SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babeş-Bolyai University**
1.2 Faculty	**Faculty of Mathematics and Computer Science**
1.3 Department	**Department of Mathematics**
1.4 Field of study	**Mathematics**
1.5 Study cycle	**Master**
1.6 Study programme / Qualification	**Advanced Mathematics**

2. Information regarding the discipline

2.1 Name of the discipline	**Rings and modules**					
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 Type of discipline	**DS**

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	42	Of which: 3.5 course	28	3.6 seminar/laboratory	14

Time allotment:	hours
Learning using manual, course support, bibliography, course notes	28
Additional documentation (in libraries, on electronic platforms, field documentation)	28
Preparation for seminars/labs, homework, papers, portfolios and essays	49
Tutorship	14
Evaluations	14
Other activities:	

3.7 Total individual study hours	133	
3.8 Total hours per semester	175	
3.9 Number of ECTS credits	7	

4. Prerequisites (if necessary)

4.1. curriculum	☐ Algebraic structures, Linear algebra
4.2. competencies	☐

5. Conditions (if necessary)

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

activities	

6. Specific competencies acquired

Professional competencies	☐ Ability to do symbolic calculations in algebraic structures. ☐ Ability to operate with abstract concepts. ☐ Ability to solve mathematical problems on the topic.
Transversal competencies	☐ Development of abstract thinking. ☐ Capacity of problem solving. ☐ Ability to perform research.

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

7.1 General objective of the discipline	☐ To acquire the basic knowledge on rings and modules.
7.2 Specific objective of the discipline	☐ To acquire specific working techniques.

8. Content

8.1 Course	Teaching methods	Remarks
1. Rings – definitions and examples	Exposition, proof, examples	
2. Modules – definitions and examples	Exposition, proof, examples	
3. Homomorphisms of rings and modules	Exposition, proof, examples	
4. Direct products and direct sums	Exposition, proof, examples	
5. Decomposition of rings	Exposition, proof, examples	
6. Semisimple rings and modules	Exposition, proof, examples	
7. Finiteness conditions for rings and modules	Exposition, proof, examples	
8. Free modules	Exposition, proof, examples	
9. Projective modules	Exposition, proof, examples	
10. Injective modules	Exposition, proof, examples	
11. Tensor products of modules	Exposition, proof, examples	
12. Flat modules and purity	Exposition, proof, examples	
13. Finitely generated modules over PIDs	Exposition, proof, examples	
14. Algebras	Exposition, proof, examples	

Bibliography
1. F.W. Anderson, K.R. Fuller, *Rings and categories of modules*, Springer, 1992.
2. T.Y. Lam, *A first course in noncommutative rings*, Springer, 2001.
3. T.Y. Lam, *Lectures on modules and rings*, Springer, 2009.
4. C. Nastasescu, *Inele, module, categorii* (in Romanian), Editura Academiei, Bucuresti, 1976.
5. I. Purdea, *Tratat de algebra moderna*, vol. II (in Romanian), Editura Academiei, Bucuresti, 1982.
6. R. Wisbauer, *Foundations of module and ring theory*, Gordon and Breach, 1991.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Rings and modules – definitions and examples	Explanation, problematization, examples	2 hours classes
2. Direct products and direct sums	Explanation, problematization, examples	
3. Semisimple rings and modules	Explanation, problematization, examples	
4. Finiteness conditions for rings and modules	Explanation, problematization, examples	
5. Free and projective modules	Explanation, problematization, examples	
6. Injective modules	Explanation, problematization, examples	
7. Tensor product of modules	Explanation, problematization, examples	

Bibliography

1. F.W. Anderson, K.R. Fuller, *Rings and categories of modules*, Springer, 1992.
2. T.Y. Lam, *A first course in noncommutative rings*, Springer, 2001.
3. T.Y. Lam, *Exercises in classical ring theory*, Springer, 2003.
4. T.Y. Lam, *Lectures on modules and rings*, Springer, 2009.
5. C. Nastasescu, *Inele, module, categorii* (in Romanian), Editura Academiei, Bucuresti, 1976.
6. R. Wisbauer, *Foundations of module and ring theory*, Gordon and Breach, 1991.

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 contents is directed towards theory and applications of categories. The topic is present in many master programs from other universities.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	Use of basic concepts, examples	Project, presentation.	50
10.5 Seminar/lab activities	Problem solving	Assignments, presentation.	50
10.6 Minimum performance standards			
☐ Grade 5			

Date   Signature of course coordinator   Signature of seminar coordinator

22.04.2022   Prof.PhD. Septimiu CRIVEI   Prof.PhD. Septimiu CRIVEI

Date of approval   Signature of the head of department

Prof.PhD. Octavian AGRATINI