200001 - CV - Single Variable Calculus

Coordinating unit: 200 - FME - School of Mathematics and Statistics
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2018
Degree: BACHELOR'S DEGREE IN MATHEMATICS (Syllabus 2009). (Teaching unit Compulsory)
ECTS credits: 7,5  Teaching languages: Catalan

Teaching staff

Coordinator: MARCOS NOY SERRANO

Others: Primer quadrimestre:
     GUILLEM BLANCO FERNÁNDEZ - A, B
     SANTIAGO BOZA ROCHO - A, B
     MARCOS NOY SERRANO - A, B
     ÓSCAR RIVERO SALGADO - A, B

Segon quadrimestre:
     MARCOS NOY SERRANO - REF
     NATALIA SADOVSKAIA NURIMANOVA - REF

Degree competences to which the subject contributes

Specific:
1. CE-2. Solve problems in Mathematics, through basic calculation skills, taking in account tools availability and the constraints of time and resources.
2. CE-3. Have the knowledge of specific programming languages and software.
3. CE-4. Have the ability to use computational tools as an aid to mathematical processes.

General:
4. CB-1. Demonstrate knowledge and understanding in Mathematics that is founded upon and extends that typically associated with Bachelor's level, and that provides a basis for originality in developing and applying ideas, often within a research context.
5. CB-2. Know how to apply their mathematical knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader or multidisciplinary contexts related to Mathematics.
6. CB-3. Have the ability to integrate knowledge and handle complexity, and formulate judgements with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgements.
7. CG-1. Show knowledge and proficiency in the use of mathematical language.
8. CG-2. Construct rigorous proofs of some classical theorems in a variety of fields of Mathematics.
9. CG-3. Have the ability to define new mathematical objects in terms of others already know and ability to use these objects in different contexts.
10. CG-4. Translate into mathematical terms problems stated in non-mathematical language, and take advantage of this translation to solve them.
12. CG-6 Detect deficiencies in their own knowledge and pass them through critical reflection and choice of the best action to extend this knowledge.
The main objective of this course is to make the student familiar with the basic concepts of calculus on one variable. The fundamentals of calculus that are needed in the other subjects of the degree are provided. The students are introduced to deduction techniques in calculus and more generally, to proof methods in an axiomatic system.

Transversal:

11. 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.

Teaching methodology

The teaching of the course will be divided into two separate blocks: theory and problems. In the theory sessions we will develop the theoretical content of the course, based on the different results and demonstrations. In addition, we will include examples to consolidate the concepts introduced. At sessions of problems we will combine theoretical and complicated exercises so that students get a maximum depth level in the field of mathematical analysis of a variable, with more mechanical ones that students must master, such as the calculation of limits and integration. Also, there will be continuous assessment tests at sessions problems of with deliveries, virtual tests and/or direct interaction sessions between the student and the subject in order to motivate him to bring the subject up to date.

One group of problems will be taught in Catalan.

Learning objectives of the subject

The main objective of this course is to make the student familiar to the basic concepts of calculus on one variable. The fundamentals of calculus that are needed in the other subjects of the degree are provided. The students are introduced to deduction techniques in calculus and more generally, to proof methods in an axiomatic system.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 187h 30m</th>
<th>Hours large group: 45h 24.00%</th>
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</thead>
<tbody>
<tr>
<td>Hours medium group: 0h 0.00%</td>
<td>Hours small group: 30h 16.00%</td>
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<tr>
<td>Hours small group: 30h 16.00%</td>
<td>Guided activities: 7h 30m 4.00%</td>
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<tr>
<td>Self study: 105h 56.00%</td>
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</tbody>
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## Content

<table>
<thead>
<tr>
<th>Introduction to Calculus</th>
<th>Learning time: 32h</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 12h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 4h</td>
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<tr>
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<td>Self study: 16h</td>
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</tbody>
</table>

**Description:**
Numbers, functions, derivatives, integrals and applications

<table>
<thead>
<tr>
<th>Sequences and numerical series</th>
<th>Learning time: 39h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 9h</td>
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<tr>
<td></td>
<td>Laboratory classes: 6h</td>
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<tr>
<td></td>
<td>Self study: 24h</td>
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</tbody>
</table>

**Description:**
Basic concepts on functions and sequences
Basic concepts on limits. Monotone convergence theorem
The number $e$
Subsequences, limit superior and limit inferior
Cauchy sequences
Series with positive terms. Convergence criteria

<table>
<thead>
<tr>
<th>Continuous functions and limits</th>
<th>Learning time: 26h</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Theory classes: 6h</td>
</tr>
<tr>
<td></td>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td></td>
<td>Self study: 16h</td>
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</tbody>
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**Description:**
Continuous functions. Limits of real functions
Intermediate value theorem
Extreme value theorem
Uniform continuity
## Qualification system

There will be a midterm exam (P), and a final exam (F)
The final mark (N) should be obtained as follows:
\[
N = \max (F; 0.4 \cdot P; 0.6 \cdot F).
\]

An extra exam will take place on July for students that failed during the regular semester.

## Bibliography

### Main