Universidad Zaragoza

Academic Year/course: 2022/23

26410 - Hydrogeology

Syllabus Information

Academic Year: 2022/23
Subject: 26410 - Hydrogeology
Faculty / School: 100 - Facultad de Ciencias
Degree: 296 - Degree in Geology
588 - Degree in Geology
ECTS: 7.0
Year: 2
Semester: Second semester
Subject Type: Compulsory
Module:

1. General information

1.1. Aims of the course

1.-Acquisition of the main concepts of Hydrogeology.

2.-Acquisition and use of hydrogeological date.

3.-Acquisition of knowledge about investigation and exploitation of groundwater.

4.-Acquisition of knowledge about the physical-chemistry of groundwater and contamination.

5.-Acquisition of knowledge on resource estimation and groundwater management.

6.-Acquisition of knowledge about the role of groundwater in geological processes.

The subject and its expected results are aligned with the Sustainable Development Goals (SDG) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of the results of Learning of the subject provides training and competence to contribute to some extent to its achievement especially in Goal 6: Clean water and sanitation.

1.2. Context and importance of this course in the degree

The subject aims to understand and assimilate the concepts, theories and models of water flow through geological materials, its importance as a geological agent, and its socio-economic interest in today's world. It is a subject located within the context of APPLIED GEOLOGY. Proper follow-up of the subject requires basic knowledge of Geology (lithostratigraphy and tectonics), geological cartography, basic sciences (mathematics, physics and chemistry), and sufficient knowledge of user computing.

1.3. Recommendations to take this course

To adequately study this subject, it is necessary to have a good level of knowledge of Geology. It is also necessary to be able to interpret geological maps and handle modern cartography techniques (geographic information systems and use of GPS). It is convenient for the student to have extensive knowledge of regional geology (Iberian Mountain Range, Pyrenees and Tertiary Ebro Basin). The student must have a sufficient level of mathematics and basic knowledge of spreadsheets.

2. Learning goals

2.1. Competences

Ability to handle the main concepts of Hydrogeology

Ability to adapt and use the basic tools of Hydrogeology

Ability to collect information on all aspects related to groundwater (inventories of water points, databases...)

Ability to manage geo-referenced data and the use of Geographic Information Systems

Ability to project the exploration and exploitation of groundwater, including the design and monitoring of drilling, surveys and water collection

Ability to manage physical-chemical data of water and its interpretation

Capacity in resource estimation and groundwater management

Ability to issue hydrogeological reports, and to implement them in other administrative reports (environmental impact assessments, discharge declarations, geotechnical reports...)

2.2. Learning goals

The student, to pass this course, must demonstrate the following results...

Ability to identify geological formations according to their hydrogeological parameters (mainly porosity and permeability)

Ability to explain and relate qualitatively and quantitatively the existing connection between all the components of the natural and artificial hydrological cycle.

Ability to acquire, analyze and synthesize hydrological information through the use of current techniques (GIS, databases, Excel sheets...)

Ability to use hydrogeological research-prospecting techniques, both for the exploitation and management of underground water resources.

Ability to carry out the design, execution and exploitation of groundwater catchments

2.3. Importance of learning goals

The management of water resources is a priority issue in the policies of European governments: The European Water Framework Directive considers the need to guarantee the supply of quality water to the populations, the conservation of wet ecosystems, and sets as an objective for 2014 a good quality for all water masses. The need for technicians trained in understanding and analyzing the different phases of the hydrological cycle, both natural and artificial, is increasingly evident. In this sense, the learning results of this subject open an important professional perspective to the students who take it.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

In the normal development of the subject, that is, carried out in person by the student during the course, the evaluation activities will consist of a continuous evaluation of the different learning activities and a final written test. The different evaluation activities designed are detailed below:

1. Written test on basic knowledge: The written tests will consist of questions that require short answers (limited response tests) or that require a broad development of the topic (essay tests or free and open response). Two problems similar to those solved in the cabinet practices are also included. The written test will be based on the scheduled learning activities program. The written test accounts for up to 50% of the evaluation, **although it MUST BE EQUAL TO OR GREATER THAN 4 to average with the continuous evaluation grades.**

2. Individual tasks with continuous evaluation: The works carried out in practices and others that are proposed, must be delivered in the ADD weekly, individually and carried out by hand, constituting the main part of the continuous evaluation. A Seminar will be given, the summary of which will be part of the tasks to be delivered. Within the continuous evaluation, the use of questionnaires will be considered. Continuous assessment will account for up to 40% of the final assessment. Attendance at practical problems will be compulsory.

3. Preparation of a complete practice notebook in digital format: all the problems carried out in the practices and other complementary ones that the student must solve personally will be included. A summary of the knowledge acquired in the field trips, which are also mandatory, will be included in the Practice Notebook. This notebook accounts for up to 10% of the fine grade.

GLOBAL EVALUATION TEST

Students who have not followed the subject in person, and those who still wish to do so, will have the right to a global evaluation test that will include:

- Examination of theoretical concepts similar to the one carried out for face-to-face students

- A written test on practical cabinet exercises (problems).

-Delivery of a complete practice notebook in digital format, with an annex that includes the development of all the practices carried out by hand.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, problem-solving sessions, field trips and autonomous work and study.

4.2. Learning tasks

This course is organized as follows:

- **Lectures** (32 hours). In addition to the lectures, where the main topics will be developed, practice sessions contribute to strengthen, extend, and apply previous concepts.
- **Problem-solving sessions** (28 hours).
- **Fieldwork** (2 trips, 10 hours).
- **Autonomous work and study** (105 hours).

4.3. Syllabus

This course will address the following topics:

- Topic 0. Introduction to hydrogeology
- Topic 1. The hydrologic cycle
- Topic 2. Porous media: porosity and permeability
- Topic 3. Aquifers, aquitards and aquicludes
- Topic 4. Storage parameter
- Topic 5. Fluid Energy: the Bernoulli equation
- Topic 6. Hydraulic head and hydraulic potential
- Topic 7. Darcy?s Law
- Topic 8. Equations of Groundwater flow
- Topic 9. Streamlines and flow nets
- Topic 10. Analytical solution of one and two-dimensional groundwater flow problems
- Topic 11. Groundwater modelling
- Topic 12. Groundwater flow patterns: Models of Hubbert and Toth
- Topic 13. Groundwater investigation techniques
- Topic 14. Water wells: design and construction
- Topic 15. Drilling techniques
- Topic 16. Well hydraulics: Thiem, Theis and Jacob equations
- Topic 17. Groundwater in various geologic settings
- Topic 18 .Groundwater interaction with stream and lakes
- Topic 19. Recharge and infiltration estimation
- Topic 20. Groundwater discharge: springs and wetlands.
- Topic 21. Heat transport and groundwater flow
- Topic 22. Chemical hydrogeology
- Topic 23. Groundwater quality and contaminant hydrogeology

4.4. Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class or please refer to the Faculty of Sciences and Earth Sciences Department websites (https://ciencias.unizar.es; https://cienciastierra.unizar.es) and Moodle.

4.5. Bibliography and recommended resources

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=26410