



Subject card

Subject name and code	Heat transfer and Heat Exchangers, PG_00042138						
Field of study	Power Engineering, Power Engineering, Power Engineering, Power Engineering, Power Engineering						
Date of commencement of studies	October 2020	Academic year of realisation of subject			2022/2023		
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			exam		
Conducting unit	Department of Energy and Industrial Apparatus -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Rafał Andrzejczyk					
	Teachers	dr hab. inż. Rafał Andrzejczyk dr hab. inż. Michał Klugmann dr inż. Paweł Szymański					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	15.0	0.0	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		5.0		50.0	100
Subject objectives	Presentation of principal mechanisms and laws of heat transfer. Lecture familiarises with methods of solving problems in technical applications, conduction and heat transfer problems as well as radiative heat transfer. Presents foundations to sizing of heat exchangers.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	K6_W09	The student is able to design heat exchangers used in the power industry (e.g. thermal power stations, combustion engines, cooling systems for compressors and other rotating machines) or to select individual elements of this device. Can describe the basic processes taking place in them with appropriate equations. The student is able to use the thermo-electric analogy to solve practical problems in the field of heat transfer.	
	K6_U04	Student is able to carry out technical and economic analysis for simple construction of heat exchangers Participant can apply appropriate calculation methods to solve design tasks in the field of heat transfer. Student is able to design heat exchangers used in power engineering or select individual elements of this device. Can describe the basic processes occurring in this devices by using appropriate equations.	
	K6_U06	The student is able, on the basis of the analysis of the operating parameters of the system, to assess the risk of a possible failure and determine possible directions of modification to avoid the risk. In particular, he can estimate the maximum allowable heat flux density that can be delivered / received from a unit of surface of a given type of heat exchanger, maximum allowable working pressure, flow resistance, material compatibility with a given type of working fluid	
Subject contents	Lecture: presentation of major mechanisms and laws governing the flow of heat. Presentation of methods of solving of technical problems incorporating heat conduction, heat convection and radiative heat transfer. Methods of heat transfer intensification. Boiling and condensation. Basics of heat exchanger design. Laboratory classes: experimental methods and hand calculations for determination of heat flow problems: determination of coefficient of thermal conductivity, heat transfer coefficient, surface cooling by means of jets of liquid, determination of the boiling curve, flow visualisation by means of liquid crystal techniques. Exercise: determination of thermal resistance of simple partitions, computational analysis of developed surfaces, determination of heat transfer coefficients for conditions of free, forced and mixed convection. Calculation of the maximum permissible thermal load capacity of the heat exchange surface, calculation of critical temperatures. Computational analysis of simple heat exchanger structures.		
Prerequisites and co-requisites	Fundamentals of differential and integral calculus, basic knowledge of thermodynamics, solid state physics, fluid mechanics, technical drawing.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Laboratory reports	60.0%	20.0%
	Test with exercise	60.0%	30.0%
	Written exam	60.0%	50.0%
Recommended reading	Basic literature	1. S. Wiśniewski, T. Wiśniewski: "Wymiana ciepła", WNT, 2007. 2. W. Pudlik, "Wymiana i wymienniki ciepła", Wydawnictwo PG, Gdańsk 1996 3. Mikielewicz J., Grochal B., Gumkowski S., Polesek-Karczewska S., Mikielewicz D., Wymiana ciepła, Wydawnictwo IMP PAN, 1996 4. Y. A. Cengel, "Heat Transfer: A Practical Approach", McGrawHill Higher Education, 20025 5. J. H. Lienhard IV, John H. Lienhard V, "A HeatTransferTextbook", Phlogiston Press, 2008	

	Supplementary literature	<p>1. F. Incropera, D. deWitt, Fundamentals of heat and mass transfer, 5th edition, CRC Press, 2007</p> <p>2. W. Pudlik, "Termodynaika", Wydawnictwo PF, Gdańsk 2011</p> <p>3. J. Cieśliński, D. Grudziński, W. Jasiński, W. Pudlik. "Termodynaika - Zadania i przykłady obliczeniowe", Wydawnictwo PG, Gdańsk 2008</p>
	eResources addresses	<p>Adresy na platformie eNauczanie:</p> <p>Wymiana i wymienniki ciepła, W, Energetyka, sem.06, letni 22/23 - Moodle ID: 29616 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29616</p> <p>Wymiana i wymienniki ciepła, W, Energetyka, sem.06, letni 22/23 - Moodle ID: 29616 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29616</p> <p>Wymiana i wymienniki ciepła, W, Energetyka, sem.06, letni 22/23 - Moodle ID: 29616 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29616</p>
Example issues/ example questions/ tasks being completed	<p>What is conduction?</p> <p>How does the vacuum between the two walls reduce conduction</p> <p>How does the vacuum between the two walls reduce convection?</p> <p>What is radiation?</p> <p>What is convection?</p>	
Work placement	Not applicable	