Universidad Zaragoza

Year : 2020/21

60379 - Geothermics and its applications

Syllabus Information

Academic Year: 2020/21
Subject: 60379 - Geothermics and its applications
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

(1) Understand planetary-scale thermal energy flows and the different heat transport mechanisms.

(2) Interpret the surface effects of the large-scale thermal heat flow and its interaction with groundwater flow to generate a geothermal system.

(3) Understand the way a geothermal system works, in order to be able to estimate the geothermal potencial of a site and to be aware of the environmental and economic implications.

1.2.Context and importance of this course in the degree

This course is part of the optional block of MSc courses, all of them taught during the second semester.

The course contents assumes that the student has a basic understanding of the Earth as a dynamic planet, specially of those topics connected with the flow of heat in the Earth's interior (both at the global and local scales). From there, the course is designed to add a quantitative dimension to this previous knowledge, focusing on the theoretical aspects of heat and water transport mechanisms. This theoretical background will allow the student to better understand a geothermal system and how to estimate its geothermal potential.

The course has two different parts: in the first, shorter, part the theoretical background of heat transport is explained, whereas in the second part the theory is applied to the assessment of geothermal resources. In this sense, the course fits perfectly in the general philosophy of the MSc, with a clear bias towards technics and applications. Among the applications of Earth Sciences studies, the assessment of the geothermal resources of a region is a growing area of research and development.

1.3.Recommendations to take this course

The course integrates theory classes, practical sessions and seminars in four-hour teaching sessions, and has been designed to be taught in continuous assessment mode. Thus, it is highly desiderable that the student adopts a constant and continuous work plan in order to be able to follow the course and its learning curve.

It is recommended that student refresh their knowledge on heat and water transport mechanism, at least in a qualitative way.

2.Learning goals

2.1.Competences

CB6 - To have a knowledge base 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 capabilities in new or little-known environments in larger (or multidisciplinary) contexts related to geothermal research.

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

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

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

CE1 - To develop the skills of analysing and synthesising geoscientific information in a critical way.

CE2 - To have the ability to integrate evidences in order to propose and test hypothesis using the scientific method in the context of the geological research.

2.2.Learning goals

- Understand matter and energy flows at planetary scale and identify the processes that generate them.
- Quantify the most important processes in a geothermal system, both physical (conduction and convection heat transport) and chemical (composition of geothermal waters).
- Apply the theoretical background to practical problems in relation with the geothermal potential of a region.

2.3.Importance of learning goals

The study of geothermal resources has a theoretical and an applied side. The applied side aims at the exploitation of Earth's internal heat given specific thermal properties of underground rocks and waters, both for the generation of electricity or for direct use of this heat (for central heating, greenhouse heating, aquaculture, thermal spas, underground thermal energy storage, and many other industrial and agricultural uses). Geothermal energy is a clean and renewable energy source with an increasing demand in our society. Thus, it is important that the student is able to assess the geothermal potential of a region, something that this course has as one of its core objectives.

3.Assessment (1st and 2nd call)

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

Continuous assessment

Assessment of learning task 1 (lecture/presentation). Written quizzes at the end of each of the three course units (30% of grade).

Assessment of learning task 2 (practice sessions and case studies). A report of each practice session, due one week after the session (50% of grade).

Assessment of learning task 3 (seminars). Individual and/or group reports (20% of grade).

Global Assessment

For those students that did not pass the course by continuous assessment, and for those that decided not to take part in the continuous assessment itinerary, a final theory and practice written exam must be taken, where the same learning goals as in the continuos assessment will be evaluated. The written exam could also include an essay part on specific scientific papers, which details will be given to the students at least one week before the examination date.

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The course is organised around three learning tasks:

Lectures/presentations: 1.4 credits.

Practice sessions (including computer sessions) and case studies: 1.2 credits

Seminars: 0.4 credits.

Each of these learning tasks is detailed in the following section.

4.2.Learning tasks

Learning task 1: lectures/presentations. Twelve (12) face to face hours. This activity is designed to present and explain the theoretical background of the course.

Learning task 2: practice sessions and case studies. Twelve (12) face to face hours. During the practical sessions specific examples and case studies will be presented to the student in the field of geothermics. In the computer sessions both specific and general-purpose software will be used in order to solve more complex problems than in the lab sessions.

Learning task 3: seminars. Four (4) face to face hours. In this activity the students will be presented in advance with specific cases of geothermal systems in order to discuss the topic during the seminar based on short presentations by the students followed by a debate.

Learning task 4: Student personal work (45 off site hours). Time required by the student to the study of the theoretical concepts, finish the lab reports, and prepare seminar presentations.

The teaching and assessment activities will be carried out on-site (face-to-face) unless, due to the exceptional health situation, the provisions issued by the competent authorities and by the University of Zaragoza provide for them to be carried out off-site (telematically), except for field practices.

4.3.Syllabus

The course is divided in the following thematic units:

1. Fundamental of geothermics (5 hours of lectures and 4 hours of practice sessions)
   - Concept of goethermics, geothermal energy and geothermal system.

- Transport of heat by conduction, convection and radiation. Heat flow and geotherms. The role of fluid in the transport of heat.
- Thermal properties of rocks and fluids.

2. Types of geothermal systems (5 hours of lectures and 4 hours of lab sessions)
    - Hydrotermal systems.
    - Petrothermal systems.
    - Shallow geothermal systems.

3. Exploitation of geothermal resources (4 hours of lectures, 4 hours of lab sessions, and 4 hours of seminars)
    - Uses of goethermal energy.
    - Exploration and survey of a geothermal systems.
    - Case study of the assessment, exploitation and environmental impact of a geothermal systems.

4.4.Course planning and calendar

The course is taught during the first part of the second semester in four-hour sessions that combine lectures and practicals. Class schedule will be announce well in advance and published in the web page of the Faculty of Sciences. Final examination dates will also be announced in advance and published in the same web page.

Key dates

Beginning of the course: first week of February, in accordance with the Faculty of Sciences academic year calendar.

End of the course: last week of March.

Lab reports deadlines: as a rule, one week after the practical session.

Mid semester written exams: one written exam at the end of each on the three course units, in the dates that will be announced in advance.

Final written exam: at the end of the semester, in accordance with examination calendar of the Faculty of Sciences.

4.5.Bibliography and recommended resources