



Subject card

Subject name and code	Mathematical and numerical modelling, PG_00059366						
Field of study	Mechanical Engineering						
Date of commencement of studies	February 2023	Academic year of realisation of subject			2022/2023		
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	Part-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			4.0		
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					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	18.0	0.0	0.0	9.0	0.0	27
	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	27		9.0		64.0	100
Subject objectives	The main aim of the lectures is to teach the students the problems and solutions connected with the mathematical modeling and numerics.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	<p>[K7_W02] possesses a wide and profound knowledge on continuum mechanics and materials strength within the range of modelling and simulating multi-function mechanical systems</p>	<p>The student recognizes phenomena related to fluid flow in pipelines, heat exchangers and other mechanical systems. The student assesses the influence of individual properties and thermal-flow parameters on the mechanical system. The student is able to assess what affects the results of numerical simulations and verify the correctness of the calculations.</p> <p>The student has the ability to analyze basic issues related to fluid mechanics and heat transfer, in terms of theory and solving simple tasks and practical problems.</p>	<p>[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects</p>
	<p>[K7_U08] is able to design a procedural equipment or device compliant with the specifications using a design aid system in the form of a design documentation, selecting the appropriate model, performing critical analysis with the proper selection of tools and technologies</p>	<p>The student has the ability to analyze basic issues related to research, design and operation of thermal-flow devices, in terms of theory and solving simple tasks and practical problems. The student is able to work in a group observing all the rules that determine professionalism.</p> <p>The student has the ability to solve basic problems related to the research, design and operation of thermal-flow devices, in the assessment of functionality, efficiency, temperature, pressure and velocity fields, including the performance of simple engineering tasks.</p> <p>The student is able to analyze the basic issues related to the research, design and operation of complex thermal-flow systems, in terms of theory and solving practical problems, including the selection of methods and tools.</p> <p>The student understands the impact of the mesh density on the results of numerical analyzes and is able to conduct a study of its impact. The student is able to critically analyze the obtained results and verify them using available methods.</p>	<p>[SU1] Assessment of task fulfilment [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 [SU5] Assessment of ability to present the results of task</p>
	<p>[K7_W01] possesses a profound mathematical knowledge useful in the analysis and description of the operation of complex mechanical systems, technological processes and operating properties of machines and devices; is familiar with the main development trends</p>	<p>The student solves the Fourier equation for a simple multi-layer wall and the Peclet equation for diaphragm heat exchangers. The student is able to find and apply thermodynamic properties of fluids used for calculations. Student presents and solves basic problems of 2- and 3-dimensional finite element methods. The student is able to solve problems related to fluid mechanics and heat transfer in various fields of technology.</p>	<p>[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects</p>

Subject contents	<p>As part of the course, the following elements of knowledge will be presented:</p> <ol style="list-style-type: none"> 1. Thematic scope. 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 - spatial issues 7. Parameterization of the considered model 8. Selected numerical methods 9. Special issues 10. Applications 											
Prerequisites and co-requisites	<p>The student should have basic knowledge of physics and applied mathematics, mathematical analysis, numerical methods, fluid mechanics, heat transfer, technical drawing and basic programming. Ability to solve ordinary and partial differential equations. Knowledge of Mathematics: linear algebra, analytic geometry, trigonometry, differential and integral calculus. Fluid mechanics knowledge. Knowledge of the subject Heat exchange.</p>											
Assessment methods and criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;">Subject passing criteria</th> <th style="width: 30%;">Passing threshold</th> <th style="width: 30%;">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>project tasks</td> <td>60.0%</td> <td>40.0%</td> </tr> <tr> <td>lecture assessment</td> <td>60.0%</td> <td>60.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	project tasks	60.0%	40.0%	lecture assessment	60.0%	60.0%
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project tasks	60.0%	40.0%										
lecture assessment	60.0%	60.0%										
Recommended reading	Basic literature	<p>Basic literature:</p> <ol style="list-style-type: none"> 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	<p>Supplementary literature:</p> <ol style="list-style-type: none"> 1. Tesch K.: Numeryczna Mechanika Płynów. Wydawnictwo politechniki Gdańskiej 2021. 2. Madejski J.: Teoria Wymiany Ciepła. Państwowe Wydawnictwo Naukowe 1963. 										
	eResources addresses	<p>Adresy na platformie eNauczanie:</p> <p>Modelowanie matematyczne i numeryczne, W, MiBM, sem.01, letni 22/23 (PG_00059366) - Moodle ID: 30398 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30398</p> <p>Modelowanie matematyczne i numeryczne, W, MiBM, sem.01, letni 22/23 (PG_00059366) - Moodle ID: 30398 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=30398</p>										

<p>Example issues/ example questions/ tasks being completed</p>	<ol style="list-style-type: none"> 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
<p>Work placement</p>	<p>Not applicable</p>