Unit 86: Aircraft Communication and Navigation Systems

Unit code: J/601/7217
QCF level: 4
Credit value: 15

Aim
The aim of this unit is to develop learners' understanding of the principles of operating aircraft communication and navigation systems.

Unit abstract
In this unit learners will investigate the operation of radio transmitters, receivers and aircraft radio navigation systems. They will examine aircraft inertial navigation systems and their operation and will carry out calculations to solve navigation problems. The unit also provides an opportunity for learners to investigate the types, operation and operating parameters of continuous wave aircraft radar systems.

Learning outcomes
On successful completion of this unit a learner will:
1. Understand the operation of a radio transmitter and receiver
2. Understand the operation of aircraft radio navigation systems
3. Understand aircraft inertial navigation systems
4. Understand pulsed and continuous wave aircraft radar systems.
Unit content

1 Understand the operation of a radio transmitter and receiver

Legal requirements: licensing; regulatory authorities; frequency of operation; spurious emissions

Amplitude modulation (AM) transmitters: principles of transmission eg electromagnetic radiation, electromagnetic spectrum and propagation of radio waves; types and principles of modulation; use of block/flow diagrams to aid explanation of the operation and stages within a transmitter system

Receivers: principles of radio reception eg demodulation, Automatic Gain Control (AGC), Automatic Frequency Control (AFC); types of receivers; use of block/flow diagrams of radio receiver systems; operation of stages within receivers; effects of noise and interfering signals on radio reception; signal to noise

Receiver performance: use of measurement and test equipment eg signal generator, power meter, oscilloscope, noise test set, spectrum analyser; performance characteristic eg sensitivity, signal to noise, adjacent channel, image channel rejection ratios

2 Understand the operation of aircraft radio navigation systems

Type of radio navigation systems: instrument landing system (ILS); very high frequency (VHF) omni-directional radio range (VOR); automatic direction finding (ADF); distance measuring equipment (DME); logan and omegal; global positioning systems (GPS)

Principles of operation: frequency bands; aerial pattern; system block diagrams; hyperbolic patterns; signal formats; GPS position determination

Aircraft systems: use of block diagrams to identify and explain a typical integrated aircraft radio navigation system; operation of the complete system

3 Understand aircraft inertial navigation systems

Principle and operations: basic principles relating to inertial navigation; Schuler tuning; block diagram of Schuler tuned Inertial Navigation System (INS); accelerometers; gyros; alignment and gyro compassing; errors; choice of platform axes; strap-down INSs; aided INSs; Kalman filters

Aircraft INS: use of block diagram of complete INS; applications of a typical align sequence; IN augmentation eg using Doppler, GPS, Kalman filter; operating principles of analogue computing systems as used in navigation systems

IN problems: calculation on acceleration, velocity, distance; errors encountered in INSs and how corrections are applied
4 Understand pulsed and continuous wave aircraft radar systems

*Radar systems*: pulsed; carrier wave (CW); primary; secondary; Doppler; applications of each system; use of block diagrams of typical radar systems

*Parameters measured*: range/bearing/height; radar equation; solve problems related to range/bearing/height
## Learning outcomes and assessment criteria

<table>
<thead>
<tr>
<th>Learning outcomes</th>
<th>Assessment criteria for pass</th>
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<tr>
<td><strong>On successful completion of this unit a learner will:</strong></td>
<td>The learner can:</td>
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<tr>
<td>LO1 Understand the operation of a radio transmitter and receiver</td>
<td>1.1 explain the legal requirements for transmitter operation</td>
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<td>1.2 explain the principles of operation of an AM radio transmitter</td>
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<td>1.3 explain the principles of operation of a radio receiver</td>
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<td>1.4 evaluate the performance of a radio receiver</td>
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<td>LO2 Understand the operation of aircraft radio navigation systems</td>
<td>2.1 compare the different types of radio navigation systems and justify the best fit for a</td>
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<td>particular aircraft</td>
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<td>2.2 explain the principles of operation of a complete aircraft radio navigation system</td>
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<td>LO3 Understand aircraft inertial navigation systems</td>
<td>3.1 explain the principles and operation of aircraft inertial navigation systems</td>
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<td>3.2 analyse the effects on aircraft performance of inertial navigation problems</td>
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<td>3.3 select and use equations of motion to solve inertial navigation problems</td>
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<tr>
<td>LO4 Understand pulsed and continuous wave aircraft radar systems</td>
<td>4.1 explain the principles of operation of aircraft radar systems</td>
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<td>4.2 analyse the factors affecting aircraft radar performance</td>
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<td>4.3 solve problems relating to range, bearing and height of aircraft radar returns.</td>
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Guidance

Links
This unit can be linked with Unit 91: Integrated Flight Instrument Systems.

Essential requirements
There are no essential resources for this unit.

Employer engagement and vocational contexts
The delivery of this unit will benefit from centres establishing strong links with employers willing to contribute to the delivery of teaching, work-based placements and/or detailed case study materials.