GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Numerical modeling of thermal-flow processes, PG_00057392		
Field of study	Mechanical Engineering		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2023/2024
Education level	second-cycle studies	Subject group	Optional 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	5.0
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	10.0	55.0	125

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_W03] possesses a profound knowledge on thermodynamic processes and their simulation, knows simulation methods and programs aiding the design and operation of power generating machines and process equipment, including renewable energy sources, air conditioning and cooling renewable energy sources, air conditioning and cooling	student is able to transform technical problem into mathematical model, applies apropriate mathematical simulation methods	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects
[K7_U06] when solving engineering problems on design, technology and operation of machines is able to assess and classify typical methods and tools, define systemic and ex-technical aspects using modern calculating methods and design tools or modifying the current ones	student is able to theoretically and experimentally formulate mathematlical model of technical problem, is conscious of the role and apply mathematical model linearization, knows standard mathematical models, can adapt standard mathematical model to the technical problem	[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
[K7_W09] possesses profound knowledge on the directions of development of construction of machines, devices, calculating methods and systems aiding the design, materials and their properties, manufacturing methods and diagnostics, control-measurement equipment	Students acquire knowledge about the possibilities of designing and optimizing the operation of heat-flow devices using numerical modeling.	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation [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
Laboratory	56.0%	30.0%
Written exam	56.0%	70.0%

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
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	Adresy na platformie eNauczanie:

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