GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Numerical methods in heat and fluid flow, PG_00064863						
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	Full-time studies		Mode of delivery	at the university			
Year of study	1		Language of instruction	English			
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	30.0	0.0	0.0	30.0	0.0	60
	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	60		6.0	34.0		100
Subject objectives	Presentation of issues concerning mathematical modelling of power installations, including thermodynamic cycles and 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.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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 the key issues of thermal-fluid machines allowing analysis and modeling of systems and processes using numerical tools.	[SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
[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 is able to assess the suitability of advanced methods and tools for solving a complex engineering task of a practical nature, namely he can indicate which approach is appropriate for the indicated engineering problem. The student is able to refer to the performance of individual devices, and then select and apply the appropriate methods and computational tools for this purpose.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task [SU1] Assessment of task fulfilment
[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 communicates and justifies opinions on specialized topics in the field of thermal-fluid devices. The student justifies his or her modeling choices in a manner that is understandable to a diverse audience, including using modern techniques, including IT based on commercial computational tools.	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[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 identifies and interprets the main development trends and the most significant new developments in the field of engineering and technical sciences in terms of thermal and utility power engineering. He/she is able to identify modern thermal-fluid devices currently used in the power industry with the indication of methods of their modeling.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge

Subject contents

Repeat the information on 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 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 the progress of the topic and the final results obtained, such as presenting them in a presentation or report	56.0%	40.0%

Recommended reading

Basic literature

Ziółkowski, Learning materials from E-nauczanie webpage.

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

	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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