MATHEMATICS 1 FIELD_10 ECTS

Introducing

Description

Évaluation

L'évaluation des acquis d'apprentissage est réalisée en continu tout le long du semestre. En fonction des enseignements, elle peut prendre différentes formes : examen écrit, oral, compte-rendu, rapport écrit, évaluation par les pairs...

Practical info

Location(s)

Toulouse

INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES TOULOUSE

Analysis 1

Introducing

Description

Series
1. Introduction, Finite and Infinite Series
2. Sums of non negative numbers
3. Rearrangement of series: absolute convergence, semi-convergence
Illustrations: decimal representation of natural numbers, of real numbers, notion of numerical errors

Topology of Normed Vector Spaces
1. Norms, Comparison of Norms
2. Sequences in Normed Spaces and Convergence
3. Topology: open and closed sets, closure, density
4. Limits, continuity of functions, compactness
5. Linear Applications between Normed Vector Spaces
Illustrations: Iterative Methods to solve linear systems, matrix condition number

Several Variable Differential Calculus

1. Derivatives in several variable calculus
2. Partial and directional derivatives
3. Taylor expansion
4. The inverse function theorem, the implicit function theorem
Illustration: Newton method to solve a system of nonlinear equations.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

• The notion of numerical series and convergence of series
• The notion of differentiability of a function of multiple variables, partial derivatives
• The concept of norms, convergence of sequences in vectorial spaces, basic topological concepts: open and closed sets, compactness

The student will be able to:

Use the main mathematical results to
• Study the convergence of numerical series with majoration and comparison methods
• Study the differentiability of a function of multiple (real) variables, carry out an asymptotic expansion
• Manipulate norms of vectors and matrices, study the convergence of a sequence or function limits in vectors spaces.

Necessary prerequisites

Basic Calculus, Basic Linear algebra

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Linear algebra

Introducing

Description

Resolution of linear systems
1. Gauss elimination. Manipulation of rows and columns. Matrix interpretation
2. Existence criterion: rank, kernel, strictly dominant diagonals
3. LU factorization

Prehilbertian and Euclidian spaces
1. Scalar product: examples, properties
2. Orthogonality: orthogonal basis, projections
3. Mean Square solution of linear systems, QR factorization

Reduction of endomorphisms
1. Eigen-elements: eigenvalues, eigenfunctions, characteristic polynom
2. Diagonalisation, trigonalisation, Cayley-Hamilton
3. Applications: linear differential systems and recurrences, spectrum computation

Endomorphisms of Euclidian spaces
1. Isometries, Orthogonal Matrices
2. Adjoint, Self-adjoint endomorphisms, diagonalization
3. Singular Value Decomposition (data visualization)

Hermitian spaces
1. Hermitian product, Orthogonality
2. Endomorphisms of Hermitian spaces: adjoint, reduction.

Objectives

At the end of this module, the student will have understood and be able to explain (main concepts):

- Knowing main factorization results on matrices: LU, QR, SVD
- Main results on diagonalization and trigonalization
- Orthogonality
- Adjoint of a matrix, self-adjoint matrices and spectral theorem, Isometries

The student will be able to:

- Solve linear system with Gauss elimination and give a matrix interpretation
- Compute orthogonal basis or orthogonal projection on a subspace
- Provide a matricial interpretation of the main classes of Euclidian endomorphisms
- Diagonalize or trigonalize matrices
- Solve numerically a linear system in a mean square sense. Apply numerical SVD.

Necessary prerequisites

Basic linear algebra: vector spaces, subspaces, linear application, matrix, Kernel and Image of a linear application

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