



Subject card

Subject name and code	Linear Algebra, PG_00021032						
Field of study	Mathematics						
Date of commencement of studies	October 2025	Academic year of realisation of subject				2025/2026	
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	1	Language of instruction				Polish	
Semester of study	2	ECTS credits				5.0	
Learning profile	general academic profile	Assessment form				exam	
Conducting unit	Divison of Dynamical Systems -> Institute of Applied Mathematics -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr Joanna Cyman				
	Teachers		dr Joanna Cyman mgr inż. Tomasz Gzella				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	0.0	0.0	60
	E-learning hours included: 0.0						
	eNauczanie source addresses: Moodle ID: 4435 Algebra liniowa II https://enauczanie.pg.edu.pl/2025/course/view.php?id=4435						
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	5.0		60.0	125	
Subject objectives	Introducing students to key concepts of vector spaces and linear transformations, as well as mastering fundamental knowledge of Euclidean spaces. Developing the ability to apply the acquired knowledge to solve theoretical and practical problems in various fields of mathematics.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	K6_W07	The student acquires the skills to apply the concepts of linear algebra in various fields of mathematics.	[SW1] Assessment of factual knowledge
	K6_U08	The student understands the concept of a vector space, is able to check the linear independence of a set of vectors, and find bases of subspaces. They can also find the coordinates of a vector in a given basis. The student understands the concept of a linear transformation and knows examples of such transformations. They can find the kernel and image of a linear transformation and understand the relationship between the dimension of the domain of the transformation and the dimensions of its kernel and image. They can find the matrix of a linear transformation in given bases. The student is able to calculate eigenvalues and eigenvectors. The student understands the concept of the scalar product and orthonormal bases. They can perform the Gram-Schmidt orthogonalization. Furthermore, they can analyze bilinear forms.	[SU4] Assessment of ability to use methods and tools
	K6_W02	The student conducts simple reasoning, correctly formulates and proves theorems from linear algebra, such as the theorem on the basis of a space and the Rank-nullity theorem.	[SW1] Assessment of factual knowledge
	K6_U01	The student is able to prove simple algebraic properties and examine linear independence and orthogonality of vectors.	[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
	K6_U03	The student correctly defines various algebraic structures.	[SU3] Assessment of ability to use knowledge gained from the subject
Subject contents	<p>Course content – lecture Vector space. Basis and dimension of vector space. Coordinates of a vector in the vector space basis. The change-of-basis matrix.</p> <p>Linear maps. Kernel and image. Matrix of a linear map. Operations on maps.</p> <p>Eigenvalues and eigenvectors. Eigenvalues and eigenvectors of matrices and mappings. Cayley-Hamilton theorem.</p> <p>Euclidean spaces. Scalar product, orthogonality of vectors, orthogonal and orthonormal basis. GramSchmidt process.</p> <p>Quadratic form. Real quadratic form. Quadratic form in canonical form.</p>		
Prerequisites and co-requisites	Linear Algebra I		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	activity	0.0%	10.0%
	colloquia	50.0%	50.0%
	exam	50.0%	40.0%

Recommended reading	Basic literature	<p>T. Jurlewicz, Z. Skoczylas, Linear Algebra 1 and 2. Definitions, theorems, formulas, Oficyna Wydawnicza GiS, Wrocław 2023/2024.</p> <p>T. Jurlewicz, Z. Skoczylas, Linear Algebra 1 and 2. Examples and tasks, Oficyna Wydawnicza GiS, Wrocław 2023/2024.</p> <p>J. Topp, Linear algebra, University of Gdańsk Publishing House, Gdańsk 2015.</p>
	Supplementary literature	<p>J. Rutkowski, Linear algebra in tasks, PWN 2008</p> <p>G. Banaszak, W. Gajda, Elements of linear algebra, WNT 2002.</p> <p>A. I. Kostrikin, Introduction to Algebra. PWN, Warszawa 2024.</p>
	eResources addresses	
Example issues/ example questions/ tasks being completed	<p>1. Given a matrix A:</p> <p>a) Find its eigenvalues and eigenvectors.</p> <p>b) Is A diagonalizable? Justify your answer.</p> <p>c) Using the Cayley-Hamilton theorem, compute A^{-1}.</p> <p>2. Check which of the following sets is a subspace of the vector space \mathbb{R}^2:</p> <p>a) $A = \{(x, y) \in \mathbb{R}^2 : x = y \}$;</p> <p>b) $B = \{(x, y) \in \mathbb{R}^2 : x = 3y\}$;</p> <p>c) $C = \{(x, y) \in \mathbb{R}^2 : x = y + 3\}$.</p> <p>3. Given the linear transformation $T : \mathbb{R}^4 \rightarrow \mathbb{R}^3$, $T(x, y, z, t) = (x + y - z, -x - y + z, x + 3t)$:</p> <p>a) Find the kernel, the image, and their bases;</p> <p>b) Orthogonalize these bases using the Gram-Schmidt method;</p> <p>c) Find the coordinates of the vectors $(5, -5, 6)$ and $(6, -2, 4, -2)$ in the chosen bases.</p> <p>4. State and prove the Ranknullity theorem.</p>	
Practical activities within the subject	Not applicable	