ME-445 **Aerodynamics**

Mulleners Karen

Cursus	Sem.	Type
Mechanical engineering minor	H	Opt.
Mechanical engineering	MA1, MA3	Opt.
Space technologies minor	H	Opt.

Language of teaching	English
Credits	4
Session	Winter
Semester	Fall
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	2 weekly
Exercises	2 weekly
Number of positions	

Summary

This course will provide the fluid dynamic background to understand how air flows around two- and three-dimensional wings and bodies and to understand and calculate the aerodynamics forces and moments acting on the objects as a result of the air flow.

Content

INTRODUCTION:
- Basic concepts
- Definitions
- Fundamental equations

STEADY INVISCID INCOMPRESSIBLE FLOWS
- Potential flow
- Infinite wing theory
- Finite wing theory

VISCOUS INCOMPRESSIBLE FLOWS
- Drag
- Boundary layes and flow separation
- Flow control

Keywords

airfoil, lift, drag, unsteady aerodynamics, flow separation, flow control

Learning Prerequisites

Recommended courses

- Incompressible fluid mechanics
- Fluid flow
- Hydrodynamics

Learning Outcomes

By the end of the course, the student must be able to:

- Describe the physical behaviour of a flow in scientific terms, AH1

- Link flow behaviour with non-dimensional parameters (e.g. Reynolds and Mach numbers), AH2
- Describe the physical differences between laminar and turbulent flows, AH4
- Describe in detail the physical phenomena associated with the interaction of a flow with a solid wall (as a function of its characteristics, e.g. roughness), AH5
- Describe flow in simple geometries, such as over a flat plate, in a tube, or around a sphere or airfoil, AH9
- Work out / Determine the flight characteristics from a wing shape and chose a wing shape to provide the desired flight characteristics, AH10
- Describe 3D effects resulting, for example, from a finite wing span or behind a blunt body, AH11
- Solve analytically or numerically the potential flow around an airfoil, AH19
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Transversal skills

- Write a scientific or technical report.
- Make an oral presentation.

Teaching methods

- The course is in the form of a flipped classroom. Students must prepare for the classroom sessions by watching prerecorded videos.
- Weekly exercise sessions in presence of teacher and teaching assistance in the classroom.
- Weekly question & answer sessions with teacher in the classroom

Expected student activities

Attendance and participation in lectures and exercise sessions.
Group project on airfoil characterisation during the sememster.

Assessment methods

Written examination (70%)
Airfoil characterisation project with presentation during the semester (30%)

Supervision

Office hours	No
Assistants	Yes
Forum	No

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

• Fundamentals of Aerodynamics. John D Anderson. McGraw-Hill, 1985.
• Aerodynamics for Engineering Students. E L Houghton, P W Carpenter, Steven H Collicott, and Daniel T Valentine. Elsevier, sixth edition, 2013.

Ressources en bibliothèque

• Fundamentals of Aerodynamics / Anderson
• Aerodynamics for engineering students / Houghton

Moodle Link

• https://go.epfl.ch/ME-445

Videos

• https://mediaspace.epfl.ch/channel/ME-445%2BAerodynamics/30095