



Subject card

Subject name and code	CFD modeling and simulations, PG_00064754						
Field of study	Power 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			2.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Geotechnical and Hydraulic Engineering -> Faculty of Civil and Environmental Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Dariusz Gąsiorowski				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	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		7.0		13.0	50
Subject objectives	Mastering the basic computational techniques of the fluid dynamics used in heating and ventilation systems.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_W04] demonstrates knowledge encompassing selected issues in the field of advanced detailed knowledge, particularly in the scope of methods, techniques, tools, and algorithms specific to Power Engineering		The student describes the solution of an engineering problem using computer modeling based on Computational Fluid Dynamics techniques.		[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects		
	[K7_W02] demonstrates structured and theory supported knowledge encompassing key issues in the field of Power Engineering, enabling modeling and analysis of energy systems, machines and devices, transmission grids and internal installations		The student formulates the problem of solving equations describing problems related to the flows in systems such as waterflow in a pipeline with heatexchange, flow in ventilation ducts.		[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects		
	[K7_U01] utilizes acquired analytical, simulation, and experimental methods, as well as mathematical models for analysis and evaluation of energy systems, machines and devices, transmission grids and internal installations		The student is able to use knowledge of the basics of numerical methods and mathematical methods to describe and analyze installations.		[SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfillment [SU4] Assessment of ability to use methods and tools		

Subject contents	<p>LECTURE: Basic physical properties of fluids. General equations describing fluid dynamics models. Compressible viscous fluid model. Simplified models of fluid dynamics: an incompressible inviscid flow and an incompressible viscous flow. Laminar and turbulent flow. Boundary layer in incompressible and compressible fluid models for laminar and turbulent flow. Determination of an averaged characteristics of turbulent flow. Reynolds equations. Basic models of turbulence. Classification of equations. Formulating problems of solving fluid dynamics equations - correct setting of boundary conditions. Fluid dynamics equations in the curvilinear coordinate system. Transformation between physical and computational coordinate systems. Generating numerical grids. Numerical solution of differential equations with partial derivatives. Finite difference method, finite element method, finite volume method, control volume method. Accuracy and stability of a numerical solution: numerical diffusion error and numerical dispersion error. Effectiveness of the numerical solution. Parallelization of the computation process using multiprocessor computers. Techniques of decomposition with respect to space and processes. Solution of the problem of water flow in a pipeline with variable geometry, taking into account heat transfer. Solutions to the problem of free and forced air convection in a room. Solving the problem of flow in the ventilation duct. Solutions to the problem of smoke spreading in the building.</p> <p>LABORATORY: Learning computer modeling with ANSYS Fluent software. Modeling of water flow in a pipeline with variable geometry including heat transfer. Modeling of convective air flow in a room.</p>											
Prerequisites and co-requisites	Knowledge from the lectures: Mathematics, Basic Computer Science, Fluid Mechanics, Numerical Methods.											
Assessment methods and criteria	<table border="1" data-bbox="448 658 1487 759"> <thead> <tr> <th data-bbox="448 658 794 692">Subject passing criteria</th> <th data-bbox="794 658 1141 692">Passing threshold</th> <th data-bbox="1141 658 1487 692">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 692 794 725">Test</td> <td data-bbox="794 692 1141 725">60.0%</td> <td data-bbox="1141 692 1487 725">50.0%</td> </tr> <tr> <td data-bbox="448 725 794 759">Laboratory reports</td> <td data-bbox="794 725 1141 759">60.0%</td> <td data-bbox="1141 725 1487 759">50.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Test	60.0%	50.0%	Laboratory reports	60.0%	50.0%
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Example issues/ example questions/ tasks being completed	<p>Determination of the temperature distribution for the convective air flow</p> <p>Generating a numerical grid in three-dimensional space.</p>											
Work placement	Not applicable											

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