SYLLABUS

1. Data about the program of study

1.1	Institution	The Technical University of Cluj-Napoca
1.2	Faculty	Automation and Computer Science
1.3	Department	Computer Science
1.4	Field of study	Computer Science and Information Technology
1.5	Cycle of study	Bachelor of Science
1.6	Program of study / Qualification	Computer Science / Engineer
1.7	Form of education	Full time
1.8	Subject code	1.00

2. Data about the subject

2.1	Subject name				***Linear Algebra and Analytical Geometry***	
2.2	Course responsible / lecturer				Prof. dr. Radu Peter- radu.peter@math.utcluj.ro	
2.3	Teachers in charge of applications				Prof. dr. Radu Peter- radu.peter@math.utcluj.ro Lect. dr. Liana Timbos - Liana.Timbos@math.utcluj.ro	
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 – fundamentală, DD – în domeniu, DS – de specialitate, DC – complementară*				DF/DOB
		DI – Impusă, DOp – opțională, DFac – facultativă				

3. Estimated total time

3.1	Number of hours per week	4	3.2	lectures	2	3.3	applications	2
3.4	Total hours in the teaching plan	104	3.5	lectures	28	3.6	applications	28

Individual study	Hours
Manual, lecture material and notes, bibliography	20
Supplementary study in the library, online, and in the field	4
Preparation for seminars/laboratory works, homework, reports, portfolios, essays	21
Tutoring	0
Exams and tests	3
Other activities	0

3.7	Total hours of individual study	48
3.8	Total hours per semester	104
3.9	Number of credit points	4

4. Pre-requisites (where appropriate)

4.1	Curriculum	Basic knowledge of Linear Algebra and Analytic Geometry
4.2	Competence	Competences in elementary Linear Algebra and Analytic Geometry: matrices, determinants, linear systems, vectors and lines in plane

5. Requirements (where appropriate)

5.1	For the course	Blackboard, video projector
5.2	For the applications	Blackboard, video projector

6. Specific competences

6.1 Professional competences	• C1.1. Professional communication using scientific concepts, theory and methods used in system engineering. C1.2. Presentation and motivation of solution to problems from system engineering using techniques, concepts and principles from mathematics, physics, etc. • C1.3. solving usual problems in system engineering by identifying techniques, principles and methods from mathematics. • C1.4. Identifying the potential, advantages and disadvantages of methods from system engineering, documentation of projects and using mathematical methods. • C1.5.Use of mathematical methods in projects in system engineering.
6.2 Cross competences	N/A

7. Discipline objectives (as results from the *key competences gained*)

7.1	General objective	A presentation of the concepts, notions, methods and fundamental techniques used in linear algebra and analytic geometry.
7.2	Specific objectives	Use of the matrix calculus (in the general context of linear algebra) in order to solve problems in engineering. Use of the vectorial calculus (in the general context of analytic geometry) in modelling and solving practical problems concerning spatial forms.

8. Contents

8.1. Lecture (syllabus)	Teaching methods	Notes
Vectors in plane and space.	Explanation Demonstration Collaboration Interactive activities	
Lines and planes.		
Vectror spaces: defntion, examles, subsaces, sums of subspaces.		
Basis and dimensions. Linar indpendence. Change of basis.		
Inner product spaces (I): definition, examples, computations, orthonormal basis, Schwarz inequalty, orthogonal complement.		
Inner product spaces (II): Gram-Schmidt ortogonalization process, Gram deteminants. Linear manifolds, distances.		
Linear maps (I): definition, kernel, image, injective and surjective maps.		
Linear maps (II): the matrix of a linear map.		
Eigenvectors and eigenvalues of operators (and associated matrix). Characteristic polynomial. Cayley-Hamilton thoerem. Diagonal form. Diagonaziabel operators.		
The Jordan canonical form for operators (and associated matrix). Jordan basis, the Jordan matrix.		
Functions of a matrix. The n-th power of a matrix. Elementary functions of a matrix.		
The adjoint operator. Definition, properties, examples.		
Special operators, Properties of eigenvalues and eigenvectors.		
Bilinear forms, quadratic forms. The associated matrix.		
Conics and quadrics. Reduction to a canonical form. Geometric properties.		

Bibliography

1. Ioan Radu Peter, Szilard Laszlo, Adrian Viorel , Elements of Linear Algebra, Mediamira 2014, https://algappl.utcluj.ro/
2. D. Cimpean, D. Inoan, I. Rasa, An invitation to Linear Algebra and Analytic Geometry, Ed. Mediamira, 2012
3. V. Pop, I. Rasa, Linear Algebra with Applications to Markov Chains, Ed. Mediamira, 2005

8.2. Applications (Seminars)	Teaching methods	Notes
Linear systems, matrices, determinants.		
Vectorial geometry. Determinants. Exercises.		
Problems in analytical geometry: lines and planes. Applications.		
Linear spaces, basis, dimension, direct sums.		

Linear indpenedence, basis, dimensions.	Explanation Demonstration Collaboration Interactive activities	
Inner product spaces (I): definition, examples, computations, orthonormal basis, Schwarz inequalty, orthogonal complement.		
Inner product spaces (II): Gram-Schmidt ortogonalization process, Gram deteminants. Linear manifolds, distances.		
Linear maps (I): definition, kernel, image, injective and surjective maps.		
Linear maps (II): the matrix of a linear map. Applications.		
Eigenvalues and eivectors. Diagonalizable linear maps.		
Jordan canonical form I. Applications.		
Jordan canonical form II, Jordan basis. Special operators.		
Bilinear forms, quadratic forms. Applications.		
Conics and quadrics, reduction to a canonical form. Recapitulative problems.		

Bibliography

1. Ioan Radu Peter, Szilard Laszlo, Adrian Viorel , Elements of Linear Algebra, Mediamira 2014, https://algappl.utcluj.ro/
2. D. Cimpean, D. Inoan, I. Rasa, An invitation to Linear Algebra and Analytic Geometry, Ed. Mediamira, 2012
3. V. Pop, I. Corovei, Algebra pentru ingineri. Culegere de probleme, Ed. Mediamira, 2003.

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

Collaboration with engineers in order to identify and solve problems raised by the market.

10. Evaluation

Activity type	10.1	Assessment criteria	10.2	Assessment methods	10.3	Weight in the final grade
Course		Abilities of understanding and using creatively the concepts and proofs		Written examination		20%
Applications		Abilities of solving problems and applying algorithms		Written examination		80%
10.4. Minimum standard of performance						
Ability to present coherently a theoretical subject and to solve problems with practical content.						

Date of filling in	**Teachers**	**Title First name Last Name**	**Signature**
26.05.2024	Course	Prof.dr. Ioan Radu Peter	
	Applications	Prof.dr. Ioan Radu Peter	
		Lect. Liana Timbos	

Date of approval in the department 20.02.2024	Head of Department of Mathematics, Prof.dr. Dorian Popa
Date of approval by the Faculty Council 22.02.2024	Dean, Prof.dr.eng. Mihaela Dînșoreanu