GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Introduction to numerical methods, PG_00037298		
Field of study	Technical Physics		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
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 Information -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor		
	Teachers		

Lesson types and methods of instruction

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 methodology and techniques, and the use of selected IT tools in physics and technology.	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] 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.	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] Knows programming languages and can use basic 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	1. (2 h.) Brief guide to good programming habits. Testing and debugging. Elentary 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 amoung other subjects: the bisection method, the Newton-Raphson method and hybrid methods. 3. (2 h.) Interpolation methods, amoung 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 leaat 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.
Prerequisites and co-requisites	Taking courses in mathematical analisys, algebra and discrete mathematic.
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Midterm colloquium	50.0%	50.0%
Practical exercise	50.0%	50.0%

Recommended reading	Basic literature	(1) P.L. DeVries "A first course in computational physics" John Willey 1994
	Supplementary literature	1) A. Ralston "Wstęp do analizy numerycznej" PWN 1975 (2) D. Potter "Metody obliczeniowe fizyki" PWN 1977
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	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 Trójdiagonalny system of four linear equations. 3 Formulas on simple and complex method of trapezoids. 4. Romberg integration..	
Work placement	Not applicable	