

Module specification

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Module Code	ENG780
Module Title	Advanced Flight Mechanics & Control
Level	7
Credit value	20
Faculty	FAST
HECoS Code	100114
Cost Code	GAME

Programmes in which module to be offered

Programme title	Is the module core or option for this programme
MSc Engineering (Aeronautical) MSc Engineering (Aeronautical) with Advanced Practice MEng Aeronautical Engineering	Core

Pre-requisites

None

Breakdown of module hours

Learning and teaching hours	20 hrs
Placement tutor support	0 hrs
Supervised learning e.g., practical classes, workshops	10 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	160 hrs
Module duration (total hours)	200 hrs

For office use only	
Initial approval date	22 nd Aug 2022
With effect from date	Sept 2022
Date and details of revision	
Version number	1

Module aims

Develop a critical understanding of the performance and sustainability requirements of modern aircraft on flight mechanics and control. Critically analyse flight mechanics, static and dynamic stability, and utilise modern control approaches for flight control systems design.

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

In addition to the module learning outcomes, students will also cover the following accreditation of higher education programme (AHEP) fourth edition learning outcomes: **M1 & M2**

1	Critically evaluate and predict the performance and sustainability requirements on modern aircraft and critically understand the modern perspectives on flight mechanics and control, aircraft performance and design.
2	Analyse and develop the flight dynamic model of a rigid aircraft with respect to body/stability axes; Critically analyse aircraft dynamic performances and stabilities.
3	Critically evaluate and effectively use a range of classical and modern control systems algorithms in the design of aircraft stability augmentation systems, attitude control systems and guidance systems.

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: A time constrained examination covering all learning outcomes. Analytical and descriptive problem-based questions proposed, the student will not have the choice in the questions to be answered to fully assess the whole learning outcomes. Assessment one is a written examination (3 hrs.) and represents 100% of the overall module mark

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)
1	1-3	Examination	100%

Derogations

Credits shall be awarded by an assessment board for those Level 7 modules in which an overall mark of at least 50% has been achieved with a minimum mark of 40% in each assessment element

Learning and Teaching Strategies

The module will be delivered through detailed presentations combined with interactive sessions to enhance students' learning. Flight simulator will be used for covering aspects of flying characteristics, flight procedures, and propulsion system management. The learning

experience will be further supported by tutorials and self-study work and case studies of world significance. This module will also follow the ALF (Active Learning Framework) guidelines, which will include alternative methods of assessment and a blended approach to delivery, with some theory and software sessions being delivered online (depending on requirements and student experience).

Indicative Syllabus Outline

- Modern perspectives on flight mechanics and control, aircraft configuration, modern aircraft powerplant, electrical aircraft, aircraft performances and design, sustainability in aviation.
- Flight mechanics, aerodynamic forces and moments on an aircraft, aerodynamic coefficients and their derivatives, longitudinal dynamics, lateral dynamics, the effects of aerodynamic coefficients and their derivatives on flight dynamics.
- Equations of motion of a rigid aircraft, axis systems used in modelling flight dynamics, analysing flight dynamic performance, and designing flight guidance and control systems, stability derivatives and stability analysis.
- Flight control systems, configuration of flight control systems, primary and secondary control surfaces, power control unit and power assistant unit, fly-by-wire, fly-by-light, control configured vehicle, flight director, flight control computer.
- Stability and guidance control, flying qualities and handling qualities, stability augmentation systems, longitudinal and lateral guidance control systems, navigational aids coupling into flight control systems, cross-coupling parameters affecting overall performance, use of modern control approaches for stability and guidance control system design.
- Case studies: problems of integration, examples of failed designs.

Indicative Bibliography:

Essential Reads

R. Stengel, *Flight Dynamics*. Princeton University Press, 2015.

Other indicative reading

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

A. L'Afflitto, *A Mathematical Perspective on Flight Dynamics and Control*. Springer, 2017.

B. W. McCormick, *Aerodynamics, Aeronautics and Flight Mechanics*. John Wiley and Son, 2006.

C. S. Chin, *Computer-Aided Control Systems Design: Practical Applications Using MATLAB and Simulink*. CRC Press, 2014.

The Aeronautical Journal RAeS

Journal of Aircraft AIAA

Plus, various others to be signposted on Moodle.

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

Adaptability

Practical Skillsets

Digital Fluency

Critical Thinking

Emotional Intelligence

Communication