

## 28756 - Extension of Underground Hydrology

### Syllabus Information

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**Academic Year:** 2019/20

**Subject:** 28756 - Extension of Underground Hydrology

**Faculty / School:** 175 -

**Degree:** 423 - Bachelor's Degree in Civil Engineering

**ECTS:** 6.0

**Year:** 4

**Semester:** Second semester

**Subject Type:** Optional

**Module:** ---

## 1.General information

### 1.1.Aims of the course

The objectives that are pursued with this course in the programming of the degree in Civil Engineering are aimed at deepening the study methodologies in this discipline. Thus, in addition to the teaching of the basic concepts, it is important to have an impact on its practical aspects, mainly in the approach and resolution of numerical problems in the classroom. The circulation of groundwater in the subsoil obeys a series of variables that it is necessary to know in order to adequately consider their participation in hydraulic works.

The approach of the course pursues to interrelate the theoretical concepts with the strategies of approach and numerical resolution. It also includes the different in situ and laboratory tests in order to obtain values ??to be able to proceed with the numerical calculations in different hydrogeological situations of interest not only in the hydraulic infrastructures, but in relation to the participation of groundwater in any civil work.

### 1.2.Context and importance of this course in the degree

The location of this course in the third year of the degree is due to the interest of offering, to the students of Civil Engineering, a deepening in aspects already presented and worked on subjects of the previous course, specifically in the so-called "Ampliación de Hidráulica e Hidrología". In addition, the location of this course allows to take advantage of the concepts worked in the previous "Geotecnia", of the second year of the degree, in relation to the different types of geological materials and the methods of physical characterization usually used to evaluate their natural behavior.

This location will allow to adequately deepen hydrogeological aspects applied to civil works, since students are trained to understand the different phases of project, execution and operation of these works and, therefore, the relevance of hydrogeology in each one of them. This course, of 6 ECTS credits, belongs to the module of specific formation of the hydrology training itinerary and it is compulsory for students of the Degree in Civil Engineering with this itinerary and optional for students who have chosen the training itinerary of Civil constructions.

### 1.3.Recommendations to take this course

For an adequate development of this course, it is convenient that the student has previously studied and passed the so-called "Fundamentos de Ingeniería Hidráulica", "Ampliación de Hidráulica e Hidrología" and "Geotecnia", of the second year of the titulación, in which basic concepts of great utility are treated for the development of this course.

## 2.Learning goals

### 2.1.Competences

### 2.2.Learning goals

### 2.3.Importance of learning goals

### 3.Assessment (1st and 2nd call)

#### 3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

### 4.Methodology, learning tasks, syllabus and resources

#### 4.1.Methodological overview

Strong interaction between the teacher/student. This interaction is brought into being through a division of work and responsibilities between the students and the teacher. Nevertheless, it must be taken into account that, to a certain degree, students can set their learning pace based on their own needs and availability, following the guidelines set by the teacher.

The current subject is conceived as a stand-alone combination of contents, yet organized into two fundamental and complementary forms, which are: the theoretical concepts of each teaching unit, and the solving of problems/resolution of questions.

#### 4.2.Learning tasks

Involves the active participation of the student, in a way that the results achieved in the learning process are developed, not taking away from those already set out, the activities are the following:

##### ? Face-to-face generic activities:

1. **Theory Classes:** The theoretical concepts of the subject are explained and illustrative examples are developed as support to the theory when necessary.
2. **Practical Classes:** Problems and practical cases are carried out, complementary to the theoretical concepts studied.
3. **Individual Tutorials:** Those carried out giving individual, personalized attention with a teacher from the department. Said tutorials may be in person or online.

##### ? Generic non-class activities:

1. ? Study and understanding of the theory taught in the lectures.
2. ? Understanding and assimilation of the problems and practical cases solved in the practical classes.
3. ? Preparation of seminars, solutions to proposed problems, etc.
4. ? Preparation of the written tests for continuous assessment and final exams.

#### 4.3.Syllabus

##### **BLOCK A.- INTRODUCTION (1 WEEK)**

1. INTRODUCTION TO HIDROGEOLOGY. RELATION BETWEEN SURFICIAL AND GROUNDWATER HYDROLOGICAL CYCLE

##### **BLOCK B.- GROUND WATER (8 WEEKS)**

2.- HYDROGEOLOGICAL PARAMETERS: POROSITY, PERMEABILITY, HYDRAULIC CONDUCTIVITY, TRANSMISIVITY, DARCY'S LAW

3.- AQUIFER TYPES

4.- RELATIONS SURFACE WATER - GROUND WATER

5.- PIEZOMETRY: HYDROGEOLOGICAL CARTOGRAPHY

6.- GROUNDWATER HYDROCHEMISTRY

##### **BLOCK C.- STUDY TECHNIQUES FOR GROUND WATER EXPLORATION (4 WEEKS)**

7.- INTRODUCTION TO MODELLING OF GROUND WATER FLOW

8.- ANALYTICAL SOLUTIONS. PUMPING TESTS: TRANSIENT AND STEADY PUMPING REGIME

9.- GRAPHICAL SOLUTIONS: FLOW NETWORKS

##### **BLOCK D.- GROUND WATERS AND CIVIL WORKS (2 WEEKS)**

10.- GROUND WATER IMPACTS ON CIVIL WORKS. PUMPING WELLS.

11.- HYDROGEOTECHNICAL EFFECTS OF CIVIL WORKS.

#### 4.4.Course planning and calendar

The subject has 6 ECTS credits, which represents 150 hours of student work in the subject during the trimester, in other words, 10 hours per week for 15 weeks of class.

A summary of a weekly timetable guide can be seen in the following table. These figures are obtained from the subject file in the Accreditation Report of the degree, taking into account the level of experimentation considered for the said subject is moderate.

<b>Activity</b>	<b>Weekly school hours</b>
Lectures	4
Other Activities	6

Nevertheless the previous table can be shown into greater detail, taking into account the following overall distribution:

? 52 hours of lectures, with 50% theoretical demonstration and 50% solving type problems.

? 4 hours of written assessment tests, two hours per test.

? 90 hours of personal study, divided up over the 15 weeks of the 2<sup>nd</sup> semester.

#### 4.5.Bibliography and recommended resources

<http://psfunizar7.unizar.es/br13/egAsignaturas.php?id=9302&p=1>