34950 - CALG - Commutative Algebra

**Coordinating unit:** 200 - FME - School of Mathematics and Statistics  
**Teaching unit:** 749 - MAT - Department of Mathematics  
**Academic year:** 2019  
**Degree:** MASTER'S DEGREE IN ADVANCED MATHEMATICS AND MATHEMATICAL ENGINEERING (Syllabus 2010). (Teaching unit Optional)  
**ECTS credits:** 7,5  
**Teaching languages:** English

### Teaching staff

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

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group:</th>
<th>Hours self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total learning time: 187h 30m</td>
<td>60h</td>
<td>68h 30m</td>
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<tr>
<td>Self study:</td>
<td>127h 30m</td>
<td>68.00%</td>
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</tbody>
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## Content

### Rings and ideals

**Description:**
Basics on ring theory and ideals.

<table>
<thead>
<tr>
<th>Learning time: 28h 20m</th>
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<tr>
<td>Theory classes: 15h</td>
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<tr>
<td>Self study : 13h 20m</td>
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### Modules

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

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<tr>
<th>Learning time: 24h</th>
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<tbody>
<tr>
<td>Theory classes: 12h</td>
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<td>Self study : 12h</td>
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### Algebraic varieties

**Description:**
The spectrum of a ring. Zariski topology.

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<th>Learning time: 24h</th>
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<tr>
<td>Theory classes: 12h</td>
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<td>Self study : 12h</td>
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### Introduction to homological algebra

**Description:**

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<th>Learning time: 24h</th>
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<tr>
<td>Theory classes: 12h</td>
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<tr>
<td>Self study : 12h</td>
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### Local algebra

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

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<th>Learning time: 18h 40m</th>
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<tr>
<td>Theory classes: 9h</td>
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<tr>
<td>Self study : 9h 40m</td>
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The qualification will be based on:
Active participation of the student during the course,
Resolution of assigned exercises
Exposition of a directed work in which the student develops some material related to the course.

If necessary, a final exam

Bibliography

Basic: