SYLLABUS

Topics in Algebra III (for teachers in Mathematics)

University year 2025-2026

1. Information regarding the programme

1.1 Higher education institution	Universitatea Babeş-Bolyai Cluj-Napoca
1.2 Faculty	Matematică şi 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 frecvenţă

2. Information regarding the discipline

2.1. Name of the discipline	Topics in Algebra III (for teachers in Mathematics)			Discipline code	**MMR3048**
2.2. Course coordinator			Prof. Simion Breaz		
2.3. Seminar coordinator			Prof. Simion Breaz		
2.4. Year of study	2	2.5. Semester	4	2.6. Type of evaluation	E	2.7. 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)					**hours**
Learning using manual, course support, bibliography, course notes					42
Additional documentation (in libraries, on electronic platforms, field documentation)					50
Preparation for seminars/labs, homework, papers, portfolios and essays					50
Tutorship					25
Evaluations					22
Other activities					-

3.7 Total individual study hours	189
3.8 Total hours per semester	225
3.9 Number of ECTS credits	9

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]

Professional/essential competencies	• Using notions and results connected to generalizations for the ring ring Z; • Solving exercises and problems; • To addapt the mathematics contents to various levels of dificulty;
Transversal competencies	• To use various mathematics objects in theoretical and practical contexts. • Acquiring skills connected to the individual study • To apply theoretical results in other domains.

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 discipline	Understanding the basic concepts about divisibility in integral domains. 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.	

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[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 Theorem	Lectures, didactical 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 specific PhD research activities.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
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							

Date:

11.04.2025

Signature of course coordinator

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Signature of seminar coordinator

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Date of approval:

25.04.2025

Signature of the head of department

Prof. dr. Andrei Mărcuş