GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modeling of non-equilibrium processes, PG_00065885						
Field of study	Nuclear Engineering						
Date of commencement of studies	February 2026		Academic year of realisation of subject		2025/2026		
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	Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology -> Wydziały Politechniki Gdańskiej						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Tomasz Muszyński				
	Teachers						
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		5.0	15.0		50
Subject objectives	The aim of the course is to present the main mechanisms and laws of thermodynamics related to nonequilibrium processes. Students will become familiar with various approaches to the analysis of these processes and will analyze examples of nonequilibrium processes and their description. Additionally, the course introduces topics related to the analysis of processes using the criterion of minimum entropy production.						

<table>
<tr><td rowspan="1">Learning outcomes</td><td>

Course outcome	Subject outcome	Method of verification
[K7_U01] utilizes acquired analytical, simulation, and experimental methods, as well as mathematical models to analyse and evaluate processes occurring in nuclear power sector and related industries	The student understands the issues related to heat exchange processes and thermodynamic cycles. This knowledge allows for the creation of mathematical models of thermodynamic processes, enabling the prediction and analysis of their behavior under various operating conditions.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject
[K7_U02] formulates and tests hypotheses concerning problems related to processes occurring in Nuclear Power Technologies, their efficiency, rationality, operation, safety and impact on the environment, as well as simple research problems	The student is able to formulate and test selected hypotheses related to heat transfer and flow issues in nuclear energy, with the aim of identifying the energy efficiency of specific processes.	[SU1] Assessment of task fulfilment [SU5] Assessment of ability to present the results of task
[K7_W02] demonstrates structured and theory supported knowledge encompassing key issues in the field of Nuclear Power Technologies enabling modeling and analysis of processes, systems, machines and devices of a nuclear power plant	The student has a theoretically grounded, detailed knowledge of nonequilibrium thermodynamics, with a particular focus on the processes occurring within nuclear power plants.	[SW3] Assessment of knowledge contained in written work and projects
[K7_K11] is aware of importance of professional acting, the need for critical verification of acquired knowledge and consulting experts opinion in case of facing difficulties with individual problem solving	The student critically evaluates their own knowledge and is able to select appropriate methods for learning for themselves and others. They are prepared to continuously supplement their knowledge throughout life, utilizing various sources of information.	[SK3] Assessment of ability to organize work [SK1] Assessment of group work skills

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<tr><td>Subject contents</td><td>

1. Principles of Thermodynamics. Reversible and Irreversible Processes.
2. Local Formulation of the Second Law of Thermodynamics.
3. Thermodynamic Driving Forces and Flows, Entropy Source, Entropy Balance.
4. Coupled Processes. Curie's Principle. Linear Processes. Onsager's Principle.
5. Sources of Entropy in Heat and Mass Transfer Processes. Minimization of Entropy Sources.
6. Exergy, Exergonic Efficiency. Exergy Balance.

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<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>

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture test	50.0%	50.0%
Tutorial test	50.0%	50.0%

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<tr><td>Recommended reading</td><td>

Basic literature	G. Lebon, D. Jou, J. Casas-Vázquez: Understanding Non-equilibrium Thermodynamics, Springer-Verlag Berlin, 2008 Bejan A., Advanced engineering thermodynamics, Wiley, Hoboken 2006
Supplementary literature	Kaushik S.C. et al. Finite Time Thermodynamics of Power and Refrigeration Cycles, Springer , 201
eResources addresses	

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<tr><td>Example issues/
example questions/
tasks being completed</td><td>How can the second law of thermodynamics be applied to analyze heat flow?
What are the main sources of entropy in heat and mass transfer processes?
What does exergonic efficiency mean, and how can it be applied to evaluate system performance?</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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