

FACULTY OF ELECTRICAL  
ENGINEERING**SUBJECT CARD**

Name in Polish: **Algebra z geometrią analityczną A**  
 Name in English: **Algebra and analytic geometry A**  
 Main field of study (if applicable): **Control Engineering and Robotics**  
 Specialization (if applicable):  
 Level and form of studies: **1st level, full-time**  
 Kind of subject: **obligatory / university-wide**  
 Subject code: **MAT001409**  
 Group of courses: **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:	examination	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 :		2			
including number of ECTS points for direct teacher-student contact (BK) classes:	1.40	1.40			

**PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES**

1. 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, learning how to calculate the distance between the points in the space  $R_n$ , how to determine the equations of lines and planes and understanding the concept of conic sections.  
 C4. Mastering the concepts of matrices, matrix operations, and learn the methods of solving systems of linear equations.

**SUBJECT EDUCATIONAL EFFECTS***relating to knowledge:*

- PEK\_W01 Knows basic properties of complex numbers, knows basic algebraic properties of polynomials  
 PEK\_W02 Knows basic concepts of theory of linear spaces and methods of description of lines, planes and conic sections  
 PEK\_W03 Knows basic methods of solving systems of linear equations

*relating to skills:*

- PEK\_U01 Can carry out calculations with complex numbers, can add, multiply and divide polynomials  
 PEK\_U02 Can find the equations of planes and lines in three dimensional space  
 PEK\_U03 Can add and multiply matrices and calculate determinants, can solve systems of linear equations

*relating to social competences:*

- PEK\_K01 Understand basic applications of complex numbers to describe physical processes

## PROGRAMME CONTENT

Form of classes - lecture		Number of hours:
Lec 1	Natural, rational and real numbers. Mathematical induction. Newton's binomial formula.	2
Lec 2	Complex numbers. Basic operations, modulus, complex conjugate.	2
Lec 3	Polar form of complex number. Multiplication, division and exponentiation in polar form. Roots of complex numbers. The notion of algebraic field.	2
Lec 4	Polynomials. Addition and multiplication of polynomials. Roots of polynomial. Polynomial remainder theorem. Fundamental theorem of algebra.	2
Lec 5	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
Lec 6	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
Lec 7	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
Lec 8	Analytic geometry of the space $R^3$ . Equations for lines and planes. Distance between point and a plane. Intersection of planes.	2
Lec 9	Linear combinations of vectors. Linearly independent vectors. The base of a space. Linear mappings. Matrix representation of linear mappings.	2
Lec 10	Addition and multiplication of matrices and its correlation with operations on linear mappings. Example of matrices.	2
Lec 11	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
Lec 12	Inverse matrix. Systems of linear equations. Cramer's formulas. Examples. Homogeneous and non-homogeneous systems.	2
Lec 13	Properties of linear mappings (kernel, image, rank). Rouché -Capelli theorem. Gaussian elimination.	2
Lec 14	Eigenvalues and eigenvectors.	2
Lec 15	Conic sections.	2
Total hours:		<b>30</b>

Form of classes - class		Number of hours:
Cl 1	Real and complex numbers.	2
Cl 2	Polynomials.	2
Cl 3	Geometry of the plane.	2
Cl 4	Geometry of the space $R^3$ .	2
Cl 5	Basis and linear mappings.	2
Cl 6	Matrices and determinants.	2
Cl 7	Systems of linear equations.	2
Cl 8	Test	1
Total hours:		<b>15</b>

## TEACHING TOOLS USED

- 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

Evaluation <i>F – forming (during semester) P – concluding (at semester end)</i>	Educational effect number	Way of evaluating educational effect achievement
F1(w)	PEK_W01 PEK_W02 PEK_W03	Exam
P(w)	P=F1	
F1(c)	PEK_U01 PEK_U02 PEK_U03 PEK_K01	Written test
P(c)	P=F1	

## PRIMARY AND SECONDARY LITERATURE

### PRIMARY LITERATURE:

- [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 LITERATURE:

- [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 2011.
- [3] T. Jurlewicz, Z. Skoczylas, Algebra liniowa. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2005.
- [4] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna.. Definicje, twierdzenia i wzory. Oficyna Wydawnicza GiS, Wrocław 2011.
- [5] T. Jurlewicz, Z. Skoczylas, Algebra liniowa. Definicje, twierdzenia i wzory. Oficyna Wydawnicza GiS, Wrocław 2005.
- [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 SUPERVISOR

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### MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT **MAT001409 - Algebra and analytic geometry A** AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY **Control Engineering and Robotics**

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	K1AiR_W01	C.1 C.2	Lec1 Lec2 Lec3 Lec4 Lec5 Lec15	N.1 N.3
PEK_W02	K1AiR_W01	C.3	Lec6 Lec7 Lec8 Lec9	N.1 N.3
PEK_W03	K1AiR_W01	C.4	Lec10 Lec11 Lec12 Lec13 Lec14	N.1 N.3
PEK_U01	K1AiR_U01	C.1 C.2	CI1 CI2	N.2 N.3
PEK_U02	K1AiR_U01	C.3	CI3 CI4 CI5	N.2 N.3
PEK_U03	K1AiR_U01	C.4	CI6 CI7	N.2 N.3
PEK_K01	K1AiR_K03 K1AiR_K07	C.1 C.4	Lec1 Lec2 Lec3 Lec4 Lec5 Lec6 Lec7 Lec8 Lec9 Lec10 Lec11 Lec12 Lec13 Lec14 Lec15 CI1 CI2 CI3 CI4 CI5 CI6 CI7 CI8	N.1 N.2 N.3