Universitat Autònoma de Barcelona

2022/2023

Commutative algebra

Code: 100112
ECTS Credits: 6

Degree	Type	Year	Semester
2500149 Mathematics	OT	4	2

Contact

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Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Prerequisites

The knowlege of all the compulsory courses in algebra, specially the course *Estructures Algebraiques*.

Objectives and Contextualisation

The aim of this course is to give an introduction a to the commutative ring theory.

This means to work with the basic concepts of commutative rings, their ideal structure and the modules over them.

At the end of the course, the student is expected to know the general constructions in rings and modules, chain conditions, and the definitions of the first groups of the K-theory. From here and depending on the topics in which more deepened during the course, the objectives to be achieved may vary.

Competences

- Actively demonstrate high concern for quality when defending or presenting the conclusions of one's work.
- Assimilate the definition of new mathematical objects, relate them with other contents and deduce their properties.
- Demonstrate a high capacity for abstraction.
- Develop critical thinking and reasoning and know how to communicate it effectively, both in one's own languages and in a third language.
- Effectively use bibliographies and electronic resources to obtain information.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
- Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
- Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.

Learning Outcomes

1. Actively demonstrate high concern for quality when defending or presenting the conclusions of one's work.
2. Develop critical thinking and reasoning and know how to communicate it effectively, both in one's own languages and in a third language.
3. Effectively use bibliographies and electronic resources to obtain information.
4. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
5. Students must be capable of collecting and interpreting relevant data (usually within their area of study) in order to make statements that reflect social, scientific or ethical relevant issues.
6. Students must be capable of communicating information, ideas, problems and solutions to both specialised and non-specialised audiences.
7. Students must develop the necessary learning skills to undertake further training with a high degree of autonomy.
8. Understand in-depth demonstrations of some theorems of advanced algebra and assimilate the definition of new algebraic structures and constructions, relating them with other knowledge and deducing their properties.
9. Use algebraic tools in different fields.

Content

This course will follow essentialy the book "M.F. Atiyah i I.G. Macdonald, Introducción al Álgebra Conmutativa". The books "Algebraic K-Theory and its applications" by J. Rosenberg, and "An algebraic introduction to K-Theory" by B. Magurn will also be used.

The contents will be:

1. Commutative rings.

2. Module theory.

3. Chain conditions.

4. Grothendieck's K_0

5. Whitehead's K_1

The realization of parts 4 and 5 will depend on the development of the course.

Methodology

This course has two hours of theory per week. The recommended bibliography is interesting; sometimes during the course the students should complement and complete the content of the lectures using this bibliography.

There are problem classes (one hour per week). Every student should present the solutions of some lists of problems on the blackboard or in paper to the lecturer. To solve questions about the course the student can approach the lecturer during the class or in the office (during office hours). The solution of these problems will be based in general on the theory: the theorems and their proofs.

Seminars will be dedicated to develop collaborative problem-solving techniques.

The course has a web "campus virtual" where the lecturer will post the problems list and other relevant information about the course.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theory classes	30	1.2	
Type: Supervised			
Problem classes	15	0.6	
Seminars	6	0.24	
Type: Autonomous			
Solving problems	60	2.4	
Study of the theory	36	1.44	

Assessment

The evaluation of the course will be a 50% of continued evaluation, and a 50% of exams.

- The continued evaluation will consist of the presentation of solutions of problems (solved individually), the attendance to the seminars and the presentation of solutions of the exercises proposed in the seminars (solved in group).
- The mark of the exams will be obtained from a final exam.

The "matrícules d'honor" will be decided taken into account the results of the continued evaluation and the exams.

The "non-evaluable" qualification will be awarded to students who do not turnout at the final exam.

In case of doubt about the interpretation of the evaluation method, the Catalan written version remains as the reference.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final exam	50%	3	0.12	8, 2, 7, 6, 4, 5
Seminar attendance	10%	0	0	1, 2, 6, 4, 5, 3, 9
Solved problems	40%	0	0	1, 2, 6, 4, 3, 9

Bibliography

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P. M. Cohn, Algebra, vol 2. Second Ed. John Wiley and Sons, New York, 1989.

D. Eisenbud, Commutative Algebra with a view toward Algebraic Geometry. Springer, New York, 2004.

B. Hartley, T. O . Hawkes, Rings, modules and linear algebra. Chapman and Hall, London 1983.

N. Jacobson, Basic Algebra I, Basic Algebra II. W. H. Freeman and Company, New York, 1989.

E. Kunz, Introduction to Commutative Algebra and Algebraic Geometry. Birkhäuser, New York, 2013.

S. Lang, Algebra. Aguilar, Madrid, 1977.

B. A. Magurn, An algebraic introduction to K-Theory, Encyclopedia of Mathematics and its applications, 87, Cambridge, 2002.

J.S. Milne, A Primer of Commutative Algebra, 2009.

J. Rosenberg, Algebraic K-Theory and its applications, Graduate Texts in Mathematics, 147, Springer-Verlag, 1994.

O. Zariski, P. Samuel, Commutative Algebra I, II, Van Nostrand, Princeton (1958, 1960).

Software

No software will be used in this course.