SYLLABUS

Algebra

University year 2025-2026

1. Information regarding the programme

1.1. Higher education institution	Babeș-Bolyai University
1.2. Faculty	Mathematics and Computer Science
1.3. Department	Mathematics
1.4. Field of study	Computer Science
1.5. Study cycle	Bachelor
1.6. Study programme/Qualification	Computer Science
1.7. Form of education	Full-time education

2. Information regarding the discipline

2.1. Name of the discipline	**Algebra**					Discipline code	**MLE0020**
2.2. Course coordinator					Prof. PhD. Septimiu Crivei		
2.3. Seminar coordinator					Prof. PhD. Septimiu Crivei		
2.4. Year of study	1	2.5. Semester	1	2.6. Type of evaluation	VP	2.7. Discipline regime	DC

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

3.1. Hours per week	**4**	of which: 3.2 course	**2**	3.3 seminar/laboratory	**2**
3.4. Total hours in the curriculum	56	of which: 3.5 course	28	3.6 seminar/laborator	**28**
Time allotment for individual study (ID) and self-study activities (SA)					**hours**
Learning using manual, course support, bibliography, course notes (SA)					28
Additional documentation (in libraries, on electronic platforms, field documentation)					14
Preparation for seminars/labs, homework, papers, portfolios and essays					28
Tutorship					10
Evaluations					4
Other activities:					0
3.7. Total individual study hours	**94**				
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	

6.1. Specific competencies acquired [1]

[1] One can choose either competences or learning outcomes, or both. If only one option is chosen, the row related to the other option will be deleted, and the kept one will be numbered 6.

Professional/essential competencies	C3.1 Description of concepts, theories and models used in the application field C4.3 Identification of adequate models and methods for solving real problems
Transversal competencies	CT2 Efficient fulfillment of organized activities in an inter-disciplinary group and development of empathic abilities of inter-personal communication, relationship and collaboration with various groups

6.2. Learning outcomes

Knowledge	The student is able to ensure the formation of skills specific to the Mathematics-related disciplines needed to complete the assignments. The student knows fundamental notions related to Algebra, and methods of applying them to areas of science related to Mathematics and Computer Science.
Skills	The student will construct clear and well-supported mathematical arguments to explain mathematical problems, topics, and ideas in writing. The student will prove theorems using the language of mathematics in theoretical junior/senior level courses and present those results both orally and in writing.
Responsibility and autonomy:	The student is able explore some mathematical content independently, drawing on ideas and tools from previous coursework to extend their understanding. The student will independently extend mathematical ideas and arguments from previous coursework to a mathematical topic not previously studied.

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 as well as some of its applications to computer science
7.2 Specific objective of the discipline	To present some applications of linear algebra to computer science

8. Content

8.1 Course	**Teaching methods**	**Remarks**
1. Functions. Equivalence relations and partitions	Interactive exposure Explanation	

	Conversation Didactical demonstration	
2. Binary operations. Groups, subgroups, group homomorphisms	Interactive exposure Explanation Conversation Didactical demonstration	
3. Rings and fields, subrings and subfields, ring homomorphisms	Interactive exposure Explanation Conversation Didactical demonstration	
4. Vector spaces, examples. Subspaces. Linear maps	Interactive exposure Explanation Conversation Didactical demonstration	
5. Linear dependence and independence. Bases, dimension. Steinitz theorem	Interactive exposure Explanation Conversation Didactical demonstration	
6. Bases and coordinates. Dimension related formulas	Interactive exposure Explanation Conversation Didactical demonstration	
7. Elementary operations. Matrices and determinants	Interactive exposure Explanation Conversation Didactical demonstration	
8. Rank and inverse of a matrix. Matrix of a list of vectors	Interactive exposure Explanation Conversation Didactical demonstration	
9. Matrix of a linear map. Change of basis	Interactive exposure Explanation Conversation Didactical demonstration	
10. Systems of linear equations, solving methods	Interactive exposure Explanation Conversation Didactical demonstration	
11. Eigenvectors and eigenvalues	Interactive exposure Explanation Conversation Didactical demonstration	
12. Linear codes, examples. Generator matrix and parity-check matrix	Interactive exposure Explanation Conversation Didactical demonstration	
13. Decoding linear codes	Interactive exposure Explanation Conversation Didactical demonstration	
14. Applications of Algebra to Computer Science	Interactive exposure Explanation Conversation Didactical demonstration	
Bibliography		

