Advanced Mathematics

Academic Year: (2022 / 2023)   **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 : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Calculus I
Calculus II
Linear Algebra

OBJECTIVES

The goal of this course is to acquaint the student with mathematical tools necessary for an adequate compression of some advanced techniques of statistical analysis:
-Complex numbers
-Series of functions
-Integral transforms
-Matrix calculus
-Singular value descomposition
-Introduction to numerical calculus

DESCRIPTION OF CONTENTS: PROGRAMME

T1. PRELIMINARIES
- Complex numbers: graph, arithmetic, complex exponential.
- Summmation, products, indexed sums.

T2. SERIES OF FUNCTIONS
- Numerical series, convergence criteria.
- Series of fucntions: powers, Taylor, Maclaurin.
- Series of functions: Fourier.

T3. INTEGRAL TRANSFORMS
- Improper integrals.
- Fourier transform.
- Laplace transform.

T4. NUMERICAL ISSUES: CALCULUS
- Errors, floating point arithmeticas.
- 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 DESCOMPOSITION
- Singular value descomposition
- 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 30% 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 10% 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.

% end-of-term-examination: 60

% of continuous assessment (assigments, laboratory, practicals…):   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