SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babeş-Bolyai University**
1.2 Faculty	**Faculty of Mathematics and Computer Science**
1.3 Department	**Department of Computer Science**
1.4 Field of study	**Computers and Information Technology**
1.5 Study cycle	**Undergraduate**
1.6 Study programme / Qualification	**Information Engineering**

2. Information regarding the discipline

2.1 Name of the discipline (en) (ro)	Linear algebra, analitical and differential geometry 1 Algebra liniară, geometrie analitică si diferențială 1						
2.2 Course coordinator	Assistant Professor PhD. Cosmin Pelea						
2.3 Seminar coordinator	Assistant Professor PhD. Cosmin Pelea						
2.4. Year of study	**1**	2.5 Semester	**1**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**Compulsory**

3. Total estimated time (hours/semester of didactic activities)

3.1 Hours per week	4	Of which: 3.2 course	3	3.3 seminar/laboratory	1
3.4 Total hours in the curriculum	56	Of which: 3.5 course	42	3.6 seminar/laboratory	14
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					28
Additional documentation (in libraries, on electronic platforms, field documentation)					24
Preparation for seminars/labs, homework, papers, portfolios and essays					28
Tutorship					14
Evaluations					4
Other activities:					-
3.7 Total individual study hours	98				
3.8 Total hours per semester	150				
3.9 Number of ECTS credits	6				

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competencies	

5. Conditions (if necessary)

5.1. for the course	
5.2. for the seminar /lab activities	

6. Specific competencies acquired

Professional competencies	C1.1 Idetifying the notions, describing the theories and using the specific language C2.3 Applying the adequate analytical theoretical methods to a given problem.
Transversal competencies	CT1. Applying some rules of precise and efficient work, showing a responsible attitude regarding the scientific domain and teaching training for an optimal and creative development of the personal potential in specific situations, respecting the deontological norms.

7. Objectives of the discipline (outcome of the acquired competencies)

7.1 General objective of the discipline	To introduce the basic notions of linear algebra.
7.2 Specific objective of the discipline	To introduce some basic results on vector spaces, matrices, systems of linear equations, eigenvalues, eigenvectors and quadratic forms.

8. Content

8.1 Course	Teaching methods	Remarks
1. Groups. Rings. Fields.	Interactive exposure Explanation Conversation Didactical demonstration	
2. Matrix rings. Determinants.	Interactive exposure Explanation Conversation Didactical demonstration	

3. The rank of a matrix. The inverse of a matrix	Interactive exposure Explanation Conversation Didactical demonstration	
4. Systems of linear equations	Interactive exposure Explanation Conversation Didactical demonstration	
5. Elementary operations on a matrix. Applications	Interactive exposure Explanation Conversation Didactical demonstration	
6. Vector spaces. Subspaces.The generated subspace	Interactive exposure Explanation Conversation Didactical demonstration	
7. Linear maps	Interactive exposure Explanation Conversation Didactical demonstration	
8. Test		
9. Linear independent vectors. Bases. The universal property of vector spaces.	Interactive exposure Explanation Conversation Didactical demonstration	
10. The exchange theorem (Steinitz). Dimension. Dimension formulas	Interactive exposure Explanation Conversation Didactical demonstration	
11. Matrices and linear maps	Interactive exposure Explanation Conversation Didactical demonstration	
12. Eigenvectors and eigenvalues	Interactive exposure Explanation Conversation Didactical demonstration	
13. Diagonalisable matrices. Hamilton-Cayley Theorem	Interactive exposure Explanation Conversation Didactical demonstration	
14. Bilinear and quadratic forms.	Interactive exposure Explanation Conversation Didactical demonstration	

Bibliography

1. R. COVACI, Algebra si programare liniara, Litografia UBB, Cluj-Napoca, 1986.
2. S. CRIVEI, Basic Abstract Algebra, Ed. Casa Cartii de Stiinta, Cluj-Napoca, 2002, 2003.
3. C. NASTASESCU, I. STANESCU, C. NITA, Matematica, Elemente de algebra superioara, Editura Didactica si Pedagogica, Bucuresti, 1995.
4. W. K. NICHOLSON, Linear Algebra and Applications, Lyryx Version, https://lila1.lyryx.com/textbooks/OPEN_LAWA_1/marketing/Nicholson-OpenLAWA-2021A.pdf
5. I. PURDEA, I. POP, Algebra, Editura GIL, Zalau, 2003.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Groups. Rings. Fields. Review.	Interactive exposure Explanation Conversation Didactical demonstration	
2. Determinants.	Interactive exposure Explanation Conversation Didactical demonstration	
3. The rank of a matrix	Interactive exposure Explanation Conversation Didactical demonstration	
4. The inverse of a matrix	Interactive exposure Explanation Conversation Didactical demonstration	
5. Systems of linear equations	Interactive exposure Explanation Conversation Didactical demonstration	
6. Vector spaces.	Interactive exposure Explanation Conversation Didactical demonstration	
7. Subspaces. Generated subspace	Interactive exposure Explanation Conversation Didactical demonstration	
8. Linear maps	Interactive exposure Explanation Conversation Didactical demonstration	
9. Bases	Interactive exposure Explanation Conversation Didactical demonstration	

10. Dimension formulas.	Interactive exposure Explanation Conversation Didactical demonstration	
11. Dimension and generated subspaces.	Interactive exposure Explanation Conversation Didactical demonstration	
12. Matrices and linear maps	Interactive exposure Explanation Conversation Didactical demonstration	
13. Eigenvectors and eigenvalues. Diagonalisable matrices. Hamilton-Cayley Theorem	Interactive exposure Explanation Conversation Didactical demonstration	
14. Bilinear and quadratic forms.	Interactive exposure Explanation Conversation Didactical demonstration	

Bibliography

1. I.D. ION, N. RADU, Algebra (ed.4), Editura Didactica si Pedagogica, 1990.
2. I.D. ION, C. NITA, D. POPESCU, N. RADU: Probleme de algebra, Editura Didactica si Pedagogica, Bucuresti, 1981.
3. C. NASTASESCU, I. STANESCU, C. NITA, Matematica, Elemente de algebra superioara, Editura Didactica si Pedagogica, Bucuresti, 1995.
4. W. K. NICHOLSON, Linear Algebra and Applications, Lyryx Version, https://lila1.lyryx.com/textbooks/OPEN_LAWA_1/marketing/Nicholson-OpenLAWA-2021A.pdf
5. I. PURDEA, C. PELEA, Probleme de algebra, EIKON, Cluj-Napoca, 2008.

9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program

The course presents notions which often appear in other undergraduate courses. The course offers a sufficiently general background for some highschool algebra topics and the necessary tools to solve some specific problems.

10. Evaluation

10.4 Course	Knowledge of basic concepts	Test	25%
	Knowledge of basic results	Final exam.	25%
10.5 Seminar/laborator	Examples and problem solving	Final exam.	50%
10.6 Minimum performance standards			

The final grade must be at least 5.

The required background for receiving the degree 5 contains:

- all the course notions;
- the statements of all the results presented in the course;
- the possibility to compute (any size) determinants, the inverse of a matrix, the rank of a matrix using all the algorithms discussed during the semester;
- the possibility to discuss the consistency and to solve systems of linear equations using all the algorithms discussed during the semester.

Date	Signature of course coordinator	Signature of seminar coordinator
23.04.2024	Assist. Prof. PhD. Cosmin Pelea	Assist. Prof. PhD. Cosmin Pelea

Date of approval

Signature of the head of department

Conf.PhD. Adrian-Ioan Sterca