

## Course guide

### 34950 - CALG - Commutative Algebra

Last modified: 26/05/2026

**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:** 2026    **ECTS Credits:** 7.5    **Languages:** English

#### LECTURER

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**Coordinating lecturer:** FRANCESC D'ASSIS PLANAS VILANOVA

**Others:** Primer quadrimestre:  
FRANCESC D'ASSIS PLANAS VILANOVA - A

#### PRIOR SKILLS

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Linear algebra, algebraic structures, topology.

#### REQUIREMENTS

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The two first years of a degree in mathematics.

#### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**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

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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:** 46h 45m

Theory classes: 15h

Self study : 31h 45m

### Modules

**Description:**

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

**Full-or-part-time:** 37h 24m

Theory classes: 12h

Self study : 25h 24m

### Algebraic varieties

**Description:**

The spectrum of a ring. Zariski topology.

**Full-or-part-time:** 37h 24m

Theory classes: 12h

Self study : 25h 24m

### Introduction to homological algebra

**Description:**

Categories and functors. Complexes of modules. Derived functors.

**Full-or-part-time:** 37h 24m

Theory classes: 12h

Self study : 25h 24m



## Local algebra

### Description:

Regular sequences. Depth.

Homological characterizations.

Regular rings, Gorenstein rings, Cohen-Macaulay rings

**Full-or-part-time:** 28h 03m

Theory classes: 9h

Self study : 19h 03m

## GRADING SYSTEM

The qualification will be based on:

60% Work in class/at home

40% Final Examination

## BIBLIOGRAPHY

### Basic:

- 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.
- 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, Jürgen. Cohen-Macaulay rings. Cambridge University Press, 1993. ISBN 0521410681.