

## Course guide

### 2500023 - GECHISPSB1 - Surface and Groundwater Hydrology I

**Last modified:** 01/10/2023

**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:** 2023    **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)

**Generical:**  
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

Type	Hours	Percentage
Self study	84,0	56.00
Guided activities	6,0	4.00
Hours large group	30,0	20.00
Hours medium group	30,0	20.00

**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:**

Well hydraulics in steady-state and transient conditions; inverse problem: parameter estimation: boundary effects (image theory). Well construction details.

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 subject's grade is obtained by taking the arithmetic average of the grades corresponding to the surface and subsurface hydrology parts. The first of these (superficial) is done as a weighted average of 5 elements:

$$=0.05*(T1+T2+T3)+0.25*T4+0.6*E1$$

Where T1, T2 and T3 are tests done in class, T4 is a paper with the HEC-HMS code, and E1 is the exam taken in the first part.

The subsurface grade is the one obtained in the final exam.

Criteria for qualification and admission to the re-evaluation: Students suspended from the ordinary evaluation who have appeared regularly in the evaluation tests of the suspended subject will have the option to take a re-evaluation test in the period set in the academic calendar. Students who have already passed or students classified as not present will not be able to take the reevaluation test of a subject. The maximum grade in the case of taking the reassessment exam will be five (5.0).

## BIBLIOGRAPHY

---

### Basic:

- Nanía Escobar, L.S.; Gómez Valentín, M. Ingeniería hidrológica. 2a ed. Granada: Grupo Editorial Universitario, 2006. ISBN 8484916367.
- Chow, V.T.; Maidment, D.R.; Mays, L.W. Hidrología aplicada. Santa Fe de Bogotá: McGraw-Hill Interamericana, 1994. ISBN 958-600-171-7.
- Bedient, P.B.; Huber, W.C.; Vieux, B.E. Hydrology and floodplain analysis. 4th ed. Upper Saddle River, NJ: Prentice Hall, 2008. ISBN 9780131745896.

### Complementary:

- Shaw, E.M. Hydrology in practice. 4th ed. Londres: Spon Press, 2011. ISBN 9780415370424.
- Viessman, W. Introduction to hydrology. 5th ed. Upper Saddle River: Prentice Hall, 2003. ISBN 067399337X.
- Custodio, E.; Llamas, M.R. (eds.). Hidrología subterránea. 2a ed. corr. Barcelona: Omega, 2001. ISBN 8428204462.