

Academic Year: ( 2023 / 2024 )

Review date: 18-05-2022

Department assigned to the subject: Mathematics Department

Coordinating teacher: ALVAREZ ROMAN, JUAN DIEGO

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester :

**REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)**

Mathematical Methods I  
Mathematical Methods II  
Advanced mathematical methods I

**OBJECTIVES**

The goal of this course is to acquaint the student with mathematical tools necessary for an adequate comprehension of some advanced techniques of statistical analysis:

- Complex numbers
- Series of functions
- Integral transforms
- Matrix calculus
- Singular value decomposition
- Introduction to numerical calculus

**DESCRIPTION OF CONTENTS: PROGRAMME****T1. PRELIMINARIES**

- Complex numbers: graph, arithmetic, complex exponential.
- Summation, products, indexed sums.

**T2. SERIES OF FUNCTIONS**

- Numerical series, convergence criteria.
- Series of functions: powers, Taylor, Maclaurin.
- Series of functions: Fourier.

**T3. INTEGRAL TRANSFORMS**

- Improper integrals.
- Fourier transform.
- Laplace transform.

**T4. NUMERICAL ISSUES: CALCULUS**

- Errors, floating point arithmetics.
- Computer: Newton Method; Trapezoidal Rule.

**T5. MATRIX CALCULUS**

- Exponential matrix
- Derivatives with scalars, vectors and matrices.
- Multidimensional integration. Integration with scalars, vectors and matrices.

**T6. SINGULAR VALUES DECOMPOSITION**

- Singular value decomposition
- Moore-Penrose pseudoinverse.
- Principal component analysis

**T7. NUMERICAL ISSUES: LINEAR ALGEBRA**

- Computer: LU factorization; Power method for approximating eigenvalues.

## LEARNING ACTIVITIES AND METHODOLOGY

The course will be taught mainly on the blackboard, with additional material available in the course webpage. Three written tests will be scheduled, to be performed within the teaching hours along the semester. Besides, there will be at least two deliverables computer homework .

## ASSESSMENT SYSTEM

A continuous assessment process will be implemented through periodical written tests within teaching hours, which will amount to 40% of the final grade. Besides, there will be at least two computer homework, which will require the delivery of some corresponding homework, with a relative weight of 20% of the final grade. Not showing up for any of the tests or lab sessions amounts to obtaining 0 points in that particular item, without affecting the remaining ones. The final examination has a weight of 40% of the final grade. The grade obtained in the continuous assessment process will be kept for those students who have to take the extraordinary examination.

<b>% end-of-term-examination:</b>	60
<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	40

## BASIC BIBLIOGRAPHY

- D. Pestana, M. Rodríguez y F. Marcellán Curso Práctico de variable compleja y teoría de transformadas, Pearson, 2014
- B.N. Datta Numerical Linear Algebra and Applications, Brooks & Cole, 1995
- D. Zill Ecuaciones diferenciales con aplicaciones de modelado, Thomson, 1997
- James E. Gentle Matrix Algebra: Theory, Computation, and Applications in Statistics, Springer, 2007
- K. Sydsaeter and P. Hammond Essential Mathematics for economics Analysis, Pearson, 2012
- L.N. Trefethen & D. Bau Numerical Linear Algebra, SIAM, 1997
- Salas, Hille y Etgen Calculus (I y II), Reverté, 2002

## ADDITIONAL BIBLIOGRAPHY

- D. Higham Matlab guide, 2nd. ed, SIAM, 2005
- D. Watkins Fundamentals of Matrix Computations, Wiley, 2002
- G. Golub & C. van Loan Matrix Computations, Johns Hopkins Press, 1996
- J.W. Demmel Applied Numerical Linear Algebra, SIAM, 1997