



## Subject card

Subject name and code	Mathematical and numerical modelling, PG_00064819						
Field of study	Mechanical Engineering						
Date of commencement of studies	February 2025		Academic year of realisation of subject		2024/2025		
Education level	second-cycle studies		Subject group		Obligatory subject group in the field of study 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 Software used in English		
Semester of study	1		ECTS credits		2.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Zakład Systemów i Urządzeń Energetyki Ciepłej -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Paweł Dąbrowski				
	Teachers		dr inż. Paweł Dąbrowski  dr hab. inż. Jerzy Głuch  dr hab. inż. Jacek Barański				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	15.0	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		5.0		15.0	50
Subject objectives	The aim of the course is to familiarize students with issues related to mathematical and numerical modeling, in particular with the importance of modeling, good practices in modeling and the influence of individual parameters and assumptions in modeling on their accuracy and reliability.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_U04] creatively designs or modifies devices, processes or systems specific to Mechanics and Mechanical Engineering, using computer-aided design systems in the form of technical documentation, taking into account aspects of economic analysis, using appropriate tools and techniques	The student creates optimal systems and processes based on mathematical and numerical modeling results	[SU1] Assessment of task fulfilment [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
	[K7_K11] is aware of importance of professional acting, the need for critical verification of acquired knowledge and consulting experts opinion in case of facing difficulties with individual problem solving	The student verifies the obtained results of mathematical and numerical modeling	[SK5] Assessment of ability to solve problems that arise in practice [SK1] Assessment of group work skills [SK2] Assessment of progress of work
	[K7_U13] evaluates the feasibility and potential for utilizing new technical and technological achievements in accomplishing tasks characteristic for the field of study	The student checks the quality of various mathematical and numerical models for a specific application	[SU1] Assessment of task fulfilment [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 explains the importance of mathematical and numerical modeling of systems and devices in engineering practice	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects
Subject contents	1. Basic concepts. Problems of fluid mechanics and heat transfer  2. Influence of the mesh density on the results of numerical simulations  3. Validation of numerical simulation results  4. Turbulence models in computational fluid dynamics  5. Modeling of fluid-solid systems  6. Finite element method  7. Parameterization of the considered model  8. Selected numerical methods  9. Application of mathematical and numerical modeling in engineering practice		
Prerequisites and co-requisites	The student should have basic knowledge of physics and applied mathematics, mathematical analysis, fluid mechanics, heat transfer, technical drawing and basic programming.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Lecture assessment	60.0%	60.0%
	Project tasks	60.0%	40.0%

Recommended reading	Basic literature	Basic literature:  1. Thompson J. F., Soni B. K., Weatherill N. P.: Handbook of Grid Generation. CRC Press 1999.  2. Tu J., Yeoh G. H., Liu C.: Computational Fluid Dynamics A Practical Approach. Elsevier 2013.  3. Fortuna Z., Macukow B., Wąsowski J.: Metody numeryczne. Wydawnictwa Naukowo-Techniczne 2001.
	Supplementary literature	Supplementary literature:  1. Tesch K.: Numeryczna Mechanika Płynów. Wydawnictwo politechniki Gdańskiej 2021.  2. Madejski J.: Teoria Wymiany Ciepła. Państwowe Wydawnictwo Naukowe 1963.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1. Modeling of thermal-flow systems  2. Validation methods of numerical simulation results  3. Influence of the mesh density on the results of numerical simulations  4. Pre-processor, Processor, Post-processor  5. Examples of numerical and mathematical modeling applications  6. Selected numerical methods  7. Selected issues of modeling heat exchangers	
Work placement	Not applicable	

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