



Subject card

Subject name and code	Introduction to numerical methods, PG_00037298						
Field of study	Technical Physics						
Date of commencement of studies	October 2022	Academic year of realisation of subject			2023/2024		
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		prof. dr hab. Józef Sienkiewicz				
	Teachers		prof. dr hab. Julien Guthmuller prof. dr hab. Józef Sienkiewicz				
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		Possesses the basic knowledge how to make usage of chosen specific to computer science in physics and technology.		[SW1] Assessment of factual knowledge		
	K6_U03		Possesses skills of writing applications with needed numerical method using the chosen programming language and adequate bundled software.		[SU1] Assessment of task fulfilment		
	K6_W03		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		

Subject contents	<p>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).</p> <p>2. (2 h.) Methods of finding the roots of functions among other subjects: the bisection method, the Newton-Raphson method and hybrid methods.</p> <p>3. (2 h.) Interpolation methods, among other subjects: the Lagrange interpolation and the Hermite interpolation.</p> <p>4. (2 h.) Interpolation- continued, functions....</p> <p>5. (2 h.) Methods of solving systems of linear equations includes: the method of Gaussian elimination also in solving tridiagonal systems, the Crout method.</p> <p>6. (2 h.) Approximation of derivatives include: difference formulas of the first and second order of derivatives, the Richardson extrapolation.</p> <p>7. (2 h.) The least squares method in linear problems.</p> <p>8. (2 h.) Nonlinear least squares method.</p> <p>9. (2 h.) Numerical integration including primitive and composite integration formulas. The Romberg integration.</p> <p>10. (2 h.) Numerical integration including the Gauss-Legendre quadrature, the Gauss-Laguerre quadrature and the Gauss-Hermite quadrature.</p> <p>11. (2 h.) Examples of integrals in the technical and physical issues.</p> <p>12. (2 h.) Numerical integration including improper integrals, multidimensional numerical integration, the Monte-Carlo method.</p> <p>13. (2 h.) The Discrete Fourier Transform (DFT) and The Fast Fourier Transform (FFT)</p> <p>14. (2 h.) Solving the ordinary differential equations (part I): the Euler, Runge-Kutta and Runge-Kutta-Fehlberg methods.</p> <p>15. A final test.</p>											
Prerequisites and co-requisites	Taking courses in mathematical analysis, algebra and discrete mathematics.											
Assessment methods and criteria	<table border="1" data-bbox="450 1070 1489 1178"> <thead> <tr> <th data-bbox="450 1070 794 1106">Subject passing criteria</th> <th data-bbox="794 1070 1139 1106">Passing threshold</th> <th data-bbox="1139 1070 1489 1106">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="450 1106 794 1137">Practical exercise</td> <td data-bbox="794 1106 1139 1137">50.0%</td> <td data-bbox="1139 1106 1489 1137">50.0%</td> </tr> <tr> <td data-bbox="450 1137 794 1178">Midterm colloquium</td> <td data-bbox="794 1137 1139 1178">50.0%</td> <td data-bbox="1139 1137 1489 1178">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%
Subject passing criteria	Passing threshold	Percentage of the final grade										
Practical exercise	50.0%	50.0%										
Midterm colloquium	50.0%	50.0%										
Recommended reading	Basic literature	(1) P.L. DeVries "A first course in computational physics" John Wiley 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 eNauczenie:										
Example issues/ example questions/ tasks being completed	<p>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?</p> <p>2 Trójdziagonalny system of four linear equations.</p> <p>3 Formulas on simple and complex method of trapezoids.</p> <p>4. Romberg integration..</p>											
Work placement	Not applicable											