Course guide
240649 - 240649 - Aerodynamics

Last modified: 17/06/2025

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 729 - MF - Department of Fluid Mechanics.

Degree: BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2025 **ECTS Credits:** 4.5 **Languages:** English

LECTURER

Coordinating lecturer: Alexandre Presas

Others: Alexandre Presas

PRIOR SKILLS

Basic knowledge on physics and mechanics

TEACHING METHODOLOGY

In the first part of the course, the basic concepts of aerodynamics will be taught. The second part of the course will consist of problems and analysis of real cases. In the last part, the most important elements that define an airfoil will be studied and simulated using CFD. The first part will have more theoretical content, the second will focus more on case resolution, and the last will be entirely practical. At the end of the practical work, the main results obtained must be presented.

LEARNING OBJECTIVES OF THE SUBJECT

The aim of the subject is to introduce the student to the world of aerodynamics with the most important applications in engineering: aviation, automotive transport. The main phenomena that take place in the two cases will be considered from a conceptual and very practical point of view, although laying the fundamental theoretical concepts.

STUDY LOAD

Type	Hours	Percentage
Self study	67,5	60.00
Hours large group	22,5	20.00
Hours small group	22,5	20.00

Total learning time: 112.5 h

CONTENTS

T1 General introduction to aerodynamics

Description:
In this subject we will make a brief review on the history, trends, techniques and fields of application of aerodynamics

Full-or-part-time: 1h 30m
Theory classes: 1h 30m

T2 Brief introduction to Flight mechanics

Description:
We will learn the general framework of aerodynamics, and we will describe the basic concepts behind forces, moments and stability in flight mechanics

Full-or-part-time: 4h 30m
Theory classes: 4h 30m

T3 Profile theory

Description:
In this subject, we will learn the basic but effective and useful theory behind aerodynamic profiles. We will learn simple formulas and the effects of modifications such as flaps, slats, and spoilers.

Full-or-part-time: 6h
Theory classes: 6h

T4 Wings

Description:
We will analyze and understand the effects of having a finite wing instead of an airfoil. We will study its influence on lift and drag forces.

Full-or-part-time: 4h 30m
Theory classes: 4h 30m

T5 Drag

Description:
We will learn about the physical mechanisms that generate drag force and how bodies are optimized to be aerodynamically efficient.

Full-or-part-time: 4h 30m
Theory classes: 4h 30m

T6 Aerodynamic efficiency and application cases

Description:
We will use the acquired knowledge to discuss and solve cases applied to the real world

Full-or-part-time: 4h 30m
Theory classes: 4h 30m

T7 High seepd aerodynamics and compressible flows

Description:
We will see the fundamentals of high speed aerodynamics, compressible flows and the effects on aerodynamic design

Full-or-part-time: 4h 30m
Theory classes: 4h 30m

ACTIVITIES

CFD SIMULATION OF A FLOW AROUND A WING WITH DIFFERENT CONFIGURATIONS

Description:
In this activity we will simulate using CFD in some of the following cases: Influence of the finite wing, flaps, slats, spoilers and see the effects on the lift and the drag

Material:
Package ANSYS-FLUENT includes CAD program for manipulating geometry, meshing program to define the various points where the fluid equations have to be solved and simulation program to make the calculations and solve the problem. The program is available to students not only during classes but always throughout the school year . Necessary tutorials to get started with the program are also availables.

Delivery:
A report of maximum 5 pages will be made with conclusions and results and also an oral presentation of the results.

Full-or-part-time: 12h
Laboratory classes: 12h

GRADING SYSTEM

Final mark= 0.8*max(midterm exam, final exam)+0.2 CFD simulation

EXAMINATION RULES.

You can bring notes and a calculator to the exam.

BIBLIOGRAPHY

Basic:
- John D. Anderson. Fundamental of aerodynamics. 5th ed. Singapore: Mc Graw Hill, 2011. ISBN 9780073398105.
- Houghton, E.L.; Carpenter, P.W.; Collicott, Steven H.; Valentine, Daniel T. Aerodynamics for engineering students [on line]. 7th ed. Oxford: Butterworth-Heinemann, 2017 [Consultation: 12/09/2025]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=7263804. ISBN 9780081002322.
- Smith, Hubert. The illustrated guide to aerodynamics. 2nd ed. New York: TAB Books, 1992. ISBN 9780830639014.

RESOURCES

Other resources:
To follow the theory/exercises classes, the student has the corresponding presentations. For the CFD simulation, students will have the ANSYS educational license as well as a couple of basic tutorials.