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820745 - EGT - Geothermal Energy

Coordinating unit: 240 - ETSEIB - Barcelona School of Industrial Engineering

Teaching unit: 724 - MMT - Department of Heat Engines

Academic year: 2019

Degree: MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional)
MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Optional)

ECTS credits: 5 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: Felipe Blanch, Jose Juan De

Others: Felipe Blanch, Jose Juan De

Opening hours

Timetable: To be published in the teaching intranet

Prior skills

Fundamentals of Heat Transfer
Fundamentals of Thermodynamics
Fundamentals of Fluid Mechanics

Requirements

Thermal Equipment

Degree competences to which the subject contributes

Specific:

CEMT1. Understand, describe and analyse, in a clear and comprehensive manner, the entire energy conversion chain, from its status as an energy source to its use as an energy service. They will also be able to identify, describe and analyse the situation and characteristics of the various energy resources and end uses of energy, in their economic, social and environmental dimensions, and to make value judgments.

CEMT4. Efficiently collect data on renewable energy resources and their statistical treatment and apply knowledge and endpoint criteria in the design and evaluation of technology solutions for using renewable energy resources, for both isolated systems and those connected to networks. They will also be able to recognise and evaluate the newest technological applications in the use of renewable energy resources.

CEMT5. Employ technical and economic criteria to select the most appropriate thermal equipment for a given application, dimension thermal equipment and facilities, and recognise and evaluate the newest technological applications in the production, transportation, distribution, storage and use of thermal energy.

CEMT7. Analyse the performance of equipment and facilities in operation to carry out a diagnostic assessment of the use system and establish measures to improve their energy efficiency.

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Teaching methodology

The course teaching methodologies are as follows:

- Lectures and conferences: knowledge exposed by lecturers or guest speakers.
- Practical sessions: resolution of exercises, debates and group dynamics, with the lecturer and other students in the classroom; classroom presentation of an activity individually or in small groups.
- Laboratory / Workshop: completion of designs, measurements, verifications, etc.; and presentation of results orally or in writing individually or in small groups.
- Theoretical/practical supervised work: classroom activity, carried out individually or in small groups, with the advice and supervision of the teacher.
- Homework assignment of reduced extension: carry out homework of reduced extension, individually or in groups.
- Homework assignment of broad extension (PA): design, planning and implementation of a project or homework assignment of broad extension by a group of students, and writing a report that should include the approach, results and conclusions.

Training activities:

The course training activities are as follows:

Face to face activities
- Lectures and conferences: learning based on understanding and synthesizing the knowledge presented by the teacher or by invited speakers.
- Participatory sessions: learning based on participating in the collective resolution of exercises, as well as in discussions and group dynamics, with the lecturer and other students in the classroom.
- Presentations: learning based on students presenting in the classroom an activity individually or in small groups.
- Laboratory / Workshop: learning based on students understanding the operation of equipment, their specifications and documentation; making designs, measurements, verifications, etc..; and presenting results orally or in writing, individually or in small groups.
- Theoretical/practical supervised work: learning based on performing an activity in the classroom with the advice of the teacher.

Study activities
- Homework assignment of reduced extension: learning based on applying knowledge and presenting results.
- Homework assignment of broad extension: learning based on applying and extending knowledge.
- Self-study: learning based on studying or expanding the contents of the learning material, individually or in groups, understanding, assimilating, analysing and synthesizing knowledge.

Learning objectives of the subject

Objectives
- Understanding the potential use of geothermal energy and its environmental impacts
- Understanding, domain and application of technologies associated with the use of low enthalpy geothermal
- Understanding and mastery of other geothermal technologies use

Learning Outcomes
At the end of the course, he / student:
* Understand the role of geothermal energy in the context of global and regional energy system, its economic, social and environmental connotations, and the impact of technologies on a local and global context.
* Meet relevant organizations, major projects internationally, the main sources of information and policy related to geothermal technology.
* They have the elements of analysis and knowledge necessary to carry out a project, basic engineering scale, related to the quality and / or supply of energy using geothermal technology.

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* Know the major lines of research in the field of geothermal utilization technologies and is able to bring innovative ideas.

Study load

Total learning time: 125h	Hours medium group:	30h	24.00%
	Guided activities:	10h	8.00%
	Self study:	85h	68.00%

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Content

1. Introduction to geothermal energy

Learning time: 8h

Theory classes: 1h
Practical classes: 1h
Guided activities: 2h
Self study : 4h

Description:
Geothermal energy source. Ranking. Potential geothermal resources at global, national and regional level. Organizations and associations.

