Course guide
270008 - M2 - Mathematics II

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, English

LECTURER

Coordinating lecturer: MONICA SANCHEZ SOLER

Others:

Primer quadrimestre:
ELOY CABEZAS CARDENAS - 41
EIXARC ESCARAMIS BABIANO - 11, 12
MARIA ISABEL GONZALEZ PEREZ - 41
FERNANDO MARTÍNEZ SÁEZ - 11
MONICA SANCHEZ SOLER - 11, 12

Segon quadrimestre:
ANDREU BELLÉS ROCA - 51, 52
ELOY CABEZAS CARDENAS - 51, 52, 53
EIXARC ESCARAMIS BABIANO - 12, 21
GUILLERMO GONZÁLEZ CASADO - 11
MARIA ISABEL GONZALEZ PEREZ - 41, 43
ROBERTO GUALDI - 22, 31, 32, 33
MONTSERRAT MAURESO SÁNCHEZ - 11, 12, 13, 14
ANA RIO DOVAL - 41, 42, 43
MONICA SANCHEZ SOLER - 14, 21, 22, 23, 24
JOAQUIM SOLER SAGARRA - 13, 23
AITOR SORT NADAL - 31, 32

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 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.
10.Work with functions of several variables.

STUDY LOAD

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

Total learning time: 187.5 h

CONTENTS

Real numbers

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

Numerical sequences

Description:
Definitions. Convergent, divergent and oscillating sequences. Convergence criteria. Recurring sequences. Monotone sequences. Monotone convergence theorem.

Theorems for continuous functions of one variable

Description:
Definitions. Sign theorem. Bolzano's theorem. Weierstrass theorem. Mean value theorem. Bisection and secant methods approximating zero in functions.

Theorems for derivatives of functions of one variable

Description:
Definitions. Rolle's theorem. Lagrange theorem. Cauchy's theorem. L'Hôpital's rule. Iterative methods for approximating zero in functions. Newton-Raphson method.

Taylor formula for functions of one variable

Description:
Taylor polynomial. Lagrange remainder formula. Error propagation formula. Using Taylor polynomials and bounding error.

Integration of functions of one variable

Description:
Definitions. Fundamental theorem of calculus. Barrow's rule. Definite integrals: areas and volumes. Approximated integrals: Trapezoidal rule and Simpson's rule.

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:
Directional derivatives. Partial derivatives. Gradient vectors. Geometric interpretation. Planes tangent to a surface.

Taylor polynomials in several variables.

Description:
Higher order partial derivatives. Hessian matrix. Taylor polynomial. Lagrange remainder formula.

Optimization of functions of several variables

Description:
Definitions. Weierstrass theorem. Lagrange multiplier method. Outlier calculation: relative, conditional and absolute.

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: 9h
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: 20h
Theory classes: 5h
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: 37h
Theory classes: 11h
Laboratory classes: 6h
Self study: 20h

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: 37h
Theory classes: 11h
Laboratory classes: 6h
Self study: 20h

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: 5h
Self study: 5h

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
Self study: 7h

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: 6h 30m
Guided activities: 2h
Self study: 4h 30m

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: 14h
Guided activities: 2h
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:

Note = 0.2 * T + max (0.3 * P+0.5 * F,0.8 * F)

Not taking the final exam means having a NP of M2 grade.

BIBLIOGRAPHY

Basic:
- Bradley, G.L.; Smith, K.J. Cálculo. Prentice Hall, 1998. ISBN 8483220415.

Complementary:
- Piskunov, N. Cálculo diferencial e integral. Limusa, 1994. ISBN 9681839854.
- Lubary, J.A.; Brunat, J.M. Cálculo para ingeniería informática. Edicions UPC, 2008. ISBN 9788483019597.
- Grau Sánchez, M.; Noguera Batlle, M. Cálculo numérico. Edicions UPC, 2001. ISBN 8483014556.
- Spiegel, M.S. Cálculo superior. McGraw-Hill, 1969. ISBN 8485240663.
- Baranenkov, G.; Demidovich, B. Problemas y ejercicios de análisis matemático. Paraninfo, 1969. ISBN 8428300496.
- Spiegel, M.R.; Lipschutz, S.; Liu, J. Fórmulas y tablas de matemática aplicada. 4a ed. McGraw Hill, 2014. ISBN 9786071511454.

RESOURCES

Hyperlink:
- http://ocw.mit.edu/ans7870/18/18.013a/textbook/MathML/index.xhtml- http://archives.math.utk.edu/visual.calculus/- http://ocw.mit.edu/OcwWeb/Mathematics/index.htm- http://ramanujan.math.trinity.edu/wtrench/misc/index.shtml- http://www.maths.mq.edu.au/~wchen/ln.html