CTRL H4614: Flight Dynamics and Control

Module Title:	Flight Dynamics and Control
Language of Instruction:	English

Credits:	10

NFQ Level:	8

Module Delivered In	No Programmes

Teaching & Learning Strategies:	The module will be delivered using lectures, tutorials and laboratory sessions to illustrate the concepts under study

Module Aim:	The aim of the module is the appraisal of an aircraft's performance and stability, in particular: • analysis of the performance of an aircraft. • analysis of the behaviour and control of dynamic systems. • design of control strategies to modify the responses of dynamic systems

Learning Outcomes	
On successful completion of this module the learner should be able to:	
LO1	Numerically analyse the performance and stability of an aircraft
LO2	Analyse the operation and performance of a feedback control system
LO3	Develop a mathematical model for commonly encountered engineering components and systems
LO4	Specify the performance characteristics of a control system
LO5	Design a control strategy in order to achieve the required system specifications
LO6	Recognise the importance of stability in feedback control

Pre-requisite learning
Module Recommendations *This is prior learning (or a practical skill) that is recommended before enrolment in this module.*
No recommendations listed
Incompatible Modules *These are modules which have learning outcomes that are too similar to the learning outcomes of this module.*
No incompatible modules listed
Co-requisite Modules
No Co-requisite modules listed
Requirements *This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.*
No requirements listed

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Module Content & Assessment

Indicative Content
Flight Dynamics Part A: n/a
Review of Flight Mechanics and the ISA Calculate relative density, relative pressure and relative temperature. Understand the Equation of state and Hydrostatic Equation Calculate Mach Number, Equivalent Airspeed, Calibrate Airspeed, True Airspeed
Weight Performance Calculate wing loading. Estimate the weight of an aircraft. Performance Range –v- Payload calculations
Drag Calculate the maximum lift to drag ratio. Calculate the minimum drag speed. Plot the Drag Polar (Appendix 2 to CS23)
Engine Performance Describe the Engine Flight Envelope Understand what effects General Engine Performance Determine fuel flows and specific fuel values. Derive and Calculate the propulsive Efficiency; Understand the thrust characteristics;
Performance Determine and aircraft's Absolute Ceiling; Calculate and aircraft's Optimal Speeds; Describe the Limiting factors on Flight Envelopes (CS23.333); Corner Velocities; Accelerated Stall lines; Structural limits; Calculate the Specific Range, Specific Endurance, Utilise the Breguet Range equations; Calculate take-off distance (CS23.59); Calculate landing distance (CS23.75);
Manoeuvres Calculate the stall speed. (CS23.39); Describe Speed stability; Calculate the max load factor in a turn (V-N Diagram) (CS23.337); Calculate the rate of turn; Calculate the minimum drag speed; Gliding; Landing;
Maintenance Test Flights Requirement for test / check flights (M.A.708); Flight test schedule; Briefing the flight crew;
Control Systems Part B: n/a
Review of control systems Reasons for using feedback; Applications of feedback control to aircraft systems; The design process;
Mathematical Modelling Mathematical modelling; Use of differential equations; Use of Laplace Transforms; Use of Matrices; Aircraft system transfer functions; Poles and zeros; Disturbance modelling; Aircraft and aircraft systems; Experimental methods; Block diagrams; Block diagram reduction; Disturbance inputs; Signal flow graphs;
Time response Transient and steady state responses; First and higher order responses; Time delay; Specifications;
Frequency response Frequency response specifications; System gain in dB; Bandwidth; Effect of system order; Resonance; Frequency response diagrams; Bode diagrams. First & higher order systems; Pure time delay; Closed loop frequency responses;
Servo Systems Components of a servo control system; Aircraft system responses to standard inputs and disturbance inputs; Design examples and component selection; Application areas – Aircraft systems;
Aircraft Stability and Control Analysis of system stability; Static and dynamic stability of aircraft; Contribution of aircraft components; Predict the lateral and longitudinal stability of an aircraft. (CS 23.173) Predict the directional, lateral and longitudinal dynamic stability . (CS 23.181); Determine the neutral point;
Sensitivity Open and closed loop systems; Parameter variations; Sensitivity functions;

Assessment Breakdown	%
Continuous Assessment	15.00%
Practical	15.00%
End of Module Formal Examination	70.00%

Continuous Assessment

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Examination	Students will be expected to sit a number of individual written assessments throughout the academic year, typically at the conclusion of one or more learning outcomes	1	5.00	Week 10
Examination	Students will be expected to sit a number of individual written assessments throughout the academic year, typically at the conclusion of one or more learning outcomes	2,3,4,5,6	7.50	Week 24
Project	Students will be required to undertake a short research project to examine the performance of aircraft.	1	2.50	n/a

No Project

Practical				
Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Practical/Skills Evaluation	Students will carry out a number of laboratory sessions throughout the academic year and will produce written reports describing each one. Students will be assigned to groups for the execution of the laboratory practical work but reports must be submitted on an individual basis. Laboratory practical work will investigate the following topics: o Control of servo mechanisms. o Computer simulation tools o Flight Stability	1,2,3,4,5,6	15.00	n/a

End of Module Formal Examination				
Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Formal Exam	n/a	1,2,3,4,5,6	70.00	End-of-Semester

SETU Carlow Campus reserves the right to alter the nature and timings of assessment

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Module Workload

Workload: Full Time		
Workload Type	*Frequency*	*Average Weekly Learner Workload*
Lecture	Every Week	3.50
Laboratory	Every Week	0.50
Independent Learning Time	Every Week	2.50
	Total Hours	6.50