

FACULTY \*\*\*\*\*

### SUBJECT CARD

**Name in English:** **ELEMENTARY LINEAR ALGEBRA**

**Name in Polish:** **ELEMENTY ALGEBRY LINIOWEJ**

**Main field of study (if applicable):**

**Specialization (if applicable):**

**Level and form of studies:** **I level, full time**

**Kind of subject:** **obligatory**

**Subject code:** **MAT001433**

**Group of courses:** **YES/NO\***

	Lecture	Classes	Laboratory	Project	Seminar
Number of hours of organized classes in University (ZZU)	30	15			
Number of hours of total student workload (CNPS)	60	60			
Form of crediting	exam	crediting with grade			
For group of courses mark (X) final course					
Number of ECTS points	2	2			
including number of ECTS points for practical (P) classes	0	2			
including number of ECTS points for direct teacher-student contact (BK) classes	1,5	1			

### PREREQUISITIES

It is recommended to know the basic algebraic operations on rational and real numbers, and knowledge of basic geometric figures and shapes.

### SUBJECT OBJECTIVES

- C1. Understanding the basic properties of complex numbers.
- C2. Learning basic algebraic properties of polynomials.
- C3. Mastering the concept of a vector, a vector space and the base of a linear space.
- C4. Learning how to calculate the distance between the points in the space  $\mathbb{R}^n$ , how to determine the equations of lines and planes and understanding the concept of conic sections.
- C5. Mastering the concepts of matrices, matrix operations, and learning the methods of solving systems of linear equations.

### SUBJECT EDUCATIONAL EFFECTS

**Relating to knowledge student:**

PEK\_W01 knows basic properties of complex numbers

PEK\_W02 knows basic algebraic properties of polynomials

PEK\_W03 knows basic concepts of theory of linear spaces and methods of description of lines, planes and conic sections

PEK\_W04 knows basic methods of solving systems of linear equations

**Relating to skills student:**

PEK\_U01 can carry out calculations with complex numbers

PEK\_U02 can add, multiply and divide polynomials

PEK\_U03 can find the equations of planes and lines in three dimensional space

PEK\_U04 can add and multiply matrices and calculate determinants

PEK\_U05 can solve systems of linear equations

**Relating to social competences:**

### PROGRAM CONTENT

Form of classes - lectures		Hours
W1	Natural, rational and real numbers. Mathematical induction. Newton's binomial formula.	2
W2	Complex numbers. Basic operations, modulus, complex conjugate.	2
W3	Polar form of complex number. Multiplication, division and exponentiation in polar form. Roots of complex numbers. The notion of algebraic field.	2
W4	Polynomials. Addition and multiplication of polynomials. Roots of polynomial. Polynomial remainder theorem. Fundamental theorem of algebra.	2
W5	The decomposition of a polynomial with real coefficients into product of linear and quadratic factors. Rational functions. Real simple rational factors. Decomposition of the functions into rational simple factors.	2
W6	Vectors in the space $R^n$ . Addition and multiplication by scalars. Distance between points. Scalar product. Length of vector. Cauchy-Schwarz inequality. The angle between vectors.	2
W7	Analytic geometry of the plane. Straight line formulas (normal parametric and directional form). Distance of a point from a line. The angle between lines.	2
W8	Analytic geometry of the space $R^3$ . Equations for lines and planes. Distance between point and a plane. Intersection of planes.	2
W9	Linear combinations of vectors. Linearly independent vectors. The base of a space. Linear mappings. Matrix representation of linear mappings.	2
W10	Addition and multiplication of matrices and its correlation with operations on linear mappings. Example of matrices.	2
W11	Permutations and its sign. Definition of determinant and methods of calculation of determinant. Algebraic complement of an element of a matrix. Laplace' formula for determinant. Determinant and volume.	2

W12	Inverse matrix. Systems of linear equations. Cramer's formulas. Examples. Homogeneous and non-homogeneous systems.	2
W13	Properties of linear mappings (kernel, image, rank). Rouché – Capelli theorem. Gaussian elimination.	2
W14	Eigenvalues and eigenvectors.	2
W15	Conic sections.	2
	<b>Total hours</b>	<b>30</b>

<b>Form of classes – classes</b>		<b>Hours</b>
Cw1	Real and complex numbers.	2
Cw2	Polynomials.	2
Cw3	Geometry of the plane.	2
Cw4	Geometry of the space $\mathbb{R}^3$ .	2
Cw5	Basis and linear mappings.	2
Cw6	Matrices and determinants.	2
Cw7	Systems of linear equations.	2
Cw8	Test.	1
	<b>Total hours</b>	<b>15</b>

<b>TEACHING TOOLS USED</b>
N1. Lecture - traditional method.
N2. Classes - traditional method.
N3. Student's self work with the assistance of mathematical packages.

### EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

<b>Evaluation (F -forming; P - concluding)</b>	<b>Educational effect number</b>	<b>Way of evaluating educational effect achievement</b>
F - Cw	PEK_U01 - PEK_U05	Oral answers, quizzes, written tests and/or e-tests
F – W	PEK_W01 - PEK_W04	Exam or e-exam
F- sets the lecturer		

<b>LITERATURE</b>
<b><u>PRIMARY:</u></b>
[1] A. Białynicki - Birula, Algebra liniowa z geometrią, PWN 1976.
[2] F. Leja, Geometria analityczna, PWN, Warszawa 1972.
[3] A. Mostowski, M. Stark, Elementy algebry wyższej, PWN, Warszawa 1963.
[4] G. Banaszak, W. Gajda, Elementy algebry liniowej, część I, WNT, Warszawa 2002.
<b><u>SECONDARY:</u></b>
[1] G. Farin, D. Hansford, Practical Linear Algebra: A Geometry Toolbox 2004, AK Peters, 2005.
[2] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2015.
[3] T. Jurlewicz, Z. Skoczylas, Algebra liniowa. Przykłady i zadania, Oficyna

Wydawnicza GiS, Wrocław 2014.

[4] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2014.

[5] T. Jurlewicz, Z. Skoczylas, Algebra liniowa. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2015.

[6] E. Kącki, D. Sadowska, L. Siewierski, Geometria analityczna w zadaniach, PWN, Warszawa 1993.

[7] W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, Cz. A, PWN, Warszawa 2003.

#### **SUBJECT SUPERVISORS**

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MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT  
**ELEMENTARY LINEAR ALGEBRA MAT001433**  
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY\*\*\*\*\*  
AND SPECIALIZATION .....

<b>Subject educational effect**</b>	<b>Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)</b>	<b>Subject objectives**</b>	<b>Programme content**</b>	<b>Teaching tool number**</b>
<b>PEK_W01</b>		C1	W1, W2, W3, W14	1,3
<b>PEK_W02</b>		C2	W4, W5	1,3
<b>PEK_W03</b>		C3, C4	W6, W7, W8, W9, W15	1,3
<b>PEK_W04</b>		C5	W10, W11, W12, W13	1,3
<b>PEK_U01</b>		C1	Cw1, Cw6, Cw7	1,2,3
<b>PEK_U02</b>		C2	Cw2	1,2,3
<b>PEK_U03</b>		C3, C4	Cw3, Cw4, Cw5	1,2,3
<b>PEK_U04</b>		C5	Cw6, Cw7	1,2,3
<b>PEK_U05</b>		C5	Cw6, Cw7	1,2,3

\*\* - from tables above