COURSE DESCRIPTION CARD - SYLLABUS

Course name
Mathematics 2 - Algebra [S1EiT1>MAT2ALG]

Course

Field of study
Electronics and Telecommunications

Year/Semester
1/1

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other (e.g. online)
0

Tutorials
15

Projects/seminars
0

Number of credit points

4,00

Coordinators

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Lecturers

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Prerequisites

The student has basic knowledge of mathematics at the high school level.

Course objective

To provide students with basic knowledge of mathematics, in the field of complex numbers, polynomials, algebraic structures, matrix calculus, vector spaces. Developing students' skills to solve simple problems of mathematical modeling by using abstract algebra and linear algebra methods. Developing students' ability to describe relationships and relationships using algebra.

Course-related learning outcomes

Knowledge:
1. has knowledge of complex numbers, operations on complex numbers, forms of complex numbers and their applications
2. has knowledge of operations on polynomials and roots of polynomials, also in the field of complex numbers
3. has knowledge of matrix calculus, matrix operations, matrix determinants, methods of calculating the inverse matrix, the use of matrix calculus to solve systems of linear equations

4. has knowledge of basic algebraic structures of monoids, groups, rings and fields
5. has knowledge of n-dimensional vector space, basis of space, change of basis, matrix eigenvalue problem

Skills:
1. can plan and carry out computer simulations, interpret the results obtained and draw conclusions, and in particular can perform operations on complex numbers, find real and complex roots of certain types of polynomials
2. can perform operations on matrices, determine the inverse of a matrix using elementary operations, calculate the determinant of a matrix, solve a system of linear equations using the Gaussian method
3. can recognize the algebraic structure, can use the monoid and group structure to describe the states of devices or processes
4. is able to determine the dimension of linear space and subspace, is able to change the base of the space, is able to solve the eigenvalue problem of a matrix

Social competence:
1. is able to properly set priorities for the implementation of a task defined by himself or others, including being able to think and act in a strict manner in the area of describing processes in technical and exact sciences

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Knowledge acquired during the lecture is verified by a 60-minute test carried out at the last lecture. Passing threshold: 50% of points. Lecture to pass. Final issues, on the basis of which questions are developed, will be made available to students on the platform ekursy.
Knowledge acquired during classes is verified by four tests in a 15-25 minute per semester. It is possible to get extra points for activity during classes, and especially for discussing additional aspects of the issue. Final exercise threshold: 50% of points obtained from tests.

Programme content

Lectures:
1. The concept of a complex number, operations on complex numbers, the trigonometric form of a complex number, the Moivre's formula, the root of a complex number.
2. Polynomials of the roots of polynomials (including: complex roots). Polynomials with complex coefficients.
3. The concept of a rectangular matrix, types of matrices. Matrix operations: matrix addition, matrix multiplication by number. The product of the matrix in the sense of Cauchy. Elemental operations on matrices, the concept of inverse matrix. The singularity and impersonality of the matrix. Calculation of the inverse matrix by the elementary operations method.
4. Determinant of the square matrix, properties of determinants, methods of calculating determinants, relationship of determinants with the inverse matrix
5. Systems of linear equations, Kronecker-Capell theorem, solving systems of linear equations by Gaussian elimination method.
6. Basic algebraic structures: groupoid, semigroup, monoid, group. Homomorphism, types of homomorphisms of groups. Rings, nucleus of rings homomorphism. Rings of polynomials. Bodies - examples. Fundamental theorem of algebra.
7. Vector spaces, linear combination, linear shell of a vector system. Independence and linear dependence. Vector space database. Space dimension. Change of base. Linear subspace.
8. Eigenvalues and eigenvector of matrix. Matrix diagonalization.
Exercises:
1. Operations on complex numbers, trigonometric form of a complex number, de Moivre's formula, root of a complex number.
2. Polynomials - roots of polynomials (including complex roots). Polynomials with complex coefficients.
3. Matrix operations, inverse matrix calculation. Calculating determinants.
4. Solving systems of linear equations.
5. Recognizing the algebraic structure that a set forms with a given operation. Determining the base of a vector space, changing the base.
6. Determining eigenvalues and eigenvectors of the matrix as a linear transformation.

Teaching methods

1. Lecture: conducted using a visualizer, the theory is illustrated with examples, giving tasks for self-solving,
2. Exercises: solving problems, discussion.

Bibliography

Basic:
1. W. Leksiński, I. Nabiałek, W. Żakowski, Matematyka. Definicje, twierdzenia, przykłady, zadania, seria EIT, WNT Warszawa 1992 (i późniejsze)
2. T.Jurlewicz, Z. Skoczylas, Algebra liniowa 1,2 Wydawnictwo GiS 2015
3. W.J. Gilbert, W.K. Nicholson, Algebra współczesna z zastosowaniami, WNT Warszawa 2008
4. M. Grzesiak, Liczby zespolone i algebra liniowa, Wydawnictwo PP Poznań 1999
5. S. Przybyło, A. Szlachtowski, Algebra i wielowymiarowa geometria analityczna w zadaniach, WNT Warszawa 1992 (i późniejsze)
6. J. Rutkowski, Algebra abstrakcyjna w zadaniach, PWN, Warszawa , 2002.
Additional:
1. J. Rutkowski, Algebra liniowa w zadaniach, PWN, Warszawa , 2008.

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,00
Classes requiring direct contact with the teacher	40	1,50
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	60	2,50