Universidad Zaragoza

Academic Year/course: 2022/23

28756 - Extension of Underground Hydrology

Syllabus Information

Academic Year: 2022/23
Subject: 28756 - Extension of Underground Hydrology
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
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.

These approaches and objectives are in line with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of the course learning outcomes provides training and competence to contribute to their achievement to some degree:

Goal 6: Ensure acces to water and sanitation for all

6.4 By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity

6.5 By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate

6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes

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 previuosly 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

Students are guaranteed to gain at least the following basic and general skills:

General skills:

- **G1.** Comprehension and mastery of fundamental knowledge in the area of study and the ability to apply this fundamental knowledge to specific tasks of an environmental professional
- **G2.** Communication and argumentation, oral and written, of stances and conclusions, to expert audiences or broadcasting and information to non-expert audiences
- **G3.** Capacity to solve problems, both generic ones and ones typical of the area, using the interpretation and analysis of relevant data and evidence, the issuing of evaluations, decisions, reflections and pertinent diagnoses, with the consideration suitable to scientific, ethical or social aspects
- **G4.** Capacity of consistent decision-making
- **G5.** Capacity of critical reasoning (analysis, synthesis and assessment)
- **G6.** Capacity to apply theoretical knowledge to an analysis of situations
- **G7.** Mastery of IT applications related to the field of study, as well as the use of the internet as medium and source of information
- **G8.** Capacity to autonomously organize and plan work and manage information
- **G9.** Capacity to work on a team, in particular tams of an interdisciplinary and international nature typical of the work in this field
- **G10.** Capacity to lead, to organize working teams and fundamental skills in interpersonal relationships
- **G11.** Capacity of communication, argumentation and negotiation both with specialists of the area as well as non-experts on the subject
- **G12.** Ethnical commitment to all aspects of one?s professional performance
- **G13.** Capacity of autonomous learning and self-assessment
- **G14.** Creativity, initiative and enterprising spirit
- **G15.** Capacity to adapt to new situations
- **G16.** Motivated by quality
- **G17.** Sensitivity towards environmental themes
- **G18.** Capacity to possess and understand knowledge in an area of ??study that starts from the general secondary education base, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that involve knowledge from the avant-garde. from your field of study
- **G19.** Ability to apply their knowledge to their job or vocation in a professional way, and possess the competencies that are usually demonstrated through the elaboration and defense of arguments and problem solving within their area of ??study
- **G20.** Ability to collect and interpret relevant data (usually within their area of ??study) to make judgments that include reflection on relevant issues of a social, scientific or ethical nature
- **G21.** Ability to transmit information, ideas, problems and solutions to both specialized and non-specialized audiences
- **G22.** Develop those learning skills necessary to undertake further studies with a high degree of autonomy
- **G23.** Competences to know and understand respect for fundamental rights, equal opportunities between women and men, universal accessibility for people with disabilities, and respect for the values ??of the culture of peace and democratic values.
- **G24.** Competences to promote entrepreneurship
- **G25.** Knowledge of information and communication technologies (ICT)

Mandatory skills:

- **EH1.-** Knowledge and ability to design and size hydraulic works and installations, energy systems, hydroelectric

utilization, and planning and management of surface and underground hydraulic resources.

2.2. Learning goals

The student, to pass this subject, must demonstrate the following learning results:

- Ability to identify geological formations according to their hydrogeological parameters (porosity and permeability mainly)
- Ability to use hydrogeological research-prospecting techniques, both for exploitation and for the management of groundwater resources.
- Ability to acquire, analyze and synthesize physical-chemical data of the waters, and relate them to urban, agricultural and industrial pollution processes.
- To know how to interpret the results of pumping tests under different execution conditions
- To understand the operation of the different types of aquifers in relation to the materials that house them, both from a conceptual and numerical point of view.
- Ability to raise possible hydrogeological problems associated with hydraulic infrastructures, and know how to propose the numerical resolution of these problems

2.3. Importance of learning goals

The learning results pursued in this subject will provide the student with a detailed vision of both the behavior of water in the subsoil, and its interaction with the different types of materials in which it can be found. It will also familiarize them with the most common field and laboratory methodologies in this area. In addition, the autonomous part of the learning will influence the development of the student's ability to identify problems and develop strategies for their resolution, particularly in relation to the interaction betwenen groundwater and civil works.

