Course guide
2500023 - GECHISPSB1 - Surface and Groundwater Hydrology I

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.
Degree: BACHELOR’S DEGREE IN CIVIL ENGINEERING (Syllabus 2020). (Compulsory subject).
Academic year: 2022  ECTS Credits: 6.0  Languages: Catalan, English

LECTURER
Coordinating lecturer: FRANCISCO JAVIER SANCHEZ VILA
Others: ALLEN BATEMAN PINZON, MARC BERENGUER FERRER, SANDRA MOLINERO GÓMEZ, FRANCISCO JAVIER SANCHEZ VILA

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
14405. Knowledge of the basics of surface and underground hydrology. (Common module to the Civil branch)

General:
14380. Scientific-technical training for the exercise of the profession of Technical Engineer of Public Works and knowledge of the functions of advice, analysis, design, calculation, project, construction, maintenance, conservation and exploitation.
14383. Ability to project, inspect and direct works, in their field.
14387. Ability to conduct studies and design surface or groundwater catchments, in their field.

TEACHING METHODOLOGY

The course consists of 2 hours per week of classroom activity (large size group) and 2 hours weekly with half the students (medium size group).

The 2 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 2 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.
LEARNING OBJECTIVES OF THE SUBJECT

Knowledge of the applied concepts of surface and groundwater hydrology and capacity to apply them to engineering problems.

1. Ability to carry out a study of the hydrological modelling study of a basin, including aspects of water resource quality and management.
2. Ability to conduct a study of hydrogeological modelling study of an aquifer and contaminant transport, including aspects of water resource quality and management.

Provide the ability to describe the physical processes associated with drainage basins and their quantification, using professional tools such as HEC-HMS. Basic concepts of groundwater flow, as well as solute transport in soil, including both qualitative and quantitative aspects. Darcy's law, Fick's law, and equations for flow and solute transport in aquifers. Well hydraulics.

Know and quantify all the main processes of the surface and underground hydrological cycle integrated in the management of water resources. The physical principles that govern each process are presented and various options for quantifying them are described, aimed at hydraulic calculation and the design of hydraulic works. The quality of the resource and its evolution is recognized.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.00</td>
</tr>
<tr>
<td>Self study</td>
<td>84,0</td>
<td>56.00</td>
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</tbody>
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Total learning time: 150 h

CONTENTS

Water Resources Management

Description:
The global water cycle is considered from the student's perspective. With an interactive proposal, all aspects of the hydrological cycle are presented, but also unconventional resources and how to take advantage of resources and preserve them, from an integrative point of view.

Students raise the concepts of good practice and exemplify some examples of bad practice in the world and discuss possible alternatives.

Specific objectives:
The student applies his previous knowledge to develop the global hydrological cycle, making visible the hydraulic works and the concepts of reuse with an engineering perspective and an environmentalist vision.

See how the knowledge that students already have allows them to propose solutions to very complex problems of global scope. The methodology is to propose 4 real problems, 2 that are cases of bad management from the point of view of surface hydrology, and 2 of groundwater. Students work the cases in groups and propose solutions.

Full-or-part-time: 9h 36m

Laboratory classes: 4h
Self study : 5h 36m
Precipitation formation

Description:
Description of rainwater formation and frequent types of precipitation

Specific objectives:
Familiar to the student with the different origins of a rain event, especially in our environment

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study : 2h 48m

Rain data measurement

Description:
Rain data collected by official agencies. Most common apparatus used for registration

Specific objectives:
Transmit to the student the existing rain data sources, AEMET, SMC, etc. Know the most used registration devices

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study : 2h 48m

Extreme precipitation data. IDF curves

Description:
Extreme Rainfall Data Summary: IDF Curves. Obtaining processes. IDF curves from synthetic IDF data and curves

Specific objectives:
Transmit the message to the student that in any flood study, the most common natural risk in our environment, must start from an official, or synthetic IDF

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study : 2h 48m

Project rains: synthetic rains, types and application

Description:
Convey the concept of design rain for any hydrological calculation, associated with a probability of occurrence or return period

Specific objectives:
Explain the most common types of design or project rainfall, according to types of rainfall in each geographical area

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study : 2h 48m
Interception, Evapotranspiration and storage losses in depressions

**Description:**
The concept of precipitation losses, the balance between gross rain and net rain, is introduced, and losses due to interception, ET and storage in depressions are described.

