GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Mathematical Modeling and Optimization, PG_00065499						
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	Part-time studies		Mode of delivery		at the university		
Year of study	1		Language of instruction		Polish		
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	18.0	0.0	0.0	18.0	0.0	36
	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	36	9.0	55.0	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_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.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools
	[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

Subject contents	searching for zeros of functions: bisection method Newton's method searching for local minimum/maximum: Newton-Raphson's method Lagrange multipliers method solving oridinary differential equations: Euler's method Runge-Kutta method interpolation: polynomial (Lagrange's polynomial) splines

Prerequisites and co-requisites	1. fundamental skills in using personal computer, 2. basic knowledge about operating system and file system, 3. bachelor's course in mathematics		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	exercises	60.0%	100.0%

Recommended reading	Basic literature	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
	Supplementary literature	Nocedal J., Wright S., Numerical Optimization, Springer Science & Business Media, 2006
		Robinson R.C., Introduction to Mathematical Optimization, Northwestern University, 2013
	eResources addresses	

Example issues/ example questions/ tasks being completed	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

Work placement	Not applicable

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