Linear Algebra EEE.1.4

The aim of the Linear Algebra course is to understand basic concepts of the subject and to develop appropriate techniques that will enable the student to effectively address the various implementation problems. Moreover, by acquiring the appropriate knowledge, the student will be able to meet the requirements of other scientific areas that use the concepts of Linear Algebra as tools. Like any Mathematics subject, the aim of the Linear Algebra course aims to promote mathematical literacy and analytical mathematical thinking of the student.
Upon successful completion of the course, the student will be able to solve linear systems of equations. The student(s) will be able to efficiently handle matrix operations, calculate matrix inverses and matrix determinants. The student(s) will understand the concept of a vector space, and independency, find a basis and its dimension. They will be able to examine whether a transformation is linear, find its representation matrix, the image and kernel spaces and to understand the concept of isomorphism and inverse transformation. They will be able to calculate the eigenvalues and the eigenvectors of a matric and its diagonalization. The student will understand the meaning of the matrix norm, the normed space and orthogonality. The student(s will be able to decompose specific categories of matrices. Finally, the student will learn the applications of Linear Algebra in various scientific fields.

Section 1 Linear Systems Solution
Systems augmented matrix. Row operations. Reduced row echelon form.
Gaussian Elimination. Applications and Examples.

Section 2 Matrices
Matrices Definitions, Matrix Algebra. Matrix Transpose, Matrix Trace ,
Inverse of a square Matrix using row operations.
Solving Square Systems by using Inverse Matrix.
Applications of Matrices. Elementary and Transformation Matrices

Section 3 Determinants
Determinants Definitions. Properties of Determinants.
Applications of Determinants. Solving Square Systems using Cramer's Rule.

Section 4 Vector Spaces
Introduction to Vector Spaces and Subspaces. Definitions, Basis, Dimension, Linear Combination and Span. Linear Independence. Matrix's Rank.
Applications and Examples. Matrix's Rank, Nullity, Row Space and Column Space.

Section 5 Linear Transformations
Definitions and Examples. Properties, Range and Kernel, Matrix representation of a Linear Mapping. Isomorphisms and Inverse Transformations. Applications.

Section 6 Eigenvalues and Eigenvectors
Characteristic Values of a Matrix (Eigenvalues, Eigenvectors)
Similar Matrices and Diagonalization.
The Caley-Hamilton Theorem.

Section 7 Normed Spaces
Norm Definitions, Normed Spaces, Inner Product, Orthogonality, Orthonormal Basis, Gram -Schmidt, Symmetric Matrices and Orthogonal Diagonalization, Quadratic Forms, Symmetric Positive Definite Matrices, Applications.

Section 8 Decompositions and Factorization of Special Form Matrices.
QR Factorization. The Singular Value Decomposition (SVD). Applications.

Section 9 Summaries of Matter and Repetition
Repetition of the Basic Course Concepts with Examples and Exercises.