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.

**Study load**

<table>
<thead>
<tr>
<th>Total learning time: 187h 30m</th>
<th>Hours large group:</th>
<th>60h</th>
<th>32.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Self study:</td>
<td>127h 30m</td>
<td>68.00%</td>
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</table>
## Content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Learning time:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modules</strong></td>
<td>24h</td>
<td>General properties of modules. Modules of fractions. Chain conditions. Homomorphisms and tensor product.</td>
</tr>
<tr>
<td><strong>Algebraic varieties</strong></td>
<td>24h</td>
<td>The spectrum of a ring. Zariski topology.</td>
</tr>
<tr>
<td><strong>Introduction to homological algebra</strong></td>
<td>24h</td>
<td>Categories and functors. Complexes of modules. Derived functors.</td>
</tr>
<tr>
<td><strong>Local algebra</strong></td>
<td>18h 40m</td>
<td>Regular sequences. Depth. Homological characterizations. Regular rings, Gorenstein rings, Cohen-Macaulay rings</td>
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</tbody>
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**Description:**

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

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

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

- **Categories and functors:**
  - Complexes of modules.
  - Derived functors.

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