MNE4202: AEROELASTICITY

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Aeroelasticity

Subject Code
MNE - Mechanical Engineering
Course Number
4202

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MNE2109 Engineering Mechanics

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Additional Information
#Prerequisites which are not part of the Major Requirement are waived for students admitted with Advanced Standing.

Part II Course Details

Abstract

This course introduces the student to the principles of static and dynamic aeroelasticity. The students are provided with knowledge of the dynamics of slender members with aerodynamic forces present and methodologies for modelling static and dynamic aeroelastic effects such as divergence, reversal and flutter.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand the fundamental principles involved in static and dynamic aeroelasticity and to be able to develop simple models for describing divergence, reversal and flutter.			x	
2	To model continuous structures under bending and torsion and appreciate the effects of aerodynamic forces on continuous slender members such as aircraft wings and how these effects can be controlled.			x	
3	Demonstrate problem solving skills and derive solutions for tasks linked to the modelling of aeroelastic effects on aerospace structures.			x	
4	Present results, analyses and conclusions from experiments or simulations in a written report such that a technically qualified person can obtain a clear understanding of the findings.			x	

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	This includes a combination of lectures, tutorial classes and case studies on modelling continous structures, static and dynamic aeroelasticity and the critical aspects such as divergence and flutter.	1, 2, 3	3 hrs/week

2	Laboratory	Students will carry out laboratory exercises to study the onset of key aeroelastic phenomena and these will be reported in the form of a short and concise technical report.	3, 4	3 hrs/week for 2 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Assignments	1, 2, 3	20	2-3 assignments to be submitted.	Yes
2	Laboratory Reports	3, 4	20	2 reports to be submitted	Yes

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

3

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Assessment Rubrics (AR)

Assessment Task

Assignments

Criterion

To carry out studies of aeroelastic instabilities such as divergence and flutter and to investigate how these can be tested and controlled.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Laboratory Reports

Criterion
Ability to explain and interpret the results from practical exercises involving aeroelastic effects on slender members and aerofoil sections.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Assessment Task
Examination

Criterion
Demonstrate an understanding of the effects of aerodynamic forces on structures such as divergence, reversal and flutter, the significance of these and how these effects can be controlled and how to model continuous systems members under bending and torsion.

Excellent (A+, A, A-)
High

Good (B+, B, B-)
Significant

Fair (C+, C, C-)
Moderate

Marginal (D)
Basic

Failure (F)
Not even reaching marginal levels

Additional Information for AR

Note: For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Part III Other Information

Keyword Syllabus

Rayleigh Ritz 'assumed shapes' method for modelling continuous systems members under bending and torsion, Static elasticity: effect of wing flexibility on lift distribution and divergence for a cantilever wing/ effect of trim, Effect of wing flexibility on control surface effectiveness and reversal, Introduction to quasi-steady and unsteady aerodynamics, Lift and Pitching moment for an aerofoil oscillating in heave and pitch-Theodorsen function, Dynamic aeroelasticity: flutter of a binary cantilever wing model, flutter speed prediction, Control surface flutter, Flutter testing, Case studies.

In addition to the examination and in-class test, students are required to learn through collaborative lab sessions in order to improve their understanding on strategic thinking, problem solving, team working processes, the relationships and interactions between the fields of knowledge that they have learnt in this and other courses.

Reading List

Compulsory Readings

	Title
1	Introduction to Aircraft Aeroelasticity and Loads, J Wright and J Cooper, 2nd edition, Wiley.

Additional Readings

	Title
1	Aeroelasticity, an introduction to fundamental problems, T Weisshaar, 3rd edition, 1995.