GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2022-2023

Geothermal Energy (C004255)

Course size *(nominal values; actual values may depend on programme)*

Credits 3.0	**Study time 90 h**	**Contact hrs**	35.0h

Course offerings and teaching methods in academic year 2022-2023

A (semester 2)	English	Gent	lecture	10.0h
			group work	22.5h
			integration seminar	2.5h
			online lecture	0.0h

Lecturers in academic year 2022-2023

Hermans, Thomas	WE13	lecturer-in-charge

Offered in the following programmes in 2022-2023	**crdts**	**offering**
Master of Science in Geology	3	A
Exchange programme in Geology (master's level)	3	A

Teaching languages

English

Keywords

Renewable energy, temperature, heat transfer, deep systems, BTES, ATES

Position of the course

With the fight against global warming and the need to reduce our CO2 emission, we have to find new ways of producing energy in a sustainable way. Geothermal energy is a renewable resource that can help to reduce our impact on the planet. The exploitation of geothermal energy is closely linked to the geological context. Mostly, the direct use of hot water or steam for the production of electricity or heat is limited by the access to hot fluids at accessible depth, what is mostly related to the tectonic and geological context. Its exploitation is also directly linked to the property of the rocks such as the permeability and the geochemistry of the fluid. More recently, the use of low-temperature systems (10-30°C) has started to increase. Those systems are using rocks and groundwater combined to heat pumps to produce heating and cooling for buildings. In this course, we will discuss the different geothermal systems and the contexts in which they can be exploited, highlighting the role of the geologist and hydrogeologist in the production of sustainable energy.

Contents

- Introduction to geothermal energy: deep and shallow system, occurrence, worldwide context
- Heat transport: free and forced convection, conduction processes, heat transport parameters, multi-phase flow, analogy with solute transport
- Deep geothermal systems: Tectonics and geological context, geothermal gradient, exploitation of high-temperature geothermal systems, sustainability and challenges.
- Shallow and low-temperature geothermal systems: principle of low-temperature geothermal energy, open and closed systems, introduction to heat pumps, sustainability and conflicting use of groundwater.

The different topics will be illustrated through integration seminars with professionals.
A group project will be organized on a selected topic related to geothermal energy. During this project, the student will become more familiar with existing analysis

and modeling tools used to characterize and predict the behavior of geothermal systems and the challenges related to their exploitation.

Initial competences

A basic knowledge of geology is required. This course builds on certain final competences of the course System Earth: Geology and Hydrogeology.

Final competences

1 Recognize the context of occurrence of geothermal systems.
2 Identify and apply heat transfer and related properties.
3 discuss en assess the conditions, challenges and limitations of geothermal projects.
4 Develop basic geothermal models, simulations and forecasts.
5 Analyze geothermal projects as a renewable energy source in a sustainable context.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Online lecture, Group work, Lecture, Integration seminar

Extra information on the teaching methods

- During the lectures, the theoretical concepts related to the course will be taught with examples. Students are encouraged to actively participate through short assignments and discussions.
- During integration seminars, professionals from the industry and consulting companies are invited to illustrate the development of geothermal projects in practice.
- During the group project, the students will become more familiar with existing analysis and modeling tools used to characterize and predict the behavior of geothermal systems and the challenges related to their exploitation.

Due to COVID-19, the learning methods can be adapted if necessary.

Learning materials and price

The slides of the theoretical lessons are available on Ufora.

References

- William E. Glassley. 2014. Geothermal Energy: renewable energy and the environment, Second edition. CRC Press

Course content-related study coaching

- Possibility to raise questions during the courses and the sessions dedicated to the project (including through e-mails).
- Treatment of problems during the courses and the practical sessions.

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Oral examination

Examination methods in case of periodic assessment during the second examination period

Oral examination

Examination methods in case of permanent assessment

Report, Assignment

Possibilities of retake in case of permanent assessment

examination during the second examination period is possible

Extra information on the examination methods

The practical group project is subject to a presentation on which is based the permanent evaluation. A feedback session is organized to make sure the topic is well covered. There is a second examination chance for the permanent evaluation (a new presentation must be submitted).

The oral examination is based on theoretical and practical questions.

Calculation of the examination mark

- Periodic evaluation, oral exam (50%)
- permanent evaluation,
- Presentation (40 %)
- Discussion (10%)