Last update: 05-10-2018

220352 - Advanced Aerodynamics

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 220 - ETSEIAT - Terrassa School of Industrial and Aeronautical Engineering
Academic year: 2018
Degree: MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Teaching unit Optional)
MASTER'S DEGREE IN SPACE AND AERONAUTICAL ENGINEERING (Syllabus 2016). (Teaching unit Optional)
ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: Roberto Flores

Prior skills

A basic understanding of low-speed aerodynamics is 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

- Theory lessons: During these lectures the teacher will introduce the theoretical basis, analysis methods and important results. Where appropriate, illustrative examples will be discussed to improve the student's understanding of the subject.

- Practice lessons: During the practice sessions the student will solve, under supervision of the teacher, review exercises in order to gain experience in the application of the analysis methods taught during the theoretical lectures.

- Exams: During the exam sessions the student will demonstrate his understanding of the theory and problem solving skills. There will be an exam for each of the course modules.

- Self-study: While the teacher will present a short overview of the subjects in the classroom, it remains the duty of the student to gain a more in-deep understanding by going over the recommended references. This is fundamental in order to acquire the necessary abilities of critical thinking and autonomous problem-solving.

Learning objectives of the subject

This course serves as an extension of the introductory aerodynamics subject taught to undergraduate students. Starting with a review of the foundations of low-speed aerodynamics, the students will be presented with an array of numerical techniques to obtain approximate solutions to real-world problems. The course focuses on inviscid flows, while also featuring a short introduction to the computation of viscous effects.

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Study load

Total learning time: 125h	Hours large group:	30h	24.00%
	Hours small group:	15h	12.00%
	Self study:	80h	64.00%

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Content

Module 1: Review of low speed aerodynamics	Learning time: 34h Theory classes: 8h Practical classes: 4h Self study : 22h

Description:
1. Review of the fundamentals of fluid dynamics:
- Basic equations
- Dimensionless parameters
- Incompressible potential flow

Related activities:
Theory lessons
Practice lessons
Module 1 exam

Module 2: Panel methods for low speed flows	Learning time: 66h Theory classes: 16h Practical classes: 8h Self study : 42h

Description:
- Green's theorem
- Low order and high order panel methods for airfoil analysis
- Lifting-line method for slender wings
- Panel methods for lifting surfaces
- Panel methods for arbitrary 3D shapes

Related activities:
Theory lessons
Practice lessons
Module 2 exam

Module 3: Introduction to viscous flow analysis	Learning time: 25h Theory classes: 6h Practical classes: 3h Self study : 16h
Description: - Boundary layer theory - Integral methods for boundary layer analysis Related activities: Theory lessons Practice lessons Module 3 exam	

Qualification system

In principle, the final course grade is a weighted average of the grades awarded in the exams of the 3 course modules. However, the final exam includes all the contents of the course, so it serves also as a retake for students whose average grade is not satisfactory. The final course grade shall be the maximum of the weighted average and the final exam result:

Final grade = MAX(Exam_3, Average_grade)
where
Average_grade = 0,30·Exam_1 + 0,35·Exam_2 + 0,35·Exam_3

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.
If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0.

Bibliography

Basic:

Katz, J.; Plotkin, A. Low-speed aerodynamics. 2nd ed. Cambridge: Cambridge University Press, 2001. ISBN 0521665523.

Complementary:

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