Course guide
270008 - M2 - Mathematics II

Unit in charge: Barcelona School of Informatics
Teaching unit: 749 - MAT - Department of Mathematics.

Degree: BACHELOR’S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2022  ECTS Credits: 7.5  Languages: Catalan, Spanish, English

LECTURER

Coordinating lecturer: MONICA SANCHEZ SOLER - FERNANDO MARTÍNEZ SÁEZ

Others: Primer quadrimestre:
ANDREU BELLÉS ROCA - 41, 42
ELOY CABEZAS CARDENAS - 41, 42
EIXARC ESCARAMIS BABIANO - 11, 12
MONICA SANCHEZ SOLER - 11, 12

PRIOR SKILLS

Students are expected be competent in mathematics to upper secondary level.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CT1.2A. To interpret, select and value concepts, theories, uses and technological developments related to computer science and its application derived from the needed fundamentals of mathematics, statistics and physics. Capacity to solve the mathematical problems presented in engineering. Talent to apply the knowledge about: algebra, differential and integral calculus and numeric methods; statistics and optimization.
CT1.2C. To use properly theories, procedures and tools in the professional development of the informatics engineering in all its fields (specification, design, implementation, deployment and products evaluation) demonstrating the comprehension of the adopted compromises in the design decisions.

Generical:
G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

TEACHING METHODOLOGY

Theory classes:
- lectures developing the theoretical aspects of the subject.
- lectures and participatory classes aimed at applying theory to problems.

Workshop/laboratory classes:
- participatory workshop sessions in which students solve problems in groups or individually.
- participatory laboratory sessions in which students complete problems individually or in groups using mathematical software.
LEARNING OBJECTIVES OF THE SUBJECT

1. Understand real numbers and their properties. Solve linear equations and inequalities, with quadratic and/or absolute values.
2. Understand the basic concept of sequences, calculate the limits of sequences and identify between convergent, divergent and oscillating sequences.
3. Understand the basic theorems for continuous functions of one variable and know how to apply them to problems such as finding zeros for functions.
4. Understand the basic theorems of differentiable functions of one variable and understand and know how to use Taylor polynomial approximations.
5. Understand the basic concepts of the integration of functions of one variable: geometric interpretation, calculation of areas, approximate calculation of definite integrals, etc.
6. Understand the basic concepts of topologies in $\mathbb{R}^n$.
7. Understand and know how to interpret the concepts of directional derivative, partial derivative and gradient vector.
8. Locate and classify outliers in a function with several variables in a domain.
9. Work with functions of several variables.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours large group</td>
<td>45.0</td>
<td>24.00</td>
</tr>
<tr>
<td>Guided activities</td>
<td>7.5</td>
<td>4.00</td>
</tr>
<tr>
<td>Self study</td>
<td>105.0</td>
<td>56.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>30.0</td>
<td>16.00</td>
</tr>
</tbody>
</table>

Total learning time: 187.5 h

CONTENTS

Real numbers

Description:
Equations and inequalities with real numbers. Absolute value. Intervals.

Numerical sequences

Description:

Theorems for continuous functions of one variable

Description:

Theorems for derivatives of functions of one variable

Description:
### Taylor formula for functions of one variable

**Description:**

### Integration of functions of one variable

**Description:**

### Functions of several variables

**Description:**
Basic definitions of topology. Functions of several variables: domain, graphics, level sets, geometric interpretation. Continuous functions.

### Partial and directional derivatives. Gradient vectors

**Description:**

### Taylor polynomials in several variables.

**Description:**

### Optimization of functions of several variables

**Description:**

### ACTIVITIES

#### Real numbers

**Specific objectives:**
1

**Related competencies:**
G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

**Full-or-part-time:** 10h
- Theory classes: 1h
- Laboratory classes: 2h
- Self study: 7h
### Numerical successions

**Specific objectives:**

2

**Related competencies:**
G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

**Full-or-part-time:** 19h
- Theory classes: 4h
- Laboratory classes: 4h
- Self study: 11h

### Basic theorems of functions of a real variable

**Specific objectives:**

3, 4

**Related competencies:**
G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

**Full-or-part-time:** 32h
- Theory classes: 9h
- Laboratory classes: 6h
- Self study: 17h

### Integration of functions of one variable

**Specific objectives:**

5

**Related competencies:**
G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

**Full-or-part-time:** 21h
- Theory classes: 6h
- Laboratory classes: 4h
- Self study: 11h
Functions of several variables

Specific objectives:
6, 7, 10

Related competencies:
G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

Full-or-part-time: 28h
Theory classes: 9h
Laboratory classes: 4h
Self study: 15h

Optimization variables

Specific objectives:
6, 7, 8, 10

Related competencies:
G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

Full-or-part-time: 31h
Theory classes: 10h
Laboratory classes: 6h
Self study: 15h

Course summary

Specific objectives:
1, 2, 3, 4, 5, 6, 7, 8, 10

Related competencies:
G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

Full-or-part-time: 11h
Theory classes: 6h
Laboratory classes: 2h
Guided activities: 3h
**Mid-semester exam (P)**

**Description:**
Exercise-based open-answer exam on learning objectives 1 to 5, referring to content for topics 1 to 6.

**Specific objectives:**
1, 2, 3, 4, 5

**Related competencies:**
G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

**Full-or-part-time:** 7h 30m  
Guided activities: 1h 30m  
Self study: 6h

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**Workshop Exam**

**Description:**
Exercise-based open-answer exam on all the learning objectives of the course referring to the problem-solving workshop session content.

**Specific objectives:**
1, 2, 3, 4, 5, 6, 7, 8, 10

**Related competencies:**
G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

**Full-or-part-time:** 7h  
Guided activities: 2h  
Self study: 5h

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**Final examination**

**Description:**
Exercise-based open-answer exam on all learning objectives referring to content for topics 1 to 10.

**Specific objectives:**
1, 2, 3, 4, 5, 6, 7, 8, 10

**Related competencies:**
G7. AUTONOMOUS LEARNING: to detect deficiencies in the own knowledge and overcome them through critical reflection and choosing the best actuation to extend this knowledge. Capacity for learning new methods and technologies, and versatility to adapt oneself to new situations.

**Full-or-part-time:** 15h  
Guided activities: 3h  
Self study: 12h
GRADING SYSTEM

Technical and transferable competencies account for 80% and 20% of the subject, respectively. The transferable competency mark will be calculated on the basis of Atenea activities and from the note of the subject.
- Workshop mark (T): it evaluates the student’s performance and achievement of objectives in workshop / laboratory sessions and Atenea.
- Mark of the mid-semester exam (P).
- Mark of the final exam (F).

The final mark is calculated as:

\[ \text{Note} = 0.2 \times T + \max (0.3 \times P + 0.5 \times F, 0.8 \times F) \]

BIBLIOGRAPHY

Basic:

Complementary:

RESOURCES

Hyperlink: