GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Numerical modelling of thermal-flow processes, PG_00064936						
Field of study	Mechanical Engineering						
Date of commencement of studies	February 2026		Academic year of realisation of subject	2026/2027			
Education level	second-cycle studies		Subject group	Specialty subject group Subject group related to scientific research in the field of study			
Mode of study	Part-time studies		Mode of delivery	at the university			
Year of study	1		Language of instruction	Polish			
Semester of study	2		ECTS credits	4.0			
Learning profile	general academic profile		Assessment form	exam			
Conducting unit	Division of Thermal Power Systems -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology -> Wydziały Politechniki Gdańskiej						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Paweł Ziółkowski				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	18.0	0.0	0.0	18.0	0.0	36
	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	36		5.0	59.0		100
Subject objectives	Presentation of issues concerning mathematical modelling of selected devices of power installations using commercial codes, so that the student is able to properly model the process and interpret the results. Presentation of capabilities of CFD code and thermodynamics cycles.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U11] communicates and justifies opinions on specialized topics in a manner understandable to diverse audiences, including the use of modern techniques, including information technology	The student is able to communicate and justify his opinions on the subject of thermal-fluid machines, in a way that can be understood by a diverse audience, also using modern techniques, including information technology based on commercial software using 0D and 3D balances.	[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information [SU5] Assessment of ability to present the results of task
[K7_W02] demonstrates a structured and theoretically grounded knowledge of the key topics in Mechanical Engineering enabling the analysis and modelling of mechanical systems, processes and devices	The student demonstrates a structured and theoretically underpinned knowledge covering thermal-fluid issues allowing analysis and modeling of thermal-fluid systems and processes.	[SW3] Assessment of knowledge contained in written work and projects
[K7_W12] identifies and interprets the main developmental trends and significant new achievements in the field of engineering and technical sciences and disciplines relevant to the course of study	The student is able to identify and interpret the main development trends in thermal and utility power engineering. The student is able to identify the most significant new developments in engineering and technical sciences in the context of thermal and pro-ecological equipment and machinery.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
[K7_U15] evaluates the feasibility of advanced methods and tools for solving complex engineering tasks of a practical nature, characteristic of the field of study, and selects and applies appropriate methods and tools for this purpose	The student evaluates the suitability of advanced numerical methods and tools for solving a complex engineering task of a practical nature - models the work of power equipment - turbines and heat exchangers. The student selects and applies appropriate methods and tools for this purpose, such as 0D or 3D.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools

Subject contents

Repeat the information on thermal-flow devices and thermodynamic cycles and broaden the information on their modeling with the use of commercial tools. Presentation of balances, constitutive equations, the way of setting conditions in CFD codes. Regulation and control of devices in the context of heat exchangers. Presentation of capabilities of CFD and CFM code.

Prerequisites and co-requisites

Thermodynamics. Mathematics I,II, III, physics, fluid mechanics, solid mechanics

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written exam	56.0%	60.0%
Project - evaluation of progress and final result	56.0%	40.0%

Recommended reading

Basic literature

Ziółkowski, Learning materials. . Also available in electronic form

Stephen Turns: Thermal-Fluid Sciences an integrated approach. Cambrige University Press, New York 2006.

Wolfgang Altmann: Practical process control for engineers and technicians. Newnes, Oxford 2005.

Rolf Kehlhofer: Combined-cycle gas & steam turbine power plant. The Fairmont Press, Lilburn, 1991

J. Badur: Pięć wykładów ze współczesnej termomechaniki płynów. Gdańsk 2005 https://www.imp.gda.pl/fileadmin/doc/o2/z3/publications/2005_piecwykladow.pdf

	Supplementary literature	F. M. White - Fluid Mechanics, McGraw-Hill, 2011 https://www.imp.gda.pl/en/imp-pan-publishing/transactions-of-the-institute-of-fluid-flow-machinery/articles/by/129/ https://iopscience.iop.org/article/10.1088/1742-6596/1101/1/012050/pdf http://journals.pan.pl/dlibra/publication/119103/edition/103642/content https://www.mdpi.com/1996-1073/13/7/1656 https://www.e3s-conferences.org/articles/e3sconf/pdf/2019/63/e3sconf_rdpe2019_01023.pdf https://www.imp.gda.pl/files/transactions/139/04_paper.pdf https://www.imp.gda.pl/files/transactions/138/138_03.pdf
	eResources addresses	
Example issues/ example questions/ tasks being completed	Balance of mass, momentum and energy in 0D and 3D approach. Analysis of the physical phenomenon and the possibility of analysis in the numerical code. Solving engineering problems using advanced commercial tools. Creating a numerical model Discretization of numeric model - types of mesh and their main characteristics Ways of defining of thermal and flow boundary conditions Analysis of received the results of numerical simulations and their interpretation	
Work placement	Not applicable	

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