LINEAR ALGEBRA

Faculty of Computer Science					
Study programme:	**Computer Science**		Degree level:		**Engineer's degree full-time programme**
Specialization	---		Diploma path:		**2026/2027W - 2026/2027S**
Module name:	**Linear Algebra** (Algebra liniowa)				
Module type:	**obligatory**	**Semester: 1**	ECTS:**5**		Module ID:**FCS-00030**
No. of hrs in semester:	Lecture (L) - **30** Classes(C) - **30** Specialization workshop (SW) - **0** Project (P) - **0** Laboratory classes (LC) - **0** Seminar (S) - **0**				
Prerequisites	-				
Aims and objectives:	Providing fundamental knowledge in the field of algebraic structures, matrix algebra and determinants, vector spaces and linear transformations, as well as their applications. Developing skills in formal mathematical thinking, problem solving using linear algebra tools, and applying methods of linear algebra.				
Forms of teching activities::	lecture, classes,		Assessment:	Evaluation must be relevant to the intended learning outcomes: Lectures: written exam with open-ended questions Exercises: written in-class tests	
Module content:	Lectures: Introduction to algebraic structures (groups, rings, fields) The field of complex numbers Matrices and matrix operations. Types of matrices, elementary operations, algebraic operations, and transpose. Properties of matrix operations Determinants, their properties, and methods of calculation. Minors Inverse matrix. Rank of a matrix. Kronecker–Capelli theorem Applications of matrices and determinants Geometric transformations Tensors. Tensor arithmetic in deep learning Systems of linear equations. Methods for solving systems of linear equations: Gaussian elimination, Gauss–Jordan elimination, Cramer's rule Applications of systems of equations Vector spaces and subspaces. Linear independence of vectors. Basis and dimension of a space. Coordinates of a vector in a basis Linear transformation. Matrix of a linear transformation. Change-of-basis matrix Kernel and image of a linear transformation Eigenvalues and eigenvectors of matrices and linear operators Vector calculus in three-dimensional space. Scalar, vector, and triple products Exercises: Examples of algebraic systems Operations on complex numbers, representation of complex numbers in trigonometric and exponential forms Performing matrix operations, transpose, block matrices Calculating determinants using various methods, analysis of their properties Examples of applications of matrices and determinants. Geometric transformations Applications of tensor arithmetic in deep learning Finding the inverse matrix and rank of a matrix. Analysis of the number of solutions of systems of equations Solving systems of linear equations using Gaussian elimination, Gauss–Jordan elimination, and Cramer's rule Examples of applications of systems of equations Testing linear independence of vectors, finding bases and dimensions of vector spaces Determining the matrix of a linear transformation and change-of-basis matrix Analysis of the kernel and image of a linear transformation Finding eigenvalues and eigenvectors of matrices Calculating scalar, vector, and triple products and their applications in analytic geometry Course completion				
Teaching methods:	subject exercises, classic problem method, conversational lecture, lecture problem, -,				

Learning outcomes

Symbol	Specify min. 4, max. 8 learning outcomes in the following order: knowledge – skills – competence. Each learning outcome must be verifiable	Reference to the programme learning outcomes of education
LO1	Basic concepts and theorems of linear algebra; illustrating examples of their applications	INF1_W01
LO2	methods and techniques of linear algebra	INF1_W01
LO3	To apply the fundamental tools and methods of linear algebra	INF1_U01
LO4	To express problems in terms of linear algebra; able to use the tools of linear algebra to solve them	INF1_U01
LO5	Critical evaluation of one's knowledge of linear algebra and recognition of the importance of acquired knowledge in solving both theoretical and practical problems	INF1_K01

No. of learning outcome	Methods of assessing the learning outcome	Type of teaching activities (if more than one) during which the outcome is assessed
LO1	Written exam	L
LO2	Written exam	L
LO3	written in-class tests	E
LO4	written in-class tests	E

LO5	written in-class tests	E	
Student's workload (in hours)	**1** - Participation in lectures	None	30
	2 - Active participation in other class formats	None	30
	3 - Individual academic support and participation in exams and assessments held outside regular class hours	None	4
	4 - Preparation for exam	None	15
	5 - Preparation for the in-class exercises tests	None	16
	6 - Preparation for current lessons	None	30
		TOTAL:	**125**
Quantitative indicators	Student's workload - activities that require direct teacher participation: (2)+(1)+(3)	64	**ECTS** 2.6
	Student's workload connected with practical classes (2)+(3)+(5)+(6)	80	3.2
Basic references:	1. T.S. Blyth, E.F. Robertson, Basic linear algebra, Springer, New York, 2002 2. D. C. Lay, Linear algebra and its applications, Pearson/Addison-Wesley, 2006 3. G.Strang, Introduction to linear algebra, Wellesley: Wellesley-Cambridge Press, 2016		
Further reading	1. T. Jankowski, Linear algebra, Politechnika Gdańska, Gdańsk, 2001 2. P. Liebeck, Vectors and matrices, Pergamon Press, Oxford, 1971 3. D. Poole, Linear algebra: a modern introduction, Thomson Brooks/Cole, Southbank, 2006		

Unit:	Department of Theoretical Computer Science	Lecturer/ instructor	dr Marzena Filipowicz-Chomko
Date of issuing the programme:	30th May 2025	Author of the programme:	dr Marzena Filipowicz-Chomko

L - lecture, C - classes, LC - laboratory classes, P-project, SW - specialization workshop, S - seminar