

Academic Year/course: 2022/23

## 60383 - Underground geological repositories

### Syllabus Information

**Academic Year:** 2022/23

**Subject:** 60383 - Underground geological repositories

**Faculty / School:** 100 - Facultad de Ciencias

**Degree:** 624 - Master's in Geology: Techniques and Applications

**ECTS:** 3.0

**Year:** 1

**Semester:** Second semester

**Subject Type:** Optional

**Module:**

## 1. General information

### 1.1. Aims of the course

The study of the geological storage and disposal integrates different issues associated to most of the geological disciplines (Petrology, Stratigraphy, Tectonics, Geochemistry, Hydrogeology, etc.) and with a clear focus on 1) the problem of wastes management and 2) the use and exploitation of geological resources. The main aim of this course is to understand the theoretical principles behind the geological storage and disposal and the specific characteristics and methodologies applied to the different materials and concepts.

These objectives are in the line of the following Sustainable Development Goals of the UN 2030 Agenda (<https://www.un.org/sustainabledevelopment/>), in such a way that the acquisition of the knowledge given in this course provides the ability and competence to contribute to their achievement:

SDG 4: Quality Education

SDG 7: Affordable and Clean Energy

SDG 9: Industry, Innovation and Infrastructure

SDG 11: Sustainable Cities and Communities

SDG 13: Climate Action

### 1.2. Context and importance of this course in the degree

This course offers an advanced formation in several interdisciplinary geological issues, focused on the study of some resources management and on one of the most important problems in the present society: the prospecting, evaluation, and management of the antropogenically generated wastes. That is why it is specially interesting for students with research and professional aims.

As it is an interdisciplinary course, the students will be able to apply specific aspects from their master's thesis to the developments of this course, and *viceversa*. Moreover, it will use some of the contents included in the compulsory courses from the first term, mainly those related to the knowledge of instrumental techniques and data management and evaluation.

### 1.3. Recommendations to take this course

The students should have a general knowledge in Petrology, Geochemistry, Stratigraphy, Hydrogeology and Structural geology. We recommend to take this course with a continuous and daily working plan. There are different supporting ways to help the students through tutorial sessions, orientation and evaluation sessions.

## 2. Learning goals

### 2.1. Competences

**After passing this course, the student will be more competent for...**

CB6 - To have and understand knowledge which provides the ground or opportunity to be innovative in the development and/or application of ideas, often in a research-based context.

CB7 - To have the ability to apply the acquired knowledge and problem solving capacities in new or little-known environments in larger (or multidisciplinary) contexts related to a field of study.

CB9 - To have the knowledge to communicate conclusions, and the reasons that sustain them, to specialized and non-specialized audiences in a clear and unambiguous way.

CG1 - To predict and control the evolution of complex situations by developing new and innovative methodologies adapted to the scientific, research and/or professional geological areas.

CG2 - To exchange and discuss information from different sources (written, oral, numerical, graphical).

CT1 - To use the English language to obtain information and to transfer it.

CT2 - To manage and select the suitable sources of bibliographic information.

Some **more specific competences** are:

1- A clear and detailed view of the several types of underground repositories,

2- A deep knowledge of the geological media as a natural system and as a corner stone to study, assess and control both, the storage of resources and the disposal of wastes.

## 2.2. Learning goals

Students should:

- know the different geological environments suitable as storage and/or disposal media;
- recognise the different properties that condition the suitability of a geological environment as a storage/disposal media;
- learn the different techniques for exploration, characterisation and assessment of the geological storage/disposal systems;
- be able to decide when a rock formation is suitable as a storage or disposal media, based on its tectonic, petrophysical, geochemical and hydrogeological properties;
- learn the methodologies for the monitoring and assessment of the geological disposal systems and their effects on the environment;
- learn to use multidisciplinary information from different sources and to integrate and summarise that in a comprehensive report and oral presentation; and
- use the English language to get information, write summaries and prepare oral presentations.

## 2.3. Importance of learning goals

The importance of the learning goals in this course is mainly related to the environmental, economical and social interest in the knowledge of the principles and functioning of the deep geological disposal as an alternative to both, dangerous wastes and energetic resources. This course will help the student to develop the ability to analyse, critically assess and, in summary, to take decisions based on reasonable facts.

