Last update: 23-04-2019

220124 - Fluid Dynamic Technologies in Vehicles

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

Teaching unit: 729 - MF - Department of Fluid Mechanics

Academic year: 2019

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

ECTS credits: 3 Teaching languages: English

Teaching staff

Coordinator: PEDRO JAVIER GAMEZ MONTERO - ROBERTO CASTILLA LOPEZ

Degree competences to which the subject contributes

Specific:

1. An understanding of, and skills for, the calculation, design and testing of machines.

2. An understanding of the basic principles of fluid mechanics and their application in solving engineering problems. The ability to calculate pipes, channels and fluid systems.
3. Applied knowledge of the fundamentals of fluid-mechanics systems and machines.

Teaching methodology

The course is divided into parts:
Theory classes
Practical classes
Self-study for doing exercises and activities.
In the theory classes, teachers will introduce the theoretical basis of the concepts, methods and results and illustrate them with examples appropriate to facilitate their understanding.
In the practical classes (in the classroom), teachers guide students in applying theoretical concepts to solve problems, always using critical reasoning. We propose that students solve exercises in and outside the classroom, to promote contact and use the basic tools needed to solve problems.
Students, independently, need to work on the materials provided by teachers and the outcomes of the sessions of exercises/problems, in order to fix and assimilate the concepts.
The teachers provide the curriculum and monitoring of activities (by ATENEA).

Learning objectives of the subject

At the end of the course, the student has to be able to:
Level 1 and 2:
- Describe the role of fluids on the road vehicles performance
- Explain the basic concepts associated with fluid technologies in road vehicles

Level 3
- Solve problems related to fluid flow in a road vehicle
- Use numerical and experimental tools for the analysis of fluid flows in a road vehicle

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Study load

Total learning time: 75h	Hours large group:	30h	40.00%
	Self study:	45h	60.00%

Content

Module 1: Introduction

Learning time: 15h

Theory classes: 5h
Self study : 10h

Description:
1.1 Review of fundamentals fluid dynamics concepts
1.2 Fluids in a vehicle
1.3 Aerodynamics of a vehcle

Module 2: Numerical techniques

Learning time: 32h

Theory classes: 12h
Self study : 20h

Description:

2.1 Introduction to CFD
2.2 Main numerical methods
2.3 Modellization of turbulence
2.4 Meshing

Module 3: Experimental techniques

Learning time: 28h

Theory classes: 10h
Self study : 18h

Description:
3.1 Wind tunnel
3.2 Anemometry
3.3 PIV

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Planning of activities

ACTIVITY 1: EXERCISES PROPOSED IN THEORY CLASSES	Hours: 30h Theory classes: 13h Self study: 17h

Description:
Simple exercises and problems proposed in the course documentation.

ACTIVITY 2: CONTROL 1	Hours: 5h Theory classes: 1h Self study: 4h

Description:
Control test made in theory class

ACTIVITY 3: CONTROL 2	Hours: 5h Theory classes: 1h Self study: 4h

Description:
Control test made in theory class

ACTIVITY 4: EXAM	Hours: 11h Theory classes: 3h Self study: 8h

Description:
Exam

ACTIVITY 5: LAB SESSION. INTRODUCTION TO CFD	Hours: 4h Theory classes: 2h Self study: 2h

Description:
Lab session for introduction to CFD

Support materials:
- CFD software
- Computer
- Course notes
- Lab sessions guide

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ACTIVITY 6: LAB SESSION. AERODYNAMICS OF AN AIRFOIL	Hours: 4h Theory classes: 2h Self study: 2h

Description:
The aerodynamics forces over a 2D airfoil will be calculated

Support materials:
· CFD software
· Computer
· Course notes
· Lab sessions guide

ACTIVITY 7: LAB SESSION. AERODYNAMICS OF A VEHICLE	Hours: 4h Theory classes: 2h Self study: 2h

Description:
The aerodynamics forces over a 3D vehicle will be calculated

Support materials:
· CFD software
· Computer
· Course notes
· Lab sessions guide

ACTIVITY 8: LAB SESSION. MEASUREMENT OF AERODYNAMIC FORCES	Hours: 4h Theory classes: 2h Self study: 2h

Description:
The aerodynamic forces on a vehicle model in a wind tunnel will be measured by means of a balance

Support materials:
· Wind tunnel
· Aerodynamic balance
· Computer
· Course notes
· Lab sessions guide

ACTIVITY 9: LAB SESSION. CTA ANEMOMETRY	Hours: 4h Theory classes: 2h Self study: 2h

Description:
The tubulence of an air jet will be measured

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Support materials:
· Wind tunnel
· Wire probes
· Constant Temperature Anemometer
· Computer
· Course notes
· Lab sessions guide

ACTIVITY 10: LAB SESSION. PIV	Hours: 4h Theory classes: 2h Self study: 2h

Description:
The velocity field around a body will be measured

Support materials:
· Lab material for PIV
· Computer
· Course notes
· Lab sessions guide

Qualification system

The final grade depends on the following assessment criteria:

- Exam, weight: 50 %
- Class works, weight: 10 %
- Controls, weight: 20 %
- Laboratory, weight: 20 %

Bibliography

Basic:

Katz, Joseph. Race car aerodynamics: designing for speed. Revised 2nd ed. Cambridge, MA: Bentley, 2006. ISBN 9780837601427.

Hucho, W.H. (ed.); Ahmed, S.R. [et al.]. Aerodynamics of road vehicles: from fluid mechanics to vehicle engineering. 4th ed. Warrendale: Society of Automotive Engineers, 1998. ISBN 0768000297.

Barnard, R.H. Road vehicle aerodynamic design: an introduction. 2nd ed. Hertfordshire: Mechaero, 2001. ISBN 0954073401.

Complementary:

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

Benzing, Enrico. Dall'aerodinamica alla potenza in Formula 1: mezzo secolo di motori in analisi. Milano: Giorgio Nada, 2004. ISBN 9788879113182.

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