SYLLABUS

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Automation and Computer Science
1.3 Department	Automation
1.4 Field of study	Systems Engineering
1.5 Cycle of study	Bachelor's Degree
1.6 Program of study / Qualification	Automation and Applied Informatics
1.7 Form of education	FT – Full-time learning

2. Data about the subject

2.1 Subject name	***Linear Algebra***			Subject code	**2**
2.2 Course responsible / lecturer	Prof. dr. Peter Radu - radu.peter@math.utcluj.ro				
2.3 Teachers in charge of seminars / Laboratory / project	Prof. dr. Peter Radu - radu.peter@math.utcluj.ro Lect. dr. Timbos Liana - 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	Formative category: DF – fundamental, DS – speciality, DC – complementary				DF
	Optionality: DOB – mandatory, DOP – optional (alternative), DFA – optional (free choice)				DOB

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	0	3.3 Project	0
3.4 Total hours in the teaching plan	104	of which:	3.5 Course	28	3.6 Seminar	28	3.6 Laboratory	0	3.6 Project	0

3.7 Time distribution (hours per semester) for:	
(a) Manual, lecture material and notes, bibliography	20
(b) Supplementary study in the library, online and in the field	3
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	18
(d) Tutoring	0
(e) Exams and tests	3
(f) Other activities:	0
3.8 Total hours individual study hours (sum of (3.3(a)...3.3(f)))	44
3.9 Total hours per semester (3.2+3.4)	100
3.10 Number of credits 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. Expected learning outcomes

Knowledge	It describes, identifies, summarizes basic concepts and methods relating to systems in general and to digital systems and computer networks in particular and how they are applied to concrete problems.
Skills	It analyzes systems using the theories studied and designs, implements, diagnoses and debugs digital systems. It uses specific theories and tools (applications, models, protocols, etc.) for the analysis, simulation, design and implementation of computer networks.
Responsibility and autonomy:	Carry out processes in computer project management and information technology, taking over the various roles in the team and clearly and concisely describing, verbally and in writing, the results.

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

8.1 General objective	A presentation of concepts, notions, methods and fundamental techniques used in linear algebra and analytic geometry and their use in automation.
8.2 Specific objectives	Use of the matrix calculus (in the general context of linear algebra) 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.

9. Contents

9.1. 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

9.2. 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 to identify and solve problems raised by the market.

10. Evaluation

Activity type	Assessment criteria	Assessment methods	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%
Minimum standard of performance: Ability to present coherently a theoretical subject and to solve problems with practical content.			

Date of filling in	**Responsible**	**Title, First name Last name**	**Signature**
	Course	Prof.dr. Ioan-Radu PETER	
	Applications	Prof.dr. Ioan-Radu PETER	
		Lect. Liana TIMBOS	

Date of approval in the department	Head of Department of Mathematics, Prof.dr. Dorian Popa
Date of approval by the Faculty Council	Dean, Prof.dr.eng. Vlad Mureșan