Degree competences to which the subject contributes

**Specific:**

3087. Knowledge of and ability to design and dimension hydraulic works and facilities, energy systems and the harnessing of hydroelectric energy, and plan and manage surface and underground hydraulic resources

3090. Knowledge and understanding of supply and treatment systems, and of how to dimension, construct and conserve them

**Generical:**

3105. Students will learn to identify, formulate and solve a range of engineering problems. They will be expected to show initiative in interpreting and solving specific civil engineering problems and to demonstrate creativity and decision-making skills. Finally, students will develop creative and systematic strategies for analysing and solving problems.

3106. Students will learn to assess the complexity of the problems examined in the different subject areas, identify the key elements of the problem statement, and select the appropriate strategy for solving it. Once they have chosen a strategy, they will apply it and, if the desired solution is not reached, determine whether modifications are required. Students will use a range of methods and tools to determine whether their solution is correct or, at the very least, appropriate to the problem in question. More generally, students will be encouraged to consider the importance of creativity in science and technology.

3107. Students will learn to identify, model and analyse problems from open situations, consider alternative strategies for solving them, select the most appropriate solution on the basis of reasoned criteria, and consider a range of methods for validating their results. More generally, students will learn to work confidently with complex systems and to identify the interactions between their components.

3111. Students will learn to plan, design, manage and maintain systems suitable for use in civil engineering. They will develop a systematic approach to the complete life-cycle of a civil engineering infrastructure, system or service, which includes drafting and finalising project plans, identifying the basic materials and technologies required, making decisions, managing the different project activities, performing measurements, calculations and assessments, ensuring compliance with specifications, regulations and compulsory standards, evaluating the social and environmental impact of the processes and techniques used, and conducting economic analyses of human and material resources.

3112. Students will develop an understanding of the different functions of engineering, the processes involved in the life-cycle of a construction project, process or service, and the importance of systematising the design process. They will learn to identify and interpret the stages in preparing a product design specification (PDS), draft and optimise specifications and planning documents, and apply a systematic design process to the implementation and operation phases. Students will learn to write progress reports for a design process, use a range of project management tools.
and prepare final reports, and will be expected to show an awareness of the basic economic concepts associated with the product, process or service in question.

3113. Students will learn to identify user requirements, to draft definitions and specifications of the product, process or service in question, including a product design specification (PDS) document, and to follow industry-standard design management models. Students will be expected to show advanced knowledge of the steps involved in the design, execution and operation phases and to use the knowledge and tools covered in each subject area to the design and execution of their own projects. Finally, students will assess the impact of national, European and international legislation applicable to engineering projects.

Transversal:

586. ENTREPRENEURSHIP AND INNOVATION - Level 2. Taking initiatives that give rise to opportunities and to new products and solutions, doing so with a vision of process implementation and market understanding, and involving others in projects that have to be carried out.

589. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 2. Applying sustainability criteria and professional codes of conduct in the design and assessment of technological solutions.

594. TEAMWORK - Level 3. Managing and making work groups effective. Resolving possible conflicts, valuing working with others, assessing the effectiveness of a team and presenting the final results.

584. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Teaching methodology

Course consists of 4 hours of class per week. Throughout the course practical exercises and 9% of the course is conducted in laboratory experiments.

It provides the student different documents which supplement the literature, and a hydraulic laboratory experimentation manual with various cases, including those experiments to be undertaken in the experimental week.

Learning objectives of the subject

Students will acquire the knowledge and skills to plan and design hydraulic works and facilities, energy systems and hydroelectric power plants, and to plan and manage surface and groundwater resources.

Hydrology pathway

Open channel flow systems such as irrigation canals and sanitary sewers; River engineering, including river morphology and transport of solids, the study of flooding and flood-protection measures, and riverbank protection; Environmental aspects of river areas and river restoration; Erosion and scour; Bridge hydraulics; Hydroelectric power plants; Hydrological, hydraulic and production-related analysis of a river elevation drop; Reversible turbines and mini-hydroelectric plants; Water hammer and mass oscillation; Classification of dams; Stability analysis; Selecting a type of dam considering the geological determining factors; Spillways, floodgates and valves; Gravity dams, earth-fill dams, rock-fill dams, arch dams and buttress dams.
### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 37h</th>
<th>24.67%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hours medium group: 17h</td>
<td>11.33%</td>
</tr>
<tr>
<td></td>
<td>Hours small group: 6h</td>
<td>4.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 6h</td>
<td>4.00%</td>
</tr>
<tr>
<td></td>
<td>Self study: 84h</td>
<td>56.00%</td>
</tr>
</tbody>
</table>
Content

**Water Supply System**

**Description:**
Operation and parts of a supply, making, transportation, purification, distribution. Evaluation of the discharge flow supply. Concept of simultaneity coefficient. Design of a pipeline. Types of supply as its main features. 
Header tank, tail off. Key features. Control concept. The volume of a tank. 

Will be solved practical exercises for water supply systems: design of deposit, different problems in the supply network.

