MODULE: **LINEAR ALGEBRA**

CODE: **BSCH-2-2-10**
Stage: II
Credit Points: 4 semester credits / 6 quarter units

Overview and Aims

This module will introduce you to some of the concepts in Linear Algebra that underpin modern computing systems. Throughout the module you will be exposed to applications of these branches of mathematics in computing.

The module covers vector algebra, and vector spaces. During this stage you will learn of the application of vectors in information retrieval systems. Also you will study matrices and their application to systems of linear equations. These systems appear routinely in linear programming and network analysis. You will also be exposed to graph theory. Graph theory forms the basis of networked systems, in order to understand the behaviour of a networked environment. You will study the basic graph definitions and types of graphs. You will also study some algorithms that are directly related to graph theory such as shortest path algorithms and minimum spanning trees.

Modular arithmetic is one of the greatest sources of one-way functions in mathematics. These functions form the basis of cryptographic systems and are used in all e-commerce transactions. Finally you will study the concept of a group. A group is an algebraic structure that obeys the associativity property, and has an identity and an inverse element. These structures are applicable to elliptic cryptography.

Learning Outcomes

Upon successful completion of this module, you will have demonstrated the ability to:

1. calculate using algebraic expressions
2. define various mathematical structures and perform operations on them
3. solve sets of linear equations using matrices
4. represent graphs in a computer programming language
5. describe certain graph algorithms
6. demonstrate the concept of a one-way function
7. perform calculations using modular arithmetic

Module Content

Introduction and review

Laws of algebra. Sets, relations, and functions

Vector algebra

Scalar and vector quantities;

Vector spaces and operations;Linear operations;

Geometrical interpretations (2D, 3D);

Orthonormal Basis;

Matrix algebra

Introduction: definition, order, types;

Operations: addition, subtraction, multiplication-scalar and matrix, transpose, inverse;

Solutions of sets of linear equations;

Eigenvalues and Eigenvectors;

Diagonalisation

Graph Theory

Graph definition

Types of graphs, complete, directed, undirected, cyclic, acyclic, etc.

Graph algorithms, shortest path, minimum spanning tree, etc.

Graph representation in a computer, adjacency lists, adjacency matrices.

Modular Arithmetic

The modulo operator

Congruence

One-way functions

Cryptography

Group theory

Properties of groups

Abelian groups