GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Linear Algebra, PG_00021032		
Field of study	Mathematics		
Date of commencement of studies	October 2024	Academic year of realisation of subject	2024/2025
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	Department of Nonlinear Analysis and Statistics -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr Joanna Cyman	
	Teachers	dr Maryna Shcholokova dr Joanna Cyman	

Lesson types and methods of instruction

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

Adresy na platformie eNauczanie:

Algebra liniowa II 2024/2025 - Moodle ID: 42731 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=42731

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_U01	The student is able to prove simple algebraic properties and examine linear independence and orthogonality of vectors.	[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information
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_U03	The student correctly defines various algebraic structures.	[SU3] Assessment of ability to use knowledge gained from the subject
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_W07	The student acquires the skills to apply the concepts of linear algebra in various fields of mathematics.	[SW1] Assessment of factual knowledge

Subject contents

Vector space. Basis and dimension of vector space. Coordinates of a vector in the vector space basis. The change-of-basis matrix.

Linear maps. Kernel and image. Matrix of a linear map. Operations on maps.

Euclidean spaces. Scalar product, orthogonality of vectors, orthogonal and orthonormal basis. GramSchmidt process.

Eigenvalues and eigenvectors. Eigenvalues and eigenvectors of matrices and mappings. Cayley-Hamilton theorem.

Quadratic form. Real quadratic form. Quadratic form in canonical form.

Prerequisites and co-requisites

Linear Algebra I

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
colloquia	50.0%	50.0%
exam	50.0%	40.0%
activity	0.0%	10.0%

<table>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>T. Jurlewicz, Z. Skoczylas, Linear Algebra 1 and 2. Definitions, theorems, formulas, Oficyna Wydawnicza GiS, Wrocław 2023/2024.

T. Jurlewicz, Z. Skoczylas, Linear Algebra 1 and 2. Examples and tasks, Oficyna Wydawnicza GiS, Wrocław 2023/2024.

J. Topp, Linear algebra, University of Gdańsk Publishing House, Gdańsk 2015.</td></tr>
<tr><td>Supplementary literature</td><td>J. Rutkowski, Linear algebra in tasks, PWN 2008

G. Banaszak, W. Gajda, Elements of linear algebra, WNT 2002.

A. I. Kostrikin, Introduction to Algebra. PWN, Warszawa 2024.</td></tr>
<tr><td>eResources addresses</td><td>Podstawowe
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=42731 -
Algebra liniowa II 2024/2025 - Moodle ID: 42731
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=42731</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">1. Given a matrix A:

a) Find its eigenvalues and eigenvectors.

b) Is A diagonalizable? Justify your answer.

c) Using the Cayley-Hamilton theorem, compute A^(-1).

2. Check which of the following sets is a subspace of the vector space R^2:

a) A = {(x, y) R^2 : |x| = |y|};

b) B = {(x, y) R^2 : x = 3y};

c) C = {(x, y) R^2 : x = y + 3}.

3. Given the linear transformation T : R^4 R^3, T(x, y, z, t) = (x + y - z, -x - y + z, x + 3t):

a) Find the kernel, the image, and their bases;

b) Orthogonalize these bases using the Gram-Schmidt method;

c) Find the coordinates of the vectors (5, -5, 6) and (6, -2, 4, -2) in the chosen bases.

4. State and prove the Ranknullity theorem.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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