# 3. Assessment (1st and 2nd call)

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

**The student will have to show that has reached the learning outcomes through the following evaluation activities:**

### Continuous Assessment:

- **Learning task 1** will be assessed through individual quizzes with theoretical-practical content of each course unit (maximum one per thematic unit). This activity is worth 50% of the final grade.

- **Learning task 2** will be assessed through the evaluation of the reports from the lab sessions. This activity is worth 25% of the final grade.

- **Learning task 3** will be assessed through individual or small-group essays presented by the students on topics related to the some of the units of the course. The active participation on the debates will also be taken into account. This activity is worth 25% of the final grade.

Each quiz/exercise or presentation in all learning tasks will be graded on a scale from 0 to 10. Each item will be passed with a grade equal or greater than 5. The final/global grade will be calculated applying the corresponding weights for each activity provided every activity has a grade greater than 4.

### Final Assessment

The student that decides to take only the final exam, or the student that has not passed the continuous assessment, will have to pass a final assessment consisting of two parts: a theoretical one about the different units treated during the course, and a practical one about the practical and seminar sessions. Each part will weigh a 50% of the total grade. The final/global grade will be calculated applying the corresponding weights for each activity provided every activity has a grade greater than 4.

### Off-site students Exams

The off-site students will be evaluated with the same final/global assessment indicated in the previous section.

## 4. Methodology, learning tasks, syllabus and resources

### 4.1. Methodological overview

The methodology followed in this course provides the students with the necessary link between the theoretical knowledge and its practical use in the resolution of actual problems in different types of geological storage. Students will develop competences to deal with different issues related to the characterisation, monitoring and assessment of different geological storage systems.

A wide range of teaching and learning tasks are implemented, such as lectures, practice sessions and seminars.

### 4.2. Learning tasks

The course includes the following learning tasks:

- **Learning task 1 - Lectures** (1.5 ECTS). Development of the concepts and theoretical basis of the course.
- **Learning task 2 - Practice Sessions** (1 ECTS). Management and assessment of real and/or theoretical-practical cases about the different types of storage systems described in the course.
- **Learning task 3 - Seminars** (0.5 ECTS). Debates, discussions and presentations on the alternatives, problems and the present and past issues related to the geological storage.

The duration of the sessions will be of 4 hours and will combine Lectures with Practice sessions or Seminars, depending on the syllabus.

Learning and assessment tasks will be under the on-site mode except if the authorities indicate the obligation of doing everything on-line due to the health situation.

*Note: The approach, methodology and evaluation indicated in this guide are prepared to be the same under any teaching scenario. They will be adjusted to the socio-sanitary conditions at any time, as well as to the instructions given by the competent authorities.*

### 4.3. Syllabus

The course will address the following topics:

#### Lectures

- Topic 1. (1 h) Introduction.
- Topic 2. (3 h) Geological storage and disposal: concept, types and characteristics.
- Topic 3. (6 h) Radioactive waste disposal. Options, characteristics, associated problems. Examples in the world.
- Topic 4. (3 h) Geological storage of CO<sub>2</sub>. Options, characteristics, associated problems.
- Topic 5. (2 h) Geological storage of gas. Options, characteristics, associated problems.

#### Practice sessions

There are several practice sessions and seminars on the topics covered during the lectures that will be given in parallel to them.

- The practice sessions (10 h) will involve solving practical cases related to the exploration and assessment of suitable geological areas for different underground repositories in Spain and other European countries.
- The seminars (5 h) will include the discussion and debate of different topics related to the worldwide socio-political, economic and scientific context, responses and positions with respect to the geological storage and disposal. Every student will prepare an oral presentation about one of the topics proposed by the lecturers at the beginning of the course.

### 4.4. Course planning and calendar

3 ECTS:

- Hours of lectures: 15
- Hours of Practice/Problem classes: 10
- Hours of Seminars: 5
- Hours of autonomous work: 45

Total hours: 75

The classes will start in the week number 8 or 9 of the second semester following the academic calendar of the Sciences Faculty. It will conveniently be announced.

### 4.5. Bibliography and recommended resources

<http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=60383>