Related activities:
0. Do a "puzzle"

Specific objectives:
What the student understands the scope and potential of geothermal energy

2. Basement, subsurface thermal properties

Learning time: 29h

Theory classes: 4h
Practical classes: 4h
Guided activities: 4h
Self study : 17h

Description:
Classification of subsoil. Geotechnical characteristics of the land. Polls. Thermal properties of the soil. Heat transfer in the soil. Thermal diffusion terrain.

Related activities:
1. Test

Specific objectives:
What the student understands and can interpret the mechanical-thermal characteristics of the ground

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3. Low enthalpy geothermal systems

Learning time: 39h

Theory classes: 4h
Practical classes: 4h
Guided activities: 4h
Self study : 27h

Description:
Classification of low enthalpy geothermal systems. Vertical and horizontal geothermal probes. Geothermal heat pumps. Geothermal heating

Related activities:
1. Test
2. Project of low enthalpy geothermal

Specific objectives:
What the student understands, knows and analyze the application of low enthalpy geothermal systems.

4. Geothermal systems of medium and high enthalpy

Learning time: 23h

Theory classes: 3h
Practical classes: 3h
Guided activities: 4h
Self study : 13h

Description:
Classification of geothermal systems of medium and high enthalpy. Geothermal plants

Related activities:
1. Test

Specific objectives:
What the student understands, knows and analyze the application of geothermal systems of medium and high enthalpy

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5. Underground thermal energy storage	Learning time: 15h Theory classes: 2h Practical classes: 2h Guided activities: 2h Self study : 9h

Description:
Systems underground thermal energy storage

Related activities:
1. Test

Specific objectives:
What the student understand and be able to assess the implementation of systems underground thermal energy storage

6. Environmental impacts and legislation	Learning time: 11h Theory classes: 1h Practical classes: 1h Guided activities: 2h Self study : 7h

Description:
Potential environmental impacts of technologies harnessing geothermal energy. legislation

Related activities:
1. Test
3. Written test

Specific objectives:
What the student understand and be able to assess the potential environmental impacts of technologies using geothermal energy. Know the law on these types of exploitation.

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Planning of activities

0. Puzzle

Hours: 1h
Practical classes: 1h

Description:
Making a type "Puzzle" cooperative learning activity on "Introduction of geothermal energy"

Support materials:
Available in digital campus

Descriptions of the assignments due and their relation to the assessment:
Handwritten document with the general ideas

Specific objectives:
CETM1

1. Test

Hours: 6h
Practical classes: 0h
Theory classes: 0h
Guided activities: 1h
Self study: 5h

Description:
Performing a test on theory subjects 2 to 6

Support materials:
Test on the digital campus.

Descriptions of the assignments due and their relation to the assessment:
Test responses in the digital campus

Specific objectives:
CETM1, CETM4 and CETM7

2. Project of low enthalpy geothermal energy

Hours: 14h
Practical classes: 0h
Theory classes: 0h
Guided activities: 4h
Self study: 10h

Description:
Develop a small project to implement low temperature geothermal energy

Support materials:
Design data, geographical location, type of technology to use

Descriptions of the assignments due and their relation to the assessment:
Project report at the end of the 10th week of the course

Specific objectives:
CETM4, CTM6 and CETM7

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3. Written test	Hours: 18h Guided activities: 0h Practical classes: 0h Theory classes: 2h Self study: 16h

Description:
Making a written test troubleshooting

Support materials:
Statements problems and calculator

Descriptions of the assignments due and their relation to the assessment:
Results of the problems solved. End of the 15th week of the course

Specific objectives:
All competencies

Bibliography

Basic:

DiPippo, Ronald. Geothermal power plants [on line]. 4th ed. Amsterdam: Butterworth-Heinemann, 2016 [Consultation: 05/10/2017]. Available on: <http://site.ebrary.com.recursos.biblioteca.upc.edu/lib/upcatalunya/detail.action?docID=11128946>. ISBN 9780081002902.

Grant, Malcom A.; Bixley, Paul F. Geothermal reservoir engineering [on line]. 2nd ed. New York: Academic Press, 2013 [Consultation: 07/09/2017]. Available on: <http://site.ebrary.com/lib/upcatalunya/detail.action?docID=10446508>. ISBN 9780323152914.

Complementary:

Llopis Trillo, Guillermo; López Jimeno, Carlos; Franqueza Palacios, Juan. Guía técnica de sondeos geotérmicos superficiales [on line]. Madrid: Fundación de la Energía de la Comunidad de Madrid, DL 2009Available on: <http://bit.ly/1udL0vw>. ISBN 9788461291366.

Conde Lázaro, Eduardo...et al. Guía técnica de bombas de calor geotérmicas [on line]. Madrid: Fundación de la Energía de la Comunidad de Madrid, 2009Available on: <http://bit.ly/1r3V5v4>. ISBN 9788461291427.

Others resources:
Presentations and other documents in digital campus