GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00059969						
Field of study	Environmental Engineering						
Date of commencement of studies	February 2025		Academic year of realisation of subject	2025/2026			
Education level	second-cycle studies		Subject group	Obligatory subject group in the field of study			
Mode of study	Full-time studies		Mode of delivery	at the university			
Year of study	1		Language of instruction	Polish			
Semester of study	2		ECTS credits	2.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	Zakład Ogrzewnictwa, Wentylacji, Klimatyzacji i Chłodnictwa -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		mgr inż. Piotr Jasiukiewicz				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	15.0	0.0	30
	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	30		5.0	19.0	54	
Subject objectives	Familiarizing students with the technology of harnessing renewable energy using heat pumps. Presentation of the theoretical basis for the operation of heat pumps. Discussion of the types and method of obtaining thermal energy from the so-called renewable heat sources, both natural and waste. Discussion of heating and cooling (air conditioning) systems in the form of reversible circuits of heat pumps. Discussion of the basics of designing the lower heat sources for heat pumps. Presentation of the methodology of thermal-flow and hydraulic calculations for installations of the lower heat sources.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W11] has knowledge to analyze, evaluate and optimize processes, objects and systems of environmental engineering and knows the principles of rational energy management and resources	The student has knowledge of acquisition and exploitation of renewable energy sources.	[SW1] Assessment of factual knowledge
K7_W01	The student knows ways to efficient management of thermal energy, for heating buildings and heating DHW, using renewable heat sources by means of heat pumps heat pumps.	[SW1] Assessment of factual knowledge
[K7_U01] can obtain information from literature, databases and other sources; can integrate the obtained information, interpret and critically evaluate them, draw conclusions, and formulate and comprehesively justify the opinions	The student is able to balance thermally residential/ public utilities, selecting, in terms of technical and economic, the size of the lower heat source	[SU2] Assessment of ability to analyse information
K7_U12	The student has knowledge of heating installations in in which the heat source is a heat pump heat pump. He or she is able to identify various sources of renewable energy. Can Evaluate the practical possibilities use of a specific source of heat for a heat pump.	[SU1] Assessment of task fulfilment
K7_U10	The student knows the environmental effects (environmental protection) that can be be obtained by using renewable heat sources for heating buildings.	[SU3] Assessment of ability to use knowledge gained from the subject

Subject contents	Lecture: 1. Theoretical basis for the use of heat pumps: among others: the idea of heat pump operation, the purpose of application, renewable/waste energy resources, the basis of left-hand circuits, the principle of heat pump operation, heat pumps classification in terms of construction and application. 2. Design and principle of operation: among others: elements of the refrigeration system), thermodynamic processes occurring in the heat pump circuit, fluids used in heat pump circuits and their thermal properties. 3. Lower heat sources: among others: quantitative and qualitative features of the lower heat sources, characteristics of available natural and waste heat sources, the following will be described: availability, temperature, heat capacity, method of obtaining, availability, pollution. Calculation of the size of the lower heat sources. 4. Heating installations of buildings cooperating with heat pumps: among others: low-temperature heating installations dedicated to cooperation with heat pumps will be discussed, 5. Preparation (heating) of domestic hot water using heat pumps: among others: the method of selecting DHW heaters for heat pumps will be discussed. The design of air heat pumps for heating DHW will be discussed. The cooperation of heat pumps with solar installations will be discussed. 6. Photovoltaic installations cooperation with heat pumps: among others: the method of selecting the size of a photovoltaic installation cooperating with a building equipped with a heat pump will be discussed, 7. Air conditioning systems refrigeration systems using reversible heat pumps as a source of heat and cold for residential buildings. 8. Natural cooling using lower heat source installations to obtain "natural cooling" for building air conditioning systems. Project: 1. Introduction to the design of heating installations cooperating with heat pumps: among others: the types, design, operating parameters of heating installations cooperating with heat pumps, guidelines for selecting the size of a heat pump for a given building, the use of installation separation buffer will be discussed. The influence of characteristic operating parameters of heat pumps on the efficiency of operation: required operating temperatures of the heating system, heat carrier flow through the condenser and evaporator of heat pump. Adaptation of the optimal temperature and flow parameters of the heat pump to the thermal capabilities of various heating systems. 2. Design of heating systems with heat pumps: among others: creating and drawing technological diagrams of heat distribution nodes with heat pumps in various configurations for different applications. 3. Heating installation for the building, in which the source of heat will be a heat pump designed by students. 4. Practical use of computer software supporting the selection and design of installations with heat pumps
Prerequisites and co-requisites	The student should have knowledge and skills in the areas of: technical thermodynamics, in particular in the field of left-hand refrigeration circuits, heat transfer, in particular in the field of heat transfer mechanisms in heating installations.
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
written assessment of the lecture	56.0%	60.0%
project	56.0%	40.0%

Recommended reading	Basic literature	Grassi W.: Heat pumps. Fundamentals and Applications, Springer International Publishing, 2018, doi:10.1007/978-3-319-62199-9
	Supplementary literature	Nowak T.: Heat pumps. Integrating technologies to decarbonise heating and cooling, European Copper Institute, 2018, https://www.ehpa.org/fileadmin/user_upload/White_Paper_Heat_pumps.pdf
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1. Discuss the principle of operation of the compressor heat pump. Present the characteristic processes of the refrigerant on the P-H diagram. 2. Discuss how to obtain thermal energy from the ground through the so-called horizontal ground exchanger. Provide characteristic parameters that affect the size and method of construction. 3. Discuss how to obtain thermal energy from the ground through the so-called vertical ground exchanger. Provide characteristic parameters that affect the size and method of construction. 4. Properties of the outside air as a heat carrier for an air source heat pump. 5. Present the parameters characterizing, in terms of suitability for the heat pump, the lower heat source. Compare the lower heat source, which is the ground, and the outside air.	
Work placement	Not applicable	

Document generated electronically. Does not require a seal or signature.