



Subject card

Subject name and code	Modeling of non-equilibrium processes, PG_00057424						
Field of study	Power Engineering, Power Engineering, Power Engineering						
Date of commencement of studies	February 2023	Academic year of realisation of subject				2022/2023	
Education level	second-cycle studies	Subject group				Obligatory subject group in the field of study 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	1	ECTS credits				3.0	
Learning profile	general academic profile	Assessment form				assessment	
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. Dariusz Mikielewicz				
	Teachers		dr hab. inż. Tomasz Muszyński				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	0.0	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	9.0		36.0	75	
Subject objectives	Presentation of fundamental mechanisms and law governing the thermodynamics of irreversible processes. Familiarisation with approaches to the analysis of irreversible processes. Analysis of examples of irreversible processes and their description. Introduction to the analysis of processes using the criterion of minimum entropy production						
Learning outcomes	Course outcome		Subject outcome			Method of verification	
	[K7_W01] has extended and deepened knowledge of mathematics indispensable for describing phenomena related to processes of energy conversion and transfer; uses advanced information technologies		Uses the differential equations in description of thermal-hydraulic problems			[SW1] Assessment of factual knowledge	
	[K7_W02] has extended and deepened knowledge of physics, chemistry, thermodynamics, fluid mechanics, material science, necessary to understand and describe basic thermal and flow phenomena occurring in and around power equipment and systems, transmission networks and internal installations		Understands the non-equilibrium issues in thermal-hydraulic problems			[SW1] Assessment of factual knowledge	
	[K7_U02] is able to use known mathematical and numerical methods to analyze and design elements, systems and power transmission networks and internal installations		Understands the non-equilibrium issues in thermal-hydraulic problems			[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools	

Subject contents	<p>1. Laws of thermodynamics. Reversible and irreversible processes.</p> <p>2. Local formulation of second law of thermodynamics</p> <p>3. Thermodynamics forces and flows, source of entropy. Entropy balance.</p> <p>4. Coniugated processes. Curie prnciple. Onsager principle</p> <p>5. Sources of entropy in heat and mass transfer processes. Minimisation of entropy sources</p> <p>6. Egzergy, egzergetica efficiency. Egzergy balance</p>											
Prerequisites and co-requisites	thermodynamics, fluid mechanics, mathematics, physics, heat transfer											
Assessment methods and criteria	<table border="1" data-bbox="448 620 1498 725"> <thead> <tr> <th data-bbox="448 620 794 651">Subject passing criteria</th> <th data-bbox="794 620 1141 651">Passing threshold</th> <th data-bbox="1141 620 1498 651">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 651 794 683">final test on lecture</td> <td data-bbox="794 651 1141 683">60.0%</td> <td data-bbox="1141 651 1498 683">50.0%</td> </tr> <tr> <td data-bbox="448 683 794 725">Tutorial test</td> <td data-bbox="794 683 1141 725">60.0%</td> <td data-bbox="1141 683 1498 725">50.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	final test on lecture	60.0%	50.0%	Tutorial test	60.0%	50.0%
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final test on lecture	60.0%	50.0%										
Tutorial test	60.0%	50.0%										
Recommended reading	Basic literature	<p>Szargut J., Termodynamika, PWN, Warszawa 1991</p> <p>G. Lebon, D. Jou, J. Casas-Vázquez: Understanding Non-equilibrium Thermodynamics, Springer-Verlag Berlin, 2008</p>										
	Supplementary literature	<p>Szargut J., Termodynamika, PWN, Warszawa 1991</p> <p>Gumiński K., Termodynamika procesów nieodwracalnych, PWN, Warszawa 1986</p> <p>Bejan A., Advanced engineering thermodynamics, Wiley, Hoboken 2006</p> <p>Kaushik S.C. et al. Finite Time Thermodynamics of Power and Refrigeration Cycles, Springer , 2017</p>										
	eResources addresses	<p>Adresy na platformie eNauczanie:</p> <p>Modelowanie procesów nierównowagowych, W/C ,Energetyka. sem 1, lato 22/23 PG_00057424 - Moodle ID: 29381</p> <p>https://enauczanie.pg.edu.pl/moodle/course/view.php?id=29381</p>										
Example issues/ example questions/ tasks being completed												
Work placement	Not applicable											