GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modeling of non-equilibrium processes, PG_00057424		
Field of study	Power Engineering		
Date of commencement of studies	February 2024	Academic year of realisation of subject	2023/2024
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 of minimum entropy production

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject
[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_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

<table>
<tr><td>Subject contents</td><td>1. Laws of thermodynamics. Reversible and irreversible processes.

2. Local formulation of second law of thermodynamics

3. Thermodynamics forces and flows, source of entropy. Entropy balance.

4. Coniugated processes. Curie pronciple. Onsager principle

5. Sources of entropy in heat and mass transfer processes. Minimisation of entropy sources

6. Egzergy, egzergetica efficiency. Egzergy balance</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>thermodynamics, fluid mechanics, mathematics, physics, heat transfer</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Tutorial test</td><td>60.0%</td><td>50.0%</td></tr>
<tr><td>final test on lecture</td><td>60.0%</td><td>50.0%</td></tr>
</table>
</td></tr>
<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>Szargut J., Termodynamika, PWN, Warszawa 1991

G. Lebon, D. Jou, J. Casas-Vázquez: Understanding Non-equilibrium Thermodynamics, Springer-Verlag Berlin, 2008</td></tr>
<tr><td>Supplementary literature</td><td>Szargut J., Termodynamika, PWN, Warszawa 1991

Gumiński K., Termodynamika procesów nieodwracalnych, PWN, Warszawa 1986
Bejan A., Advanced engineering thermodynamics, Wiley, Hoboken 2006
Kaushik S.C. et al. Finite Time Thermodynamics of Power and Refrigeration Cycles, Springer , 2017</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:
Modelowanie procesów nierównowagowych - Moodle ID: 37034
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37034
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https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37034</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td></td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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