Wrexham glyndŵr UNIVERSITY

MODULE SPECIFICATION

Module Title:	**Aircraft Stability, Control, and Design**	**Level**:	6	**Credit Value**:	20

Module code:	ENG60K	**Is this a new module?**	Yes	**Code of module being replaced**:	ENG698

Cost Centre(s):	GAME	**JACS3 code**:	H660

Trimester(s) in which to be offered:	1, 2	**With effect from:**	September 18

School:	Faculty of Arts, Science and Technology	**Module Leader:**	Dr Z Chen

Scheduled learning and teaching hours	60 hrs
Guided independent study	140 hrs
Placement	0 hrs
Module duration (total hours)	200 hrs

Programme(s) in which to be offered	Core	Option
BEng (Hons) Aeronautical and Mechanical Engineering	☐	✓☐

Pre-requisites
None

Office use only
Initial approval: February 17
APSC approval of modification: September 18 Version: 1
Have any derogations received Academic Board approval? Yes √ No ☐ N/A ☐
If new module, remove previous module spec from directory? Yes ☐ No ☐

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MODULE SPECIFICATION

Module Aims
1. 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. 2. To develop comprehensive understanding on the issues relating to modern aircraft design and to conduct critical analysis and evaluation on aircraft design.

Intended Learning Outcomes

Key skills for employability

KS1	Written, oral and media communication skills
KS2	Leadership, team working and networking skills
KS3	Opportunity, creativity and problem solving skills
KS4	Information technology skills and digital literacy
KS5	Information management skills
KS6	Research skills
KS7	Intercultural and sustainability skills
KS8	Career management skills
KS9	Learning to learn (managing personal and professional development, self-management)
KS10	Numeracy

At the end of this module, students will be able to		Key Skills	
1	Apply the equations of motion of a rigid Aircraft referred to moving axes; develop and apply Aerodynamic Derivatives for Longitudinal and Lateral Dynamic Stability;	KS5	KS10
2	Analyse aircraft performance using aircraft flying and handling qualities specifications;	KS5	
3	Design aircraft stability augmentation systems, attitude control systems and guidance systems.	KS3	KS6
4	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.	KS3	KS5
		KS6	
5	Critically evaluate the major design considerations of a modern airplane; engineering professional codes of conduct and ethical conduct in aviation, air worthiness legislation, reliability, operation risks, environmental and commercial risks, health and safety.	KS5	KS7

Transferable skills and other attributes

1. Apply technology;
2. Relate theory to applications;

3. Problem solving;
4. Mathematical applications.

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%.

Assessment:

The assessment of this module consists of two parts:

1. Exam – At the end of semester, candidates will sit in an unseen written exam.
2. Report – Candidates will conduct investigation on topics about aircraft design and a written report will be submitted for the assessment.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)	Duration (if exam)	Word count (or equivalent if appropriate)
1	1,2,3	Examination	50%	2 hours	
2	4,5	Report	50%		2000

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 aided packages from within the department, will be used to aid learning. Relevant video material will be used to strengthen topics from within the module.

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.

Bibliography:

Essential reading

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

Other indicative reading

McLean, D. (1992) Automatic Flight Control Systems, Prentice Hall.

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

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

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

McRuer, D.T. et al. (1973) Aircraft Dynamics and Automatic Control, Princeton University Press.

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