



Subject card

Subject name and code	Mathematical Modeling and Optimization, PG_00070347						
Field of study	Naval Architecture and Offshore Structures						
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				Polish	
Semester of study	1	ECTS credits				3.0	
Learning profile	general academic profile	Assessment form				exam	
Conducting unit	Institute of Naval Architecture -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Aleksander Kniat				
	Teachers		dr inż. Aleksander Kniat mgr inż. Karol Ciba				
Lesson types	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		3.0		12.0	75
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.			[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools	

Subject contents	<p>Course content – lecture</p> <p>searching for zeros of functions: bisection method Newton's method</p> <p>searching for local minimum/maximum: Newton's method Lagrange multipliers method</p> <p>solving ordinary differential equations: Euler's method Runge-Kutta method</p> <p>interpolation: polynomial (Lagrange's polynomial) splines</p>		
Prerequisites and co-requisites	<p>1. fundamental skills in using personal computer, 2. basic knowledge about operating system and file system, 3. bachelor's course in mathematics</p>		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	exercises	60.0%	100.0%
Recommended reading	Basic literature	<p>Chapra S., Clough D., Applied Numerical Methods with Python for Engineers and Scientists, 1st Edition, Mc Graw Hill, 2022</p> <p>Moin P., Fundamentals of Engineering Numerical Analysis, Cambridge University Press, 2-nd Edition, 2010</p> <p>Bjorck A., Dahlquis G., Numerical methods, Dover Publications Inc., Prentice Hall, 1974</p>	
	Supplementary literature	<p>Nocedal J., Wright S., Numerical Optimization, Springer Science & Business Media, 2006</p> <p>Robinson R.C., Introduction to Mathematical Optimization, Northwestern University, 2013</p>	
	eResources addresses		
Example issues/ example questions/ tasks being completed	<p>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</p> <p>2. Interpolation with Lagrange polynomial</p> <p>3. Interpolation with Splines</p>		
Practical activites within the subject	Not applicable		

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