University of the West of Scotland

Module Descriptor

Session: 2024/25

Title of Module: Aeroelasticity			
Code: ENGG11049	**SCQF Level: 11 (Scottish Credit and Qualifications Framework)**	**Credit Points: 20**	**ECTS: 10 (European Credit Transfer Scheme)**
School:	School of Computing Engineering and Physical Sciences		
Module Co-ordinator:	Dr Bassam Rakhshani		

Summary of Module

This module intends to introduce students to the importance of aeroelastic phenomena and their implication on aircraft structural design and analysis. It addresses the level and types of aircraft structures interaction with elastic, inertial and aerodynamic forces. Students are familiarised with issues related to aeroelastic stability and response, concept of flexible aircraft, and static and dynamic aeroelastic problems such as; control reversal, divergence, flutter, and limit cycle oscillations. Also unsteady aerodynamic phenomena such as vortex shedding, and buffeting are discussed in- line with the aeroelastic stability of the aircraft structure.

Particular topics to be covered:

Structural and aerodynamic stiffness

Static aeroelasticity: static divergence of airfoil section/wing, adverse static aeroelastic effects and control reversal and effectiveness

Dynamic Aeroelasticity: aerodynamic loads on flexible /oscillating wing, gust response, types of flutter, solutions to flutter problem

Aeroelastic design (FSI): use of combined- mathematical model(s) (in the form of simulation package, e.g. CFD-FEA) to solve and model aerodynamic forces interacting with the (aircraft) structures and the structural dynamic response.

Experimental Aeroelastic: aeroelastic scaling, flutter test

During the course of this module students will develop their UWS Graduate Attributes (https://www.uws.ac.uk/current-students/your-graduate-attributes/); Universal: academic atributes (critical thinking and analytical & inquiring mind); professional attribute (research-mind) Work-Ready: academic attributes (knowledge of aeroelasticity and relevant ICT skills, problem solving). Successful: academic attribute (autonomous); personal attribute (resilient); professional attribute (driven).

This module has been reviewed and updated, taking cognisance of the University's Curriculum Framework principles. Examples of this are found within the module such as active and engaging module assessment which reflects industry design activities, learning synergies across modules and levels of study, recorded lecture content supporting students to organise their own study time and the use of real-world practical student generated data with to compare with and validate simulation activity developing digital

intelligence meta-skills.

Module Delivery Method					
Face-To-Face	**Blended**	**Fully Online**	**HybridC**	**Hybrid 0**	**Work-Based Learning**
☒	☐	☐	☐	☐	☐
See Guidance Note for details.					

Campus(es) for Module Delivery						
The module will **normally** be offered on the following campuses / or by Distance/Online Learning: (Provided viable student numbers permit) (tick as appropriate)						
Paisley:	Ayr:	Dumfries:	Lanarkshire:	London:	Distance/Online Learning:	Other:
☒	☐	☐	☐	☐	☐	

Term(s) for Module Delivery					
(Provided viable student numbers permit).					
Term 1	☐	Term 2	☒	Term 3	☐

Learning Outcomes: (maximum of 5 statements) At the end of this module the student will be able to:	
L1	Analyse the impact of aeroelastic effects on aircraft design and performance characteristics.
L2	Analyse and examine the occurrence and effect of flutter, divergence and control reversal on aircraft high-lift systems, and identify and utilise their associated aeroelastic parameters.
L3	Apply analytical, computational and experimental method to analyse a practical aeroelastic problem.

Employability Skills and Personal Development Planning (PDP) Skills	
SCQF Headings	During completion of this module, there will be an opportunity to achieve core skills in:
Knowledge and Understanding (K and U)	SCQF Level **11** Demonstrate and work with a broad and integrated knowledge and understanding of the scope, main areas, and boundaries of aircraft aeroelastic performance. A critical understanding of the principal theories, concepts and terminologies. Specific and detailed knowledge and understanding of the application, techniques and practices associated with aeroelastic analysis. Detailed knowledge and understanding of methods and techniques to solve a range of aeroelastic practical problems.
Practice: Applied Knowledge and Understanding	SCQF Level **11** Apply knowledge and understanding to develop computational and experimental analysis strategies for a certain range of aeroelastic problems. The ability to use a range of specialised skills, techniques/tools, practices and materials to obtain solutions to aeroelastic problems. Apply a range of specialised research outcomes and other techniques to advance understanding of the aeroelasticity phenomena. Plan, develop and use aeroelastic design tool (FSI) to assess aspects of aircraft aeroelastic design requirements. Select and critically evaluate technical literature and other sources of information to solve complex problems Use practical laboratory and workshop skills to investigate complex problems.
Generic Cognitive skills	SCQF Level **11** Undertaking, evaluating and assessing aeroelastic performance and design characteristics. Making judgements on appropriate analytical approaches and their findings. Being able to develop conceptual solutions and strategies to complex aeroelastic problems.