**Learning time:** 9h 36m  
Theory classes: 3h  
Practical classes: 1h  
Self study: 5h 36m

**Hydropower and Irrigation Channels**

**Description:**


Open Channel sizing simple problems

**Learning time:** 9h 36m  
Theory classes: 3h  
Practical classes: 1h  
Self study: 5h 36m

**Urban Drainage**

**Description:**
Types of drainage systems, unit, separately. Design flows. Design criteria. 

Design recommendations

**Learning time:** 7h 11m  
Theory classes: 3h  
Self study: 4h 11m
# Hydroelectric System

**Description:**

The electricity market. Types of power plants. Central role of the fluid, the reversible, central point. Combined power management, power optimization.

Basic principles of designing a turbina. Types of turbine. Features: Pelton, Francis and Kaplan. Parts of a hydroelectric power production equipment

Practical exercises of hydroelectric systems

**Learning time:** 9h 36m
- Theory classes: 3h
- Practical classes: 1h
- Self study: 5h 36m

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# Dams

**Description:**
Characteristics of a reservoir: Levels, flooded area, height, volume useful.

**Learning time:** 9h 36m
- Theory classes: 4h
- Self study: 5h 36m
### Fluvial Dynamic and structures

<table>
<thead>
<tr>
<th>Learning time: 40h 48m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes: 13h</td>
</tr>
<tr>
<td>Practical classes: 4h</td>
</tr>
<tr>
<td>Self study : 23h 48m</td>
</tr>
</tbody>
</table>

**Description:**

The river system. Composition and relationship to the environment. Sediment characteristics. Grading curve and grain characteristics.


Exercises in resistance to flow.
Exercises at the start of the movement.

Fluvial, Regime Theory.
Dynamic stability in channels. Transport formulas. The balance of Lane.
Exner equation (Equation morphodynamics)

River morfollogía simple exercise, explanation of the Exner equation in practical example.

Evaluation of erosion in channels: long-term erosion, erosion by bed forms. The power flow.
Estabilidad examples of channels.

General characteristics of local erosion, bridge piers, abutments, sleepers, beds outstanding items, drops, walls.
Maximum erosion and the temporal evolution of erosion.
The mechanics of local scour at bridge abutments cells and formulas, maximum, time-evolution equations.
Permanent quasi calculations of the evolution of erosion in piles and abutments.
Elevation on jumpers. Characteristics, formulations.

Exercises to assess erosion on structures and stability of beds.

Channeling, protective materials, design of longitudinal protection.
Protection for bridge piers and bridge abutments.
Reservoir sedimentation, calculation of production and progress of the delta. Sediment management.

Several design examples of protection of works on runways.
## Hydraulic Phenomena in the Environment

**Learning time:** 12h  
Theory classes: 5h  
Self study: 7h

**Description:**  
Description of the phenomenon. What is the thermocline. Implications for water quality.  
Description of the phenomenon, simple calculations to assess the spill of pollutants into waterways. Longitudinal dispersion, vertical and transverse. Basic examples.  
Description of the phenomenon. Evaluation of the front velocity. Parameters that influence the development of the phenomena.  
Description of the phenomenon. Application to fast, spillways, stepped spillways and other hydraulic structures.  
Description of the phenomenon. Triggering circumstances. The debris flow rheology. Basic formulations.

## Floods and Risk Evaluation

**Learning time:** 9h 36m  
Theory classes: 3h  
Practical classes: 1h  
Self study: 5h 36m

**Description:**  
Which are flows that are sudden and debris flows. Trigger mechanisms. Concepts of flooding (water and debris), simple evaluation mechanisms. Risk assessment, vulnerability, susceptibility, resilience. Construction of hazard maps, design rules for a risk map.  
Practical application to generate a risk map.

## Special Works and calculation methods

**Learning time:** 21h 36m  
Practical classes: 9h  
Self study: 12h 36m

**Description:**  
Experimental Analysis of Hydraulic Phenomena in structures and environment.

<table>
<thead>
<tr>
<th>Description:</th>
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</thead>
<tbody>
<tr>
<td>Velocity distribution channels. The capacity and determination of the resistance to flow.</td>
</tr>
<tr>
<td>Dispersion of pollutants, determination of longitudinal dispersion coefficients, transverse and vertical</td>
</tr>
<tr>
<td>Backwater curves and hydraulic jump</td>
</tr>
<tr>
<td>Home of the movement, local erosion bridge piers.</td>
</tr>
</tbody>
</table>

**Learning time:** 14h 23m
- Laboratory classes: 6h
- Self study: 8h 23m

**Qualification system**

25% Assessment 1 at mid-semester (individual)
25% Assessment 2 at the end of the semester (individual)
25% practical exercises at home (group and individual)
25% Laboratory by submitting a document. (Group)

Criteria for re-evaluation qualification and eligibility: Students that failed the ordinary evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test or were qualified as non-attending will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.

**Regulations for carrying out activities**

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.
Bibliography

Basic:


Complementary:


