Module Specification

Aero-Elasticity

Version: 2026-27, v7.0, Approved

Contents

Part 1: Information

Module title: Aero-Elasticity

Module code: UFMEWC-15-M

Level: Level 7

For implementation from: 2026-27

UWE credit rating: 15

ECTS credit rating: 7.5

College: College of Arts, Technology and Environment

School: CATE School of Engineering

Partner institutions: None

Field: Engineering, Design and Mathematics

Module type: Module

Pre-requisites: Aero Structures 2026-27

Excluded combinations: None

Co-requisites: None

Continuing professional development: No

Professional, statutory or regulatory body requirements: None

Part 2: Description

Overview: The module examines aeroelasticity and its implications for aircraft design. Students will learn both theoretical and experimental methods to model, predict, and validate aeroelastic effects, integrating them into the engineering design process.

Features: Not applicable

Educational aims: The aim of this module is to equip students with a comprehensive understanding of aeroelastic phenomena, including flutter and divergence. It integrates theoretical principles with computational and experimental methods. Additionally, the module aims to develop the skills necessary to model, predict, and validate the dynamic behaviour of aircraft structures when subjected to aerodynamic loading.

Outline syllabus: Topics covered likely to include but not limited to:

Flutter and divergence modelling. Flutter and divergence speed prediction. 2 D.O.F. flutter equation, Classical equations to predict flutter speeds. Structural modes, Eigen-problem solution. Aeroelastic frequencies, damping ratios and mode shapes calculation using eigenvalues and eigenvectors.

Aerodynamic modelling and static aeroelasticity: Static divergence and Control reversal. Strip theory. Unsteady aerodynamics: Theodorsen model. Aerodynamic stiffness and damping ratio.

Structural modelling: Stiffness properties, Calculation of wing modes and inertias. Effects of mass, flexural axis, frequency parameter, and density on the flutter solution. Structural damping modelling. Lagrangian equations, torsional and bending beam theory. Bending and torsion coupling. Euler-Bernoulli Finite Element model.

Experimental: Ground Vibration Tests. Introduction to Operational and Experimental Modal Analysis. Eigenfunction Realisation Algorithm (ERA). Structural System Identification Methods for Structural Properties. Stabilisation Diagrams.

Part 3: Teaching and learning methods

Teaching and learning methods: Students will learn through a combination of formal lectures and tutorial sessions. The lectures will focus on delivering key concepts of the aeroelasticity discipline, while tutorials will demonstrate to students how to numerically and computationally predict aeroelastic behaviours. The module will also include lab sessions that focus on practical applications of experimental aerodynamics.

Module Learning outcomes: On successful completion of this module students will achieve the following learning outcomes.

MO1 Apply experimental and numerical methods to identify wing structural properties for aeroelastic modelling.

MO2 Apply the principles of aeroelasticity to predict the structural response of an aircraft to elastic, inertial and unsteady aerodynamic loads, including the estimation of flutter and divergence speeds

Hours to be allocated: 150

Contact hours:

Independent study/self-guided study = 114 hours

Staff-guided learning = 36 hours

Reading list: The reading list for this module can be accessed at readinglists.uwe.ac.uk via the following link https://uwe.rl.talis.com/index.html

Part 4: Assessment

Assessment strategy: The final assessment will consist of a 20-minute presentation structured as an industrial report in which the student will explain and detail the numerical and experimental aeroelastic analysis of a wing. The wing model will be provided to the student in the coursework brief, and a physical model will be available for experimental testing.

The presentation will be followed by a Q&A session in which the student will be asked to demonstrate their understanding of the aeroelastic discipline while answering questions about the work presented in the slides.

The resit assessment will be the same as the first sit.

Assessment tasks:

Presentation (First Sit)
Description: 20-minute presentation on the aeroelastic modelling of the wing, followed by a 40-minute Q&A session.
Weighting: 100 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2

Presentation (Resit)
Description: 20-minute presentation on the aeroelastic modelling of the wing, followed by a 40-minute Q&A session.
Weighting: 100 %
Final assessment: Yes
Group work: No
Learning outcomes tested: MO1, MO2

Part 5: Contributes towards

This module contributes towards the following programmes of study:

Aerospace Engineering (Design) [Sep][PT][Frenchay][8yrs] MEng 2019-20

Aerospace Engineering with Pilot Studies [Frenchay] MEng 2023-24

Aerospace Engineering [Frenchay] MEng 2023-24

Aerospace Engineering [Frenchay] MEng 2023-24

Aerospace Engineering with Pilot Studies [Frenchay] MEng 2023-24

Aerospace Engineering with Pilot Studies [Frenchay] MEng 2022-23

Aerospace Engineering with Pilot Studies [Frenchay] MEng 2023-24

Aerospace Engineering [Frenchay] MEng 2022-23

Aerospace Engineering [Frenchay] MEng 2023-24

Aerospace Engineering with Pilot Studies [Frenchay] MEng 2022-23

Aerospace Engineering [Frenchay] MEng 2022-23

Aerospace Engineering with Pilot Studies [Frenchay] MEng 2023-24

Aerospace Engineering [Frenchay] MEng 2023-24

Aerospace Engineering [Sep][PT][Frenchay][8yrs] MEng 2019-20

Aerospace Engineering [Frenchay] MEng 2022-23

Aerospace Engineering with Pilot Studies [Frenchay] MEng 2022-23