

**AGH**AGH UNIVERSITY OF SCIENCE
AND TECHNOLOGY

Module name: Przedmiot obieralny w języku angielskim Geothermal energy resources

Academic year: 2016/2017 Code: BEZ-1-514-s ECTS credits: 3

Faculty of: Geology, Geophysics and Environmental Protection

Field of study: Ecological Sources of Energy Specialty: —

Study level: First-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 5

Course homepage: —

Responsible teacher: dr inż. Papiernik Bartosz (papiern@geol.agh.edu.pl)

Academic teachers:

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence			
M_K001	Student is aware and understands economic, social and ecological impact of engineering activity in the field of prospecting and exploitation of geothermal deposits. Student knows the basics of modern modeling techniques subsurface geothermal deposits occurrence.	EZ1A_K02, EZ1A_K01	Activity during classes, Test
Skills			
M_U001	Student is able to analyze the conditions of geothermal waters occurrence and assess their suitability for specific purposes using the literature, materials and professional software.	EZ1A_U03, EZ1A_U08, EZ1A_U01	Test, Presentation, Report
M_U002	Student has the ability to extend his knowledge in the field geothermal energy.	EZ1A_U07	Test, Presentation
Knowledge			
M_W001	Student has the basic language skills in the field of geothermal resources. Student has the knowledge on basic definitions of geothermal energy, geothermal deposits.	EZ1A_W01	Test

M_W002	Student has basic knowledge of geology of various geothermal regions and related to them types of geothermal deposits. Student is aware of geothermal resources renewability and has basic information on technology of geothermal drillings.	EZ1A_W01	Test
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FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Others	E-learning
Social competence												
M_K001	Student is aware and understands economic, social and ecological impact of engineering activity in the field of prospecting and exploitation of geothermal deposits. Student knows the basics of modern modeling techniques subsurface geothermal deposits occurrence.	+	-	-	-	-	-	-	-	-	-	-
Skills												
M_U001	Student is able to analyze the conditions of geothermal waters occurrence and assess their suitability for specific purposes using the literature, materials and professional software.	+	-	-	+	-	-	-	-	-	-	-
M_U002	Student has the ability to extend his knowledge in the field geothermal energy.	+	-	-	+	-	-	-	-	-	-	-
Knowledge												
M_W001	Student has the basic language skills in the field of geothermal resources. Student has the knowledge on basic definitions of geothermal energy, geothermal deposits.	+	-	-	-	-	-	-	-	-	-	-

M_W002	Student has basic knowledge of geology of various geothermal regions and related to them types of geothermal deposits. Student is aware of geothermal resources renewability and has basic information on technology of geothermal drillings.	+	-	-	-	-	-	-	-	-	-	-
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Module content

Lectures

1. Translation of the basic geothermal terms from English into Polish
2. Basic definitions on geothermal energy. Basic geological description of favorable conditions for different types of geothermal deposits occurrence. Basic concepts related to geothermics (a thermal gradient of the Earth, and the geothermal degree, geothermal water and steam deposits). High-temperature and low-temperature geothermal resources and conditions of their occurrence. Sources of heat in the Earth's crust and the processes responsible for the heat flow.
3. General characteristics of geothermal systems in the world and in Poland – the present day and the future.
4. Basic methods of geothermal energy utilization – direct utilization, geothermal heat pumps (GHP), ground source or ground coupled heat pumps (GSHP or GCH) binary fluid generators for electrical production, electricity production.
5. Methods of geothermal deposits exploitation . The technologies performing geothermal wells (vertical, directional, horizontal). Methods of water production. The disposal of geothermal fluids. Geological and economic aspects of extraction using deep hole drilling (drilling costs, performance, temperature, mineralization, the chemical composition of the waters, etc.).
6. Methods for assessment of geothermal resources and reserves. Examples of classifications of geothermal resources types. Methodology of the assessment – Factors affecting aquifers, and geothermal resources.
7. Review of computer modeling techniques useful in geothermal resources prospecting and assessment.
8. Geothermal waters and energy in Poland and in the world – examples of reporting, installations and contribution to energy balances of different countries.
9. Utilization of geothermal waters in balneotherapy and recreation. Basic concepts of balneotherapy. Factors enabling the use of the waters for medicinal and recreational objectives (e.g. temperature, mineralization, chemical composition). Recreation and balneotherapy centers in Poland and in the world.

Project classes

Student during lab exercises uses static 3D geomodel prepared in professional software format (preferentially Petrel), complements it with an additional reservoir and thermal parameters. Using methodology of geothermal parameters assessment the student will determinate the prospective areas in accordance with the accepted assumptions. The results of the analyses student shows during a brief presentation/report.

In the framework of student activities:

1. Student recognizes and assesses the basic parameters of the geothermal using

knowledge, statistical analysis and specialized software.

2.Student interprets the results obtained, specifies the criteria prospectivity and on that basis defines borders of geothermal prospect.

Method of calculating the final grade

Ocena końcowa = 0,6• ocena z kolokwium + 0,4• ocena z opracowanego raportu

Prerequisites and additional requirements

- Knowledge of the basic rules of thermal calculation
- Basic knowledge of the English language
- Basic statistical calculations knowledge
- Basic skills in selection and interpretation of geological data
- Basic skills in application of specialist software for subsurface cartography and geomodelling

Recommended literature and teaching resources

- 1.Górecki W. (red.), 2006 - Atlas zasobów geotermalnych formacji mezozoicznych i paleozoicznych na Niżu Polskim.
- 2.Solik-Heliasz E. (red.), 2009 - Atlas zasobów energii geotermalnej w regionie górnośląskim. Utwory neogenu, karbonu i dewonu.
- 3.Górecki W. (red.), 2011 - Atlas zasobów wód i energii geotermalnej Karpat Zachodnich.
- 4.Górecki W. (red.), 2013 - Atlas zasobów wód i energii geotermalnej Karpat Wschodnich.
- 5.Muffler P., Cataldi R., 1978, Methods for regional assessment of geothermal resources, Geothermics, Volume 7, Issues 2-4, 1978, Pages 53-89
- 6.Popovski K. et al., 2010 - Geothermal energy.
- 7.Kochański J.W., 2002 - Balneologia i hydroterapia. Wyd. AWF we Wrocławiu.
- 8.Kochański J.W., 2008 - Lecznictwo uzdrowiskowe. Wyd. Wyższej Szkoły Fizjoterapii we Wrocławiu.
- 9.Materiały ze Światowego Kongresu Geotermalnego na Bali (Indonezja) w 2010 r. - dostępne w formie elektronicznej

Scientific publications of module course instructors related to the topic of the module

Additional scientific publications not specified

Additional information

None

Student workload (ECTS credits balance)

Student activity form	Student workload
Participation in lectures	15 h
Participation in project classes	15 h
Realization of independently performed tasks	40 h
Preparation of a report, presentation, written work, etc.	20 h
Summary student workload	90 h
Module ECTS credits	3 ECTS