GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modeling of non-equilibrium processes, PG_00064746		
Field of study	Power Engineering, Power Engineering		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2026/2027
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	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Energy and Industrial Apparatus -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Dariusz Mikielewicz	
	Teachers	dr hab. inż. Tomasz Muszyński prof. dr hab. inż. Dariusz Mikielewicz	

Lesson types	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	11.0	50

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] formulates and tests hypotheses concerning problems related to energy conversion processes, their efficiency, control, safety and impact on the environment, as well as simple research problems	Identifies non-equilibrium processes in thermal-hydraulic problems	[SU2] Assessment of ability to analyse information
[K7_U01] utilizes acquired analytical, simulation, and experimental methods, as well as mathematical models for analysis and evaluation of energy systems, machines and devices, transmission grids and internal installations	Understands non-equilibrium issues in thermal-hydraulic problems	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_W02] demonstrates structured and theory supported knowledge encompassing key issues in the field of Power Engineering, enabling modeling and analysis of energy systems, machines and devices, transmission grids and internal installations	Applies differential equations to the description of thermal-hydraulic problems	[SW1] Assessment of factual knowledge
[K7_W13] explains the main principles of individual and teamwork organization, including various forms of entrepreneurship utilizing knowledge from the field of engineering and technical sciences and disciplines relevant to the course of study	Can conduct analysis of a problem with at least two coupled simultaneous effects.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture

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

Prerequisites and co-requisites

thermodynamics, fluid mechanics, mathematics, physics, heat transfer

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Tutorial test	60.0%	50.0%
final test on lecture	60.0%	50.0%

Recommended reading

Basic literature	Szargut J., Termodynamika, PWN, Warszawa 1991
	G. Lebon, D. Jou, J. Casas-Vázquez: Understanding Non-equilibrium Thermodynamics, Springer-Verlag Berlin, 2008

	Supplementary literature	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
	eResources addresses	
Example issues/ example questions/ tasks being completed	Explain the mechanisms and law governing the thermodynamics of non-equilibrium processes.	
Practical activites within the subject	Not applicable	

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