SYLLABUS

Algebra 2 (Basic algebraic structures)

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	Mathematics
1.5. Study cycle	Bachelor
1.6. Study programme/Qualification	Mathematics Computer Science
1.7. Form of education	Full-time education

2. Information regarding the discipline

2.1. Name of the discipline	**Algebra 2 (Basic Algebraic Structures)**					Discipline code	**MLE0021**
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	2	2.6. Type of evaluation	E	2.7. Discipline regime	DF

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)					20
Preparation for seminars/labs, homework, papers, portfolios and essays					28
Tutorship					14
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	C1.1 Identifying 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.

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 some basic notion and results regarding algebraic structures.
7.2 Specific objective of the discipline	To introduce some basics of group theory and ring theory.

8. Content

8.1 Course	**Teaching methods**	**Remarks**
1. Groups	Interactive exposure Explanation	

	Conversation Didactical demonstration	
2. Subgroups. Generated subgroup. Subgroup lattice	Interactive exposure Explanation Conversation Didactical demonstration	
3. Group homomorphisms	Interactive exposure Explanation Conversation Didactical demonstration	
4. Cyclic groups. Order of an element	Interactive exposure Explanation Conversation Didactical demonstration	
5. Equivalence relations induced by a subgroup	Interactive exposure Explanation Conversation Didactical demonstration	
6. Normal subgroups. Factor group	Interactive exposure Explanation Conversation Didactical demonstration	
7. Isomorphism theorems for groups	Interactive exposure Explanation Conversation Didactical demonstration	
8. Permutation groups. Special groups	Interactive exposure Explanation Conversation Didactical demonstration	
9. Rings and fields	Interactive exposure Explanation Conversation Didactical demonstration	
10. Subrings and subfields	Interactive exposure Explanation Conversation Didactical demonstration	
11. Ring homomorphisms	Interactive exposure Explanation Conversation Didactical demonstration	
12. Ideals. Factor ring	Interactive exposure Explanation Conversation Didactical demonstration	
13. Special rings	Interactive exposure Explanation Conversation Didactical demonstration	
14. Rings of polynomials	Interactive exposure Explanation Conversation Didactical demonstration	
Bibliography		

1. I.D. ION, N. RADU, Algebra (ed.4), Editura Didactica si Pedagogica, 1990.
2. S. CRIVEI, Basic Abstract Algebra, Ed. Casa Cartii de Stiinta, Cluj-Napoca, 2002, 2003.
3. W.J. GILBERT, W.K. NICHOLSON, Modern Algebra with Applications, John Wiley, 2004.
4. I. PURDEA, I. POP, Algebra, Editura GIL, Zalau, 2003.
5. J. ROTMAN, Advanced Modern Algebra, Prentice Hall, New Jersey, 2002.

8.2 Seminar / laboratory	**Teaching methods**	**Remarks**
1. Groups	Interactive exposure Explanation Conversation Didactical demonstration	
2. Subgroups. Generated subgroup. Subgroup lattice	Interactive exposure Explanation Conversation Didactical demonstration	
3. Group homomorphisms	Interactive exposure Explanation Conversation Didactical demonstration	
4. Cyclic groups. Order of an element	Interactive exposure Explanation Conversation Didactical demonstration	
5. Equivalence relations induced by a subgroup	Interactive exposure Explanation Conversation Didactical demonstration	
6. Normal subgroups. Factor group	Interactive exposure Explanation Conversation Didactical demonstration	
7. Isomorphism theorems for groups	Interactive exposure Explanation Conversation Didactical demonstration	
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11. Ring homomorphisms	Interactive exposure Explanation Conversation Didactical demonstration	
12. Ideals. Factor ring	Interactive exposure Explanation Conversation Didactical demonstration	

13. Special rings	Interactive exposure Explanation Conversation Didactical demonstration	
14. Rings of polynomials	Interactive exposure Explanation Conversation Didactical demonstration	
Bibliography 1. G. CALUGAREANU, P. HAMBURG, Exercises in basic ring theory, Kluwer, Dordrecht, 1998. 2. I.D. ION, C. NITA, D. POPESCU, N. RADU, Probleme de algebra, Editura Didactica si Pedagogica, Bucuresti, 1981. 3. 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 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							
								

[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.*”.

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