GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Numerical methods, PG_00061921		
Field of study	Materials Engineering		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2025/2026
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	3	Language of instruction	Polish
Semester of study	5	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Division of Physics of Disordered Systems -> Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Jacek Dziedzic	
	Teachers	dr hab. inż. Jacek Dziedzic	

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

eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=1109

Moodle ID: 1109 Metody numeryczne https://enauczanie.pg.edu.pl/2025/course/view.php?id=1109

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	25.0	75

Subject objectives

The aim of this class is to familiarise students with numerical methods for data processing. After a brief introduction devoted to floating-point arithmetics, we cover the most important classes of numerical methods algorithms for numerical integration, methods of solving nonlinear equations, function approximation, Monte-Carlo methods. In the laboratory part, students are introduced to the Mathematica symbolic computation package, which they subsequently employ in practical problems, thus consolidating the acquired theoretical knowledge.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U01] Can properly use selected analytical, simulation and experimental methods, as well as devices for measuring the fundamental properties of materials and technological processes.	The student knows how to program in the Mathematica symbolic computation language and, optionally, in a high-level language of their choice that is customarily used in numerical computations (eg. Python, C, C + +, Fortran). Knows how to select suitable numerical methods to analyse experimental data.	[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
[K6_W06] Knows selected methods, techniques, tools and materials used in solving simple engineering problems within the scope of materials engineering.	The student knows and understands selected numerical methods, with particular emphasis on methods used in materials science.	[SW1] Assessment of factual knowledge
[K6_K01] Understands the need to improve professional and personal competencies; is conscious of own limitations and knows when to turn to experts, properly establishes priorities helping to accomplish tasks defined by oneself or others.	The student is able to plan the work required to complete a task that demands two to three weeks of effort, appropriately setting priorities. They can independently search software documentation to improve their skills. They know how to formulate queries to quickly find expert-level information.	[SK5] Assessment of ability to solve problems that arise in practice [SK3] Assessment of ability to organize work [SK2] Assessment of progress of work
[K6_W01] Has knowledge of selected branches of mathematics, useful for formulating and solving problems and describing mechanical and physical phenomena, and chemical processes.	The student has an extended and structured knowledge of numerical methods and appropriate IT tools used in numerical and symbolic computations. The student is able to create a simple program in the Mathematica symbolic computation language.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge

Subject contents

Lecture:

Non-decimal systems.

Floating point representation. IEEE 754 standard.

Methods of integrating functions of one variable: quadrature with fixed nodes, Newton-Cotes quadrature, Romberg's method, Gauss quadrature.

Methods of solving nonlinear equations of one variable: bisection, regula falsi, secant method, Newton's method.

Approximation and interpolation of functions: Lagrange interpolation formula, Newton interpolation formulas, mean square and polynomial approximation, orthogonal polynomials, trigonometric approximation.

Monte Carlo method applied to the calculation of the definite integral of functions of one and many variables.

Computer lab:

The Mathematica package: arithmetics, function notation, built-in functions, variables, assignment, delayed assignment, basic symbolic calculations, partial and total derivatives, indefinite and definite integrals, user-defined functions, boolean logic, graphing functions, solving equations and systems of equations - symbolically and numerically, substitutions and rules, lists and list operations, importing numerical data and fitting, loops and conditions.

Non-decimal systems. Lagrange polynomial interpolation. Methods of integrating functions of one variable. Piecewise constant interpolation. Fitting of experimental data. Numerical integration. Monte Carlo method.

Prerequisites and co-requisites

Basic: Basics of calculus (continuous functions, Riemann integral, minimisation of a function, zeroes of a function, partial and total derivatives).

Additional: Fourier series.

Assessment methods and criteria		

Subject passing criteria	Passing threshold	Percentage of the final grade
written assessment	50.0%	50.0%
lab reports	50.0%	50.0%

Recommended reading	Basic literature	1. Szatkowski, Cichosz Metody numeryczne, Wydawnictwo PG, 2008. 2. Fortuna, Macukow, Wąsowski Metody numeryczne, Wydawnictwa Naukowo-Techniczne, 1995. UZUPEŁNIAJĄCE 3. Press, Teukolsky, Vetterling, Flannery Numerical Recipes The Art of Scientific Computing, Cambridge University Press, 2007. 4. Materials provided by the teacher.
	Supplementary literature	1. Press, Teukolsky, Vetterling, Flannery Numerical Recipes The Art of Scientific Computing, Cambridge University Press, 2007. 2. Materials provided by the teacher.
	eResources addresses	
Example issues/ example questions/ tasks being completed	List and discuss the main sources of numerical errors in computation. Discuss the IEEE 754 floating point representation. Compare the methods of integrating functions of one variable: quadrature with fixed nodes and Newton-Cotes quadrature. Discuss the Gauss quadrature method. Compare the methods for numerically solving nonlinear equations of functions of one variable. Discuss Lagrange interpolation. Discuss Newton's interpolation. Discuss the mean square approximation. Discuss the trigonometric approximation. For which classes of functions can it be applied? Discuss the Monte Carlo method applied to the calculation of the definite integral of functions of one and many variables.	
Work placement	Not applicable	

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