

Subject card

Subject name and code	Mathematical methods in Bioinformatics - vector analysis, PG_00155805						
Field of study	Bioinformatics						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2025/2026		
Education level	Bachelor's studies		Subject group		Obligatory subject group 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	2		ECTS credits		7.0		
Learning profile	academic		Assessment form		exam		
Conducting unit	Institute of Theoretical Physics and Astrophysics -> Faculty of Mathematics, Physics and Informatics -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Waldemar Kłobus				
	Teachers		dr hab. Waldemar Kłobus				
			dr Adrian Kołodziejski				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	45.0	45.0	0.0	0.0	0.0	90
	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	90		0.0		85.0	175
Subject objectives	The aim of the course is to introduce the tools for studying and analyzing functions of several variables provided by linear algebra and differential calculus, as well as to present the applications of these tools in the analysis of specific physical and natural phenomena.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[BIOINL3_W03] Has sufficient knowledge of mathematical and statistical methods in order to describe and model biological phenomena and processes	The student knows: The concept of vector space and related concepts The principles of matrix calculus Methods for solving systems of linear equations Basic concepts and methods of multivariable calculus Methods for solving simple partial differential equations Applications of multivariable calculus and linear algebra in simple physical and natural models.	[SW4] test/exam - oral or written [SW3] text preparation/written work
	[BIOINL3_W02] Has the scientific knowledge necessary to understand the basic processes in living organisms.	The student knows: The concept of vector space and related concepts The principles of matrix calculus Methods for solving systems of linear equations Basic concepts and methods of multivariable calculus Methods for solving simple partial differential equations Applications of multivariable calculus and linear algebra in simple physical and natural models.	[SW4] test/exam - oral or written [SW3] text preparation/written work
	[BIOINL3_U03] Graduate applies fundamental mathematical and statistical methods to describe phenomena and analyze data; has the ability to perform basic data analysis in professional databases used in bioinformatics	The student is able to: Use vector and matrix calculus Solve systems of linear equations using various methods Apply methods of multivariable calculus to study functions Solve simple partial differential equations Use multivariable calculus and linear algebra to describe and analyze physical and natural models.	[SU3] text preparation/written work [SU4] test/exam - oral or written
Subject contents	1. The concept of vector space, examples, linear combination of vectors, linearly independent systems, bases, dimension of a vector space, subspace. 2. Matrices, operations on matrices and their properties, rank of a matrix, determinant of a square matrix, Laplace expansion, elementary row and column operations, non-singular matrices, inverse matrix and its determination. 3. Eigenvalue problem of a linear operator; application to the description of simple linear population models 4. Systems of linear equations in multiple variables, matrix form, Cramer's theorem, Kronecker-Capelli theorem, Gaussian elimination method. 5. Partial derivatives of real-valued functions of several variables, gradient. 6. Determining local extrema of functions of several variables. 7. Vector product in 3-dimensional space and its properties. 8. Vector fields and their differentiation, potential fields, determining the potential, curl and divergence of a vector field, physical interpretations. 9. Simple partial differential equations. 10. Applications in the analysis of physical and natural systems: wave equation, heat transport equation, population models, fluid dynamics problems.		
Prerequisites and co-requisites	Knowledge of differential calculus of functions of a single variable		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
		51.0%	60.0%
		51.0%	40.0%
Recommended reading	Basic literature	n	
	Supplementary literature	n	
	eResources addresses		
Example issues/ example questions/ tasks being completed	n		

Work placement	Not applicable
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