MNE4201: AERODYNAMICS

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Aerodynamics

Subject Code
MNE - Mechanical Engineering
Course Number
4201

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
MNE3122 Fluid 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

The purpose of this course is to provide an in-depth understanding of the physics of aerodynamics by using the features from a two dimensional (2D) aerofoil through to an actual aircraft wing such that the student has the knowledge to describe the key elements involved in different flight regimes and hence the design requirements for efficient flying configurations.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand the underlying physics and fundamental aerodynamic behaviour of the flow around a standard two dimensional (2D) aerofoil and to describe the key features such as centre of pressure, lift, drag, pitching, stall.			x	
2	To be able to evaluate the forces and moments generated on 2D aerofoils, finite wings at subsonic and supersonic flight regimes.			x	
3	Formulate solutions using relevant principles for the aerodynamic performance of aircraft in flight.			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 and tutorial classes on aerodynamics accompanied by in-class problem solving sessions.	1, 2, 3	3 hrs/week

2	Laboratory	Students will carry out practical laboratory exercises to practise real aerodynamic measurements on 2D aerofoils at subsonic speeds via wind tunnel experiments. 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 (e.g. Parameter for GenAI use)
1	Assignments	1, 2, 3	10	2-3 assignments to be submitted.
2	Test	1, 2, 3	10	1 test will be given
3	Laboratory Reports	3, 4	20	2 reports to be submitted

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

3

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

Test and Assignments

Criterion

Describe the underlying physics for the aerodynamics of finite wings and 2D aerofoils and apply them to solve problems with given principles.

Excellent (A+, A, A-)

75%-100%

Good (B+, B, B-)

60%-74%

Fair (C+, C, C-)

45%-59%

Marginal (D)

40%-44%

Failure (F)
<40%

Assessment Task
Laboratory Reports

Criterion
Ability to explain the methodology and procedures used and analyse the experimental data, discuss the experimental findings with concise conclusions.

Excellent (A+, A, A-)
Strong evidence of critical thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge of the experimental matters concerned.

Good (B+, B, B-)
Evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with experiment.

Fair (C+, C, C-)
Student who is profiting from the laboratory class; understanding of the subject; ability to develop solutions to concerning the experiment.

Marginal (D)
Sufficient familiarity with the laboratory content to enable the student to move onto other laboratory materials.

Failure (F)
Little evidence of familiarity with the laboratory class materials; weakness in critical and analytic skills; limited, or irrelevant use of data.

Assessment Task
Examination

Criterion
Demonstrate an understanding of the fundamental aerodynamic behavior of aerofoils and wings and to solve problems relating to the design and flight behaviour of aerospace vehicles.

Excellent (A+, A, A-)
Strong evidence of original thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge base.

Good (B+, B, B-)
Significant evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with course matter.

Fair (C+, C, C-)
Student is profiting from the university experience; understanding of the aerodynamics; ability to develop solutions to simple problems in the course.

Marginal (D)
Basic familiarity with the subject matter to enable the student to progress without repeating the course.

Failure (F)

Little evidence of familiarity with the subject matter; weakness in critical and analytic skills; very limited demonstration of correct use knowledge in aerodynamics.

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

International Standard Atmosphere, Dynamic pressure, Mach number, Reynolds number, Aerodynamic behaviour of a 2D aerofoil, Aerodynamic behaviour of a 3D wing, Potential flow aerodynamics, Thin 2D aerofoil theory, Vortex Lattice panel method for a 3D wing, Boundary layers, An introduction to the aerodynamics of supersonic wings/aerospace vehicles.

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	Fundamentals of Aerodynamics , J Anderson, 6th edition, McGraw-Hill.

Additional Readings

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