

SYLLABUS

MATH 21001 – Linear Algebra with Applications

(3 Credit Hours)

Catalog Information: Systems of linear equations and the associated matrix operations, linear transformations, vector spaces, bases, eigenvectors. Prerequisite: MATH 11012 or MATH 12002 with a minimum grade of C (2.0).

Text: Linear Algebra and Its Applications, 5th Edition, Lay, Pearson, ISBN: 9780321982384

There are 41-44 classes available; for the time remaining optional topics are suggested below.

Core Sections:

1.1 (2 days) **Systems of Linear Equations:** Basic definitions and notations, possible number of solutions of linear equations, elementary row operations, equivalent systems, existence and uniqueness questions.

1.2 (2 days) **Row Reduction and Echelon Forms:** Echelon form, reduced echelon form, uniqueness of the reduced echelon form, pivot positions, the row reduction algorithm, solutions of linear systems, parametric description of solution sets, implications for existence, uniqueness, and number of solutions.

1.3 (1 day) **Vector Equations:** Vectors in R^n , linear combinations, span.

1.4 (1 day) **The Matrix Equation $Ax=b$:** Existence of solutions, computation of Ax , properties of matrix-vector product Ax .

1.5 (2 day) **Solution Sets of Linear Systems:** Homogeneous linear systems, solutions of nonhomogeneous systems.

2.1 (2 days) **Matrix Operations:** Sums and scalar multiples, matrix multiplication, properties of matrix multiplication, powers of a matrix, the transpose of a matrix and its properties.

2.2 (2 days) **The Inverse of a Matrix:** definition, existence, properties, inverses and the solution of linear systems, elementary matrices, an algorithm for finding the inverse.

2.3 (2 days) **Characterizations of Invertible Matrices:** The invertible matrix theorem.

3.1 (2 days) **Introduction to Determinants:** cofactors, definition of the determinant in terms of cofactors.

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3.2 (2 days) **Properties of Determinants:** Row operations, inverses, column operations, determinants and matrix products.

3.3 (1 days) **Cramer's Rule:** adjugate or adjoint and its properties, inverse via adjoint.

1.7 (1 day) **Linear Independence:** linear independence of a set of vectors, linear independence of matrix columns, sets of one or two vectors, sets of two or more vectors.

4.1 (2 days) **Vector Spaces and Subspaces:** Definition, examples, subspaces, a subspace spanned by a set.

4.2 (2 days) **Null Spaces, Column Spaces, and Linear Transformations:** The null space of a matrix, the column space of a matrix.

4.3 (1 days) **Linear Independent Sets; Bases:** Definitions, examples, the spanning set theorem, bases for null spaces and column spaces.

4.4 (2 days) **Coordinate Systems:** The unique representation theorem, coordinates in \mathbb{R}^n .

4.5 (2 days) **The Dimension of a Vector Space:** definitions, examples, proof that all bases of the same vector space have the same number of vectors, subspaces of a finitedimensional space, the dimension of null-space and column space of a matrix.

4.6 (2 days) **Rank:** The row space, the rank theorem, applications to systems of equations, rank and the invertible matrix theorem.

4.7 (2 days) **Change of Basis.**

5.1 (2 days) **Eigenvectors and Eigenvalues:** Definitions and calculations.

5.2 (2 days) **The Characteristic Equation.**

Optional sections: (choose by topic)—Diagonalization (chapter 5.3), Linear Transformations (chapters 1.8, 4.2 & 5.4), Orthogonality and/or Least Squares (chapter 6).