	The ability to practice and critically identify, analyse, conceptualise and define new ideas and concepts and their applications in aircraft aeroelastic design performance. Critically review, consolidate and extend knowledge, skills, practices and thinking in the field of aircraft aeroelasticity. Bringing information together from a variety of sources during problem solving and being able to perceive potential problems with methods and strategies.	
Communication, ICT and Numeracy Skills	SCQF Level **11** Communicate and using appropriate methods to a range of audience with different levels of knowledge/expertise. Communicate with peers, more senior colleagues and specialists. Use a wide range of ICT applications to support and enhance work level 11 and show critical understanding of the scope and limitations of the tools used and their underlying theoretical basis. Undertake critical evaluations of a wide range of numerical and graphical data with the ability to deal with situations involving missing data and lack of information using research.	
Autonomy, Accountability and Working with others	SCQF Level **11** Exercise high level of autonomy and initiative in professional and equivalent activities with the ability to work independently on significant and demanding tasks. Take responsibility for own work and/or significant responsibility for the work of others providing leadership. Take responsibility for a significant range of resources. Demonstrate leadership and/or initiative and make an identifiable contribution to change and development Practise in ways which draw on critical reflection on own and others' roles and responsibilities. Deal with complex ethical and professional issues in engineering context and make informed judgements on issues not addressed by current professional and/or ethical codes or practices.	
Pre-requisites:	Before undertaking this module the student should have undertaken the following:	
	Module Code:	**Module Title:**

	Other:	
Co-requisites	**Module Code:**	**Module Title:**

*Indicates that module descriptor is not published.

Learning and Teaching	
The learning and teaching activity for this module will be a combination of lectures, online materials, class-based tutorials, computer laboratory sessions, guided independent study, and through a flipped classroom approach in some topic areas. Independent study includes all study, learning, and processing undertaken by a student, outside of the scheduled classes. This is a Level 11 Masters Level module, and the students are expected to work more independently and with relatively less instruction and guidance from the lecturers. Students will be highly encouraged and directed to review relevant research papers with the aim to develop and/or complement an in-depth knowledge of the topics with the possibility of developing research ideas.	
Learning Activities During completion of this module, the learning activities undertaken to achieve the module learning outcomes are stated below:	**Student Learning Hours** (Normally totalling 200 hours): (Note: Learning hours include both contact hours and hours spent on other learning activities)
Lecture/Core Content Delivery	12
Tutorial/Synchronous Support Activity	24
Independent Study	164
	Hours Total 200

****Indicative Resources: (eg. Core text, journals, internet access)**
The following materials form essential underpinning for the module content and ultimately for the learning outcomes: R.L. Bisplinghoff, H. Ashley, and R.L. Halfman (1955). Aeroelasticity. J.R. Wright and J.E. Cooper, (2007). Introduction to Aircraft Aeroelasticity and Loads. D.H.Hodges and G.A. Pierce (2014). Introduction to Structural Dynamics and Aeroelasticity. MATLAB/SIMULINK Programs or equivalent for Vibration, Flutter and Manoeuvres and Gusts

(**N.B. Although reading lists should include current publications, students are advised (particularly for material marked with an asterisk*) to wait until the start of session for confirmation of the most up-to-date material)

Attendance and Engagement Requirements
In line with the Student Attendance and Engagement Procedure: Students are academically engaged if they are regularly attending and participating in timetabled on-campus and online teaching sessions, asynchronous online learning activities, course-related learning resources, and complete assessments and submit these on time.

Equality and Diversity
The University's Equality, Diversity and Human Rights Procedure can be accessed at the following link: UWS Equality, Diversity and Human Rights Code.
(N.B. Every effort will be made by the University to accommodate any equality and diversity issues brought to the attention of the School)

Supplemental Information

Divisional Programme Board	Engineering and Physical Sciences
Assessment Results (Pass/Fail)	Yes ☐No ☒
School Assessment Board	Engineering
Moderator	Tony Murmu
External Examiner	E Tingas
Accreditation Details	This module is part of the IMechE accredited programmes BEng/Meng (Hons) Aircraft Engineering.
Changes/Version Number	1.12 (was 1.11) Module Delivery Changed to Face-To-Face from Blended & Face-To-Face

Assessment: (also refer to Assessment Outcomes Grids below)
Assessment 1 – Unseen Open book examination 70% of the final mark.
Assessment 2 - A coursework 30% of the final mark.
(N.B. (i) **Assessment Outcomes Grids** for the module (one for each component) can be found below which clearly demonstrate how the learning outcomes of the module

will be assessed.
(ii) An **indicative schedule** listing approximate times within the academic calendar when assessment is likely to feature will be provided within the Student Module Handbook.)

Assessment Outcome Grids (See Guidance Note)

Component 1					
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Unseen Open Book	✓	✓	✓	70	2

Component 2					
Assessment Type (Footnote B.)	**Learning Outcome (1)**	**Learning Outcome (2)**	**Learning Outcome (3)**	**Weighting (%) of Assessment Element**	**Timetabled Contact Hours**
Essay			✓	30	0
Combined Total for All Components				**100%**	**2 hours**