GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Symbolic computation in physics, PG_00064058		
Field of study	Technical Physics		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2026/2027
Education level	first-cycle studies	Subject group	Optional subject group 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	Department of Atomic Physics and Luminescence -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Paweł Wojda	
	Teachers		

Lesson types

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	4.0	26.0	75

Subject objectives

The aim of the course is to educate the student a coherent view on the basic issues of physics / mathematics / techniques and tools to solve these problems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W05] has knowledge of programming methodology and techniques, and the use of selected IT tools in physics and technology	The student knows the basics of programming, computing, data reading and data processing.	[SW1] Assessment of factual knowledge
[K6_U03] knows programming languages and can use basic software packages	Student uses symbolic calculations and uses basic commands, such as loops, in C ++	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools
[K6_W03] has systematized knowledge of higher mathematics, including algebra, analysis, probability theory and numerical methods, allowing for basic description, understanding and modelling of physical phenomena and some technical processes	The student is able to explain the solution of a problem in physics or mathematics.	[SW1] Assessment of factual knowledge
[K6_U02] analyzes and solves simple scientific and technical problems, based on possessed knowledge, using analytical, numerical, simulation and experimental methods	The student refers to the knowledge gained during the studies in physics / mathematics and uses IT tools.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools

<table>
<tr><td>Subject contents</td><td>Course content – lecture

Course content lecture
1. Introduction.Symbolic computation program (Mathematica, Maple, etc).
2. Mathematical Modelling. General mathematical notions and symbols.
3. Algebraic manipulations. Algorithm. Programs.
4. Polynomials, intertwine relations. Integral and difference operators factorization.
5. Entanglement relations. Factorization of integral and differential operators. Factorization of ordinary differential operators.
6. Differential operators factorization. Differential equations solution. Eigenvectors.
7. Algorithm for the tridiagonal matrix (Thomas algorithm).
8. Numerical and analytical solution of ordinary differential equations and partial differential equations (finitedifference method and separation of variables method).
9. Mathematical description of physical phenomena.

Course content – laboratory

Course content laboratory
1. Numerical determination of differential solutions of hyperbolic and parabolic equations (finite differencemethod, Runge-Kutta method, and discrete Fourier transform).
2. Solving the thermal conductivity equation using separation of variables.
3. Determining solutions to the paraxial Helmholtz equation.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td></td></tr>
<tr><td>Assessment methods and criteria</td><td><table><tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr><tr><td>passing tests</td><td>50.0%</td><td>30.0%</td></tr><tr><td>passing laboratories</td><td>50.0%</td><td>70.0%</td></tr></table></td></tr>
<tr><td>Recommended reading</td><td><table><tr><td>Basic literature</td><td>1. D. Kincaid, W. Cheney, Analiza numeryczna, 2006
2. Mathematica. Wolfram Research. https://www.wolfram.com/mathematica/online/
3. Tao Pang, Metody obliczeniowe w fizyce : fizyka i komputery,Wydawnictwo Naukowe PWN, Warszawa, 2001
4. P. Krzyżanowski, Metody numeryczne, Wydawnictwo Naukowe PWN, Warszawa, 2024</td></tr><tr><td>Supplementary literature</td><td>1. Journal of symbolic computations. S. Leble Skrypt.
2. Ruas, Victoriano, Numerical methods for partial differential equations :an introduction finite differences, finite elements and finite volumes; Wydawca Chichester, West Sussex, England : Wiley; 2016
3. Joseph W. Goodman , Introduction to Fourier optics, Englewood :Roberts & Company, 2005
4. James, J. F. (John Francis), A student's guide to Fourier transforms : with applications in physics and engineering, Cambridge University Press, 2011.</td></tr><tr><td>eResources addresses</td><td></td></tr></table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>Determine eigenvectors, eigenvalues of the matrix. Determine the solutions of the system of first order differential equations. Description of sound propagation.</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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