GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	CFD (Computational Fluid Dynamics) modeling and simulations, PG_00057358		
Field of study	Power Engineering, Power Engineering, Power 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	2	Language of instruction	Polish
Semester of study	3	ECTS credits	4.0
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	30.0	0.0	15.0	0.0	0.0	45
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	45	7.0	48.0	100

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_U04] is able to plan and perform experiments using measurements and computer simulations, together with interpretation of results, is able to present and evaluate the course and results of work in a team realizing an advanced engineering project, is able to use technical documentation and to create it independently	The student describes the solution of an engineering problem using computer modeling based on Computationl Fluid Dynamics techniques.	[SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task
[K7_U02] is able to use known mathematical and numerical methods to analyze and design elements, systems and power transmission networks and internal installations	The student formulates the problem of solving the equations describing problems related to the flows in systems such as water flow in a pipeline with heat exchange, flow in ventilation ducts.	[SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment

Subject contents

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.

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.

Prerequisites and co-requisites	Knowledge from the lectures: Mathematics, Basic Computer Science, Fluid Mechanics, Numerical Methods.	
Assessment methods and criteria		

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory reports	60.0%	50.0%
Test	60.0%	50.0%

Recommended reading	Basic literature	Fletcher C.A.J.: Computational Techniques for Fluid Mechanics Volume 1, Fundamental and General Techniques. Springer, 1991. Fletcher C.A.J.: Computational Techniques for Fluid Mechanics Volume 2, Specific Techniques for Different Flow Categories. Springer, 1991. Fletcher C.A.J.: Computational Techniques for Fluid Mechanics Volume 3, A Solution Manual. Springer, 1991. Patankar S.V.: Numerical Heat Transfer and Fluid Flow. McGraw-Hill Book Company, 1980
	Supplementary literature	Szymkiewicz R., Huang Suiliang, Szymkiewicz A.: Introduction to Computational Engineering Hydraulics, Gdańsk University of Technology, 2016
	eResources addresses	
Example issues/ example questions/ tasks being completed	Determination of the temperature distribution for the convective air flow Generating a numerical grid in three-dimensional space.	
Work placement	Not applicable	