraft. The Unit provides partial coverage of EASA 66 Module 4, Chapter 4 and Chapter 5.

Whilst many approaches can be utilised for the delivery of the above material, it is desirable to set them within the context of the aviation technician. Wherever possible, the delivery of the curriculum material in this Unit should utilise practical examples of where the concepts may be found on an aircraft.

In aviation maintenance a technician must be familiar with aircraft electronic systems. By understanding the principles of basic electronic devices and their circuit applications, the technician may effectively diagnose, isolate and repair aircraft electrical/electronic problems.

Wherever possible you should endeavour to provide the candidate with practical examples to work with. Where this is not practicable, simulation software may be used to confirm and visualise concepts and results.

Guidance on the delivery and assessment of this Unit

Content/context corresponding to Outcomes:

- 1 Candidates should start by comparing the features of hardwired and programmable, embedded systems. The advantages and disadvantages (in terms of functionality, adaptability and cost) of each approach may be discussed. The structure of a microcontroller at a basic level should be introduced, and features such as types of memory, analogue/digital conversion, input/output discussed. Application Specific Integrated Circuits (ASIC) should be introduced.
- 2 Candidates should be introduced to a variety of transducers used in aircraft systems in the measurement of temperature, pressure, proximity, fluid flow rate and rotational speed. Practical activities with transducers should be carried out where practicable. Candidates should then be introduced to electrical, hydraulic and pneumatic actuators. The advantages and disadvantages for aircraft application of electrical, hydraulic and pneumatic actuators should be discussed. It would also be advantageous to point out to candidates the location of transducers and actuators on a hangar aircraft.

Higher National Unit specification: support notes (cont)

Unit title: Aircraft Servo Control Systems

- 3 Candidates should be introduced through simple examples to the concepts of open loop, closed loop control and feedback. They may be familiar with these concepts as applied to electronic amplifiers and oscillators from their study of Unit DR07 34 *Electronic Fundamentals for Aviation*, and this knowledge should be extended to the electronic control of mechanical systems on aircraft. The effects of proportional, integral and derivative control should be demonstrated in the laboratory and/or by electronic simulation.
- 4 Candidates should be introduced to the need for, and applications of, synchro systems on aircraft. Features and components such as resolvers, differential control and torque, transformers, inductance and capacitance transmitters and synchronous transmitters should be discussed. Some common servomechanism defects and their effects should be discussed. It would also be advantageous to point out to candidates the locations of synchro systems on a hanger aircraft.

Opportunities for developing Core Skills

The Core Skill of Problem Solving at SCQF level 6 may be developed in this Unit through:

- ◆ Planning and organising reports in Outcome 1 and Outcome 4.
- ◆ Critical thinking when comparing hardwired and embedded systems in Outcome 1, and electrical, hydraulic and pneumatic actuators in Outcome 2.
- ◆ Reviewing and evaluating information gained from manufacturers' data sheets in Outcome 1.

Open learning

If this Unit is to be offered on a Distance or Open Learning basis, adequate provision must be made for the practical activities of the Unit. A centre may judge that a candidate, through his/her employment, has gained adequate practical experience of aircraft servo control systems. However, the assessment of Outcome 2 includes a practical activity and adequate provision for this must be made. This may require the candidate to attend the centre or other suitable location for preparation and assessment.

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: Aircraft Servo Control Systems

This Unit is intended for those who are interested in Aircraft Engineering. This Unit provides partial coverage of EASA 66 Modules 4 and 5.

This Unit is designed to introduce you to the concepts of servo control systems on aircraft and the components in these systems. The emphasis of this Unit is in understanding the operation and application of these systems. Useful preparation for this Unit would be completion of Unit DR07 34 *Electronic Fundamentals for Aviation*.

The Unit has four main areas, each covered by a separate Outcome. On completion of the Unit you will be able to:

- ◆ Investigate the feature of embedded control in aircraft systems
- ◆ Investigate the uses of embedded control in aircraft systems
- ◆ Analyse the characteristics and properties of servomechanisms in aircraft systems
- ◆ Investigate the applications of servomechanisms in aircraft systems

This Unit may be assessed on an Outcome-by-Outcome basis.

Outcome 1 may be assessed by means of a case study or investigation report. You may be required to produce a report based on your investigations, analyses and practical activities.

Outcome 2 may be assessed by an examination lasting 40 minutes and, in addition, a practical task. The examination may be composed of an appropriate balance of short answer, restricted response and structured questions. Performance of the practical task may be confirmed by the completion of a checklist. Assessment of Outcome 2 should be carried out under closed-book, supervised, controlled conditions.

Outcome 3 may be assessed by an examination lasting 40 minutes. The assessment may be composed of an appropriate balance of short answer, restricted response and structured questions. Assessment of Outcome 3 should be carried out under closed-book, supervised, controlled conditions.

Outcome 4 may be assessed by means of a case study or investigation report. You may be required to write a report on your investigations, analyses and practical activities.