SYLLABUS

1. Data about the program of study

1.1	Institution	Technical University of Cluj-Napoca
1.2	Faculty	Faculty of Electrical Engineering
1.3	Department	Electrotechnics and Measurements
1.4	Field of study	Electrical Engineering
1.5	Cycle of study	Bachelor of Science
1.6	Program of study/ Qualification	Electrical System Cluj-Napoca in English language
1.7	Form of education	Full time
1.8	Subject code	02.00

2. Data about the subject

2.1	Subject name			Linear algebra and analytical geometry		
2.2	Course responsible/ lecturer			Lecturer Berchesan Mihaela, PhD.		
2.3	Teachers in charge of Seminars/ Laboratory/ Project			Lecturer Berchesan Mihaela, PhD.		
2.4 Year of study	I	2.5 Semester	1	2.6 Type of assessment *(E – exam, C – colloquium, V – verification)*	E	
2.7 Subject category	*DF – fundamental, DD – in the field, DS – specialty, DC – complementary*				DF	
	DI – compulsory, DO – elective, Dfac – optional				DI	

3. Estimated total time

3.1 Number of hours per week:	4	of which	3.2 Course	2	3.3 Seminar	2	3.3 Laboratory		3.3 Project	
3.2 Total hours per semester	56	of which	3.5 Course	28	3.6 Seminar	28	3.6 Laboratory		3.6 Project	

3.7 Individual study:	
(a) Manual, lecture material and notes, bibliography	14
(b) Supplementary study in the library, online and in the field	4
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	22
(d) Tutoring	2
(e) Exams and tests	2
(f) Other activities	

3.8 Total hours of individual study *[sum (3.7(a) to 3.7(f))]*	44
3.9 Total hours per semester *[sum of 3.4 and 3.8]*	100
3.10 Number of credit points	4

4. Prerequisites (where applicable)

4.1	Curriculum	-
4.2	Competences	-

5. Requirements (where appropriate)

5.1	For the course	On site
5.2	For the applications	On site

6. Specific competences

Professional competences	C1. Operation with mathematical, engineering, and computer science fundamentals: C1.1 – Recognition and description of concepts related to computability, complexity, programming paradigms, and the modeling of computing and communication systems C1.2 – Use of specific theories and tools (algorithms, schemes, models, protocols, etc.) to explain the structure and operation of hardware, software, and communication systems C1.3 – Development of models for various components of computing systems C1.4 – Formal evaluation of functional and non-functional characteristics C1.5 – Theoretical substantiation of the characteristics of designed systems
Cross competences	N/A

7. Expected learning outcomes

Knowledge	The student/graduate identifies and describes basic concepts, principles, and methods in mathematics, physics, chemistry, technical drawing, economics, and computer science.
Abilities	The student/graduate operates with basic concepts, principles, and methods from fundamental disciplines. The student/graduate solves problems of mathematics, physics and chemistry with applicability in engineering and validates the solution obtained. The student/graduate performs engineering and economic calculations of medium complexity and associates them with graphic representations of letters or specific to computer-aided design. The student/graduate describes physico-chemical and economic phenomena and processes.
Responsibility and autonomy	The student/graduate applies the values of ethics and deontology of the engineering profession. The student/graduate practices logical reasoning, evaluation and self-evaluation in decision-making.

8. Discipline objectives (based on specific competencies acquired)

8.1	General objective	Development of the ability to apply the concepts and methods of linear algebra and analytic geometry in scientific contexts.
8.2	Specific objectives	Application of matrix-based methods (within the broader framework of linear algebra) to address engineering-related problems. Application of vector-based methods (within the broader framework of analytic geometry) to model and solve practical problems involving spatial structures.

9. Contents

9.1. Course (Lectures)		Number of hours	Teaching methods	Additional remarks
1	Linear spaces: definition, linear subspaces, examples	2	Presentation, discussions	

2	Linear independence, basis, dimension, change of basis	2		
3	Inner product spaces: definition, properties, the Schwarz inequality, examples	2		
4	Linear transformations: definition, basic properties, kernel and image	2		
5	Matrix associated with a linear transformation: standard constructions, expressions in terms of coordinates	2		
6	Eigenvalues and eigenvectors: definitions, invariant subspaces, characteristic polynomial	2		
7	Diagonal form: canonical forms, diagonalizability	2		
8	Jordan canonical form: construction of a Jordan basis and the Jordan matrix	2		
9	Matrix functions: powers of order n, elementary matrix functions	2		
10	Adjoint operator: definition, properties, examples	2		
11	Self-adjoint operators, unitary operators, properties of eigenvalues and eigenvectors	2		
12	Bilinear forms, quadratic forms, associated matrix	2		
13	Canonical form: reduction to canonical form, eigenvalue method and Jacobi method	2		
14	Conics and quadrics: reduction to canonical form, geometric properties	2		

Bibliography

[1] D. Cimpean, D. Inoan, I. Rasa, An Invitation to Linear Algebra and Analytic Geometry, Ed. Mediamira 2010

[2] V. Pop, I. Rasa, Linear Algebra with Applications to Markov Chains, Ed. Mediamira, 2005.

[3] V. Pop, I. Corovei, Algebra pentru ingineri. Culegere de probleme, Ed. Mediamira, 2003.

9.2. Applications - Seminar /Laboratory/Project		Number of hours	Teaching methods	Additional remarks
1	Determinants, matrices, geometric vectors	2	Interactive teaching approach, based on a teacher–student partnership	
2	Linear spaces, basis, dimension	2		
3	Inner product spaces	2		
4	Linear transformations: examples	2		
5	Linear transformations characterized in terms of matrices	2		
6	Invariant subspaces, eigenvectors and eigenvalues	2		
7	Diagonalizable linear transformations	2		
8	Jordan bases, Jordan canonical form	2		
9	Elementary matrix functions: examples	2		

10	Adjoint operator	2		
11	Special classes of operators	2		
12	Bilinear forms, quadratic forms	2		
13	Reduction to canonical form	2		
14	Conics and quadrics, reduction to canonical form	2		

Bibliography

[1] https://www.researchgate.net/publication/259779204, Laszlo Szilard Csaba, Radu Ioan Peter, A. Viorel, Elements of Linear Algebra, 2014

10. Alignment of course content with expectations of the epistemic community, professional associations, and representative employers in the field

In consultation with faculty teaching specialized courses, the content of lectures and seminars will be periodically updated to ensure alignment with market requirements.

11. Assessment

Activity type	11.1 Assessment criteria	11.2 Assessment methods	11.3 Weight in the final grade (%)
11.4 Course	Knowledge of theoretical principles and results, Problem-solving skills	Written exam	80%
11.5 Seminar	Problem-solving skills; attendance; participation	Written exam	20%

11.6 Minimum standard of performance:

Ability to coherently present a theoretical result and solve application-oriented problems.

Condition for obtaining credits: T ≥ 5, AS ≥ 5, CP ≥ 5

Date of completion	Lecturers	Title/ Surname/ Name:	Signature
September 2025	Course	Lecturer Berchesan Mihaela, PhD.	
	Applications Seminar/ Laboratory/ Project	Lecturer Berchesan Mihaela, PhD.	
			...

Date of approval in the ETHM Department Council September 2025	**Head of Department:** Prof. Eng. MICU Dan Doru, PhD
Date of approval in the Faculty of Electrical Engineering Council September 2025	**Dean:** Assoc. Prof. Eng. CZIKER Andrei, PhD