



Subject card

Subject name and code	Numerical methods, PG_00055980						
Field of study	Power Engineering, Power Engineering, Power Engineering						
Date of commencement of studies	October 2023	Academic year of realisation of subject				2025/2026	
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	3	Language of instruction				Polish	
Semester of study	6	ECTS credits				4.0	
Learning profile	general academic profile	Assessment form				assessment	
Conducting unit	Department of Geotechnical and Hydraulic Engineering -> Faculty of Civil and Environmental Engineering -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Dariusz Gąsiorowski					
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	15.0	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		6.0		49.0	100
Subject objectives	Mastering the basic numerical techniques used in fluid mechanics.						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	[K6_U12] can correctly choose tools (analytical or numerical) to solve engineering problems filtration processes, and data analysis; is able to use photogrammetric and remote sensing tools in engineering tasks in the field of geodetic techniques and metrology	The student formulates the problem of solving equations describing selected problems in fluid mechanics.			[SU3] Assessment of ability to use knowledge gained from the subject		
	[K6_W15] knows and understands the basic quantities characteristic methods for thermodynamics, fluid mechanics and hydraulics, hydrology; knows the calculation methods and IT tools necessary to analyse the results of laboratory and field work	The student can use appropriate software to simulate problems such as water flow in tank and pipeline systems, pollutant transport in rivers and air, air flow in ventilation systems, and water flow in porous media.			[SW3] Assessment of knowledge contained in written work and projects		
	[K6_W01] has basic knowledge of mathematics necessary to describe the phenomena related to the processes of energy conversion and transfer; uses information technology to solve mathematical problems	The student is able to select and apply basic numerical methods to solve the problems mentioned above.			[SW3] Assessment of knowledge contained in written work and projects		

Subject contents	<p>Course content – lecture</p> <p>Selected problems in solving systems of algebraic linear equations, the triangular matrix decomposition method, iterative methods (Jacobi, Gauss-Seidel, overrelaxation). Interpolation, interpolation polynomials, third-degree spline interpolation. Least squares function approximation. Solving nonlinear algebraic equations, examples of nonlinear equations in civil engineering, the bisection method, the secant method, the simple iteration method, and Newton's method. Solving systems of nonlinear equations, the Picard method, and Newton's method. Elements of optimization methods, techniques for finding the extremum of functions of one variable, the golden ratio method, and the Fibonacci sequence method. Numerical integration, the method of rectangles, Simson's method, and double integrals. Solving ordinary differential equations, examples of ordinary differential equations, initial value problem, boundary value problem, numerical methods for solving initial value problems: classification of methods, explicit and implicit methods, single- and multi-step methods. Solving partial differential equations, classification of equations and problem formulation, introduction to the finite difference method, solution algorithms for typical partial differential equations: Laplace's equation, Poisson's equation, one- and two-dimensional diffusion equation. Introduction to the finite element method, solution algorithms for selected partial differential equations.</p>		
	<p>Course content – project</p> <p>Solution of nonlinear equations using the following methods: bisection, linear interpolation (secant), simple iteration, and Newton's method, based on selected examples from water engineering. Solution of ordinary differential equations using the equation describing steady, nonuniform flow and unsteady outflow from a reservoir. Approximation of functions using the least squares method. Numerical integration using the rectangle and trapezoidal methods. Solution of a differential equation with partial derivatives, based on the example of the Laplace equation.</p>		
Prerequisites and co-requisites	Basic computer skills and knowledge of the Windows operating system. Knowledge of the following subjects: mathematics, physics, and basic computer science.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Lecture: test	60.0%	50.0%
	Project: preparation of a reports on the calculations performed	60.0%	50.0%
Recommended reading	Basic literature	Fletcher C.A.J.: Computational techniques for fluid mechanics, Springer, 1991	
	Supplementary literature	Szymkiewicz R.: Numerical modeling in open channel hydraulics, Springer, 2010.	
	eResources addresses		
Example issues/ example questions/ tasks being completed	<ol style="list-style-type: none"> <li>1. Solving a nonlinear equation using Newton's method.</li> <li>2. Approximating a flow curve using the least squares method.</li> <li>3. Numerical solution of an ordinary differential equation using the trapezoidal method.</li> <li>4. Numerical solution of Laplace's equation.</li> </ol>		
Practical activities within the subject	Not applicable		

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