GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Numerical methods, PG_00052076		
Field of study	Nanotechnology		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2023/2024
Education level	first-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	2	Language of instruction	Polish
Semester of study	4	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Szymon Winczewski	
	Teachers	dr inż. Szymon Winczewski	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	30.0	0.0	0.0	45
	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	45	5.0	50.0	100

Subject objectives	
	The aim of the course is to familiarize the students with basic numerical methods. The course covers the discussion of methods used to solve various types of mathematical problems (finding zeros and extremes of functions, solving systems of equations, differentiation/integration of functions), which often appear in scientific/engineering practice and are characterized by the fact that they are not analytically solvable. The subject also includes learning programming (by implementing selected numerical methods in the form of computer programs written in C++).

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_W04	The student knows the tools (gnuplot program) used for presenting the results of numerical calculations in a graphical form. The student is able to write (from scratch) a computer program that implements the selected numerical method, using the selected integrated development environment (Dev-C++ program).	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
K6_U01	The student is able to familiarize himself with the selected numerical method on the basis of the indicated literature and search the literature for information on alternative numerical methods for solving analogous problems. The student is able to discuss the advantages and disadvantages of particular methods, and choose the method that will be the most adequatefor solving the problem under consideration.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU5] Assessment of ability to present the results of task
K6_U03	The student knows the C++ programming language and is able to use it in practice, implementing selected numerical methods from scratch.	[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
K6_K04	The student is able to work on solving a given problem, cooperating in a multi-person group. The student is open to criticism of his own results. He can also critically look at the results obtained and solutions proposed by other members of the group.	[SK1] Assessment of group work skills [SK3] Assessment of ability to organize work [SK4] Assessment of communication skills, including language correctness

Subject contents

1. Numerical methods - their characteristics and applications.
2. Errors of numerical calculations - classification, nature.
3. Floating point representation, the IEEE 754 standard.
4. Methods for solving non-linear equations.
5. Methods for solving systems of linear equations.
6. Methods for solving ordinary differential equations.
7. Numerical integration.
8. Interpolation and approximation.
9. Programming in C++ language.

Prerequisites and co-requisites

Knowledge of mathematical analysis and algebra at the basic level.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
written exam in theory	50.0%	30.0%
implementation of selected numerical methods in a form of computer programs	50.0%	35.0%
solving of exemplary mathematical problems with numerical methods	50.0%	35.0%

Recommended reading

Basic literature	[1] S. Bielski, Wstęp do metod numerycznych, Wydawnictwo Politechniki Gdańskiej, Gdańsk 2015.

	Supplementary literature	[2] B. Pańczyk, E. Łukasik, J. Sikora, T. Guziak, Metody numeryczne w przykładach, Politechnika Lubelska, Lublin 2012.http:// www.math.uni.wroc.pl/~ikrol/metody_num.pdf [3] C++ Language Tutorial, https://cplusplus.com/doc/tutorial/ [4] Standard C++ Library reference, https://cplusplus.com/reference/ [5] other online C++ programming tutorials
	eResources addresses	Adresy na platformie eNauczanie: Metody numeryczne 2023/2024 - Moodle ID: 37157 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=37157
Example issues/ example questions/ tasks being completed	1. Describe/implement/apply the bisection method. 2. Describe/implement/apply the the Newton's method. 3. Describe/implement/apply Verlet integration method. 4. Describe/implement/apply the leapfrog algorithm. 5. Describe/implement/apply the trapezoidal rule. 6. Describe/implement/apply the NewtonCotes quadrature rules. 7. Describe/implement/apply the finite difference method. 8. Describe/implement/apply the Monte Carlo method.	
Work placement	Not applicable	

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