Course guide
250252 - HIDSUPSUB2 - Surface and Groundwater Hydrology II

Last modified: 19/06/2024

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: BACHELOR'S DEGREE IN PUBLIC WORKS ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2024 **ECTS Credits:** 4.5 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: CARLES FERRER BOIX

Others: CARLES FERRER BOIX, ALBERT FOLCH SANCHO, MAARTEN WILLEM SAALTINK
Bateman Pinzon, Allen

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
3088. Knowledge and understanding of the functioning of ecosystems and environmental factors

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

The course consists of 3 hours per week of classroom activity .

The professor presents the basic concepts and topics of the subject, shows examples and solves exercises.

Some hours are devoted to solving practical problems with greater interaction with students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

There are 4 hours of practical activities in the computer classrom

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

Although most of the sessions will be given in the language indicated, sessions conducted by other occasional guest experts may be given in other languages.

LEARNING OBJECTIVES OF THE SUBJECT

Introduction to drought management. Introduction to water resources management. Flood propagation. Design of reservoirs for flood protection. Flood management and control.

Recharge and unsaturated area. Groundwater numerical Models.

1 Ability to apply different methods of infiltration in the land and know how to apply aquifer recharge models.
2 Ability to use tools for water resources management and for flood propagation.

Development at the level of specialization of the basic concepts acquired from superficial and subterranean hydrology in the preceding courses on water technologies. Introduction. Analysis of precipitation and rainfall-runaoff transformation. Introduction to the HEC-HMS code. Urban hydrology (hydrology in urban environment. Raising of grids and sinks. Design criteria for sewers networks. Hydraulic calculations with commercial codes: SWMM5) recharging and unsaturated area (level and pressure, unsaturated Darcy law, infiltration according to Green Ampt and according to Horton. Radiation, Vapor, evaporation, Penman, evapotranspiration, stationary situation in basin, water balance Models in soil). Transport of Solutes (Advection, diffusion, dispersion, ADE, analytical solutions, matrix diffusion, types of tracers, types of tests, interpretation). Numerical groundwater models.

STUDY LOAD

Type	Hours	Percentage
Self study	63,0	56.00
Hours small group	9,0	8.00
Hours medium group	18,0	16.00
Guided activities	4,5	4.00
Hours large group	18,0	16.00

Total learning time: 112.5 h

CONTENTS

Introduction

Description:
Description of the teaching methodology and assessment. Review of elementary concepts presented in previous courses.

Specific objectives:
Revision of needed previous knowledge.

Full-or-part-time: 2h 30m
Theory classes: 1h
Self study : 1h 30m

Recharge and unsaturated zone

Description:
Level and Pressure, Wettability and retention, Unsaturated Darcy's Law, Richards equation, Infiltration according to Horton and Green Ampt
Radiation (long and short wave, radiation balance, albedo, calculation of radiation), Vapor (saturated vapor, relative humidity), Evaporation, Penman evapotranspiration (reference and actual), Penman-Monteith, Thornthwaite, Hargreaves.
Steady state in a basin, water balance models in soil
A example for calculation of recharge

Specific objectives:
Knowing the basics of unsaturated flow. Knowing how to apply infiltration models
Knowing the basics of evapotranspiration. Knowing how to apply models of evapotranspiration.
Knowing how to apply aquifers recharge models

Full-or-part-time: 21h 43m
Theory classes: 4h 20m
Practical classes: 4h 20m
Self study : 13h 03m

Solute transport

Description:
Advection, diffusion, dispersion, ADE, analytical solutions, matrix diffusion
Types of tracer, types of tests, interpretation
Definition and classification of contamination, adsorption and degradation processes, reactive ADE, vulnerability and protective perimeters
Example for a calculation of contamination

Specific objectives:
Knowing the solute transport processes in groundwater. Knowing how to formulate an PDE a for solute transport and how to solve it by analytical methods.
Knowing how to interpret a tracer test.
Knowing the relevant processes of aquifer contamination.

Full-or-part-time: 9h 49m
Theory classes: 2h
Practical classes: 1h 58m
Self study : 5h 51m

Numerical groundwater models

Description:
Types of models, numerical methods, using models
Example of a numerical model
Modflow workshop

Specific objectives:
Understanding what does a numerical model and know its capabilities and limitations.
Evaluation
Become familiar with the code Modflow

Full-or-part-time: 24h 43m
Theory classes: 2h 26m
Practical classes: 2h 26m
Laboratory classes: 5h
Self study : 14h 51m

Introduction to drought management methods

Description:
Definitions (meteorological drought, agricultural drought, hydrological drought), recharge coefficients, time scales in hydrological processes. Large-scale atmospheric causes of droughts. Probabilistic distributions.

Specific objectives:
To know the basic aspects of the causes of droughts.
To know how to elaborate a flow frequency curve. To know how to define the minimum flow thresholds for droughts.
To know the general probabilistic distributions applicable to droughts.

Full-or-part-time: 8h 35m
Theory classes: 1h 08m
Practical classes: 1h 07m
Laboratory classes: 0h 45m
Self study : 5h 35m

Water resources management

Description:
Introduction to water economics: General legal framework, Pricing, Water costs and resources.
Introduction to water resources management: Hydrological planning, water resources assessment, water uses, consumptions, water demand guarantee.
Regulation and reservoir desing methods.
Water resources management in the Metropolitan Area of Barcelona.

Specific objectives:
To know the main aspects of water economics and pricing.
To know the principles of water resources management.
To know how to design the capacity of a reservoir.

Full-or-part-time: 18h 40m
Theory classes: 3h
Practical classes: 3h
Laboratory classes: 2h
Self study : 10h 40m

Flood management

Description:
Flooding risks, Structural and non-structural measures for flood mitigation. Legislation, zoning and European directives.
Flood propagation and atenuation. Examples
Design of flood protection works. Cost-benefit analysis.

Specific objectives:
To know the main aspects of the legislation applicable to flood management.
To know and being able to apply the available flood propagation methods.
To know and being able to apply the criteria for designing dikes for flood protection

Full-or-part-time: 22h
Theory classes: 3h 56m
Practical classes: 3h 56m
Laboratory classes: 2h 38m
Self study : 11h 30m

GRADING SYSTEM

The continuous assessment will take into account the following factors:

- Exams (NE)
- Exercises performed at home (NP)

50% of the grade will be the surface hydrology and the other 50% of the groundwater hydrology.

The rating of both parts is the weighted average: NF = 0.7 *NE 0.3 · NP where NE is the average obtained in the exams, NP is the average mark obtained in the practical exercises.

It is possible that in the continuous assessment there are no exams. In these cases, the grade for each part (surface hydrology and groundwater hydrology) will be obtained from the grades of the practical exercises (NP).

Class attendance, which is essential, may be reflected in the final grade of the course.

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.

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

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