Course guide
34950 - CALG - Commutative Algebra

Last modified: 01/06/2023

Unit in charge: School of Mathematics and Statistics
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: MASTER'S DEGREE IN ADVANCED MATHEMATICS AND MATHEMATICAL ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2023 **ECTS Credits:** 7.5 **Languages:** English

LECTURER

Coordinating lecturer: JOSEP ALVAREZ MONTANER

Others: Primer quadrimestre:
JOSEP ALVAREZ MONTANER - A

PRIOR SKILLS

Linear algebra, algebraic structures, topology.

REQUIREMENTS

The two first years of a degree in mathematics.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. RESEARCH. Read and understand advanced mathematical papers. Use mathematical research techniques to produce and transmit new results.
2. CALCULUS. Obtain (exact or approximate) solutions for these models with the available resources, including computational means.
3. CRITICAL ASSESSMENT. Discuss the validity, scope and relevance of these solutions; present results and defend conclusions.

Transversal:
4. SELF-DIRECTED LEARNING. Detecting gaps in one's knowledge and overcoming them through critical self-appraisal. Choosing the best path for broadening one's knowledge.
5. EFFICIENT ORAL AND WRITTEN COMMUNICATION. Communicating verbally and in writing about learning outcomes, thought-building and decision-making. Taking part in debates about issues related to the own field of specialization.
6. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
7. TEAMWORK. Being able to work as a team player, either as a member or as a leader. Contributing to projects pragmatically and responsibly, by reaching commitments in accordance to the resources that are available.
8. EFFECTIVE USE OF INFORMATION RESOURCES. Managing the acquisition, structure, analysis and display of information from the own field of specialization. Taking a critical stance with regard to the results obtained.

TEACHING METHODOLOGY

Teaching Classes, resolution of problems

LEARNING OBJECTIVES OF THE SUBJECT

Basic course in Commutative Algebra.
An introduction to the theory of rings, ideals and modules.
Some basics on local algebra.

STUDY LOAD

Type	Hours	Percentage
Hours large group	60,0	32.00
Self study	127,5	68.00

Total learning time: 187.5 h

CONTENTS

Rings and ideals

Description:
Basics on ring theory and ideals.
Rings of fractions. Primary decomposition. Chain conditions. Noetherian and Artinian rings.

Full-or-part-time: 28h 20m
Theory classes: 15h
Self study : 13h 20m

Modules

Description:
General properties of modules.
Modules of fractions. Chain conditions. Homomorphisms and tensor product.

Full-or-part-time: 24h
Theory classes: 12h
Self study : 12h

Algebraic varieties

Description:
The spectrum of a ring. Zariski topology.

Full-or-part-time: 24h
Theory classes: 12h
Self study : 12h

Introduction to homological algebra

Description:
Categories and functors. Complexes of modules. Derived functors.

Full-or-part-time: 24h
Theory classes: 12h
Self study : 12h

Local algebra

Description:
Regular sequences. Depth.
Homological characterizations.
Regular rings, Gorenstein rings, Cohen-Macaulay rings

Full-or-part-time: 18h 40m
Theory classes: 9h
Self study : 9h 40m

GRADING SYSTEM

The qualification will be based on:
60% Resolution of assigned exercises and/or projects
40% Final Exam

BIBLIOGRAPHY

Basic:
- Rotman, J.J. An Introduction to homological algebra [on line]. Academic Press, 1979 [Consultation: 10/07/2023]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/b98977. ISBN 0125992505.
- Bruns, Winfried; Herzog, Jürguen. Cohen-Macaulay rings. Cambridge University Press, 1993. ISBN 0521410681.
- Atiyah, Michael Francis; MacDonald, I. G. Introduction to commutative algebra. Reading: Addison-Wesley, 1969. ISBN 0201407515.
- Reid, Miles. Undergraduate commutative algebra. Cambridge: Cambridge University Press, 1995. ISBN 0521452554.
- Eisenbud, David. Commutative algebra : with a view toward algebraic geometry. Corrected 2nd. printing. New York: Springer-Verlag, 1996. ISBN 0387942696.
- Kunz, Ernst. Introduction to commutative algebra and algebraic geometry [on line]. Birkhäuser, 2013 [Consultation: 10/07/2023]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-1-4614-5987-3. ISBN 9781461459866.
- Matsumura, Hideyuki. Commutative ring theory. Cambridge: Cambridge University Press, ISBN 0521259169.