Course guides
250822 - 250822 - Stochastic Methods in Hydrology

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: 2019  ECTS Credits: 5.0  Languages: English

LECTURER

Coordinating lecturer: DANIEL SEMPERE TORRES
Others: MARC BERENGUER FERRER, DANIEL SEMPERE TORRES

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
13315. To calculate, evaluate, plan and regulate surface and groundwater resources. (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 subject consists of 3 hours of class per week. The proportion Theory and problems is variable for each session with a final percentage of 55% of Theory and 45% of problems. In addition there is a 3 hour session of follow-up and resolution of doubts, and a session of 3h of evaluation.

As a fundamental activity for the evaluation, a personal work of understanding, application and discussion of an analysis of data from a real case is requested. This work will be the subject of an oral presentation that will be evaluated by the teachers.

Support material is used in the format of a detailed teaching plan through the ATENEA virtual campus: contents, programming of assessment activities and directed learning and bibliography.d'aprenentatge dirigit i bibliography.
LEARNING OBJECTIVES OF THE SUBJECT

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 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 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.

- Geostatistics fundamentals
  - Theory of regionalized variable.
  - Variogram.
  - Structural analysis.
  - Theory of local Kriging estimation.
  - Montecarlo method.
  - Simulation of regionalized variables.
- Introduction to stochastic hydrogeology. Multiple regression. Analysis of the principal components.

Introductory course to the basic techniques of statistical analysis that are used Hydrology. Given that our experience shows that students have the basic concepts acquired mainly at the theoretical level, the course reviews the most important data analysis techniques and focuses on the realization of exercises and application practices to real data. The purpose being to acquire the ability to apply these techniques of spatial and temporal data analysis to real cases.

Generic objectives: Learn to handle basic statistical analysis techniques commonly used in applying them to real data in exercises on real problems Hydrology.

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 large group</td>
<td>19,5</td>
<td>15.59</td>
</tr>
<tr>
<td>Hours medium 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 small group</td>
<td>9,8</td>
<td>7.83</td>
</tr>
</tbody>
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Total learning time: 125.1 h
CONTENTS

1. Introducción a la asignatura/Introducción a los métodos estadísticos utilizados en hidrología:

Description:
* Sistema de evaluación.
* Características del trabajo personal a realizar.
* Que aporta la estadística a la hidrología.
* Técnicas de análisis de datos en hidrología. La importancia de las técnicas estadísticas.
* Caracterización estadística de las variables hidrológicas.
* Ajustes de leyes de distribución de probabilidad.
* Bondad de un ajuste. Criterios estadísticos objetivos.
* Ejemplos con la distribución normal y lognormal

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

2. Calculation of return periods of variable hydrological

Description:

Full-or-part-time: 24 h
Theory classes: 4h
Practical classes: 6h
Self study : 14h

5. Multivariate statistical analysis:

Description:
5. Multivariate statistical analysis:
* Troubleshooting and exercises fit multiple regression

Full-or-part-time: 9 h
Theory classes: 2h
Practical classes: 2h
Self study : 5h 36m
7. Principal Component Analysis:

Description:
* Troubleshooting and exercises Principal Components Analysis

Full-or-part-time: 9 h
Theory classes: 2h
Practical classes: 2h
Self study : 5h 36m

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9. Introduction of regionalized variables and Kriging:

Description:

Full-or-part-time: 21 h
Theory classes: 6h
Practical classes: 3h
Self study : 12h 36m

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13. Validation:

Description:

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

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14. Probabilistic models of hydrological forecasting:

Description:

Full-or-part-time: 4 h
Theory classes: 2h
Self study : 2h 48m
15. Follow-up session:

Description:
* Resolution of doubts. * Presentation of results of exercises

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

16. Control of personal gain:

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

GRADING SYSTEM

The qualification of the subject is distributed in 10% of follow-up activities throughout the course 60% of the personal work presented orally and 30% of the written exam.

EXAMINATION RULES.

If one of the activities of continuous evaluation is not carried out in the programmed period, it will be considered not evaluated.

BIBLIOGRAPHY

Basic: