COURSE DESCRIPTION

Algebra

Academic year 2026-2027

1. Programme-related data

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

2. Course-related data

2.1. Course title	**Algebra**			Course 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	21	2.6. Type of assessment	Progress check
2.7. Course status		Compulsory		2.8. Course type	Core subject

3. Total estimated time (hours per semester of teaching activities)

3.1. Number of hours per week	**4**	of which: 3.2. course	**2**	3.3. seminar/ laboratory/ project	**2**
3.4. Total of hours in the curriculum	56	of which: 3.5. course	28	3.6. seminar/ laboratory	**28**
Time allocation for individual study (IS) and self-taught activities (ST)					**hours**
Learning from textbooks, course materials, bibliography, and notes (IS)					28
Additional research in the library, on subject-specific electronic platforms, and on-site					14
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays					28
Tutoring (professional guidance)					10
Examinations					14
Other activities					0
3.7. Total hours of individual study (IS) and self-taught activities (ST)				**94**	
3.8. Total hours per semester				**150**	
3.9. Number of credits				**6**	

4. Prerequisites (where applicable)

4.1. curriculum-related	
4.2 skills-related	

5. Specific conditions (where applicable)

5.1. course-related	
5.2. seminar/laboratory-related	

6.1. Competencies resulting from the completion of the degree programme *(as referred to in the curriculum)*[1]

Professional competencies	
Competency code	**Competency**
CP2	perform analytical mathematical calculations
CP6	think abstractly
CP8	study relationships between quantities
Transversal competencies	
Competency code	**Competency**
CT2	Solve problems
CT3	Think analytically

6.2. Learning outcomes relevant to the degree programme (as referred to in the curriculum)[2]

Learning outcomes targeted by the subject		
Competency code	**Knowledge and comprehension**	**Specific academic skills**
CP2	7. The student/graduates selects, explains, and specifies the mathematical foundations applied in computer science, including formal logic, algebra, probability, and statistics.	7. The student/graduates applies, evaluates, and proposes mathematical methods for modeling, simulating, and solving computer science problems.
CP6	4. The student/graduate defines the basic concepts from advanced mathematics disciplines in the curriculum.	4. The student/graduate answers questions and correctly and rigorously formulates the statements of mathematical assertions (lemmas, propositions, theorems) from the disciplines in the curriculum.
CP8	3. The student/graduate formulates observations and differentiates notions, properties, and assertions from the core disciplines of mathematics through examples and counterexamples.	3. The student/graduate identifies and describes the essential elements in the construction of proofs of mathematical assertions (lemmas, propositions, theorems), recognizes errors in reasoning, and corrects them.
CT4, CT5	2. The student/graduate compares and distinguishes related notions and their properties from the core disciplines of mathematics.	2. The student/graduate recognizes and analyzes the necessary and/or sufficient conditions in the statements of mathematical assertions and specifies their role in the proof.

7. Subject-specific learning outcomes

Knowledge and comprehension
1. The student is able to ensure the formation of skills specific to the Mathematics-related disciplines needed to complete the assignments.
2. The student knows fundamental notions related to Algebra, and methods of applying them to areas of science related to Mathematics and Computer Science.

[1] The professional and/or transversal skills targeted by the subject for which the course description is prepared will be copied from the curriculum of the degree programme. For each competency, the complete entry, including the competency code, will be copied with the exact wording that appears in the curriculum, without any changes. If no competency is copied from either of the two categories, the row corresponding to that category is deleted from the table.

[2] The learning outcomes relevant for the degree programme and targeted by the subject for which the course description is prepared will be listed. The entries, copied without any changes from the Curriculum by subject type (Core Subject/Specialisation Subject/Complementary Subject), are listed under the corresponding competency.

	Specific academic skills
1.	The student will construct clear and well-supported mathematical arguments to explain mathematical problems, topics, and ideas in writing.
2.	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.

8. Contents

8.1. Course	**Teaching and learning methods**	**Remarks[3]**
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	

[3] For example, organisational aspects, recommendations for students, specific aspects relating to the course/seminar, such as inviting experts in the field, etc.

	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 and learning 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. Evaluation

Type of activity	9.1 Evaluation criteria[4]	9.2 Evaluation methods[5]	9.3 Percentage in the final grade
9.4. Course	Knowledge of concepts, results, examples	Midterm exam, final exam	1/3 of the grade
9.5. Seminar/ laboratory	Problem solving	Midterm exam, final exam	2/3 of the grade
9.6 Minimum standard for passing			
The final grade must be at least 5.			

10. SDG labels (Sustainable Development Goals)[6]

	○	Sustainable Development Generic Label

1 FĂRĂ SĂRĂCIE	2 FOAMETE „ZERO"	3 SĂNĂTATE ȘI BUNĂSTARE	4 EDUCAȚIE DE CALITATE	5 EGALITATE DE GEN	6 APĂ CURATĂ ȘI SANITAȚIE	7 ENERGIE CURATĂ ȘI LA PREȚURI ACCESIBILE	8 MUNCĂ DECENTĂ ȘI CREȘTERE ECONOMICĂ	9 INDUSTRIE, INOVAȚIE ȘI INFRASTRUCTURĂ
○	○	○	○	○	○	○	○	X

[4] The evaluation criteria must directly reflect the learning outcomes targeted at the level of the degree programme respectively at the level of the subject. More specifically, the learning outcomes set out in the expected learning outcomes are assessed.

[5] Both final evaluation methods and ongoing evaluation strategies should be established.

[6] Select a single label which, according to the *Implementation of SDG labels in the academic process*, best matches the subject. If the subject addresses sustainable development in a generic manner (i.e. by presenting/introducing the general framework of sustainable development, etc.), then the Sustainable Development generic label may be applied. If none of the labels describe the subject, select the last option: *"No label applies."*

								No label applies
○	○	○	○	○	○	○	○	○

Date of entry:
15.04.2026

Signature of course coordinator

Prof. PhD. Septimiu Crivei

Signature of seminar coordinator

Prof. PhD. Septimiu Crivei

Date of approval in the department:
23.04.2026

Signature of the head of department

Prof. PhD. Andrei Mărcuș