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
220124 - Fluid Dynamic Technologies in Vehicles

Study load

<table>
<thead>
<tr>
<th>Total learning time: 75h</th>
<th>Hours large group: 30h</th>
<th>40.00%</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Self study: 45h</td>
<td>60.00%</td>
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</tbody>
</table>

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 vehicle

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
## Planning of activities

| ACTIVITY 1: EXERCISES PROPOSED IN THEORY CLASSES | Hours: 30h  
Theory classes: 13h  
Self study: 17h |
<table>
<thead>
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<tbody>
<tr>
<td><strong>Description:</strong> Simple exercises and problems proposed in the course documentation.</td>
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</table>

| ACTIVITY 2: CONTROL 1 | Hours: 5h  
Theory classes: 1h  
Self study: 4h |
<table>
<thead>
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<tbody>
<tr>
<td><strong>Description:</strong> Control test made in theory class</td>
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</tbody>
</table>

| ACTIVITY 3: CONTROL 2 | Hours: 5h  
Theory classes: 1h  
Self study: 4h |
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<tbody>
<tr>
<td><strong>Description:</strong> Control test made in theory class</td>
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</tbody>
</table>

| ACTIVITY 4: EXAM | Hours: 11h  
Theory classes: 3h  
Self study: 8h |
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<tbody>
<tr>
<td><strong>Description:</strong> Exam</td>
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</tbody>
</table>

| ACTIVITY 5: LAB SESSION. INTRODUCTION TO CFD | Hours: 4h  
Theory classes: 2h  
Self study: 2h |
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</thead>
<tbody>
<tr>
<td><strong>Description:</strong> Lab session for introduction to CFD</td>
<td></td>
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</tbody>
</table>
| **Support materials:**  
- CFD software  
- Computer  
- Course notes  
- Lab sessions guide |
**ACTIVITY 6: LAB SESSION. AERODYNAMICS OF AN AIRFOIL**

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

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

**Hours:** 4h
- Theory classes: 2h
- Self study: 2h

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**ACTIVITY 7: LAB SESSION. AERODYNAMICS OF A VEHICLE**

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

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

**Hours:** 4h
- Theory classes: 2h
- Self study: 2h

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**ACTIVITY 8: LAB SESSION. MEASUREMENT OF AERODYNAMIC FORCES**

**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

**Hours:** 4h
- Theory classes: 2h
- Self study: 2h

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**ACTIVITY 9: LAB SESSION. CTA ANEMOMETRY**

**Description:**
The turbulence of an air jet will be measured

**Hours:** 4h
- Theory classes: 2h
- Self study: 2h
220124 - Fluid Dynamic Technologies in Vehicles

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

<table>
<thead>
<tr>
<th>ACTIVITY 10: LAB SESSION. PIV</th>
<th>Hours: 4h</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
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<tr>
<td></td>
<td>Self study: 2h</td>
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</tbody>
</table>

**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:**

**Complementary:**