Module specification

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Module Code	ENG6A7
Module Title	Aircraft Design & Flight Stability
Level	6
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
BEng (Hons) Aeronautical Engineering	Core
MEng Aeronautical Engineering	Core

Pre-requisites

N/A

Breakdown of module hours

Learning and teaching hours	24 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	24 hrs
Placement / work based learning	0 hrs
Guided independent study	176 hrs
Module duration (total hours)	200 hrs

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Initial approval date	22 Aug 2022
With effect from date	Sept 2022
Date and details of revision	

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Version number	1

Module aims

- To develop comprehensive understanding on the issues relating to modern aircraft design and to conduct critical analysis and evaluation on aircraft design.
- To develop an understanding of the basic principles of Aircraft Flight Dynamics, Longitudinal and Lateral Dynamic Stability, Control and Guidance, including current and emerging developments

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

1	Use a detailed knowledge of the shapes of various sections of the flight vehicle in order to transform given data into novel design solutions for aircraft.
2	Critically evaluate the major design considerations of a modern aircraft; engineering professional codes of conduct and ethical conduct in aviation, air worthiness legislation, reliability, operation risks, environmental and commercial risks, health and safety.
3	Apply the equations of motion of a rigid Aircraft referred to moving axes; develop and apply Aerodynamic Derivatives for Longitudinal and Lateral Dynamic Stability. Analyse modern control and guidance.
4	Analyse aircraft performance using aircraft flying and handling qualities specifications.

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.

The assessment of this module consists of two parts:

1. Written Assignment – Candidates will conduct investigation on topics about aircraft design and a written report will be submitted for the assessment. The candidate's word count is 2000 words.
2. Exam – At the end of semester, candidates will sit in an unseen written exam. This exam will have a 2hr duration

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 will be presented to students through a series of lectures, tutorials and case studies utilising laboratory equipment where appropriate. Use of computer packages, including specially developed computer software from within the department such as the Flight Simulator, will be used to aid learning. Relevant video material will be used to strengthen topics from within the module. This module maybe undertaken synchronously, or asynchronously, and could be delivered face to face, or via online methods.

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

Equations of motion of a rigid aircraft referred to moving axes: General dynamic equation for a rigid aircraft referred to moving axes. Equation of motion for small disturbances of a symmetric aircraft. Axis system to be used in stability analysis. Apply the non-dimensional form of the equations of motion.

Longitudinal and lateral aerodynamic derivatives of an aircraft: Derivatives due to: force velocity, pitching moment, rates of change, sideslip, rate of roll, rate of yaw. Non dimensional forms of derivatives. Apply the general solution of the equations of motion. Dynamic stability criteria. Analyse the roots of the characteristic equation. Stability aspects of high-speed aircraft.

Handling and Flying Qualities: Definitions and main difference between handling and flying qualities. Flying qualities specifications of aircraft performance. Stability analysis. Aircraft Flight Control Systems Design: Stability Augmentation Systems. Pitch attitude control. Roll attitude control. Flight path control and guidance.

Aircraft configuration design: Effect of aerofoil section shape in both supersonic and subsonic flow. The unswept wing and the swept wing (forward and backward) and effects of leading and trailing edges. Relaxed Static Stability and Control-Configuration Vehicle in modern aircraft design.

Case studies: impacts of economic, operation, maintenance; social, economic, commercial and ethical issues in aircraft design; health and safety, system reliability and operation risk assessment, commercial and environmental risks.

Indicative Bibliography:

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

Essential Reads

D.P. Raymer, *Aircraft Design – A Conceptual Approach (AIAA Educational Series)*, 6th Ed. AIAA, (2018)

Other indicative reading

M.V. Cook, *Flight Dynamics Principles: A Linear Systems Approach to Aircraft Stability and Control (Aerospace Engineering),* 3rd ed. Butterworth-Heinemann, 2012.

J.D. Anderson, *Fundamentals of Aerodynamics*. McGraw-Hill, 2011.

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

J. Roskam, *Airplane Flight Dynamics and Automatic Flight Controls*. DAR Corporation, 2003.

I.H. Abbot and A.E. Von Doenhoff, *Theory of Wing Sections*, Dover Publications Inc, 1960.

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
Enterprising
Creative
Ethical

Key Attitudes
Commitment
Curiosity
Resilience
Confidence
Adaptability

Practical Skillsets
Digital Fluency
Organisation
Leadership and Team working
Critical Thinking
Emotional Intelligence
Communication