Course guide
270002 - FM - Fundamentals of Mathematics

Last modified: 30/01/2024

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: 2023 **ECTS Credits:** 7.5 **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: RAFAEL FARRÉ CIRERA

Others:

Primer quadrimestre:
GEMMA ALSINA RUIZ - 73
ANDREU BELLÉS ROCA - 53, 63
ANNA DE MIER VINUÉ - 13, 42
RAFAEL FARRÉ CIRERA - 33, 71, 72, 73
AMAIA ELISA GIRALT CASTELLANO - 61, 71
GUILLERMO GONZÁLEZ CASADO - 11, 12, 13, 21, 22, 23, 32
MARIA ISABEL GONZALEZ PEREZ - 72
VICTORIA GRAFFIGNA - 12, 22
ERIC LÓPEZ PLATÓN - 52, 62
JOSÉ LUIS RUIZ MUÑOZ - 41, 42, 43
MONICA SANCHEZ SOLER - 31, 41
AITOR SORT NADAL - 11, 21
FRANCESC TIÑENA SALVAÑÀ - 31, 32, 33, 43, 51, 61, 62, 63
LLUIS VENA CROS - 51, 52, 53

Segon quadrimestre:
RAFAEL FARRÉ CIRERA - 11, 21
FERNANDO MARTÍNEZ SÁEZ - 21

PRIOR SKILLS

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

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:
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 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 u nderstand the concept of congruence and to be able of computing with congruences. To apply the language of congruences to solve arithmetic problems.

STUDY LOAD

Type	Hours	Percentage
Hours small group	30,0	16.00
Guided activities	7,5	4.00
Self study	105,0	56.00
Hours large group	45,0	24.00

Total learning time: 187.5 h

CONTENTS

Reasoning

Description:
Sentences, statements and propositions. Formal propositional calculus. Proofs. Predicate logic.

The principle of induction

Description:
Induction. Complete induction.

Sets

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

Functions

Description:
Functions. Injectivity and surjectivity. Inverse function. Image and pre-imaging. Composition.

Divisibility of integers

Description:
The divisibility relation in the set of integers. The division theorem. Primes. Infinitude of primes. Sieve of Eratosthenes. Greatest common divisor and least common multiple. Euclidean algorithm. Bézout's identity. Gauss Lemma.

Congruences of integers

Description:
The relation of congruence. Operations with congruences. Modular inverse: calculation. Congruence classes and the quotient group Zn. Operations with congruence classes.

Applications of congruences

Description:
Modular exponentiation. Linear equations in congruences. The chinese remainder theorem. The RSA cryptography systgem.

ACTIVITIES

Reasoning

Description:
Logic formalism

Specific objectives:
1

Related competencies :
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.

Full-or-part-time: 28h
Theory classes: 6h
Laboratory classes: 6h
Self study: 16h

Sets

Description:
Sets and proofs about sets

Specific objectives:
2, 3

Related competencies :
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.

Full-or-part-time: 32h
Theory classes: 7h
Laboratory classes: 4h
Self study: 21h

Mappings

Description:
Set mappings

Specific objectives:
4

Related competencies :
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.

Full-or-part-time: 26h
Theory classes: 6h
Laboratory classes: 6h
Self study: 14h

The Induction Principle

Description:
The Induction Principle

Specific objectives:
5

Related competencies :
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.

Full-or-part-time: 22h
Theory classes: 4h
Laboratory classes: 4h
Self study: 14h

Partial exam

Description:
Partial exam

Specific objectives:
1, 2, 3, 5

Related competencies :
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.

Full-or-part-time: 4h
Guided activities: 2h
Self study: 2h

Divisibility

Description:
Divisibility of integers

Specific objectives:
2, 5, 6

Related competencies :
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.

Full-or-part-time: 23h
Theory classes: 5h
Laboratory classes: 4h
Self study: 14h

Congruences

Description:
Congruences of integers

Specific objectives:
2, 6, 7

Related competencies :
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.

Full-or-part-time: 23h
Theory classes: 5h
Laboratory classes: 4h
Self study: 14h

Applications of congruences

Description:
Some applications of congruences

Specific objectives:
4, 6, 7

Related competencies :
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.

Full-or-part-time: 11h
Theory classes: 2h
Laboratory classes: 2h
Self study: 7h

Review

Description:
Review of the main contents and problem solution

Full-or-part-time: 10h
Theory classes: 3h
Self study: 7h

Final exam

Description:
Final exam

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

Related competencies :
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.

Full-or-part-time: 6h
Guided activities: 3h
Self study: 3h

Partial exam

Specific objectives:
4, 6, 7

Related competencies :
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.

Full-or-part-time: 2h 30m
Guided activities: 2h
Self study: 0h 30m

GRADING SYSTEM

* There are two midterm exams, not in class time, (35% each one). Rating: P1 and P2 (both out of 10).

* The goal achievements in the laboratory sessions will be also considered (20%). Rating: L (out of 10)

*There will be several ATENEA tests (10%). Rating: A (out of 10)

* The continuous evaluation mark AC is obtained as follows:

AC= 0.35*P1+0.35*P2+0.2*L+0.1*A

*Students can take the final exam (100%). Rating :F (out of 10)

* The course grade is the maximum between AC and F: max (AC, F)

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:
- Farré, Rafel. Apunts de FONAMENTS MATEMÀTICS, part 1.
- Farré, Rafel. Apunts de FONAMENTS MATEMÀTICS, part 2.
- Rosen, Kenneth H; Pérez Morales, José Manuel. Matemática discreta y sus aplicaciones. 5a ed. Madrid: McGraw-Hill, cop. 2004. ISBN 8448140737.

Complementary:
- Lipschutz, S. Teoría y problemas de teoría de conjuntos y temas afines. McGraw-Hill, 1970. ISBN 007091625X.
- Smullyan, R.M. ¿La Dama o el tigre? y otros pasatiempos lógicos : incluyendo una novela matemática que presenta el gran descubrimiento de Gödel. 10a ed. Cátedra, 2017. ISBN 9788437604145.
- Lipschutz, S.; Lipson, M.L. 2000 problemas resueltos de matemática discreta. McGraw-Hill, 2004. ISBN 9788448142780.
- Smullyan, R.M. ¿Cómo se llama este libro?: el enigma de Drácula y otros pasatiempos lógicos. 17a ed. Cátedra, 2008. ISBN 9788437602974.