Course guide
220352 - 220352 - Advanced Aerodynamics

Last modified: 19/04/2023

Unit in charge:	Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit:	220 - ETSEIAT - Terrassa School of Industrial and Aeronautical Engineering.

Degree: MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN SPACE AND AERONAUTICAL ENGINEERING (Syllabus 2016). (Optional subject).

Academic year: 2023   **ECTS Credits:** 5.0   **Languages:** English

LECTURER

Coordinating lecturer: Manel Soria

Others: Arnau Miró

PRIOR SKILLS

A basic understanding of Navier-Stokes equations and familiarity with at least one computer language (C, Matlab, Python..) are required

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEEVEHI1. MUEA/MAS: Sufficient applied knowledge of advanced, experimental and computational aerodynamics (specific competency for the specialisation in Aerospace Vehicles).
CEEVEHI3. MUEA/MASE: Applied knowledge of composite materials technology and a capacity for designing the basic elements of these materials (specific competency for the specialisation in Aerospace Vehicles).
CEEVEHI2. MUEA/MAS: Sufficient applied knowledge of the aeroelasticity and structural dynamics of aircraft (specific competency for the specialisation in Aerospace Vehicles).

TEACHING METHODOLOGY

Lectures and hands-on sessions to solve problems with the help of computers

LEARNING OBJECTIVES OF THE SUBJECT

This course is an extension of previous subjects taught at the Degree and first Master course. It provides an introduction to the numerical solution of aerodynamics problems using Computational Fluid Dynamics. In addition to introduction to theoretical aspects such as turbulence models and turbulent boundary layers, the course also covers other aspects such as the use of modern supercomputers for aerodynamics, mesh generation, post-processing of the results or use of experimental data as a reference.

STUDY LOAD

Type	Hours	Percentage
Hours small group	15,0	12.00
Hours large group	30,0	24.00
Self study	80,0	64.00

Total learning time: 125 h

CONTENTS

Module 1: Introduction to turbulent flows for aerodynamics applications

Description:
-Review of governing equations
-Turbulence models for aerodynamics
-Turbulent boundary layers
-Airfoil aerodynamics
-Introduction to aeroacoustics
-Hands on: post-processing of turbulent airfoil flow data

Full-or-part-time: 41h
Theory classes: 10h
Practical classes: 5h
Self study : 26h

Module 2: High performance computing for aerodynamics applications

Description:
-Parallel algorithms for Navier-Stokes integration
-Case study: Poisson equation solvers
-Case study: Aeroacoustics
-Hands on: solving a turbulent flow with a parallel computer

Full-or-part-time: 41h
Theory classes: 10h
Practical classes: 5h
Self study : 26h

Module 3: Open-source CFD codes for aerodynamics applications

Description:
-Introduction to open-source CFD codes
-Overview of aerodynamics workflow
-Mesh generation
-Solving the flow with RANS/LES models
-Post-processing

Full-or-part-time: 43h
Theory classes: 10h
Practical classes: 5h
Self study : 28h

GRADING SYSTEM

Class participation and class exercises: 30%
Assignment: 30%
Project: 40%
Students with a grade below 5.0 in the project, or the assignments, or the classroom participation, will be able to take an additional written exam covering all the subject, that will take place in the date fixed in the calendar of final exams. The grade obtained in this exam will range between 0 and 10, and will replace the part or parts below 5.0 only in case it is higher, up to a maximum of 5.0 points. The additional exam will be done on the appointed day for the reconduction of bimonthly subjects in the academic calendar.

BIBLIOGRAPHY

Basic:

- Tennekes, Hendrik ; Lumley, John L. A first course in turbulence. Cambridge: MIT Press, 1972. ISBN 0262200198.
- Pope, Stephen B. Turbulent flows. Cambridge [etc.]: Cambridge University Press, 2000. ISBN 0521591252.

Complementary:

- Anderson, John D. Fundamentals of aerodynamics. 5th ed. New York: McGraw-Hill, 2011. ISBN 9780073398105.

BIBLIOGRAPHY