34957 - GT - Graph Theory

Coordinating unit: 200 - FME - School of Mathematics and Statistics
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2018
Degree: MASTER'S DEGREE IN ADVANCED MATHEMATICS AND MATHEMATICAL ENGINEERING (Syllabus 2010). (Teaching unit Optional)
ECTS credits: 7.5

Teaching staff
Coordinator: MARCOS NOY SERRANO
Others: Primer quadrimestre:
       ANNA LLADO SANCHEZ - A
       MARCOS NOY SERRANO - A
       ORIOL SERRA ALBO - A

Prior skills
Elementary Calculus and Linear Algebra; basic notions and abilities in combinatorics and probability.

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
Sessions of presentation of material alternate with sessions with student presentations of problems and specific topics. The active participation of students is a requirement for the evaluation of the course.

Learning objectives of the subject
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Application of spectral techniques to the study of graphs.
Application of the probabilistic method.
Properties of almost all graphs.
Properties of Cayley and vertex symmetric graphs.
Graphs on surfaces.
Minors.

<table>
<thead>
<tr>
<th>Study load</th>
<th>Hours large group:</th>
<th>Self study:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total learning time:</strong> 187h 30m</td>
<td>60h</td>
<td>127h 30m</td>
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<tr>
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<td>32.00%</td>
<td>68.00%</td>
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# 34957 - GT - Graph Theory

## Content

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<thead>
<tr>
<th>Topic</th>
<th>Learning time: 1h</th>
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<tbody>
<tr>
<td>Spectral techniques in Graph Theory</td>
<td>Theory classes: 1h</td>
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### Spectral techniques in Graph Theory

**Description:**
- Adjacency and Laplacian matrix.
- Spectral properties.
- Cospectral graphs.
- Graph invariants and spectral properties: chromatic number, Cheeger constant, expansion properties, maxcut, bisection width. The matrix tree theorem.

**Specific objectives:**
- Computation of spectra.
- Circulant graphs.
- Spectra and graph operations.
- Obtention of spectral bounds for graph invariants.

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<thead>
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<tr>
<td>Symmetries in graphs</td>
<td>Theory classes: 1h</td>
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### Symmetries in graphs

**Description:**

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<th>Topic</th>
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<tbody>
<tr>
<td>Minors and treewidth</td>
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### Minors and treewidth

**Degree competences to which the content contributes:**

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<tr>
<th>Topic</th>
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<tbody>
<tr>
<td>Graphs on surfaces</td>
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### Graphs on surfaces

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<tr>
<td>Graph homomorphisms</td>
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### Graph homomorphisms

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<tbody>
<tr>
<td>Random graphs</td>
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</table>

### Random graphs

**Degree competences to which the content contributes:**
The evaluation of the course is based on the weekly work on problems proposed in the presentation sessions. There will be a final comprehensive exam based on the problem sessions during the course.

**Qualification system**

The active participation in the course is a requirement for the evaluation of the final exam.

**Bibliography**

**Basic:**