GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mathematical and numerical modelling, PG_00064827		
Field of study	Mechanical Engineering		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2026/2027
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	English
Semester of study	1	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of Thermal Power Systems -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Paweł Dąbrowski	
	Teachers		

Lesson types

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_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_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
[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_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

<table>
<tr><td>Subject contents</td><td>Course content – lecture
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</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>The student should have basic knowledge of physics and applied mathematics, mathematical analysis, fluid mechanics, heat transfer, technical drawing and basic programming.</td></tr>
<tr><td>Assessment methods and criteria</td><td><table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><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></table></td></tr>
<tr><td>Recommended reading</td><td><table><tr><td>Basic literature</td><td>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.</td></tr><tr><td>Supplementary literature</td><td>Supplementary literature:
1. Tesch K.: Numeryczna Mechanika Płynów. Wydawnictwo politechniki Gdańskiej 2021.
2. Madejski J.: Teoria Wymiany Ciepła. Państwowe Wydawnictwo Naukowe 1963.</td></tr><tr><td>eResources addresses</td><td></td></tr></table></td></tr>
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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
Practical activites within the subject	Not applicable

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