**Course Title: Linear Algebra**

**Course No: Math 2022**

**Credit Hours: 3**

**Contact Hours: 3 (3 lect. Hrs.)**

**Prerequisite: NA**

**Laboratory: Not Required**

**Course Objectives**

At the end of the course, the student will be able to:

* Describe matrices, vector and vector space.
* Differentiate linearly dependent and linearly independent vectors.
* Define linear transformation.
* Develop techniques of solving system of linear equation.
* Compute matrix representation of a linear transformation and vice versa.
* Compute the magnitude of a square matrix.
* Identify the magnitude of a square matrix.

**Course Description**

This course is one of mathematics courses that should be given to computer science majoring students in order to help them have better understanding of concepts where linear algebra is applied. Topics include systems of linear equations and their solutions, matrices and matrix algebra, inverse matrices; the algebra of matrices, different types of matrices, square, identity, triangular, symmetric and skew symmetric matrices, elementary row (column) operations, inverse of a matrix using row operations, definition of point in n-space, lines and planes, cross product, vector space axioms, linear dependence and independence of vectors, bases and dimension of a vector space, sum and direct sum, definition of Linear transformation, the rank-nullity theorem, the algebra of Linear transformation, matrix representation of linear transformation, Cramer’s rule, inverse of matrix, the rank of a matrix, determinants as area and volume, polynomial of matrices and linear Maps, Eigenvalues and Eigenvectorsand the Characteristic Polynomial.

**Course Contents**

1. Vectors
   1. Points and vectors in n – Space
      1. Points in n – space, vectors in n-space and a correspondence between them
      2. Representation of vectors(Geometric representation of vectors, Coordinate representation of vectors)
      3. Special types of vectors (Null vector, unit vector, opposite vectors, co initial vectors, collinear vectors, coplanar vectors)
   2. Operation with vectors
      1. Addition and subtraction of vectors
      2. Multiplication of vectors by scalar
      3. Algebra of vectors
   3. Scalar product of vectors and angle between vectors
      1. Projection of a vector along another vector
      2. Vector product of vectors
      3. Lines and planes in space
2. Vector Spaces
   1. Definition and properties of a vector spaces
   2. Subspaces
   3. Sums of direct sums of subspaces of a vector space
   4. Linear combinations and generators
   5. Linear dependence and independence of vectors
   6. Basis and dimensions of a vector space
3. Matrices
   1. Definition and types of matrices
   2. Operation with matrices
   3. Non singularity of matrices
   4. System of linear equations
   5. Elementary row and column operations with matrices
   6. Rank of a matrix
   7. Applications to system of linear equations
4. Determinants
   1. Definition of determinant of a square matrix
   2. Minors and contactors
   3. Determinant
5. Linear transformation/Mapping
   1. Definitions and mappings
   2. Kernel and image of a linear mapping
   3. Rank and nullity
   4. Composition of liner mappings
   5. Inverse of linear mapping
   6. Linear mapping associated with a matrix
   7. System of linear equations
6. Linear transformation/Mapping of matrices
   1. The matrix associated with a linear transformation
   2. Matrix of change of bases
7. Eigen Values of eigen vectors
   1. Definition of eigen values of eigen vectors
   2. The eigen space of a linear operator
   3. Definition of eigen values and corresponding eigen vectors of a matrix
   4. Polynomial of matrices and linear maps
   5. Diagonalization of matrices

**Course Delivery Modalities**

**Teaching Methods:** Lecture and tutorial

**Evaluation Methods:** Theoretical Tests (30%), Assignments (20%) and Final Exam (50%)

**Text Book**

1. Kolman, Bernard and David R. Hill, *elementary Linear Algebra with application,* 9th ed. (2007) Prentice-Hall

**Reference Books**

1. Cooperstein, Bruce ; Advanced linear algebra, 2nd ed. (2015), CRC Press
2. Steven Roman ; Advanced Linear Algebra; 3rd ed. (2007), Springer