



Subject card

Subject name and code	Introduction to numerical methods, PG_00037298						
Field of study	Technical Physics						
Date of commencement of studies	October 2026	Academic year of realisation of subject			2027/2028		
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	Department of Theoretical Physics and Quantum Computing -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Marta Łabuda					
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	30.0	0.0	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	4.0	36.0	100		
Subject objectives	To teach students how to use basic numerical methods.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_W05] has knowledge of programming methodologies and techniques, as well as the use of selected IT tools in physics and engineering.	Possesses the basic knowledge how to make usage of chosen specific to computer science in physics and technology.			[SW1] Assessment of factual knowledge		
	[K6_W03] possesses structured knowledge of higher mathematics, including algebra, analysis, probability and numerical methods, sufficient to describe, understand and model complex physical phenomena and selected technical processes.	Possesses the orderly knowledge of the basic numerical methods which enables to model physical chosen phenomena and some technical processes.			[SW1] Assessment of factual knowledge		
	[K6_U03] possesses programming skills in a selected language and the ability to use selected software packages.	Possesses skills of writing applications with needed numerical method using the chosen programming language and adequate bundled software.			[SU1] Assessment of task fulfilment		

Subject contents	<p>Course content – lecture</p> <ol style="list-style-type: none"> 1. (2 h.) Brief guide to good programming habits. Testing and debugging. Elementary computer graphics. Drawing curves given by formulas. Fractals. Fractional dimension. Examples include the snowflake (the von Koch curve and the Mandelbrot set). 2. (2 h.) Methods of finding the roots of functions among other subjects: the bisection method, the Newton-Raphson method and hybrid methods. 3. (2 h.) Interpolation methods, among other subjects: the Lagrange interpolation and the Hermite interpolation. 4. (2 h.) Interpolation- continued, functions.... 5. (2 h.) Methods of solving systems of linear equations includes: the method of Gaussian elimination also in solving tridiagonal systems, the Crout method. 6. (2 h.) Approximation of derivatives include: difference formulas of the first and second order of derivatives, the Richardson extrapolation. 7. (2 h.) The least squares method in linear problems. 8. (2 h.) Nonlinear least squares method. 9. (2 h.) Numerical integration including primitive and composite integration formulas. The Romberg integration. 10. (2 h.) Numerical integration including the Gauss-Legendre quadrature, the Gauss-Laguerre quadrature and the Gauss-Hermite quadrature. 11. (2 h.) Examples of integrals in the technical and physical issues. 12. (2 h.) Numerical integration including improper integrals, multidimensional numerical integration, the Monte-Carlo method. 13. (2 h.) The Discrete Fourier Transform (DFT) and The Fast Fourier Transform (FFT) 14. (2 h.) Solving the ordinary differential equations (part I): the Euler, Runge-Kutta and Runge-Kutta-Fehlberg methods. 15. A final test. <hr/> <p>Course content – laboratory</p> <ol style="list-style-type: none"> 1. The bisection method 2. The Newton-Raphson method 3. Hybrid methods 4. The false position method and the secant method 5. Lagrange interpolation and Hermite interpolation 6. Solving systems of linear equations: the Gaussian elimination method applied to a tridiagonal system and in the general case; Crout's method 7. Splines 8. Difference formulas for derivatives of functions, including formulas for first and second derivatives 9. Numerical integration, including simple and composite methods; Romberg integration 10. The Monte Carlo method 11. Euler's method 12. The Discrete Fourier Transform (DFT) and the Fast Fourier Transform (FFT) 											
Prerequisites and co-requisites	Taking courses in mathematical analysis, algebra and discrete mathematics.											
Assessment methods and criteria	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;">Subject passing criteria</th> <th style="width: 30%;">Passing threshold</th> <th style="width: 30%;">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Practical exercise</td> <td>50.0%</td> <td>50.0%</td> </tr> <tr> <td>Midterm colloquium</td> <td>50.0%</td> <td>50.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Practical exercise	50.0%	50.0%	Midterm colloquium	50.0%	50.0%
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Midterm colloquium	50.0%	50.0%										
Recommended reading	<p>Basic literature</p> <p>Supplementary literature</p> <p>eResources addresses</p>	<p>(1) P.L. DeVries "A first course in computational physics" John Wiley 1994</p> <p>1) A. Ralston "Wstęp do analizy numerycznej" PWN 1975 (2) D. Potter "Metody obliczeniowe fizyki" PWN 1977</p>										
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> 1 Methods of bisection and Newton-Raphson method for finding roots of the equation at the given interval. How can I combine these two methods to propose a hybrid method? 2 Trójdziagonalny system of four linear equations. 3 Formulas on simple and complex method of trapezoids. 4. Romberg integration.. 											
Practical activities within the subject	Not applicable											

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