**Specific objectives:**
State the importance of these loss processes, according to the time scale of the study. Quantification processes for these losses are introduced.

**Full-or-part-time:** 4h 48m
Theory classes: 2h
Self study: 2h 48m

Infiltration losses: infiltration models Horton, linear losses and fi index

**Description:**
The concept of infiltration is introduced, the most relevant loss of all. Different models of infiltration losses are described in the technical literature. Enter the curve number yield, developed by the SCS to describe infiltration losses.

**Specific objectives:**
The student is introduced to quantify the losses of a rain event and its uncertainties. Some of the most common processes in professional practice are shown. The CN procedure is one of the most widely used at a professional level worldwide. The student must understand the bases and their application to a natural basin.

**Full-or-part-time:** 9h 36m
Theory classes: 4h
Self study: 5h 36m

Hidrograph propagation. Changes in the hydrograph when moving in the channel

**Description:**
The last of the great processes of the surface cycle. Description of the changes that the hydrograph undergoes when propagating through a channel.

**Specific objectives:**
Know the effects on a hydrograph of the propagation process, flow lamination, peak flow delay, etc.

**Full-or-part-time:** 4h 48m
Theory classes: 2h
Self study: 2h 48m
## Propagation in reservoirs. Lamination calculation

**Description:**
Explain the effect of a rolling reservoir as population protection. Hypothesis and laminating effect of reservoir. Flow reduction calculation

**Course practice:** design of a rolling reservoir to protect a population.

**Specific objectives:**
Provide the student with knowledge of how a reservoir punctually attenuates the peak of a hydrograph. Reservoir design criteria. Management of the HMS program for hydrological calculation and design of hydraulic works.

**Full-or-part-time:** 19h 12m
- Theory classes: 2h
- Practical classes: 6h
- Self study: 11h 12m

## Propagation in natural channels. Muskingum method

**Description:**
Propagation in channels: Muskingum method

**Specific objectives:**
Introduce methods for quantifying the attenuation of the peak flow. Hydrological and hydraulic methods.

**Full-or-part-time:** 4h 48m
- Theory classes: 2h
- Self study: 2h 48m

## Evaluation

**Full-or-part-time:** 19h 12m
- Laboratory classes: 8h
- Self study: 11h 12m

## Aquifer systems

**Description:**
Aquifers and their types. Hydraulic head. Darcy’s Law

**Full-or-part-time:** 4h 48m
- Theory classes: 2h
- Self study: 2h 48m
Conservation equation and flow nets

Description:
The flow equation is posed as a mass balance. Boundary and initial conditions are defined. Some simple examples but with physical interest are solved
Drawing of flow nets; calculation of well drawdowns; water balance; residence time calculations

Specific objectives:
Know the equation not as a theoretical entity, but looking for its applicability to hydrological problems
Students learn to draw flow nets with specific cases and to make the calculations corresponding to water balance from the networks.

Full-or-part-time: 21h 36m
Theory classes: 3h
Practical classes: 6h
Self study: 12h 36m

Well hydraulics

Description:
Problems solved in class of calculation regarding well drawdown and hydraulic parameter estimation

Specific objectives:
Estimate the pumping effects of a well on an aquifer under various conditions of proximity to other wells or contours; learn to estimate hydraulic parameters from pumping tests and understand the constructive details of a well

Full-or-part-time: 14h 23m
Theory classes: 4h
Practical classes: 2h
Self study: 8h 23m

Quality and contamination

Description:
Quality of a drinking water; hydrochemistry: aquifer pollution; solute transport processes
Problem solving in hydrochemistry and aquifer pollution

Specific objectives:
Evaluate a chemical analysis of water; obtain notions of hydrochemistry that allow to evaluate the effects of aquifer pollution and its possible evolution in the space and the time

Full-or-part-time: 12h
Theory classes: 3h
Practical classes: 2h
Self study: 7h
**GRADING SYSTEM**

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

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.

**EXAMINATION RULES.**

Each of the two parts of the subject has a minimum of two tests. Also in the superficial part, the course work counts 25% of the final grade of the superficial part.

**BIBLIOGRAPHY**

**Basic:**

**Complementary:**