1. G. Calugareanu, Lectii de algebra liniara, Lito UBB, Cluj-Napoca, 1995.
2. S. Crivei, Basic linear algebra, Cluj University Press, Cluj-Napoca, 2022.
3. C. Gherghe, D. Popescu, Criptografie. Coduri. Algoritmi, Editura Univ. Bucuresti, 2005.
4. J. Gilbert, L. Gilbert, Elements of modern algebra, PWS-Kent, Boston, 1992.
5. W. J. Gilbert, W. K. Nicholson, Modern Algebra with Applications, John Wiley, 2004.
6. P. N. Klein, Coding the Matrix. Linear Algebra through Applications to Computer Science, Newtonian Press, 2013.

8.2 Seminar / laboratory	**Teaching methods**	**Remarks**
1. Functions. Equivalence relations and partitions	Interactive exposure Explanation Conversation	
2. Binary operations. Groups, subgroups, group homomorphisms	Interactive exposure Explanation Conversation	
3. Rings and fields, subrings and subfields, ring homomorphisms	Interactive exposure Explanation Conversation	
4. Vector spaces, examples. Subspaces. Linear maps	Interactive exposure Explanation Conversation	
5. Linear dependence and independence. Bases, dimension. Steinitz theorem	Interactive exposure Explanation Conversation	
6. Bases and coordinates. Dimension related formulas	Interactive exposure Explanation Conversation	
7. Elementary operations. Matrices and determinants	Interactive exposure Explanation Conversation	
8. Rank and inverse of a matrix. Matrix of a list of vectors	Interactive exposure Explanation Conversation	
9. Matrix of a linear map. Change of basis	Interactive exposure Explanation Conversation	
10. Systems of linear equations, solving methods	Interactive exposure Explanation Conversation	
11. Eigenvectors and eigenvalues	Interactive exposure Explanation Conversation	
12. Linear codes, examples. Generator matrix and parity-check matrix	Interactive exposure Explanation Conversation	
13. Decoding linear codes	Interactive exposure Explanation Conversation	
14. Applications of Algebra to Computer Science	Interactive exposure Explanation Conversation	

Bibliography

1. S. Crivei, Basic linear algebra, Cluj University Press, Cluj-Napoca, 2022.
2. W. J. Gilbert, W. K. Nicholson, Modern Algebra with Applications, John Wiley, 2004.
3. P. N. Klein, Coding the Matrix. Linear Algebra through Applications to Computer Science, Newtonian Press, 2013.
4. I. Purdea, C. Pelea, Probleme de algebra, Editura 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 high-school algebra topics and the opportunity to develop some problem solving skills useful for further teaching activities.

10. Evaluation

Activity type	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Percentage of final grade
10.4 Course	Knowledge of concepts, results, examples	Midterm exam, final exam	1/3 of the grade
10.5 Seminar/laboratory	Problem solving	Midterm exam, final exam	2/3 of the grade
10.6 Minimum standard of performance			
The final grade must be at least 5.			

11. Labels ODD (Sustainable Development Goals)[2]

	General label for Sustainable Development							
								

Date:
11.04.2025

Signature of course coordinator

Prof. PhD. Septimiu Crivei

Signature of seminar coordinator

Prof. PhD. Septimiu Crivei

Date of approval:
25.04.2025

Signature of the head of department

Prof. PhD. Andrei Mărcuş

[2] Keep only the labels that, according to the *Procedure for applying ODD labels in the academic process*, suit the discipline and delete the others, including the general one for *Sustainable Development* – if not applicable. If no label describes the discipline, delete them all and write „*Not applicable.*”.