

Aquifers Balance and Recharge (250823)

General Information

School	ETSECCPB
Departments	Departament d'Enginyeria Civil i Ambiental (DECA)
Credits	5.0 ECTS
Programs	MÀSTER UNIVERSITARI EN ENGINYERIA DEL TERRENY (pla 2015)
Course	2024/25

Main teaching language at each group

- Group 10ES1 Spanish (Q1)

Faculty

Responsible Faculty: Daniel Fernandez Garcia

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Objectives of Education

To conceive soils and rocks as porous media governed by Solid and Fluid Mechanics.

To characterize the geological environment and its interaction with civil works.

To interpret laboratory tests and field observations so as to identify the mechanisms responsible for soil response. To propose testing programmes.

To formulate and implement Finite Element and Finite Differences numerical models with the objective to analyze the processes that govern ground response, to interpret field information and to predict soil response.

To analyze, discriminate and integrate geological and geotechnical information in studies and projects.

To calculate, evaluate, plan and regulate surface and groundwater resources. (Specific competence of the specialization in Groundwater Hydrology).

To model, assess and manage geological resources, including mineral and thermal groundwater. (Specific competence of the specialization in Groundwater Hydrology).

- * To manipulate the theoretical concepts of multiphase flow, heat flow and reactive transportation.
- * To manipulate the theoretical concepts in geo-statistics.
- * To analyze the stochastic data in hydrology and hydrogeology.
- * To analyze the flow and reactive transportation processes in aquifers.
- * To calculate the groundwater balance.
- * To carry out practical aquifer reloading calculations.
- * To apply hydrogeochemical and isotopic techniques to the study of aquifer reloading.
- * To suggest general studies in groundwater hydrology.

- Scientific fundamentals for aquifer recharge techniques and methods of groundwater balance.
- Methods of calculations applied to practical problems.
- Application of hydrogeochemical and isotopic study of groundwater recharge techniques.
- Bases for general studies of groundwater hydrology.

a) Overview of the scientific basis of natural recharge of aquifers and groundwater balance. b) Discussion of the calculation methods applied to solving practical problems. c) Application of hydrogeochemical and isotopic study of recharge techniques. d) Provide the basis for focusing the thesis work and studies Hydrogeology.

Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	25.5 h	56.67 %
	Medium group	9.75 h	21.67 %
	Laboratory classes	9.75 h	21.67 %
	Guided Activities	0.0 h	0.00 %
Self Study		80.0 h	

Contents

Topic 0

Overview . Content of the syllabus. Work to be done .

Specific Objectives

Overview

Topic 1

Concepts and definitions. Unsaturated zone: characteristics, flow and mass transport. Measurements.

Specific Objectives

The basic principles of water flow are set out in the unsaturated zone and hydrologic balance in soil is calculated. simple calculations in simplified situations are made, and how they can deal with more complex cases

Theme 2

Actual and potential evapotranspiration. Measurement and calculation. Phreatic evapotranspiration. Questions on the previous session

Specific Objectives

Understand the evapotranspiration process and learn how to be estimated

Tema3

Measurement and calculation of components. Recharge as a residual term. Sequential calculation. Models and visual-Balan. Special situations: concentrated recharge in fissures and discontinuities; repellency. Questions on the previous session

Specific Objectives

To introduce and understand the key concept of soil-water balance as a mean to evaluate water resources

Topic 4

Principles. Profiles of salinity in the soil and the unsaturated zone. Limitations and causes of error. Questions on the previous session

Specific Objectives

Water balance in the soil media by applying chemical methods

Item 5

Isotopic and thermal effects. Applications. Limitations. Tracer tests. Questions on the previous session

Specific Objectives

Analysis of the processes of natural recharge and application of tracer tests

Topic 6

Measurement and observation time. Phreatic level answer to recharge. Modeling. Questions on the previous session

Specific Objectives

Recharge assessment from soil moisture. Measurement methods and modelling

Topic 7

Effect of heterogeneities. Recharge from surface water. Loser rivers, swamp and Piedmont areas. Questions on the previous session

Specific Objectives

Assessment of the processes due to surface water recharge and its estimate. Study of the effect of heterogeneity

Topic 8

Consideration in the balance. Questions on the previous session

Specific Objectives

Identify the impact of the agricultural management in recharge and water balance according to crops

Topic 9

Obtaining terms of water balance. Application and evolution. Questions on the previous session

Specific Objectives

Application of new airborne technologies in obtaining water balance

Topic 10

Particularities. Paleo-recharge. Effects of climate change. Preguntas específicas sobre el tema anterior. Questions on the previous session

Specific Objectives

Approach to recharge in arid areas and the effects of the climate change

Practical work

Application recharge methods

Specific Objectives

Simple exercises for recharge calculation by various methods

Activities

Practical work

-take contact with the more usual bibliographical sources on the subject
- exercising on a real case

Each student must select two subjects from among those proposed, one from each group. The topics are selected by more than one student will be assigned by the teacher. Given the nature of the subject and the fact that some students are doctoral students or scholars on specific issues, some issues may be pre-assigned.

Dedication

6h

Teaching Methodology

The course consists of 1,9 hours per week of classroom activity (large size group) and 0,5 hours weekly with half the students (medium size group).

The 1,9 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 0,5 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.

Grading Rules

() The evaluation calendar and grading rules will be approved before the start of the course.*

The mark of the course is obtained from the ratings of continuous assessment. Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (in the classroom). 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 practical work.

All theoretical sessions will be preceded by one hour of discussion and comments regarding the previous subject. The objective is to introduce to motivate discussion and comprehension of the previous subject

Test Rules

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

Office Hours

hours requested

Bibliography

Basic

- Custodio, E.; Llamas, M.R. (eds.). [Hidrología subterránea](#). 2a edición corregida. Barcelona: Omega, 1983. ISBN 8428204462.
- Custodio, E.; Llamas, M.R.; Samper, J. [La evaluación de la recarga a los acuíferos en la planificación hidrológica: textos del seminario celebrado en Las Palmas de Gran Canaria, enero de 1997](#). Madrid: Instituto Tecnológico GeoMinero de España, 1997. ISBN 8478402926.

- Bierkens, M.; Dolman, H.; Troch, P. [Climate and the hydrological cycle](#). Wallingford, Oxfordshire: IAHS, 2008.
- EAGLESON, P.S. Climate, soil and vegetation. 1978.
- JYRKAMA, M.L. SYKES, J.F. The impact of climate change on groundwater. The Handbook of Groundwater Engineering. 2nd ed.: 28-1 /28-42., 2007.
- Bierkens, M.F.P.; Dolman, A.J.; Troch, P.A. (eds.). [Climate and the hydrological cycle](#). Wallingford: International Association of Hydrological Sciences, 2008. ISBN 9781901502541.
- Candela, L.; Varela, M. [La Zona no saturada y la contaminación de las aguas subterráneas : teoría, medición y modelos](#). Barcelona: CIMNE, 1993. ISBN 8487867278.