



## Subject card

Subject name and code	Selected problems of heat and mass transfer, PG_00059161						
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				
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 Ekoinżynierii i Silników Spalinowych -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Janusz Cieśliński				
	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		8.0		22.0	75
Subject objectives	<p>The main objectives of the course are:</p> <p>1. presentation of practical aspects of the use of heat transfer theory as applied to the design of heat exchangers;</p> <p>2. presentation of fabrication methods, thermophysical properties and application possibilities of new working media, especially ionic liquids and nanofluids;</p> <p>3. introduction to the theory of mass transfer with particular emphasis on the similarity of heat and mass transfer.</p>						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_U05] is able to integrate technical and economic analysis of the use of various energy technologies, including technologies using renewable energy sources and conventional and nuclear energy	Student is able to choose the right one type of heat and mass exchanger for the respective application from a technical and economic point of view	[SU3] Assessment of ability to use knowledge gained from the subject
	[K7_W06] knows the extended issues of reliability of power equipment and diagnostics of defects in this equipment	The student is familiar with TEMA regulations and knows the ranges of the relevant restrictions: corrosive environment, high temperature, maximum velocities, high pressure for heat exchangers.	[SW3] Assessment of knowledge contained in written work and projects
	[K7_W07] knows the environmental effects of energy technologies used; is familiar with the issues of effective energy management and use of renewable energy sources, has a broad and well-established knowledge of the processes of energy production and use	Student is able to propose a number of solutions increasing the intensity of heat and mass exchange, limiting the impact of the construction and operation of heat and mass exchangers on the environment	[SW1] Assessment of factual knowledge
Subject contents	<p>Part A. High-efficiency heat exchangers 1. Design of heat exchangers 2. Organization of the flow 3. Thermal efficiency of the heat exchanger 4. Intensification of heat transfer 5. Operation of heat exchangers</p> <p>Part B. New working fluids 1. Ionic liquids 2. Nanofluids: a) Base liquids, nanoparticles, manufacturing methods; b) Thermophysical properties of nanofluids c) Convective heat transfer using nanofluids d) Application of nanofluids in thermal engineering 3. Selection of the working liquid</p> <p>Part C. Introduction to mass transfer 1. Basic concepts 2. Diffusive mass transport 3. Convective mass transport 4. The law of conservation of substances for a stationary medium 5. The analogy between heat and mass transfer 5. Simultaneous transport of heat and mass</p>		
Prerequisites and co-requisites	Applied thermodynamics, heat and mass transport, energy conversion		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Design	56.0%	50.0%
	Lecture	56.0%	50.0%

Recommended reading	Basic literature	<p><b>Cz. A</b></p> <ol style="list-style-type: none"> <li>1. Gupta J.P.: Fundamentals of Heat Exchanger and Pressure Vessel Technology, Hemisphere, Washington, DC, 1986.</li> <li>2. Zohuri B.: Compact Heat Exchangers, Springer International Publishing Switzerland 2017, DOI 10.1007/978-3-319-29835-1_3</li> <li>3. Pudlik W.: Wymiana i wymienniki ciepła. Wyd. 5 cyfrowe, Wyd. PG, 2012.</li> <li>4. Piroo L.S., Piroo I.L.: Industrial Two-phase Thermosyphons. Begell House Inc. New York, Wallingford (UK) 1997.</li> <li>5. Shah, R.K. and Focke, W.W., Plate Heat Exchangers and Their Design Theory, in Heat Transfer Equipment Design, ed. R.K. Shah, E.C. Subbarao, and R.M. Mashelkar, Hemisphere, Washington, DC, 1983</li> <li>6. Webb RL. Principles of enhanced heat transfer, New York: Wiley, 1994</li> </ol> <p><b>Cz. B</b></p> <ol style="list-style-type: none"> <li>1. Das S.K. et al.: Nanofluids: Science and Technology, Wiley, 2007.</li> <li>2. Ali M.H. (ed): Hybrid nanofluids for convection heat transfer, AP, 2020</li> </ol> <p><b>Cz. C</b></p> <ol style="list-style-type: none"> <li>1. Bergman T.L., Lavine A.S., Incropera F.P., Dewitt D.P.: Fundamentals of heat and mass transfer, J. Wiley&amp;Sons, 2011</li> <li>2. Kreith F., Manglik R.M., Bohn M.S., Tiwari S.: Principles of heat transfer, Cengage Learning, 2011</li> </ol>
	Supplementary literature	<p>Journals:</p> <ul style="list-style-type: none"> <li>• Nanomaterials</li> <li>• Powder Technology</li> <li>• Particuology</li> <li>• J. Therm. Anal. Calorim.</li> <li>• Int. J. Heat Mass Transfer</li> <li>• Nanoscale Research Letters</li> <li>• Heat Transfer Engineering</li> <li>• Experimental Thermal and Fluid Science</li> <li>• Applied Thermal Engineering</li> </ul>
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	<p>A study/design on the use of heat exchangers in selected installations:</p> <ul style="list-style-type: none"> <li>• cryogenic installations,</li> <li>• nuclear reactor cooling systems,</li> <li>• microgravity conditions (space stations, installations on the moon),</li> <li>• heat exchangers in the pharmaceutical, food and other industries with increased hygiene standards,</li> <li>• installations of very high pressures and / or very high temperatures,</li> <li>• installations with highly corrosive agents,</li> <li>• special purpose installations,</li> <li>• mini- and micro heat exchangers</li> </ul>	
Work placement	Not applicable	