SYLLABUS

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	Advanced Mathematics	

2. Information regarding the discipline

2.1 Name of the discipline	**Modules and Abelian Categories**						
2.2 Course coordinator	**Assoc. Prof. Simion Breaz**						
2.3 Seminar coordinator	**Assoc. Prof. Simion Breaz**						
2.4. Year of study	**2**	2.5 Semester	**3**	2.6. Type of evaluation	**E**	2.7 Type of discipline	**DC**

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					42
Additional documentation (in libraries, on electronic platforms, field documentation)					32
Preparation for seminars/labs, homework, papers, portfolios and essays					32
Tutorship					34
Evaluations					18
Other activities:					

3.7 Total individual study hours	133
3.8 Total hours per semester	200
3.9 Number of ECTS credits	8

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. Specific competencies acquired

Professional competencies	Knowledge, understanding and use of main concepts and results in from module theory (injectivity, projectivity, finiteness conditions) Ability to extend fundamental theoretical concepts from Module Theory to Category Theory in order to apply these in other particular cases.
Transversal competencies	Ability to inform themselves, to work independently or in a team; Ability to approach complex problems and to use information from various specific fields; Ability to identify and use advanced techniques and methods in order to realize a specific research.

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 about modules and abelian categories Ability to use concepts and fundamental results in some specific fields (abelian groups, modules over commutative rings, Grothendieck categories)
7.2 Specific objective of the discipline	Understanding the basic concepts about modules and abelian categories. Ability to use specific results and tools in order to study various categories.

8. Content

8.1 Course	Teaching methods	Remarks
1. Basic notions	Lectures, didactical demonstration, conversation.	
2. Direct sums and direct products	Lectures, didactical demonstration, conversation.	
3. Functors	Lectures, didactical demonstration, conversation.	
4. Injective modules	Lectures, didactical demonstration, conversation.	
5. Projective modules	Lectures, didactical demonstration, conversation.	
6. Semi-simple modules	Lectures, didactical demonstration, conversation.	

7. Finiteness conditions	Lectures, didactical demonstration, conversation.	
8. Co-finiteness conditions	Lectures, didactical demonstration, conversation.	
9. Purity	Lectures, didactical demonstration, conversation.	
10. Pure-injective/projective modules	Lectures, didactical demonstration, conversation.	
11. Hereditary rings and generalizations	Lectures, didactical demonstration, conversation.	
12. Modules over PID	Lectures, didactical demonstration, conversation.	
13. Natural transformations	Lectures, didactical demonstration, conversation.	
14. Equivalences and dualities	Lectures, didactical demonstration, conversation.	

Bibliography

1.Anderson, F.W., Fuller, K.R.: Rings and Categories of Modules, Graduate Texts in Math. Vol. 13, Springer-Verlag, 1992.

2.Lam, T.Y.: Lectures On Modules and Rings, Graduate Texts in Math. Vol. 189, Springer-Verlag, 1999.

3.Lam, T.Y.: A First Course in Noncommutative rings, Graduate Texts in Math. Vol. 131, Springer-Verlag, 1991.

4.Stenstrom, B.: Ring of Quotients, Graduate Texts in Math., Springer-Verlag, 1975.

5.Wickless, W.: A First Course in Graduate Algebra, Taylor and Francis, 2004.

8.2 Seminar / laboratory	Teaching methods	Remarks
1. Basic notions	problematization, exercises, problem solving,	
2. Direct sums and direct products	problematization, exercises, problem solving,	

3. Functors	problematization, exercises, problem solving,	
4. Injective modules	problematization, exercises, problem solving,	
5. Projective modules	problematization, exercises, problem solving,	
6. Semi-simple modules	problematization, exercises, problem solving,	
7. Finiteness conditions	problematization, exercises, problem solving,	
8. Co-finiteness conditions	problematization, exercises, problem solving,	
9. Purity	problematization, exercises, problem solving,	
10. Pure-injective/projective modules	problematization, exercises, problem solving,	
11. Hereditary rings and generalizations	problematization, exercises, problem solving,	
12. Modules over PID	problematization, exercises, problem solving,	
13. Natural transformations	problematization, exercises, problem solving,	
14. Equivalences and dualities	problematization, exercises, problem solving,	

Bibliography

1. S. Breaz, G. Calugareanu, G. Modoi, D. Valcan: Exercices in Abelian Group Theory, Kluwer 2003.

2. Lam, T.Y.: Exercices in Classical Ring Theory, Problem Books in Mathematics, Springer-Verlag, 1995.

3. Lam, T.Y.: Exercices in Modules and Rings, Problem Books in Mathematics, Springer-Verlag, 2007.

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 homological algebra were used during the time to solve important problems in mathematics.

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 (%)
10.4 Course	Concepts and basic results	Final exam	50%
	Standard example		
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.			

Date	Signature of course coordinator	Signature of seminar coordinator
30.04.2015	Assoc. Prof. Simion Breaz	Assoc. Prof. Simion Breaz

Date of approval ..... Signature of the head of department

Prof. Octavian Agratini