270002 - FM - Fundamentals of Mathematics

Coordinating unit: 270 - FIB - Barcelona School of Informatics
Teaching unit: 749 - MAT - Department of Mathematics
Academic year: 2018
Degree: BACHELOR'S DEGREE IN INFORMATICS ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
ECTS credits: 7,5 Teaching languages: Catalan, Spanish

Teaching staff

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Prior skills

The kind of abilities that a student that has successfully passed his/her secondary studies is supposed to have

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.

General:
G9. PROPER THINKING HABITS: capacity of critical, logical and mathematical reasoning. Capacity to solve problems in her study area. Abstraction capacity: capacity to create and use models that reflect real situations. Capacity to design and perform simple experiments and analyse and interpret its results. Analysis, synthesis and evaluation capacity.

Teaching methodology

In theoretical classes the theoretical content of the course is taught and illustrated with examples. In workshops students, guided by the teacher, will work topics explained in theoretical classes.

Learning objectives of the subject

1. To understand the importance of language in scientific communication and the need to refine it and define it to avoid, as far as possible, the ambiguity.
2. To understand what a mathematical proof is and to know the main types of proofs which the student may meet.
3. Understanding the language of sets as an essential tool in mathematical communication and also as an instrument.
4. Understanding the language of mappings as a way to define and to study correspondences and rules.
5. To understand that we cannot prove that a certain property is valid for infinitely many numbers by testing the property on one number at a time but that we must use some principle that makes possible the proof.
6. To understand the properties of the divisibility of integers, to calculate the greatest common divisor using Euclid's algorithm and to write Bézout's identity of two integers. To calculate small prime numbers and to understand the
difficulty of performing integer factorization.

7. To understand the concept of congruence and to be able of computing with congruences. To apply the language of congruences to solve arithmetic problems.

### Study load

<table>
<thead>
<tr>
<th>Total learning time: 187h 30m</th>
<th>Theory classes:</th>
<th>45h</th>
<th>24.00%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical classes:</td>
<td>0h</td>
<td></td>
<td>0.00%</td>
</tr>
<tr>
<td>Laboratory classes:</td>
<td>30h</td>
<td></td>
<td>16.00%</td>
</tr>
<tr>
<td>Guided activities:</td>
<td>7h 30m</td>
<td></td>
<td>4.00%</td>
</tr>
<tr>
<td>Self study:</td>
<td>105h</td>
<td></td>
<td>56.00%</td>
</tr>
</tbody>
</table>
## Content

### Reasoning

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

**Description:**


### Sets

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

**Description:**

Sets and elements, the membership relation. Elementary operations with sets. Relations. Equivalence relations and quotient set.

### Mappings

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

**Description:**

Functions and mappings.Injective mappings, surjective mappings and bijective mappings. Finite sets, countable and infinite.

### The principle of induction

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

**Description:**

The first principle of induction. The second principle of induction.

### Divisibility of integers

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

**Description:**


### Congruences of integers

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

### Applications of congruences

<table>
<thead>
<tr>
<th>Degree competences to which the content contributes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description:</td>
</tr>
<tr>
<td>Modular exponentiation. Linear equations in congruences. The chinese remainder theorem. The RSA cryptography system.</td>
</tr>
</tbody>
</table>
# Planning of activities

| **Reasoning** | **Hours**: 26h  
Theory classes: 6h  
Practical classes: 0h  
Laboratory classes: 6h  
Guided activities: 0h  
Self study: 14h |
|---|---|
| **Description**:  
Logic formalism |  |
| **Specific objectives**:  
1 |  |

| **Sets** | **Hours**: 34h  
Theory classes: 9h  
Practical classes: 0h  
Laboratory classes: 4h  
Guided activities: 0h  
Self study: 21h |
|---|---|
| **Description**:  
Sets and proofs about sets |  |
| **Specific objectives**:  
2, 3 |  |

| **Partial exam** | **Hours**: 1h 30m  
Guided activities: 1h 30m  
Self study: 0h |
|---|---|
| **Description**:  
Partial exam |  |
| **Specific objectives**:  
1, 2, 3, 4, 5 |  |

| **Mappings** | **Hours**: 24h  
Theory classes: 6h  
Practical classes: 0h  
Laboratory classes: 4h  
Guided activities: 0h  
Self study: 14h |
|---|---|
| **Description**:  
Set mappings |  |
| **Specific objectives**:  
4 |  |
## The Induction Principle

**Description:**
The Induction Principle

**Specific objectives:**
5

**Hours:** 24h
- Theory classes: 6h
- Practical classes: 0h
- Laboratory classes: 4h
- Guided activities: 0h
- Self study: 14h

## Partial exam

**Description:**
Partial exam

**Hours:** 1h 30m
- Guided activities: 1h 30m
- Self study: 0h

## Divisibility

**Description:**
Divisibility of integers

**Specific objectives:**
2, 5, 6

**Hours:** 24h
- Theory classes: 6h
- Practical classes: 0h
- Laboratory classes: 4h
- Guided activities: 0h
- Self study: 14h

## Congruences

**Description:**
Congruences of integers

**Specific objectives:**
2, 6, 7

**Hours:** 24h
- Theory classes: 6h
- Practical classes: 0h
- Laboratory classes: 4h
- Guided activities: 0h
- Self study: 14h
## Applications of congruences

### Hours: 14h
- Theory classes: 3h
- Practical classes: 0h
- Laboratory classes: 4h
- Guided activities: 0h
- Self study: 7h

### Description:
Some applications of congruences

### Specific objectives:
4, 6, 7

## Review

### Hours: 10h
- Theory classes: 3h
- Practical classes: 0h
- Laboratory classes: 0h
- Guided activities: 0h
- Self study: 7h

### Description:
Review of the main contents and problem solution

## Final exam

### Hours: 3h
- Guided activities: 3h
- Self study: 0h

### Description:
Final exam

### Specific objectives:
1, 2, 3, 4, 5, 6, 7
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**Qualification system**

* There are two partial exams, not in classtime, (20% each one). Rating: P1 and P2 (both over 10).

* There is be a final exam, not in classtime, (40%). Rating: F (over 10)

* The achievement of objectives in the workshop sessions will be also considered (20%). Rating: T (over 10)

Moreover, there is the possibility to improve the partial marks during the final exam by answering and additional task. Say that RP1 and RP2 are the marks corresponding to those additional parts. Then the mark for the course is computed as:

$$0.20 * T + 0.20*\max(P1,RP1) + 0.20*\max(P2,RP2) + 0.40*F$$

All the students who want to do the additional task in the final exam to improve the partial marks have to say so in advance.

Due to the particularities of the subject, the grade for the cross competition will be calculated from the course grade as follows:

* between 0 and 4.9 : D
* between 5 to 6.9 : C
* between 7 and 8.4 : B
* between 8.5 and 10 : A

**Bibliography**

**Basic:**


**Complementary:**