



## Subject card

Subject name and code	Numerical modelling of thermal-flow processes, PG_00064849						
Field of study	Mechanical Engineering						
Date of commencement of studies	February 2025		Academic year of realisation of subject		2025/2026		
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		Polish		
Semester of study	2		ECTS credits		4.0		
Learning profile	general academic profile		Assessment form		exam		
Conducting unit	Department of Energy and Industrial Apparatus -> Faculty of Mechanical Engineering and Ship Technology						
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		5.0		35.0	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_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.	[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 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.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
	[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.	[SU5] Assessment of ability to present the results of task [SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
	[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
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 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	<p>Basic literature</p> <p>Ziółkowski, Learning materials. . Also available in electronic form</p> <p>Stephen Turns: Thermal-Fluid Sciences an integrated approach. Cambridge University Press, New York 2006.</p> <p>Wolfgang Altmann: Practical process control for engineers and technicians. Newnes, Oxford 2005.</p> <p>Rolf Kehlhofer: Combined-cycle gas &amp; steam turbine power plant. The Fairmont Press, Lilburn, 1991</p> <p>J. Badur: Pięć wykładów ze współczesnej termomechaniki płynów. Gdańsk 2005 <a href="https://www.imp.gda.pl/fileadmin/doc/o2/z3/publications/2005_piecwykladow.pdf">https://www.imp.gda.pl/fileadmin/doc/o2/z3/publications/2005_piecwykladow.pdf</a></p>		

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

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