GDAŃSK UNIVERSITY
OF TECHNOLOGY

Subject card

Subject name and code	Numerical Methods in Electronics and Telecommunications, PG_00048288					
Field of study	Electronics and Telecommunications					
Date of commencement of studies	February 2023		Academic year of realisation of subject		2022/2023	
Education level	second-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	1		Language of instruction		Polish	
Semester of study	1		ECTS credits		3.0	
Learning profile	general academic profile		Assessment form		assessment	
Conducting unit	Department of Microwave and Antenna Engineering -> Faculty of Electronics, Telecommunications and Informatics					
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Michał Rewieński			
	Teachers		dr inż. Michał Rewieński dr inż. Barbara Stawarz-Graczyk dr inż. Arkadiusz Szewczyk dr inż. Piotr Sypek			

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	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	30	6.0	39.0	75

Subject objectives	The goal of this course is to introduce the computational techniques for the simulation and modeling of engineering systems. Topics include mathematical formulations of simulation problems, linear and nonlinear system solution techniques, techniques for differential and integral equations. Methods are illustrated by various applications. During laboratory classes students implement and analyze computational techniques, applied to specific engineering problems.

Learning outcomes	**Course outcome**	**Subject outcome**	**Method of verification**
	[K7_W01] Knows and understands, to an increased extent, mathematics to the extent necessary to formulate and solve complex issues related to the field of study.	The student knows and understands the following computational math problems: systems of linear equations represented in matrix form, eigenvalue problems, initial and boundary value problems for systems of differential equations and Fredholm integral equations of the first kind. The student knows the weak (variational) formulation for Dirichlet problems.	[SW1] Assessment of factual knowledge
	[K7_U03] can design, according to required specifications, and make a complex device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment	The student is able to formulate a mathematical model from the physical description of a device or system. The student knows how to apply an appropriate numerical technique to solve a computational problem.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information
	[K7_W03] Knows and understands, to an increased extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum.	The student knows numerical techniques for solving systems of algebraic equations, eigenvalue problems, initial and boundary value problems for differential and integral equations. The student is familiarized with the problems of computational complexity, convergence, and stability of numerical algorithms.	[SW1] Assessment of factual knowledge
	[K7_U08] while identifying and formulating engineering tasks specifications and solving these tasks, can:n- apply analytical, simulation and experimental methods,n- notice their systemic and non-technical aspects,n- make a preliminary economic assessment of suggested solutions and engineering workn	The student is able to assess if an implementation of an algorithm is correct, by analyzing convergence and convergence rate of the computational process, as well as the quality of the results. The student is able to assess memory and computational cost required to solve a particular problem if using a selected numerical technique.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
	[K7_U05] can plan and conduct experiments related to the field of study, including computer simulations and measurements; interpret obtained results and draw conclusions	The student is able to perform computer simulations for selected engineering problems encountered in electronics and telecommunications, and interpret the results of the computations.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools

Subject contents	Lecture topics: Uses For Simulation, Formulating Simulation Problems; Equation formulation methods; Solving Linear Systems; Direct Methods for Sparse Linear Systems; Techniques for solving eigenvalue problems; Krylov Subspace Methods for Linear Systems; Multidimensional Newton Methods for Nonlinear Problems; Methods for Ordinary Differential Equations; Multistep Integration Methods; Mesh methods for Partial Differential Equations (PDEs); Basis Function methods for PDEs. Weak and Strong formulations. Boundary conditions. Collocation and Galerkin schemes; Boundary Element Method for Integral Equations.
Prerequisites and co-requisites	Prerequisites for this course include fundamentals of mathematical analysis and linear algebra, basic physics and circuit theory.

Assessment methods and criteria	**Subject passing criteria**	**Passing threshold**	**Percentage of the final grade**
	two tests	0.0%	72.0%
	completion of lab problems	50.0%	28.0%

Recommended reading	Basic literature	L. N. Trefethen, D. Bau, III, “Numerical Linear Algebra,” SIAM 1997 A. Tveito, R. Winther, “Introduction to Partial Differential Equations: A Computational Approach,” Springer 1998 Z. Fortuna, B. Macukow, J. Wąsowski, „Metody Numeryczne,” Wydawnictwa Naukowo-Techniczne, 1993

	Supplementary literature	A. Szatkowski, J. Cichosz, „Metody Numeryczne” Wydawnictwo PG, 2002-2010 T. Ratajczak, „Metody Numeryczne”, Wydawnictwo PG, 2006 M. Berry et. al, “Templates for the Solution of Linear Systems: Building Blocks for Iterative Methods,” SIAM 1994 Z. Bai et. al. eds, “Templates for the Solution of Algebraic Eigenvalue Problems: A Practical Guide,” SIAM 1987
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	Lab topics: Lab 1: Introduction to MATLAB. Lab 2: Modeling temperature distribution in a heat conducting bar. Lab 3: Computing internet web site ranks using Google's PageRank algorithm. Lab 4: Modeling a nonlinear circuit using multidimensional Newton's method. Lab 5: Methods for solving ODEs - simulating transient behavior of a linear circuit. Lab 6: Modeling traffic jams - nonlinear hyperbolic equations. Lab 7: Computing capacitance of a conducting plane and sphere using Boundary Element Method.	
Work placement	Not applicable	