Linear Algebra

1. **Course number and name:** 020ALNNI2 Linear Algebra

2. **Credits and contact hours:** 8 ECTS credits, 4x1:15 contact hours

3. **Name of course coordinator:** Rim Al Dbaissy

4. **Instructional materials:** PowerPoint slides; Lecture notes; worksheets.

   Reference :
   - Maths PCSI, X. Oudot et V. Queffelec, Vuibert, 2014

5. **Specific course information**
   a. **Catalog description:**
      This course enables students to manipulate complex numbers and explore their properties to perform calculations and solve equations. They also develop an understanding of geometric transformations such as translations, rotations and homothety. This module introduces students to vector spaces and helps them understand concepts like linear independence, basis, and dimension. Linear transformations and matrices play a central role in this course. students examine the properties of linear transformations by learning how to find the kernel and image of these transformations and identify endomorphisms, automorphisms and isomorphisms. They also learn to represent these transformations using matrices. Additionally, they master the computation of determinants, which play a key role in the study of linear systems and their solutions. By acquiring these knowledge and skills, students are able to solve real-world problems and apply their knowledge in fields such as science, engineering and computer science.

   b. **Prerequisites:** None

   c. **Required/ Selected Elective/Open Elective:** Required

6. **Educational objectives for the course**
   a. **Specific outcomes of instruction:**
      - Understand the fundamental concepts of complex numbers, including their algebraic form, conjugate, modulus and the properties of complex exponential.
      - Manipulate the nth roots of a complex number and solve quadratic equations.
      - Apply geometric transformations in the complex plane.
      - Define and manipulate vector spaces, including linear combinations, subspaces, families of vectors, bases and the dimension of a vector space.
      - Understand the properties of linear transformations, including the image of a vector subspace, the kernel of a linear transformation, isomorphism and the rank of a linear transformation.

- Manipulate matrices, including operations such as transposition, matrix multiplication, trace, equivalence and similarity.
- Compute determinants of square matrices
- Understand the properties of determinants and their use in calculating matrix inverses.
- Solve linear systems using matrices.

b. PI addressed by the course:

PI	1.1
Covered	x
Assessed	x

7. Brief list of topics to be covered

- Complex Numbers: Algebraic form, conjugate and modulus of a complex number (3 Lectures)
- Trigonometric form of a complex number. (3 Lectures)
- Complex exponential. (1 Lecture)
- Nth roots of unity, nth roots of a complex number. (3 Lectures)
- Quadratic equation. (1 Lecture)
- Geometric transformations. (2 Lectures)
- Vector space, subspace and linear combinations. (2 Lectures)
- Spanning sets, linearly independent sets and basis. (2 Lectures)
- Finite-dimensional vector spaces. (2 Lectures)
- Sum of two vector subspaces. (2 Lectures)
- Linear transformations: Definitions and examples. (2 Lectures)
- Image of a subspace by a linear transformation, Kernel of a linear transformation. (2 Lectures)
- Isomorphism and Isomorphic Vector Spaces. (1 Lecture)
- Effect of a Linear Transformation on Dimension and Rank. (1 Lecture)
- Matrices: Definitions, matrix of a linear transformation, structure of a vector space and transposition. (4 Lectures)
- Matrix multiplication. (2 Lectures)
- Inverse of a matrix. (3 Lectures)
- Equivalence and Similarity. (3 Lectures)
- Determinants: Definitions and properties. (3 Lectures)
- Determinant of an Endomorphism, Determinant of a system of vectors, Calculation of the inverse of a matrix. (3 Lectures)
- Linear Systems. (3 Lectures)