



Subject card

Subject name and code	Geothermal energy and heat pumps, PG_00055942						
Field of study	Power Engineering, Power Engineering, Power Engineering						
Date of commencement of studies	October 2021	Academic year of realisation of subject				2023/2024	
Education level	first-cycle studies	Subject group				Optional subject group Subject group related to scientific research in the field of study	
Mode of study	Full-time studies	Mode of delivery				at the university	
Year of study	3	Language of instruction				Polish	
Semester of study	6	ECTS credits				4.0	
Learning profile	general academic profile	Assessment form				assessment	
Conducting unit	Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Jan Wajs				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	15.0	0.0	45
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	45		6.0		49.0	100
Subject objectives	Discussion on the power engineering technology applied to the energy from geothermal resources. Discussion of theoretical fundamentals, constructions and applications of heat pumps. Presentation of designing principles of heating installations with heat pumps.						
Learning outcomes	Course outcome		Subject outcome			Method of verification	
	[K6_U04] is able to design a simple device structure and prepare the accompanying technical documentation, conduct a basic technical and economic analysis of energy systems, including technologies using renewable and pro-ecological energy sources as well as conventional and nuclear energy, design energy installations for them and their basic elements (including electric lighting)); select, operate and control the most commonly used electrical devices and drive systems.		Student is able to perform a project with thermodynamic and economic calculations of the geothermal energy conversion system.			[SU4] Assessment of ability to use methods and tools	
	[K6_W06] knows classic and developmental energy technologies, rules for the selection and operation of heat and energy devices and installations, basic principles of energy systems operation, basic issues regarding the reliability of energy devices and diagnostics, environmental effects of energy technologies used, methods of using renewable energy sources		Student possesses knowledge of systems with heat pumps. Student possesses knowledge of devices diagnostics in the compressor heat pump cycle. He/She is able to evaluate an influence of heat pump working fluid on the environment			[SW1] Assessment of factual knowledge	
	[K6_W10] knows the basic installations in the field of renewable energy sources and their impact on the environment		Student has knowledge about the operation of energy equipment for geothermal technologies.			[SW1] Assessment of factual knowledge	

Subject contents	<p>LECTURE: Origin of geothermal energy, its characteristics and place in Europe and in the World, the basic concepts of geothermal energy. Selection of geothermal energy in Poland. Shallow geothermal energy and its use in heating. Systems supported by geothermic energy and geothermal energy. Principles of operation of compressor heat pumps. Construction of compressor heat pumps. Heat sources of low temperature for installation with heat pump. Heat source of high temperature in the system with heat pump. Working fluids aspects of thermodynamic properties and environmental impact. High temperature compressor heat pump. Introduction to a designing of heating installations with compressor heat pump.</p> <p>Project: Guidelines of heat source selection in dependence on installation/building type. Selection of main components and safety devices. Creation of technological schemes of heat centres with heat pumps.</p>											
Prerequisites and co-requisites	Knowledge from course of Applied thermodynamics and Heat transfer.											
Assessment methods and criteria	<table border="1" data-bbox="451 461 1487 568"> <thead> <tr> <th data-bbox="451 461 798 499">Subject passing criteria</th> <th data-bbox="798 461 1141 499">Passing threshold</th> <th data-bbox="1141 461 1487 499">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="451 499 798 533">project</td> <td data-bbox="798 499 1141 533">56.0%</td> <td data-bbox="1141 499 1487 533">40.0%</td> </tr> <tr> <td data-bbox="451 533 798 568">written assessment of the lecture</td> <td data-bbox="798 533 1141 568">56.0%</td> <td data-bbox="1141 533 1487 568">60.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	project	56.0%	40.0%	written assessment of the lecture	56.0%	60.0%
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project	56.0%	40.0%										
written assessment of the lecture	56.0%	60.0%										
Recommended reading	Basic literature	<ol style="list-style-type: none"> 1. Stober I., Bucher K.: Geothermal energy - from theoretical models to exploration and development. Springer, Berlin, 2013. 2. Nowak T.: Heat pumps. Integrating technologies to decarbonise heating and cooling, European Copper Institute, 2018. 3. Grassi W.: <i>Heat pumps. Fundamentals and Applications</i>, Springer International Publishing, 2018. 										
	Supplementary literature	no requirements										
	eResources addresses											
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> 1. The term of geothermal energy. 2. Provide classification of heat pumps. 3. Discuss operational principles of compressor heat pumps. 4. Provide information about applications of heat pumps in geothermal systems. 											
Work placement	Not applicable											