

FACULTY OF COMPUTER SCIENCE AND MANAGEMENT
SUBJECT CARD

Name in English: **LINEAR ALGEBRA 1**
 Name in Polish: **ALGEBRA LINIOWA 1**
 Main field of study (if applicable): **COMPUTER SCIENCE**
 Specialization (if applicable):
 Level and form of studies: **I level, full time**
 Kind of subject: **obligatory**
 Subject code: **MAT001652**
 Group of courses: **NO**

| | Lecture | Classes | Laboratory | Project | Seminar |
|---|---------|----------------------|------------|---------|---------|
| Number of hours of organized classes in University (ZZU) | 30 | 30 | | | |
| Number of hours of total student workload (CNPS) | 90 | 60 | | | |
| Form of crediting | exam | crediting with grade | | | |
| For group of courses mark (X) final course | | | | | |
| Number of ECTS points | 3 | 2 | | | |
| including number of ECTS points for practical (P) classes | | 2 | | | |
| including number of ECTS points for direct teacher-student contact (BK) classes | 1,8 | 1,2 | | | |

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 | | Hour |
|----------------------------|---|------|
| Lec1 | Natural, rational and real numbers. Mathematical induction. Newton's binomial formula. | 2 |
| Lec2 | Complex numbers. Basic operations, modulus, complex conjugate. | 2 |
| Lec3 | Polar form of complex number. De Moivre's formula. Roots of complex numbers. The notion of algebraic field. | 2 |
| Lec4 | Polynomials. Addition and multiplication of polynomials. Roots of polynomial. Polynomial remainder theorem. Fundamental theorem of algebra. | 2 |
| Lec5 | 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 |
| Lec6 | Vectors in the space \mathbb{R}^n . Addition and multiplication by scalars. Distance between points. Scalar product. Length of vector. Cauchy-Schwarz inequality. The angle between vectors. | 2 |
| Lec7 | 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 |
| Lec8 | Analytic geometry of the space \mathbb{R}^3 . Equations of lines and planes. Distance between point and a plane. Intersection of planes. | 2 |
| Lec9 | Linear combinations of vectors. Linearly independent vectors. The base of a space. Linear mappings. Matrix representation of linear mappings. | 2 |
| Lec10 | Addition and multiplication of matrices and its correlation with operations on linear mappings. Example of matrices. | 2 |
| Lec11 | 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 |
| Lec12 | Inverse matrix. Systems of linear equations. Cramer's formulas. Examples. Homogeneous and non-homogeneous systems. | 2 |

| | | |
|-------|--|-----------|
| Lec13 | Properties of linear mappings (kernel, image, rank). Rouché-Capelli theorem. Gaussian elimination. | 2 |
| Lec14 | Eigenvalues and eigenvectors. | 2 |
| Lec15 | Conic sections. | 2 |
| | Total hours | 30 |

| Form of classes – classes | | Hours |
|----------------------------------|--|--------------|
| Cl1 | Real and complex numbers. | 4 |
| Cl2 | Polynomials. | 4 |
| Cl3 | Geometry of the plane. | 4 |
| Cl4 | Geometry of the space \mathbb{R}^3 . | 4 |
| Cl5 | Basis and linear mappings. | 4 |
| Cl6 | Matrices and determinants. | 4 |
| Cl7 | Systems of linear equations. | 4 |
| Cl8 | Test. | 2 |
| | Total hours | 30 |

TEACHING TOOLS USED

1. Lecture - traditional method.
2. Classes - traditional method.
3. Student's self work with the assistance of mathematical packages.

EVALUATION OF SUBJECT EDUCATIONAL EFFECTS ACHIEVEMENT

| Evaluation (F -forming; P - concluding) | Educational effect number | Way of evaluating educational effect achievement |
|---|---------------------------|---|
| F - Cl | PEK_U01 - PEK_U05 | Oral answers, quizzes, written tests and/or e-tests |
| P – Lec | PEK_W01 - PEK_W04 | Exam or e-exam |

LITERATURE

PRIMARY:

- [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.

SECONDARY:

- [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. Jurliewicz, Z. Skoczylas, Algebra i geometria analityczna. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2014.
- [5] T. Jurliewicz, 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
LINEAR ALGEBRA 1 MAT001652
AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY*****
AND SPECIALIZATION

| Subject educational effect | Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable) | Subject objectives | Programme content | Teaching tool number |
|----------------------------|---|--------------------|-------------------|----------------------|
| PEK_W01 | | C1 | Lec1-3, Lec14 | 1,3 |
| PEK_W02 | | C2 | Lec4-5 | 1,3 |
| PEK_W03 | | C3, C4 | Lec6-9, Lec15 | 1,3 |
| PEK_W04 | | C5 | Lec10-13 | 1,3 |
| PEK_U01 | | C1 | C11, C16, C17 | 1,2,3 |
| PEK_U02 | | C2 | C12 | 1,2,3 |
| PEK_U03 | | C3, C4 | C13-5 | 1,2,3 |
| PEK_U04 | | C5 | C16, C17 | 1,2,3 |
| PEK_U05 | | C5 | C16, C17 | 1,2,3 |