Course guide
270201 - CAL - Calculus

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

Degree: BACHELOR'S DEGREE IN DATA SCIENCE AND ENGINEERING (Syllabus 2017). (Compulsory subject).

Academic year: 2024   **ECTS Credits:** 7.5   **Languages:** Catalan, Spanish

LECTURER

Coordinating lecturer: JORDI VILLANUEVA CASTELLTORT

Others: Primer quadrimestre:
JOSE TOMAS LAZARO OCHOA - 11
RAFAEL RAMIREZ ROS - 12
JORDI VILLANUEVA CASTELLTORT - 11, 12

PRIOR SKILLS

Knowledge on basic calculus theory at level 2n Batxillerat

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE1. Skillfully use mathematical concepts and methods that underlie the problems of science and data engineering.

Generical:
CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.

Transversal:
CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.
CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.

Basic:
CB1. That students have demonstrated to possess and understand knowledge in an area of ??study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply Knowledge from the vanguard of their field of study.

TEACHING METHODOLOGY

Lectures introduce the concepts, algorithms and results needed to reach athe required level of understanding. These concepts are put into practice in the problem classes in which, due to its structure, it is easier to encourage the active participation of students. The practice note is aimed at encouraging the most creative and transversal aspects of the subject since it involves the completion of problems that involve the understanding of concepts and the use of tools that we could hardly fit into the regulated exhibition.

LEARNING OBJECTIVES OF THE SUBJECT

1.Elementary functions, continuity, limit and associated concepts
2.The derivative and its use as a basic calculation tool.
3.Calculation of primitives and definite integrals.
4.Discussion of the convergence of improper integrals, sequences and series and calculation of their limit in simple cases where it is approachable.

STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	24.00
Hours small group	30,0	16.00
Self study	112,5	60.00

Total learning time: 187.5 h

CONTENTS

Functions

Description:
Rational and real numbers. Absolute value. Qualitative study of the most usual functions and their inverses. Limit and continuity. Theorem of Bolzano and theorem of the intermediate value.

Derivation

Description:
Derivative of a function. Direct applications of the derivative. Rolle's and mean value theorems. Rule of L'Hôpital. Taylor's formula and applications. Introduction to the functions of several variables. Numerical derivation. Numerical computation of zeros of functions.

Integration

Description:
Calculation of primitives. Definite integrals. Numerical integration. Improper integrals and their convergence criteria. Euler's Gamma function.

Sequences and series

Description:
Sequences and their limit. Numerical series and their convergence criteria. Power series. Taylor series.

ACTIVITIES

Midterm exam

Specific objectives:
1, 2

Related competencies :
CB1. That students have demonstrated to possess and understand knowledge in an area of ??study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply Knowledge from the vanguard of their field of study.
CE1. Skillfully use mathematical concepts and methods that underlie the problems of science and data engineering.
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CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.

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

Final exam

Specific objectives:
1, 2, 3, 4

Related competencies :
CB1. That students have demonstrated to possess and understand knowledge in an area of ??study that starts from the base of general secondary education, and is usually found at a level that, although supported by advanced textbooks, also includes some aspects that imply Knowledge from the vanguard of their field of study.
CE1. Skillfully use mathematical concepts and methods that underlie the problems of science and data engineering.
CG2. Choose and apply the most appropriate methods and techniques to a problem defined by data that represents a challenge for its volume, speed, variety or heterogeneity, including computer, mathematical, statistical and signal processing methods.
CT6. Autonomous Learning. Detect deficiencies in one's own knowledge and overcome them through critical reflection and the choice of the best action to extend this knowledge.
CT5. Solvent use of information resources. Manage the acquisition, structuring, analysis and visualization of data and information in the field of specialty and critically evaluate the results of such management.

Full-or-part-time: 12h 30m
Self study: 10h
Guided activities: 2h 30m

Functions

Full-or-part-time: 38h
Self study: 22h
Theory classes: 9h
Practical classes: 7h

Differentiability

Full-or-part-time: 53h 30m
Self study: 31h
Theory classes: 12h 30m
Practical classes: 10h

Integrability

Full-or-part-time: 45h 30m
Self study: 26h 30m
Theory classes: 11h
Practical classes: 8h

Sequences and series

Full-or-part-time: 31h
Self study: 18h
Theory classes: 8h
Practical classes: 5h

GRADING SYSTEM

Final grade = max(0.1*NPract + 0.9*NExFinal, 0.1*NPract + 0.3*NExParcial + 0.6*NExFinal)
on
[NPract]: numerical methods exam
[NExParcial]: midterm exam
[NExFinal]: final examen grade

In case of reevaluation, the new grade will replace the previous.

BIBLIOGRAPHY

Basic:
- Apostol, Tom M. Análisis matemático. 2a ed. Reverté, 1977. ISBN 8429150048.
- Burgos Román, J.. Cálculo infinitesimal de una variable. 2a ed. Madrid: McGraw-Hill, 2007. ISBN 9788448156343.
- Larson, R.; Edwards, B. Cálculo. 10a ed. México, D.F.: McGraw Hill, 2016. ISBN 9786075220154.
- Zill, D.G. Cálculo de una variable: trascendentes tempranas [on line]. 5a ed. México: McGraw Hill, 2019 [Consultation: 14/03/2025]. A v a i l a b l e   o n : https://www-ingebook-com.recursos.biblioteca.upc.edu/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=8726.   ISBN 9781456272340.

Complementary:
- Thompson, Silvanus Phillips; Gardner, Martin. Calculus made easy : being a very-simplest introduction to those beautiful methods of reckoning which are generally called by the terrifying names of the differential calculus and the integral calculus. 2nd ed. Macmillan and co., limited, 1998. ISBN 9781514779545.

RESOURCES

Hyperlink:

- https://openstax.org/details/books/calculus-volume-1 - https://openstax.org/details/books/calculus-volume-2 - https://openstax.org/details/books/calculus-volume-3 - https://web.mat.upc.edu/rafael.ramirez/ACcY/index.html