GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mathematical modeling and optimization, PG_00065615		
Field of study	Naval Architecture and Offshore Structures		
Date of commencement of studies	February 2026	Academic year of realisation of subject	2025/2026
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	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Naval Architecture -> Faculty of Mechanical Engineering and Ship Technology -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Aleksander Kniat	
	Teachers		

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	30.0	0.0	60

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	60	10.0	30.0	100

Subject objectives

The aim of the subject is to apply mathematical modelling for solving physical problems. In particular subject includes numerical methods and enhances the skills to create algorithms / computer programs, as well as using ready-made software tools to perform simulations in shipbuilding.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W02] demonstrates structured and theory supported knowledge encompassing key issues in the field of Naval Architecture and Ocean Engineering, enabling modeling and analysis of shipborne and offshore systems, devices, and processes	Student knows principles of algorithm creation and uses structural/ objective programming language to implement algorithms.	[SW1] Assessment of factual knowledge
[K7_U15] evaluates the feasibility of advanced methods and tools for solving complex engineering tasks of a practical nature, characteristic of the field of study, and selects and applies appropriate methods and tools for this purpose	Student is able to describe physical phenomena with differential equation and propose a numerical solution method.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment

Subject contents

searching for zeros of functions:
- bisection method
- Newton's method

searching for local minimum/maximum:
- Newton's method
- Lagrange multipliers method

solving oridinary differential equations:
- Euler's method
- Runge-Kutta method

interpolation:
- polynomial (Lagrange's polynomial)
- splines

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="3">1. fundamental skills in using personal computer,
2. basic knowledge about operating system and file system,
3. bachelor's course in mathematics</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="3"><table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>exercises</td><td>60.0%</td><td>100.0%</td></tr></table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">Chapra S., Clough D., Applied Numerical Methods with Python for Engineers and Scientists, 1st Edition, Mc Graw Hill, 2022

Moin P., Fundamentals of Engineering Numerical Analysis, Cambridge University Press, 2-nd Edition, 2010

Bjorck A., Dahlquis G., Numerical methods, Dover Publications Inc., Prentice Hall, 1974</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">Nocedal J., Wright S., Numerical Optimization, Springer Science & Business Media, 2006

Robinson R.C., Introduction to Mathematical Optimization, Northwestern University, 2013</td></tr>
<tr><td>eResources addresses</td><td colspan="2"></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="3">1. Solving one dimensional physical problems defined with differential equation e.g.:
damping oscillations of a mass hanged on spring,
damping oscillations of a cylinder fallen into water

2. Interpolation with Lagrange polynomial

3. Interpolation with Splines</td></tr>
<tr><td>Work placement</td><td colspan="3">Not applicable</td></tr>
</table>

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