250345 - HIDROG - Hydrogeology

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering
Academic year: 2017
Degree: BACHELOR'S DEGREE IN GEOLOGICAL ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Catalan, Spanish

Teaching staff
Coordinator: DANIEL FERNANDEZ GARCIA
Others: DANIEL FERNANDEZ GARCIA, ALBERT FOLCH SANCHO

Opening hours
Timetable: By appointment with professors

Degree competences to which the subject contributes

Specific:
4040. Hydrological, hydrogeological, stratigraphic and palaeontological studies.
4041. (ENG) Capacitat pel desenvolupament i selecció d'eines per l'anàlisi de problemes hidrogeològics i estratigràfics.

Transversal:
588. SUSTAINABILITY AND SOCIAL COMMITMENT - Level 1. Analyzing the world’s situation critically and systemically, while taking an interdisciplinary approach to sustainability and adhering to the principles of sustainable human development. Recognizing the social and environmental implications of a particular professional activity.
592. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
596. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.
599. EFFECTIVE USE OF INFORMATION RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.
602. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
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.
250345 - HIDROG - Hydrogeology

Teaching methodology

The course consists of 4 hours per week of classroom activity.

Theoretical lectures serve to present the basic concepts and topics of the subject, shows examples and solves exercises.

Other classes are 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.

Learning objectives of the subject

Students will acquire an understanding of hydrogeology and solute transport in porous media and learn how they apply to technological problems.

Upon completion of the course, students will be able to: 1. Apply equations of flow in porous media to aquifer problems; 2. Solve problems involving well and collector hydraulics; 3. Solve solute transport problems in aquifer systems (for example, contamination of groundwater).

Water cycle; Recharge; Elementary processes; Aquifer types; Theory of potential groundwater flow; Water level; Permeability; Darcy’s law; Piezometric surfaces; Hydrographs; Flow equation; Unsaturated flow; Underground hydraulics; Pump testing; Wells; Superposition; Boundary effects; Unconfined aquifers; Delayed drainage; Linear uptake; Fractured media; Hydrogeochemistry and mass transport; Genesis of groundwater composition; Chemical reactions; Natural isotopes; Mass transfer processes; Transport equation; Basic solutions; Numerical modelling of aquifers; Aquifer exploration: Geophysical methods; Hydrogeological characteristics of unconsolidated formations, large sedimentary basins, carbonate rocks, volcanic rocks and other rock types; Wetlands; Sea intrusion; Aquifer contamination; Protected areas; Recovery methods; Groundwater impact of mining engineering; Groundwater management

Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Theory classes: 42h</th>
<th>28.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Practical classes: 12h</td>
<td>8.00%</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 6h</td>
<td>4.00%</td>
</tr>
<tr>
<td></td>
<td>Guided activities: 6h</td>
<td>4.00%</td>
</tr>
<tr>
<td></td>
<td>Self study: 84h</td>
<td>56.00%</td>
</tr>
</tbody>
</table>

The course consists of 4 hours per week of classroom activity.

Theoretical lectures serve to present the basic concepts and topics of the subject, shows examples and solves exercises.

Other classes are 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.

Students will acquire an understanding of hydrogeology and solute transport in porous media and learn how they apply to technological problems.

Upon completion of the course, students will be able to: 1. Apply equations of flow in porous media to aquifer problems; 2. Solve problems involving well and collector hydraulics; 3. Solve solute transport problems in aquifer systems (for example, contamination of groundwater).

Water cycle; Recharge; Elementary processes; Aquifer types; Theory of potential groundwater flow; Water level; Permeability; Darcy’s law; Piezometric surfaces; Hydrographs; Flow equation; Unsaturated flow; Underground hydraulics; Pump testing; Wells; Superposition; Boundary effects; Unconfined aquifers; Delayed drainage; Linear uptake; Fractured media; Hydrogeochemistry and mass transport; Genesis of groundwater composition; Chemical reactions; Natural isotopes; Mass transfer processes; Transport equation; Basic solutions; Numerical modelling of aquifers; Aquifer exploration: Geophysical methods; Hydrogeological characteristics of unconsolidated formations, large sedimentary basins, carbonate rocks, volcanic rocks and other rock types; Wetlands; Sea intrusion; Aquifer contamination; Protected areas; Recovery methods; Groundwater impact of mining engineering; Groundwater management
# 250345 - HIDROG - Hydrogeology

<table>
<thead>
<tr>
<th>Content</th>
<th>Learning time</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Introduction</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td>Introduction to the subject</td>
</tr>
<tr>
<td><strong>Water balance</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td>Water balance Practical exercise water balance</td>
</tr>
<tr>
<td><strong>Flow theory</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Specific objectives:</strong></td>
<td>Understanding the theory of flow Problems</td>
</tr>
<tr>
<td>Well hydraulics</td>
<td>Learning time: 31h 12m</td>
</tr>
<tr>
<td>----------------</td>
<td>------------------------</td>
</tr>
<tr>
<td></td>
<td>Theory classes: 10h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 1h</td>
</tr>
<tr>
<td></td>
<td>Self study : 18h 12m</td>
</tr>
</tbody>
</table>

**Description:**
- Pumping tests. Interpretation of pumping tests: Semigraphic methods.
- Overlapping fields pumping effects. Effect of linear boundaries: limits of recharge and impermeable boundary.
- Variable flow. Recovery, recovery tests. Estimating aquifer transmissivity from specific flows observed.
- Unconfined aquifers: effects of delayed drainage. Pumping from incomplete wells.
- Characteristic of a well: determination. Significance of the coefficients. Influence of inefficiency in specific flows in the estimation of transmissivity from them.
- Other types of deposits, drainage ditches, drains, wells point, mines, ...
- Drilling a well, characteristics, ...

**Specific objectives:**
- Knowledge of groundwater wells
- Practice

<table>
<thead>
<tr>
<th>Mathematical models</th>
<th>Learning time: 9h 36m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 2h</td>
</tr>
<tr>
<td></td>
<td>Self study : 5h 36m</td>
</tr>
</tbody>
</table>

**Description:**
- Learn how a mathematical model. MODFLOW
- Learn Modflow

**Specific objectives:**
- Consolidate knowledge of well hydraulics. Learn how a model works
- MODFLOW learn and consolidate knowledge models
### Hydrogeochemistry

**Learning time:** 21h 36m  
- Theory classes: 6h  
- Practical classes: 2h  
- Laboratory classes: 1h  
- Self study: 12h 36m

**Description:**  

**Specific objectives:**  
Practice

### Stream-aquifer interaction

**Learning time:** 19h 12m  
- Theory classes: 6h  
- Practical classes: 2h  
- Self study: 11h 12m

**Description:**  

**Specific objectives:**  
Knowledge of the relationship between an aquifer and the rivers and the sea

Practice
Solute transport

Description:

Specific objectives:
Knowledge of solute transport
Practice

Learning time: 26h 24m
Theory classes: 8h
Practical classes: 2h
Laboratory classes: 1h
Self study: 15h 24m

Qualification system

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment is an activity conducted with different milestones and assessable exercises throughout term time (DT) and the assessment test (EX).

The grade is estimated as: $0.5 + 0.5 \times TD \times EX$

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.

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.

Regulations for carrying out activities

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.
250345 - HIDROG - Hydrogeology

Bibliography

Basic:

Complementary: