GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Numerical methods, PG_00063346		
Field of study	Nanotechnology		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2026/2027
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	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		

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=1129

Moodle ID: 1129 Metody numeryczne https://enauczanie.pg.edu.pl/2025/course/view.php?id=1129

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_K04] can cooperate and work in a team, adopting different roles.	The student is able to work in a group of several people on one specific issue. The student is able to identify and implement steps leading to the goal.	[SK1] Assessment of group work skills [SK4] Assessment of communication skills, including language correctness [SK5] Assessment of ability to solve problems that arise in practice
[K6_W04] Has knowledge of IT tools (word processors, spreadsheets, etc.), preparing multimedia presentations, programming and computer graphics	The student has an extended and structured knowledge of IT tools used for numerical and symbolic calculations. 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
[K6_U01] can learn independently, obtain information from literature, databases and other properly selected sources	The student has the ability to extend their knowledge by consulting the content provided by the teacher. He can also find and use other sources (built-in help, user manuals).	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment
[K6_U03] has programming skills in a selected language, and is able to use basic software packages.	The student knows how to program in the Mathematica symbolic computation language and, optionally, in a high-level language of his/her choice that is customarily used in numerical computations (eg. Python, C, C + +, Fortran).	[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 [SU5] Assessment of ability to present the results of task

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.

<table>
<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>written assessment</td><td>50.0%</td><td>50.0%</td></tr>
<tr><td>lab reports</td><td>50.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td colspan="2">1. Szatkowski, Cichosz Metody numeryczne, Wydawnictwo PG, 2008.
2. Fortuna, Macukow, Wąsowski Metody numeryczne, Wydawnictwa Naukowo-Techniczne, 1995.</td></tr>
<tr><td>Supplementary literature</td><td colspan="2">1. Press, Teukolsky, Vetterling, Flannery Numerical Recipes The Art of Scientific Computing, Cambridge University Press, 2007.
2. Materials provided by the teacher.</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">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.</td></tr>
<tr><td>Work placement</td><td colspan="3">Not applicable</td></tr>
</table>

Document generated electronically. Does not require a seal or signature.