

## Mathematics II

**Course Title:** Mathematics II  
**Course No:** MTH163  
**Nature of the Course:** Theory  
**Semester:** II

**Full Marks:** 80 + 20  
**Pass Marks:** 32 + 8  
**Credit Hrs:** 3

**Course Description:** The course contains concepts and techniques of linear algebra. The course topics include systems of linear equations, determinants, vectors and vector spaces, eigen values and eigenvectors, and singular value decomposition of a matrix.

**Course Objectives:** The main objective of the course is to make familiarize with the concepts and techniques of linear algebra, solve system of linear equation with Gauss-Jordon method, to impart knowledge of vector space and subspace, eigenvalues and eigenvectors of a matrix and get the idea of diagonalization of a matrix, linear programming, Group, Ring, and Field.

### Course Contents:

#### Unit 1: Linear Equations in Linear Algebra (5 Hrs.)

System of linear equations, Row reduction and Echelon forms, Vector equations, The matrix equations  $A\mathbf{x} = \mathbf{b}$ , Applications of linear system, Linear independence

#### Unit 2: Transformation (4 Hrs.)

Introduction to linear transformations, the matrix of a linear Transformation, Linear models in business, science, and engineering

#### Unit 3: Matrix Algebra (5 Hrs)

Matrix operations, The inverse of a matrix, Characterizations of invertible matrices, Partitioned matrices, Matrix factorization, The Leontief input output model, Subspace of  $\mathbb{R}^n$ , Dimension and rank

#### Unit 4: Determinants (4 Hrs.)

Introduction, Properties, Cramer's rule, Volume and linear transformations

#### Unit 5: Vector Spaces (5 Hrs.)

Vector spaces and subspaces, Null spaces, Column spaces, and Linear transformations, Linearly independent sets: Bases, Coordinate systems

#### Unit 6: Vector Space Continued (4 Hrs.)

Dimension of vector space and Rank, Change of basis, Applications to difference equations, Applications to Markov Chains

#### Unit 7: Eigenvalues and Eigen Vectors (5 Hrs.)

Eigenvectors and Eigenvalues, The characteristic equations, Diagonalization, Eigenvectors and linear transformations, Complex eigenvalues, Discrete dynamical systems, Applications to differential equations

**Unit 8: Orthogonality and Least Squares (5 Hrs.)**

Inner product, Length, and orthogonality, Orthogonal sets, Orthogonal projections, The Gram-Schmidt process, Least squares problems, Application to linear models, Inner product spaces, Applications of inner product spaces

**Unit 9: Groups and Subgroups (5 Hrs.)**

Binary Operations, Groups, Subgroups, Cyclic Groups

**Unit 10: Rings and Fields (4 Hrs.)**

Rings and Fields, Integral domains

**Text Books:**

1. Linear Algebra and Its Applications, David C. Lay, 4<sup>th</sup> Edition, Pearson Addison Wesley.
2. Linear Algebra and Its Applications, Gilbert Strang, 4<sup>th</sup> Edition, Addison, CENGAGE Learning.