



Subject card

Subject name and code	Heat recovery in energy sector and industry, PG_00057264						
Field of study	Power Engineering, Power Engineering, Power Engineering						
Date of commencement of studies	February 2023	Academic year of realisation of subject				2023/2024	
Education level	second-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	1	Language of instruction				Polish	
Semester of study	2	ECTS credits				3.0	
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		dr hab. inż. Jan Wajs				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	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		8.0		37.0	75
Subject objectives	Teaching in the field of the energy technologies and efficient energy utilization						
Learning outcomes	Course outcome		Subject outcome			Method of verification	
	[K7_W06] knows the extended issues of reliability of power equipment and diagnostics of defects in this equipment		Student has knowledge about the operation of energy systems and in the basis of thermal-hydraulic measurements is able to conclude about their technical states.			[SW1] Assessment of factual knowledge	
	[K7_W10] knows the basic installations of advanced energy systems, transmission networks and internal installations and their impact on the environment		The student understands the technological /energy processes and is able to indicate ways of reducing their negative impact on the environment.			[SW1] Assessment of factual knowledge	
	[K7_U06] is able to apply basic and advanced knowledge of power equipment and transmission network and internal installations to the preliminary design of a modern power plant or part thereof		The student presents a technical problem solution in the form of a conceptual design, with thermodynamic, ecological and economic analyzes.			[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment	
	[K7_W08] as knowledge about development trends in the field of known technologies and non-technical aspects to solve simple engineering tasks in the field of power systems and equipment or transmission networks and internal installations		The student knows a modern technologies of waste energy management, in particular the technologies of heat recovery from a low-temperature media. The student knows methods of heat transfer enhancement and directions of recuperators' development for an effective heat recovery.			[SW1] Assessment of factual knowledge	
Subject contents	Introduction includes definition of energy, methods of energy transfer, mechanisms of heat transfer and methods of heat transfer enhancement in the recuperators. Waste energy, its types and general classification of its usage. The economic effect of waste energy recovery. Evaluation of waste energy resources. Physical and chemical recuperation. Chemical energy of solid wastes. Thermal energy storage. Fundamentals of heat recovery from ventilation systems, air conditioning systems and compressors cooling systems. Cooling sorption technologies supplied by waste heat. Estimation of environmental benefits from system utilizing waste heat. Examples of installations/facilities utilizing waste heat. Study trip to chosen company that uses heat recovery.						

Prerequisites and co-requisites	Knowledge from courses: Thermodynamics, Heat transfer and Polygeneration systems		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	written assessment of the lecture	56.0%	70.0%
	Laboratory report	100.0%	30.0%
Recommended reading	Basic literature	U.S. Department of Energy, "Waste Heat Recovery - Technology and Opportunities in U.S. Industry". BCS, Incorporated, 2008. https://www1.eere.energy.gov/manufacturing/intensiveprocesses/pdfs/waste_heat_recovery.pdf	
	Supplementary literature	No requirements	
	eResources addresses		
Example issues/ example questions/ tasks being completed	Types of waste energy and their examples. Method of calculation of heat exchanger effectiveness. Technologies of heat utilization from high temperature processes. Technologies of heat recovery from low temperature processes.		
Work placement	Not applicable		