3. Assessment (1st and 2nd call)

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

The students must demonstrate that they have achieved the expected learning outcomes through the following assessment activities:

The evaluation must be understood as a continuous and individualized process along the entire teaching-learning period, prioritizing the capacities and abilities of each student, as well as their performance. Following the spirit of the Bologna Treaty, regarding the degree of involvement and continued work of the student throughout the course, the evaluation of the subject considers the continuous evaluation system as the most consistent to be in line with the guidelines set by the new framework of the EHEA.

The **continuous evaluation system** will have the following group of qualifying activities:

- **1.- Continuous assessment exercices:** The student must carry out several continuous assessment exercises, which will be distributed throughout the course, according to the planning table. Each exercise will be delivered to the student after completing the theory topics and corresponding exercises in class. The student will have a week to do it and deliver it to the teacher, since this activity is continuous and should not be delayed in time. These exercises will be similar to those carried out in class, and for its resolution the student will also have the assistance of the teacher during tutoring hours, to clarify any doubts about it. This activity will contribute globally with 30% to the final grade for the course and to take this grade into account, all exercises must be submitted.
- **2.- Continuous assessment tests:** The student will take a total of two compulsory written tests in the continuous assessment system, which will be distributed throughout the course, one halfway through and the other at the end of the semester. These tests will collect theoretical questions and exercises on the corresponding topics. This activity will globally contribute with 70% to the final grade for the course.

To opt for the continuous assessment system, the student must attend at least 80% of the class activities, including practicals and technical visits.

The evaluation criteria to be followed for the activities of the continuous evaluation system are:

- **Exercises:** Its presentation and correct development, the writing and coherence of what was discussed, as well as the achievement of results and the final conclusions obtained will be valued. The score will range from 0 to 10 points.
- **Tests:** They will consist of a written exam scored from 0 to 10. The final grade will be calculated as the arithmetic

average of the two tests, as long as there is no unit grade below 4.0 points, in this case the activity will be suspended. The approach and the correct resolution will be valued, as well as the justification of the methodology used when solving the exercises.

In case of not passing in this way, the student will have two calls to do so, but this time under the modality of global assessment test. In addition, the student who has passed the subject through this dynamic, may also choose the final evaluation to increase grade but never to lower.

Final assessment global test

The student will be able to opt for this modality when, due to his personal and reasonably justifiable situation, he cannot adapt to the rhythm of work required in the continuous evaluation system, or when he has suspended or wants to upload a grade having participated in this last evaluation methodology. As in the continuous assessment methodology, the global final assessment test aims to check if the learning results have been achieved, as well as contributing to the acquisition of the various skills.

The global final evaluation test in both calls will include the following group of qualifying activities:

- **Written test:** Due to the type of subject, the most appropriate type of test consists of solving exercises of theoretical and/or practical application with similar characteristics to those solved during the conventional development of the subject, together with the answer to brief theoretical questions.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, practice sessions, tutorials, and autonomous work and study.

A strong interaction between the teacher/student is promoted. 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 approach, methodology and assessment of this guide are intended to be the same for any teaching scenarios. They will be adapted to the social-health situation at any particular time, as well as to the instructions given by the authorities concerned.

4.2. Learning tasks

This course is organized as follows:

- **Lectures**: The theoretical concepts of the course are explained and illustrative examples are developed as support to the theory when necessary.
- **Practice sessions**: Problems and practical cases are carried out, complementary to the theoretical concepts studied.
- **Tutorials**: Carried carried out by giving individual, personalized attention with a teacher from the department, they can be on-site or online.
- **Autonomous work and study**
    - Study and understanding of the theory taught in the lectures.
    - Understanding and assimilation of the problems and practical cases solved in the practice sessions.
    - Preparation of seminars, solutions to proposed problems, etc.
    - Preparation of the written tests for continuous assessment and final exams.

4.3. Syllabus

This course will address the following topics:

SECTION A.- INTRODUCTION (1 WEEK)

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

SECTION B.- GROUND WATER (8 WEEKS)

2.- HYDROGEOLGICAL 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

SECTION C.- STUDYING 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

SECTION D.- GROUND WATERS AND CIVIL WORKS (2 WEEKS)

10.- GROUNDWATER IMPACTS ON CIVIL WORKS. PUMPING WELLS.

11.- HYDROGEOTECHNICAL EFFECTS OF CIVIL WORKS.

4.4. Course planning and calendar

This course 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 course file in the Accreditation Report of the degree, taking into account the level of experimentation considered for this course is moderate.

Activity	**Weekly hours**
Lectures	4
Other Activities	6

Nevertheless, the previous table can be shown in 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 2nd semester.

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the Faculty of EUPLA website and Moodle.

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=28756