Course guide
250531 - MODSOLAQCO - Modelling of Soil and Groundwater Contamination

Last modified: 25/01/2024

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

Degree: MASTER'S DEGREE IN GEOTECHNICAL AND EARTHQUAKE ENGINEERING (Syllabus 2009). (Optional subject).
MASTER'S DEGREE IN GEOLOGICAL AND MINING ENGINEERING (Syllabus 2013). (Compulsory subject).
MASTER'S DEGREE IN GEOTECHNICAL ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: DANIEL FERNANDEZ GARCIA

Others: MARCOS CARNICERO DEL RIO, DANIEL FERNANDEZ GARCIA

TEACHING METHODOLOGY

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

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

The 0,8 hours 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.

The rest of weekly hours devoted to laboratory practice.

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.

LEARNING OBJECTIVES OF THE SUBJECT

Ability to plan and execute transportation facilities, distribution and storage of solids, liquids and gases.

Ability to plan and implement water treatment and waste management plants (municipal, industrial and hazardous).

Ability to assess and manage environmentally projects, plants and facilities.

Ability to address and solve advanced mathematical engineering problems, from problem statement to formulation development and its implementation in a computer program. In particular, the ability to formulate, plan and implement advanced analytical models and numerical calculation, project planning and management, and the ability to interpret the results in the context of mining engineering.

Specialized knowledge on environmental engineering to be able to apply advanced techniques and methodologies. The aim is to deepen the knowledge on the ability to model, assess and manage the impact of the civil works and exploitation of minerals and energy resources on the environment. An important aspect to consider will be sustainable development as related to water resources, waste, and contaminated sites.

Water Engineering. Interactions between groundwater, civil works and the environment, fluvial and marine sedimentary dynamics.

The aim of the course is to understand the behavior and transport mechanisms of non-aqueous phase organic liquids pollutants in the subsurface. Application to mathematical modeling, human health risk analysis and ecosystems.

STUDY LOAD

Type	Hours	Percentage
Hours large group	25,5	20.38
Hours medium group	9,8	7.83
Hours small group	9,8	7.83
Self study	80,0	63.95

Total learning time: 125.1 h

CONTENTS

Introduction

Description:
Sources of contamination and types of contaminants
State waters and soils in Catalonia and Europe, description of the ciontamination problem

Specific objectives:
Understand the various sources and types of contamination of soil and groundwater
State waters and soils in Catalonia and Europe, conceptual models of contaminated sites

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

Properties and characteristics of contaminants

Description:
Description of the parameters that control the infiltration capacity such as the viscosity, density and relative mobility.
Description of the parameters that control the distribution of mass between phases: solubility, vapor pressure, and distribution coefficient and Henry's constant
Description of the parameters that control movement: saturation, moisture content, interfacial tension, contact angle, capillary pressure, residual saturation, hydraulic conductivity, relative permeability

Specific objectives:
Knowing the parameters that control the infiltration capacity such as the viscosity, density and relative mobility.
Knowing the parameters that control the distribution of mass between phases: solubility, vapor pressure, distribution coefficient and Henry's constant
Knowing the parameters that control movement: saturation, moisture content, interfacial tension, contact angle, capillary pressure, residual saturation, hydraulic conductivity, relative permeability

Full-or-part-time: 12h
Theory classes: 5h
Self study : 7h

Multiphase flow

Description:
Theoretical basis of multiphase flow
Description of methods to design and evaluate the operation of an oil reservoir

Specific objectives:
Generalized Darcy's law, the law limits Darcy relative permeability curves and retention of mass conservation in multiphase flow, phase continuity, flow Buckingham, analytical solutions (Buckley-Leverett, McWhorter and Sunada)
Learn methods to design and evaluate the operation of a reservoir of oil

Full-or-part-time: 16h 48m
Theory classes: 7h
Self study : 9h 48m

Contaminant transport

Description:
Description of the dissolution of non-aqueous liquids such as chlorinated solvents are, gasoline, ...
Description of transport processes in the saturated zone and presentation of basic equations of transport
Description of transport processes in the vadose zone and the basic equations of transport of gases and vapors

Specific objectives:
Learn to evaluate the time of dissolution and the dissolution of a cup of liquid non aqueous
Knowing the transport processes in the saturated zone
Knowing the transport processes in the vadose zone and the basic equations of transport of gases and vapors

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

Characterization of contaminated sites

Description:
Characterization of groundwater
Characterization of soils
Characterization of gases
Characterization of NAPLs
Description of how to interpret the results of analysis of water, soil and gases in the subsurface

Specific objectives:
Learn the characterization of groundwater, soil, gas and NAPLs in contaminated sites
Learn how to interpret the results of analysis of water, soil and gases in the subsurface

Full-or-part-time: 7h 11m
Theory classes: 3h
Self study : 4h 11m

Assessment of water contamination and soil

Description:
Presentation of the legislative framework for contaminated soil and water protection of the environment and human health
Anàlsis risk to the environment and human health risk, toxicity and dose

Specific objectives:
Learn the legislative framework for contaminated soil and water protection of the environment and human health
Learn how to estimate the risk to the environment and human health problems associated with contamination of soil and groundwater

Full-or-part-time: 7h 11m
Theory classes: 3h
Self study : 4h 11m

Remediation engineering

Description:
Description of tènciques decontamination of groundwater
Description of the decontamination of polluted soils

Specific objectives:
Learn different techniques of decontamination of groundwater. Design and evaluation.
Learn techniques for decontamination of polluted soils. Design, implementation and evaluation.

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

Problem

Description:
Solving exercises in the classroom

Specific objectives:
Learn to evaluate, calculate, and project design.

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

Models of contaminated soils and aquifers

Description:
Presentation of models for risk analysis problems in contaminated soils and aquifers

Specific objectives:
Learn tools to assess the risk associated with a pollution problem

Full-or-part-time: 7h 11m
Laboratory classes: 3h
Self study : 4h 11m

Guided activities

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

GRADING SYSTEM

The rating will be obtained from continuous assessment of qualifications. Continuous assessment consists of doing various activities, both individual and group character and additive training, conducted during the year (in the classroom and outside of it). The rating is the average of the activities of this type, obtained through exercises (PR), a directed work (TD) and an examination (EX). The final mark is estimated as: 0.3 * 0.4 * PR * 0.3 TD EX

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.

BIBLIOGRAPHY

Basic:
- Mayer, A.S.; Hassanizade, S.M. Soil and groundwater contamination: nonaqueous phase liquids. Washington, DC: American Geophysical Union, 2005. ISBN 9780875903217.
- Suthersan, S.S.; Horst, J.; Schnobrich, M.; Welty, N.; McDonough, J. Remediation engineering: design concepts. 2nd ed. Boca Raton: CRC Press, 2017. ISBN 9781498773270.
- Fetter, C.W.; Boving, T.; Kreamer, D. Contaminant hydrogeology. 3rd ed. Long Grove, Illinois: Waveland Press, Inc, 2018. ISBN 9781478632795.
- Pankow, J.F.; Cherry, J.A. Dense chlorinated solvents and other DNAPLs in groundwater : history, behavior and remediation. Portland, Or: Waterloo press, 1996. ISBN 0964801418.
- Cossé, R. Basics of reservoir engineering. Paris: Edition Technip, 1993. ISBN 9782710806301.

Complementary:
- Helmig, R. Multiphase flow and transport processes in the subsurface : a contribution to the modeling of hydrosystems. Berlin ; New York: Springer, 1997. ISBN 3540627030.
- Lake, L.W. Enhanced oil recovery. Austin, Texas: University Co-op, 2011. ISBN 9780840066039.