FACULTY OF ELECTRICAL ENGINEERING

SUBJECT CARD

Name in Polish:	**Algebra z geometrią analityczną**
Name in English:	**Algebra and analytic geometry**
Main field of study (if applicable):	**Electrical Engineering**
Specialization (if applicable):	
Level and form of studies:	**1st level, full-time**
Kind of subject:	**obligatory / university-wide**
Subject code:	**MAT001736**
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 that the knowledge of mathematics is equivalent to high school certificate at the basic level.

SUBJECT OBJECTIVES

C1. Presentation of basic theorems and algorithms concerning the theory of linear equations.
C2. Presentation of basic notions concerning matrix calculus, eigenvalues and eigenvectors of matrices.
C3. Exposition of rudiments of the theory of complex numbers, polynomial and rational functions.
C4. Exposition of rudiments of analytic geometry in R3.

SUBJECT LEARNING OUTCOMES

relating to knowledge:

PEU_W01 knows basic methods of solving systems of linear equations,
PEU_W02 knows basic properties of complex numbers and basic algebraic properties of polynomials,
PEU_W03 knows characterizations of lines, planes and conic sections,

relating to skills:

PEU_U01 can add and multiply matrices and calculate determinants, can solve systems of linear equations,
PEU_U02 can carry out calculations with use of complex numbers,
PEU_U03 can find line and plane equations in the space R3,

relating to social competences:

PEU_K01 understands the need for systematic and independent work on mastery of course material

PROGRAMME CONTENT		
Form of classes - lecture		**Number of hours:**
Lec 1	Mathematical induction. Newton’s binomial formula.	1
Lec 2	The notion of a matrix. Operations on matrices. Transposition. Examples of matrices (triangular, symmetric, diagonal etc.).	2
Lec 3	The determinant of a matrix. The Laplace expansion. Cofactor of an element of a matrix. Minors. Properties of determinants. Calculation of determinants by elementary row and column operations. Cauchy’s theorem. Nonsingular matrix.	3
Lec 4	Inverse matrix. Computation of inverse matrix by cofactors or by elementary row operations. Properties of inverse matrices. Matrix equations. Rank of a matrix. Applications of determinants, their connections with rank and invertibility.	2
Lec 5	Systems of linear equations. Rouché–Capelli theorem. Cramer’s formulas. Gaussian elimination. Solving arbitrary systems of linear equations.	3
Lec 6	Complex numbers. Operations on complex numbers in algebraic form. Complex conjugate. Modulus. Argument.	2
Lec 7	Geometric interpretation of a complex number. Polar form of a complex number. De Moivre’s formula. Roots of complex numbers.	2
Lec 8	Polynomials. Polynomial remainder theorem. Fundamental theorem of algebra. Roots of polynomials with real coefficients.	2
Lec 9	Linear and quadratic factors of a real polynomial. Decomposition of a polynomial into factors. Rational functions. Real partial fractions with irreducible denominators. Partial fraction decomposition of a real rational function.	2
Lec 10	Analytic geometry in the space R3. Operations on vectors. Length of a vector. Scalar product, cross product and triple product of vectors - computing area and volume.	2
Lec 11	Planes. Normal to a plane. Equations of a plane. Relative location of planes.	1
Lec 12	Line in the space. Equations of a line (parametric, directional). Line as an intersection of planes. Relative location of two lines. Relative location of a line and a plane. Orthogonal projection of a point onto a line or a plane.	3
Lec 13	Conic sections. Circle. Ellipse. Hyperbola. Parabola.	2
Lec 14	Applications of linear algebra. Eigenvalues and eigenvectors of a matrix.	3
	Total hours:	**30**

Form of classes - class		**Number of hours:**
Cl 1	Transformation of algebraic expressions. Newton’s binomial formula. Operations on matrices.	1
Cl 2	Calculation of matrix determinants with use of their properties. Laplace expansion. Computation of an inverse matrix. Solving matrix equations. Cramer’s formulas. Gaussian elimination. Solving of arbitrary systems of linear equations.	3
Cl 3	Operations on complex numbers in algebraic form. Polar form. Geometric interpretation. Powers and roots of complex numbers. Solving simple equations and inequalities.	4
Cl 4	Finding roots of polynomials. Decomposition of a polynomial into irreducible components. Partial fraction decomposition of a real rational function.	2
Cl 5	Vector operations. Scalar, cross or triple product of vectors and their applications to calculating area and volume. Solving problems in analytic geometry in R3 – finding equations of lines and planes, finding projections of vectors etc.	4
Cl 8	Test	1
	Total hours:	**15**

TEACHING TOOLS USED
N1. Lecture - traditional method or using multimedia tools.
N2. Classes – traditional method (problems sessions and discussion).
N3. Tutorial.

EVALUATION OF SUBJECT LEARNING OUTCOMES ACHIEVEMENT		
Evaluation *F – forming (during semester) P – concluding (at semester end)*	**Educational effect number**	**Way of evaluating educational effect achievement**
F1(W)	PEU_W01 PEU_W02 PEU_W03	exam
P(W)	P=F1	
F1(C)	PEU_U01 PEU_U02 PEU_U03 PEU_K01	oral presentations, quizzes, tests
P(C)	P=F1	

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Przykłady i zadania, Oficyna Wydawnicza GiS, Wrocław 2017.
[2] T. Jurlewicz, Z. Skoczylas, Algebra i geometria analityczna. Definicje, twierdzenia, wzory. Oficyna Wydawnicza GiS, Wrocław 2016.
[3] P. Kajetanowicz, J. Wierzejewski, Algebra z geometrią analityczną, PWN 2008.
[4] M. Zakrzewski, Markowe wykłady z matematyki, Algebra z geometrią, Oficyna Wyd. GiS, Wrocław 2015.

SECONDARY LITERATURE:

[1] B. Gleichgewicht, Algebra, Oficyna Wydawnicza GiS, Wrocław 2004.
[2] Mostowski, M. Stark, Elementy algebry wyższej, PWN, Warszawa 1963.
[3] W. Stankiewicz, Zadania z matematyki dla wyższych uczelni technicznych, Cz. A, PWN, Warszawa 2003.
[4] F. Leja, Geometria analityczna, PWN, Warszawa 1972.
[5] E. Kącki, D. Sadowska, L. Siewierski, Geometria analityczna w zadaniach, PWN, Warszawa,1993.

SUBJECT SUPERVISOR

Karina Olszak, karina.olszak@pwr.edu.pl