ME-445

Aerodynamics

Mulleners Karen

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

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 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 the aerodynamics forces and moments acting on the objects as a result of the air flow.

Content

INTRODUCTION:
- Basic concepts
- Definitions
- Fundamental equations

STEADY INCOMPRESSIBLE FLOW PAST WINGS AND BODIES
- Potential flow
- Infinite wing theory
- Finite wing theory

UNSTEADY AERODYNAMICS
- Flapping wing flight
- Rotary wing air vehicles and wind turbines

APPLIED AERODYNAMICS
- Flow control
- Wing design

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, AH11
- Work out / Determine the flight characteristics from a wing shape and chose a wing shape to provide the desired flight characteristics, AH12
- Describe 3D effects resulting, for example, from a finite wing span or behind a blunt body, AH13
- Solve analytically or numerically the potential flow around an airfoil, AH25

Teaching methods

Lectures, written exercises

Assessment methods

Written examination

Supervision

Office hours	Yes
Assistants	Yes

Resources

Bibliography

- Theory of Wing Sections. Ira H Abbott and Albert E von Doenhoff. Dover Publications, 1959.
- Fundamentals of Aerodynamics. John D Anderson. McGraw-Hill, 1985.
- Fundamentals of modern unsteady aerodynamics. U#lgen Gu#lc#at. Springer, second edition, 2016.
- Aerodynamics for Engineering Students. E L Houghton, P W Carpenter, Steven H Collicott, and Daniel T Valentine. Elsevier, sixth edition, 2013.
- Low-Speed Aerodynamics. Joseph Katz and Allen Plotkin. Cambridge University Press, 2001.
- An Introduction to Flapping Wing Aerodynamics. Wei Shyy. Cambridge aerospace series, April 2013.
- Aerodynamics of Wind Turbines. Martin O L Hansen. Taylor & Francis, 2012.

Ressources en bibliothèque

- Low-speed aerodynamics / Katz, Plotkin
- Fundamentals of Aerodynamics / Anderson
- Aerodynamics of wind turbines
- Fundamentals of modern unsteady aerodynamics / Gulçat
- Theory of wing sections / Abbott, von Doenhoff
- Aerodynamics for engineering students / Houghton