250422 - INTAIGSUBO - Interaction Between Groundwater and Civil Works

<table>
<thead>
<tr>
<th>Coordinating unit:</th>
<th>250 - ETSECCPB - Barcelona School of Civil Engineering</th>
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</thead>
<tbody>
<tr>
<td>Teaching unit:</td>
<td>751 - DECA - Department of Civil and Environmental Engineering</td>
</tr>
<tr>
<td>Academic year:</td>
<td>2019</td>
</tr>
<tr>
<td>Degree:</td>
<td>MASTER'S DEGREE IN GEOLOGICAL AND MINING ENGINEERING (Syllabus 2013). (Teaching unit Compulsory)</td>
</tr>
<tr>
<td></td>
<td>MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Teaching unit Optional)</td>
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<tr>
<td></td>
<td>MASTER'S DEGREE IN GEOTECHNICAL AND EARTHQUAKE ENGINEERING (Syllabus 2009). (Teaching unit Optional)</td>
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<tr>
<td></td>
<td>MASTER'S DEGREE IN GEOTECHNICAL ENGINEERING (Syllabus 2015). (Teaching unit Optional)</td>
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<tr>
<td>ECTS credits:</td>
<td>5</td>
</tr>
<tr>
<td>Teaching languages:</td>
<td>Spanish, English</td>
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</tbody>
</table>

Teaching staff

Coordinator: DANIEL FERNANDEZ GARCIA

Others: DANIEL FERNANDEZ GARCIA

Opening hours

Timetable: Office D2-004, by appointment

Degree competences to which the subject contributes

Specific:
8200. The ability to apply knowledge of soil and rock mechanics to the study, design, construction and operation of foundations, cuts, fills, tunnels and other constructions over or through land, whatever its nature and state, and whatever the purpose of the work.
8231. The ability to plan, evaluate and regulate the use of surface water and groundwater resources.

Transversal:
8559. ENTREPRENEURSHIP AND INNOVATION: Being aware of and understanding the mechanisms on which scientific research is based, as well as the mechanisms and instruments for transferring results among socio-economic agents involved in research, development and innovation processes.
8560. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.
8561. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
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**Teaching methodology**

The course consists of 3 hours per week of classes in the classroom. These hours are devoted to lectures where the teacher explains the concepts and theory, presents examples and exercises with greater interaction with students. The remaining weekly hours are dedicated to practice in laboratories. It uses material support in the form of detailed syllabus through campus ATENEA: content, programming and evaluation activities directed learning and literature.

**Learning objectives of the subject**

Specialization subject in which knowledge on specific competences is intensified.

Knowledge and skills at specialization level that permit the development and application of techniques and methodologies at advanced level.

Contents of specialization at master level related to research or innovation in the field of engineering.

Impact of civil works on aquifers and groundwater in the following cases: Excavations, tunnels and linear underground works. Environmental aspects of water resources quality, emphasis on aquifer contamination. Knowledge of mathematical modeling: use of numerical models to assess the impact of civil works on aquifers.

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Hours large group: 19h 30m 15.60%</th>
<th>Hours medium group: 9h 45m 7.80%</th>
<th>Hours small group: 9h 45m 7.80%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guided activities:</td>
<td>6h</td>
<td>Guided activities:</td>
<td>6h</td>
</tr>
<tr>
<td>Self study:</td>
<td>80h</td>
<td>Self study:</td>
<td>80h</td>
</tr>
</tbody>
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## Content

<table>
<thead>
<tr>
<th>Hydrogeology and Environment</th>
<th>Learning time: 57h 35m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 19h</td>
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<tr>
<td></td>
<td>Practical classes: 5h</td>
</tr>
<tr>
<td></td>
<td>Self study : 33h 35m</td>
</tr>
</tbody>
</table>

**Description:**
- Course introduction
- Basics
- Darcy's law, hydraulic parameters, the flow equation, groundwater networks, particular solutions, parameter estimation.
- Problem
- Solving the flow equation using numerical methods. Application to hydrogeology through the program MODFLOW
- Resolution numerical models through practice exercises
- Hydrochemistry. Mixing. Impactos and public works
- Contents of a hydrogeological study

**Specific objectives:**
- Course introduction
- Basics
- Knowledge of hydraulic aquifer
- Practical application of knowledge
- Learn hydrogeological modeling problems
- Learn to solve practical exercises using numerical models
- Study of water quality
- Learning is a hydrogeological study

<table>
<thead>
<tr>
<th>Impact of civil works on aquifers</th>
<th>Learning time: 36h</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 6h</td>
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<tr>
<td></td>
<td>Practical classes: 6h</td>
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<tr>
<td></td>
<td>Laboratory classes: 3h</td>
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<tr>
<td></td>
<td>Self study : 21h</td>
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</tbody>
</table>

**Description:**
- Theory and applications of dewatering systems
- Dewatering exercises
- Theory of tunnels and barrier effects. Corrective measures
- Application of the theory of tunneling and barrier effect

**Specific objectives:**
- Learn the theory and application of dewatering systems in excavations
- Application of the theory of dewatering systems
- Learn the theory of tunneling and barrier effect. Corrective measures
- Application of the theory of tunneling and barrier effect by practical exercises
The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment is evaluated by exercises (PR), a directed project work (TD) and assessment tests (EX). Evaluation tests consist on issues associated to concepts of the course, learning objectives with regard to knowledge or understanding, and a set of application exercises.

The final mark is estimated as: 0.2*PR + 0.4*EX + 0.4*TD

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:**