Syrian Arab Republic

Higher Institute for Applied Sciences and Technology

HIAST

Course Specification Document

Title	Linear Algebra

Credits	7.5 ECTS

Aims	This course aims to understand vector space structure and to recognize it in many mathematical fields, and to understand the basic theorems in finite dimensional spaces and their applications in solving linear systems, using determinants, finding eigenvalues and eigenvectors of matrices and diagonalization of matrices.

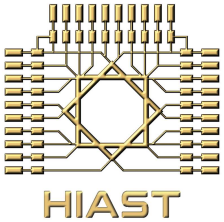
Intended learning outcomes

On successful completion of this course, the student will be able to:

- Identify finite and infinite dimensional spaces.
- Deal with linear maps and to define them by their values at the elements of a basis.
- Do matrix operations, discern invertible matrices, and understand their link with linear maps.
- Determine a basis of a vector space.
- Determine a basis of the image and the kernel of a linear map.
- Find the rank and the inverse of a matrix by row and columns operations.
- Solve a system of linear equations and know the proprieties of the set of solutions.
- Evaluate and factorize determinants.
- Find eigenvalues and eigenvectors of a matrix.
- Know if a matrix is diagonalizable and triangularizable
- Diagonalize a matrix.
- Find the power of a matrix.
- Deal with linear forms.

Syllabus

- **Vector spaces:** Defining the subspace, generating sets, linearly independent sets and the basis, sum and intersection of vector spaces, complement to a subspace of a finite-dimensional vector space and determining a basis for them.
- **Linear maps:** Relation between the dimensions of the kernel and the image of a linear map, bijective linear maps, definition of a linear map by the determination of its values at the elements of a basis, basic examples: projection and symmetry.
- **Matrices:** Matrix operations and identifying of invertible matrices, Equivalent and similar matrices, Representation of a linear map by a matrix.
- **Row and column operations that conserve the rank and their applications:** Transforming a matrix into an echelon form and fining its rank, inverting a matrix using just one type of operations (rows or columns).



- **Systems of linear equations:** Dimension of space of solutions of homogeneous system and its relation with system rank, finding the set of solutions and express it by a minimal number of parameters.
- **Determinants:** Multilinear and alternating forms, the determinant of a linear map and of the product of matrices, the formula of matrix's inverse using determinants.
- **Eigenvalues and Eigenvectors:** Characteristic polynomial, basic theorems of diagonalizability and triangularizability, the Cayley–Hamilton theorem and its application in the calculation of matrix power.
- **Dual spaces:** The dual basis for a basis, applications in polynomials, calculation of matrix exponential.