Aim

This unit will develop learners' understanding of the function, characteristics and operating parameters of aircraft automatic flight control systems.

Unit abstract

This unit will examine the automatic flight control systems that are key to the safe operation of aircraft. Learners will investigate and carry out a systems analysis on aircraft servo-mechanisms, such as control and indication systems and integrated flight control systems. They will then analyse the function and operation of yaw damper systems and will examine yaw channel instability. The behaviour and parameters of auto pilot and auto throttle systems are also investigated, before learners look at the characteristics of auto land systems.

Learning outcomes

On successful completion of this unit a learner will:

1. Be able to carry out systems analysis on aircraft servo-mechanisms
2. Understand the function and operation of yaw damper systems
3. Understand auto pilot and auto throttle systems
4. Understand auto land systems.
Unit content

1 Be able to carry out systems analysis on aircraft servo-mechanisms

Aircraft servo-mechanisms: control and indication systems; remote position control (RPC) servomechanisms; digital and analogue control systems; integrated flight control systems; autopilots and autostabilisers

Block diagram analysis: closed and open loop systems; input signals (transient and steady state); position and velocity feedback; integral control; transfer functions

Nyquist diagrams and Bode plots: use of data to determine accuracy, stability and gain in servo-systems

2 Understand the function and operation of yaw damper systems

Characteristics and operating parameters: use of system schematics to determine effect of aileron cross-feed, integration of yaw and aileron channels

System functions: band pass filters; rate gyro control

3 Understand auto pilot and auto throttle systems

Auto pilot inputs: radio including Instrument Landing System (ILS), Extended Twin-Engine Operations (ETOPS), collision avoidance such as Traffic alert and Collision Avoidance System (TCAS)

Auto pilot parameters: inner loop; series and parallel systems; synchronising; demand limiting evaluation; logic diagrams; detailed operation in various modes; fault diagnosis; built-in test equipment (BITE)

Auto throttle parameters: engine pressure ratio (EPR) control; Mach hold; airspeed control; flap rate; pitch rate; long-term errors; auto land

4 Understand auto land systems

Characteristics: categories of landing; reliability requirements; auto land profile

Parameters: terrain clearance; landing profile; captive and track; attitude hold; exponential flare; kick-off drift; instinctive cut-off
## Learning outcomes and assessment criteria

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<tr>
<th>Learning outcomes</th>
<th>Assessment criteria for pass</th>
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| **LO1** Be able to carry out systems analysis on aircraft servo-mechanisms | 1.1 carry out a system analysis on an aircraft servo-mechanism  
1.2 prepare a block diagram for a servo-mechanism and reduce to a transfer function  
1.3 produce Nyquist diagrams and Bode plots from data obtained practically and theoretically |
| **LO2** Understand the function and operation of yaw damper systems | 2.1 determine the function, operation and characteristics of a yaw damper system  
2.2 examine yaw channel instability |
| **LO3** Understand auto pilot and auto throttle systems | 3.1 describe the inputs to an auto pilot system  
3.2 determine and explain the behaviour and parameters of an auto pilot system  
3.3 determine and explain the behaviour and parameters of an auto throttle system  
3.4 interpret typical auto pilot and auto throttle schematics |
| **LO4** Understand auto land systems | 4.1 explain the characteristics and operating parameters of an auto land system  
4.2 evaluate safety margins in multiplex systems  
4.3 interpret auto land system schematics. |
Guidance

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

Essential requirements
Learners will need access to basic avionic training rigs. Visits to modern aircraft operating facilities are considered to be an essential part of unit delivery.

Employer engagement and vocational contexts
Centres will need to create links with aircraft maintenance companies or airlines so that learners can view flight control systems on full-size aircraft.