

# **Mathematics**

ECTS:4

Volume horaire : 30

# Description du contenu de l'enseignement :

To provide a working understanding of matrices and vector spaces for later modules to build on and to teach students practical techniques and algorithms for fundamental matrix operations and solving linear equations.

## Compétence à acquérir :

By the end of this module, students will have demonstrated: **Knowledge** 

- 1. The understanding algebraic and geometric representations of vectors in R^n and their operations
- 2. The ability to define a linear combinaision, a dependant, independent and spanning set of vectors
- 3. The ability to define subspace of a vector space, recognize and use basic properties of subspaces and vector spaces
- 4. The ability to recognize echelon forms, to identify the number of pivots and to interprete the result
- 5. The ability to define the size of a matrix, the inverse of a matrix, the transpose of a matrix
- 6. The ability to provide a definition of the determinant and describe its properties (including the determinant of the inverse, the transpose, the determinant of a product, the determinant of an upper/lower triangular matrix)
- 7. The ability to describe how performing row operations affects the determinant
- 8. The ability to recognise a basis of the vector space Rn and describe coordinates of a vector relative to a given basis
- 9. The ability to define the Image and the Kernel of a vector space and state the rank-nullity theorem
- 10. The ability to define, give examples, and properties of the eigenvectors and eigenvalues

### Skills

- 1. The ability to determine whether or not particular subsets of a vector space are subspaces
- 2. The ability to perform row operations on a matrix and solve systems of linear equations using Gauss-Jordan elimination to reduce to echelon form
- 3. The ability to perform common matrix operations such as addition, scalar multiplication, multiplication (when possible), and transposition
- 4. The ability to solve linear systems of equations using the language of matrices and solve systems of linear equations using the inverse of the coefficient matrix when possible
- 5. The ability to compute the inverse of a matrix using Gauss elimnination
- 6. The ability to compute the determinant of a two-by-two matrix or three-by-three matrix and the determinant of a matrix n x n via formula involving recuding to a determinant of size (n-1) x (n-1)
- 7. The ability to determine a basis, the dimension and the equations of a finite-dimensional space in particular the Image and the Kernel of a matrix ( using the rank nullity theorem if need be).
- 8. The ability to determine the eigenvalues and eigenvectors of a matrix and use characteristic polynomials to compute eigenvalues and eigenvectors and, when possible diagonalize a matrix.
- 9. The ability to use diagonal matrix to solve systems involving sequences of vectors or power of matrices.

### Values and Attitudes

- 1. Ability to articulate deductive reasoning
- 2. Rigor in reasoning and notation