



Subject card

Subject name and code	Heat Exchange and Heat Exchangers, PG_00033008						
Field of study	Nanotechnology						
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	5	ECTS credits			3.0		
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	prof. dr hab. inż. Janusz Cieśliński					
	Teachers	prof. dr hab. inż. Janusz Cieśliński dr hab. inż. Jan Wajs mgr inż. Piotr Jasiukiewicz dr inż. Marcin Jewartowski dr hab. inż. Michał Klugmann dr hab. inż. Zbigniew Kneba					
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	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_W06	The student is able to perform the analysis for the case of heat conduction in solids and in the boundary layer. It has a basis for assessing the influence of the type of substance and its structure on thermal and thermal-flow properties that directly affect heat transport. In particular, he can connect the internal structure of a solid and a fluid with the tendency to conduct thermal energy and electricity.	[SW3] Assessment of knowledge contained in written work and projects
	K6_U04	The student can plan simple experiments in the field of heat transfer.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task
	K6_U01	The student can use the literature on the subject and other literature sources, in particular from e-sources available through the GUT library.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
	K6_W02	The student can perform calculations: - for cases of heat conduction in solids - radiative heat exchange and forced and natural convection for simple geometric cases. The participant should be able to perform hydraulic calculations (especially pressure resistance) and balance calculations for simple heat exchanger structures.	[SW3] Assessment of knowledge contained in written work and projects
Subject contents	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.		
Prerequisites and co-requisites	maths I, II, III, physics, fluid mechanics		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Laboratory reports	60.0%	20.0%
	Written exam	60.0%	80.0%
Recommended reading	Basic literature	1. Mikielewicz J., Grochal B., Gumkowski S., Polesek-Karczewska S., Mikielewicz D., Wymiana ciepła, Wydawnictwo IMP PAN, 1996 2. F. Incropera, D. deWitt, Fundamentals of heat and mass transfer, 5th edition, CRC Press, 2007. 3. Wiśniewski S., Wiśniewski T., Wymiana ciepła, WNT, 2007. 4. Pudlik W., Wymiana i wymienniki ciepła, Wydawnictwo PG, Gdańsk 1996	
	Supplementary literature	No requirements	
	eResources addresses	Adresy na platformie eNauczenie: Wymiana i wymienniki ciepła - Moodle ID: 25216 https://enauczenie.pg.edu.pl/moodle/course/view.php?id=25216	

Example issues/ example questions/ tasks being completed	What is conduction? How does the vacuum between the two walls reduce conduction? How does the vacuum between the two walls reduce convection? What is radiation? What is convection?
Work placement	Not applicable