Module specification

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Module Code	ENG5A7
Module Title	Flight Mechanics, Avionics and Control
Level	5
Credit value	20
Faculty	FAST
HECoS Code	100117
Cost Code	GAME

Programmes in which module to be offered

Programme title	Is the module core or option for this programme
BEng / MEng Aeronautical Engineering	Core

Pre-requisites

None

Breakdown of module hours

Learning and teaching hours	30 hrs
Placement tutor support	0 hrs
Supervised learning e.g. practical classes, workshops	0 hrs
Project supervision (level 6 projects and dissertation modules only)	0 hrs
Total active learning and teaching hours	30 hrs
Placement / work based learning	0 hrs
Guided independent study	170 hrs
Module duration (total hours)	200 hrs

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Initial approval date	22/08/2022
With effect from date	September 2022
Date and details of revision	
Version number	1

Module aims

- To develop an understanding of the principles of flight mechanics, aircraft motion measurement and control and sensors and actuator for aircraft control and guidance.
- To develop concepts of mathematical modelling in the area of control engineering and to extend established mathematical skills and thus to apply analytical methods to control system design implementation, particularly to aircraft control.

Module Learning Outcomes - at the end of this module, students will be able to:

1	Develop knowledge and skills to analyse flight dynamics, select and apply appropriate avionics sensors and transducers for the measurements of aircraft flight.
2	Analyse the functional structure of avionics systems within a modern aircraft and to define the performance of a component sub-system.
3	Apply mathematical techniques to analyse dynamic systems.
4	Design and modify a control system to meet a specified performance in the time domain and frequency domain using analytic, graphical, empirical and computer methods.

In addition to the module learning outcomes, students will also cover the following accreditation of higher education programme (AHEP) fourth edition learning outcomes: C1, C2, C3, C4, C13, M1, M2, M3, M4, and M13.

Assessment

Indicative Assessment Tasks:

This section outlines the type of assessment task the student will be expected to complete as part of the module. More details will be made available in the relevant academic year module handbook.

Assessment One: is by means of a written assignment (a report, 2000 words) of research, design and problem-solving tasks covering outcomes 1 and 2.

Assessment Two: is by means of an examination (2 hours) covering outcomes 3 to 4. It is an unseen time-constrained examination.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)
1	1, 2	Written Assignment	50%
2	3, 4	Examination	50%

Derogations

A derogation from regulations has been approved for this programme which means that whilst the pass mark is 40% overall, each element of assessment (where there is more than one assessment) requires a minimum mark of 30%.

Learning and Teaching Strategies

The module is taught through a combination of lectures and workshops. An active and inclusive approach is used to engage learners in the topics and will involve individual, group work and flipped learning experiences aligned to the university's Active Learning Framework (ALF). The approach offers students a flexible and adaptive learning experience that can accommodate a range of options that includes both on campus learning and remote learning where appropriate.

The Moodle VLE and other on-line materials and resources will be available to support learning. ALF offers a balance between the classroom elements and digitally enabled activity incorporating flexible and accessible resources and flexible and accessible feedback to support learning.

Indicative Syllabus Outline

Flight Dynamics Principles: Aerodynamic forces, lift and drag, control surfaces, aircraft handling and flying qualities, aircraft stability; Aircraft modelling for control, Longitudinal Dynamics, Lateral Dynamics.

Principles of Flight Instruments: altimeter, VSI, air speed indicator, Mach number, Compressibility, density errors, IAS, TAS. Attitude Indicator, Direction Indicator, Radio Magnetic Indicator (RMI), Magnetic variation and deviation, Turn Coordinator.

Navigation and Guidance: Inertial Navigation, terrestrial radio navigation (NDB, VOR, DME, ILS), satellite radio navigation (GPS), multi-sensor navigation (Doppler/INS, GPS/INS).

Elements of Flight Control Systems: sensors, actuators and control laws; stability augmentation, attitude control and navigation and guidance.

Systems Modelling and Analysis: System models of Aero/Mech systems; open and closed loop systems; similarities of models from different systems; Laplace transform solutions for step, ramp and sinusoidal inputs; transfer functions and characteristic equations; block diagram algebra; poles and zeros.

Time Domain and frequency Domain Analysis: Performance criteria; steady state and transient response; stability criteria; Routh Hurwitz stability criterion; system class and steady state errors for standard input functions; final value theorem; proportional, integral and derivative control; PID control system tuning; Bode diagrams; gain and phase margins; correlation between frequency response and transient response parameters; Bode diagram based control system analysis and design; use of computer software for the above.

Indicative Bibliography:

Please note the essential reads and other indicative reading are subject to annual review and update.

Essential Reads

R.C. Dorf, and R.D. Bishop, *Modern Control Systems*, 14th ed. Pearson, 2021.

Other indicative reading

R.P.G. Collinson, *Introduction to Avionics Systems*, 3rd ed. Springer, 2013.

C.R. Spitzer, *Digital Avionics Handbook*, 2nd ed. CRC Press, 2013.

S. Attaway, *Matlab: A Practical Introduction to Programming and Problem Solving*, 2nd ed. Butterworth-Heinemann, 2011.

Employability skills – the Glyndŵr Graduate

Each module and programme is designed to cover core Glyndŵr Graduate Attributes with the aim that each Graduate will leave Glyndŵr having achieved key employability skills as part of their study. The following attributes will be covered within this module either through the content or as part of the assessment. The programme is designed to cover all attributes and each module may cover different areas.

Core Attributes

Engaged
Creative
Ethical

Key Attitudes

Commitment
Curiosity
Resilience
Confidence
Adaptability

Practical Skillsets

Digital Fluency
Critical Thinking
Communication