Course guides
250829 - 250829 - Groundwater and Environment

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.
Degree: MASTER'S DEGREE IN GEOTECHNICAL ENGINEERING (Syllabus 2015). (Optional subject).
Academic year: 2020  ECTS Credits: 5.0  Languages: Spanish, English

LECTURER

Coordinating lecturer: MAARTEN WILLEM SAALTINK
Others: MAARTEN WILLEM SAALTINK

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
13311. 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.
13315. To calculate, evaluate, plan and regulate surface and groundwater resources. (Specific competence of the specialization in Groundwater Hydrology).
13316. To assess and manage environmental impacts from waste disposal, soil contamination and groundwater pollution. (Specific competence of the specialization in Groundwater Hydrology).
13320. To design and execute hydraulic systems, including transportation facilities, distribution and storage of solids, liquids and gases, water treatment plants and waste management (urban, industrial or hazardous). (Specific competence of the specialization in Groundwater Hydrology).
13321. To assess and manage projects, plants and water facilities for the environmental point of view. (Specific competence of the specialization in Groundwater Hydrology).
13323. To model, assess and manage geological resources, including mineral and thermal groundwater. (Specific competence of the specialization in Groundwater Hydrology).

Generical:
13300. To apply advanced knowledge in sciences and technology to the professional or research practice.
13301. To lead, coordinate and develop integrated projects in Geo-Engineering.
13302. To identify and design solutions for geo-engineering problems within ethical, social and legislative frameworks.
13303. To evaluate the impact of Geo-engineering on environment, sustainable social development and the significance of working within reliable and conscientious professional environment.
13304. To incorporate new technologies and advanced tools in Geo-engineering into professional and research activities.
13305. To conceive Geo-engineering as a multi-disciplinary field that includes relevant aspects from geology, sismology, hydrogeology, geotechnical and earthquake engineering, geomechanics, physics of porous media, geophysics, geomatics, natural hazard, energy and climate interactions.
13306. To promote innovation for the development of methodology, analyses and solutions in Geo-engineering.
13307. To tackle and solve advanced mathematical problems in engineering from the drafting of the problem to the development of formulation and further implementation in computer programs. Particularly, to formulate, code and apply analytical and numerical advanced computational tools to project calculations in order to plan and manage them as well as to interpret results in the context of Geo-engineering and Mining engineering.

TEACHING METHODOLOGY

The course consists of lectures in which the teacher explains the concepts and basic material, presents examples and exercising. In addition to the lectures, there are three exercises that consist of making calculations related to the topics explained in the lectures, which the students have to do at home and m are explained in class after having been deliverd. There is a class that uses computer codes to do some exercises.
LEARNING OBJECTIVES OF THE SUBJECT

To conceive soils and rocks as porous media governed by Solid and Fluid Mechanics.
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 assess and manage environmental impacts from waste disposal, soil contamination and groundwater pollution. (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 recognize the relationship between soil mechanics and hydrogeology.
* To evaluate the impacts caused by civil works (excavations, walls, tunnels) in aquifers and vice versa.
* To acquire concepts on exceptional contamination of aquifers and remediation techniques.
* To gather knowledge on the mathematical models to evaluate the impact of works on aquifers.
* To recognize the main technologic options available to grant economical and efficient services with regards to the basin.
* To suggest solutions to benefit from the local natural resources taking into account the economical, social and environmental sustainability.
* To understand the chemical balance and kinetic processes from a rigorous mathematical point of view.
* To suggest and solve the reactive transport equations in simple cases.
* To recognize the most frequent processes and sources of contamination in soils, aquifers, rivers, dykes, coasts and wetlands.
* To suggest solutions to remediate the contamination of water masses using numerical modelling.
* To acquire advanced knowledge on the problems regarding urban and especial solid waste management.
* To understand the extent of the studies on environmental impact.
* To understand the atmosphere-soil hydrological processes.
* To model the hydrological processes at a local, basin and regional scale.
* To know the differences among different types of hydrological modelling.
* To understand the effects of precipitation on soil stability.
* To admit the possibility of natural disasters occurring due to water and to be able to estimate the vulnerability and risk of a ground when facing flooding or debris flow.

- Contamination of rivers and reservoirs. Contamination of coastal waters and moisture.
- Numerical methods and modeling.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self study</td>
<td>80,0</td>
<td>63.95</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>9,8</td>
<td>7.83</td>
</tr>
<tr>
<td>Hours small group</td>
<td>9,8</td>
<td>7.83</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.80</td>
</tr>
<tr>
<td>Hours large group</td>
<td>19,5</td>
<td>15.59</td>
</tr>
</tbody>
</table>

Total learning time: 125.1 h
## Contents

### Processes

**Description:**
- Mass balances and field theory
- Review flow and Water quantity
- Pollutants and environmental Impact
- Contaminants and environmental impact
- Vulnerability and catchment perimeters
- Vulnerability and catchment perimeters
- Plumes of pollutants
- Multiphase flow
- Hydrogeochemical review
- Hydrogeochemical systems
- Hydrogeochemical systems
- Isotopes
- Isotopes

**Full-or-part-time:** 64h 48m  
Theory classes: 18h  
Practical classes: 9h  
Self study: 37h 48m

### Cases

**Description:**
- Acid mine drainage
- Nuclear waste

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

### Evaluable

**Full-or-part-time:** 14h 23m  
Laboratory classes: 6h  
Self study: 8h 23m
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.

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: