SYLLABUS

Topics in Algebra III (for teachers in Mathematics)

University year 2025-2026

1. Information regarding the programme

1.1 Higher education institution	Universitatea Babeș-Bolyai Cluj-Napoca
1.2 Faculty	Matematică și Informatică
1.3 Department	Matematică
1.4 Field of study	Matematică
1.5 Study cycle	Master
1.6 Study programme / Qualification	Metode moderne in predarea matematicii / Modern Methods in
	Mathematics Teaching
1.7. Form of education	Cu frecvență

2. Information regarding the discipline

2.1. Name of the dis	scipli	ne Topics in A	Topics in Algebra III (for teachers in Mathematics)					Discipline code	MMR3048
2.2. Course coordinator				Pr	of. Sim	ion Br	eaz		
2.3. Seminar coordinator				Pr	of. Sim	ion Br	eaz		
2.4. Year of study	of study 2 2.5. Semester 4 2.6. Type of evaluati			on	Е	2.7. I	Discipline regime	optional	

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

3.1 Hours per week	3	Of which: 3.2 course	2	3.3 seminar/laboratory	1
3.4 Total hours in the curriculum	36	Of which: 3.5 course	24	3.6 seminar/laboratory	12
Time allotment for individual study (ID) and self-study activities (SA)					
Learning using manual, course support, bib	liogra	aphy, course notes			42
Additional documentation (in libraries, on e	electr	onic platforms, field docu	nentati	ion)	50
Preparation for seminars/labs, homework, papers, portfolios and essays					
Tutorship					
Evaluations					
Other activities					-
3.7 Total individual study hours		189			
3.8 Total hours per semester 225					

4. Prerequisites (if necessary)

3.9 Number of ECTS credits

4.1. curriculum					
4.2. competencies					

9

5. Conditions (if necessary)

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

6.1. Specific competencies acquired ¹

<u>- speeme et</u>	sinpetencies acquireu	
tial	• Using notions and results connected to generalizations for the ring ring Z;	
essen	Solving exercises and problems;	
Professional/(competen	• To addapt the mathematics contents to various levels of dificulty;	
	To use various mathematics objects in theoretical and practical contexts.	
rsal	Acquiring skills connected to the individual study	
Transve compete	• To apply theoretical results in other domains.	

1

6.2. Learning outcomes

Knowledge	The graduate knows fundamental notions related to Arithmetic, and methods of applying them in various contexts.
Skills	The graduate is able to use appropriate teaching materials in the field of Mathematics. The graduate has the ability to treat differently, depending on their specific needs, secondary school students in the field of Mathematics.
Responsibility and autonomy:	The graduate is able to use the acquired knowledge and skills to design, organize and implement educational approaches in the field of Mathematics. The graduate will construct clear and well-supported mathematical arguments to explain mathematical problems, topics, and ideas in writing.

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

7.1 General objective of the discipline	Knowledge, understanding and use of main concepts and results in Number Theory
	Ability to use concepts and fundamental results in some specific fields of mathematics.
7.2 Specific objective of the	Understanding the basic concepts about divisibility in integral domains.
discipline	Ability to use specific results in concrete situations, e.g. to solve exercises.
-	

8. Content

8.1 Course	Teaching methods	Remarks
1. Preliminaries	Lectures, didactical	
	demonstration, conversation.	

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.

2. Division with remainder.	Lectures, didactical
	demonstration, conversation.
3. Elementary divisibility	Lectures, didactical
	demonstration, conversation.
4. Greatest common divisor	Lectures, didactical
	demonstration, conversation.
5. The Euclidian Algorithm	Lectures, didactical
	demonstration, conversation.
6. Prime numbers. The Sieve of Eratostene.	Lectures, didactical
	demonstration, conversation.
7. The fundamental theorem of arithmetic.	
8. Congruences	Lectures, didactical
	demonstration, conversation.
9. Linear Diophantine Equations. The Chinese Remainder	Lectures, didactical
Theorem	demonstration, conversation.
10. Residues systems and Euler's totient	Lectures, didactical
	demonstration, conversation.
11. Theorems of Fermat, Euler, Wilson	Lectures, didactical
	demonstration, conversation.
12. Multiplicative number theoretic functions	Lectures, didactical
	demonstration, conversation.
13. Mobius Function	Lectures, didactical
	demonstration, conversation.
14. Perfect, Mersenne and Fermat numbers	Lectures, didactical
	demonstration, conversation.

Bibliography

[1] Becheanu, M. si colectiv, Algebra pentru perfectionarea profesorilor, Ed. Didactica si Pedagogica, Bucuresti, 1983.

[2] S. Breaz, C. Pelea: Exercises in Number Theory, LAP LAMBERT Academic Publishing, 2018

[3] S. Breaz, C. Pelea: Elemente de teoria numerelor si combinatorica, Casa Cartii de stiinta, 2017.

[4] Burton D. Elementary number theory, 6ed., MGH, 2007

[5] Vraciu, C., Vraciu, M., Elemente de aritmetică, Ed. All, 1998

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Induction	problematization, exercises,	
	problem solving,	
2. Division with remainder.	problematization, exercises,	
	problem solving,	
3. Elementary divisibility	problematization, exercises,	
	problem solving,	
4. Greatest common divisor	problematization, exercises,	
	problem solving,	
5. The Euclidian Algorithm	problematization, exercises,	

	problem solving,
6. Prime numbers.	problematization, exercises, problem solving,
7. The fundamental theorem of arithmetic. Applications	problematization, exercises, problem solving,
8. Perfect squares	problematization, exercises, problem solving,
9. Methods to solve diphantine equations (1)	problematization, exercises, problem solving,
10. Methods to solve diphantine equations (2)	problematization, exercises, problem solving,
11. Multiplicative number theoretic functions	
12. Problems for math contests (1)	problematization, exercises, problem solving,
13. Problems for math contests (2)	problematization, exercises, problem solving,
14. Problems for math contests (3)	

Bibliography

[1] T. Andreescu, D. Andrica: Number Theory. Structure, examples and problems, Birkhauser, 2009.

[2] S. Breaz, C. Pelea: Exercises in Number Theory, LAP LAMBERT Academic Publishing, 2018.

[3] S. Breaz, C. Pelea: Elemente de teoria numerelor si combinatorica, Casa Cartii de stiinta, 2017.

[4] Panaitopol, L., Serbanescu, D.: Probleme de teoria numerelor si combinatorica pentru juniori, Ed. Gill

[5] ***, Probleme date la diverse concursuri.

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 content is in accordance with the curricula of many important universities where pure mathematics plays important places in their research.

This discipline is useful since it realizes connections between various mathematical domains, and it is well known that the methods of arithmetic were used during the time to solve theoretica an practical problems (e.g. in cryptography).

The methods and tools presented here are often used in specifical PhD research activities.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade			
			(70)			
10.4 Course	Concepts and basic results	Final exam	50%			
	Standard examples					
10.5 Seminar/lab activities	Ability to use the concepts in order to solve problems	Final exam and a midterm test.	25%+25%			
10.6 Minimum performance standards						
At least grade 5 from 10.						

11. Labels ODD (Sustainable Development Goals)²

General label for Sustainable Development						
						9 INDUSTRY, INDUATION ANDIARASTRUCTURE

Date:	Signature of course coordinator	Signature of seminar coordinator	
11.04.2025			
Date of approval:	5	Signature of the head of department	
25.04.2025		Prof. dr. Andrei Mărcuș	
Date	Signature of course coordinator	r Signature of seminar coordinator	
23.04.2023	Prof. Simion Breaz	Prof. Simion Breaz	
Date of approval	Signa	ature of the head of department	
	Prof. Andrei Marcus		

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.*".