SYLLABUS

MATH 21002 – Applied Linear Algebra

(3 Credit Hours)

Catalog Information: This is an introductory course in linear algebra. The goal of the course is to teach the math fundamentals of linear algebra in a way that focuses more on applications. The topics include systems of linear equations, matrix operations, vector spaces, eigenvalues and eigenvectors, singular value decompositions, and their applications. Prerequisite: Minimum C grades in Minimum C grades in MATH 12002 or MATH 11012 or MATH 12012 or MATH 12021.

Text: Introduction to Linear Algebra, 5th Edition, Gilbert Strang, ISBN: 9780980232776

Core Sections: (1 day=50 minutes, number of days for each topic is suggested only)

1.1 and 1.2 (2 days) Vectors: Basic definitions and notations, operations of vectors, linear combinations of vectors, dot product and angle of vectors.

1.3 and 2.4 (3 days) Matrices: Basic definitions, notations, and operations of matrices, matrix times vector, matrix times matrix, matrices of special structures (diagonal matrices, identity matrix), matrices in block form and operations.

Complementary Materials (3 days) Graph and Adjacency Matrices: Definition, notation, and representation of graphs, adjacency matrix, edge sequences, shortest path between nodes, connected/disconnected graphs, the most important node in a graph.

2.2 and 3.3 (4 days) Gaussian Elimination: 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.

10.4 and Complementary Materials (3 days) Linear Programming and Simplex Method: notation and standard form of linear programming problems, feasible set, geometric method of solution, slack variables, basic feasible solution, the simplex tableau.

3.1 (2 day) Spaces and Subspaces: Definition, examples, subspaces, a subspace spanned by a set, isomorphism of spaces, column space of matrices,

3.2 (1 day) Null Space of Matrices: spanning set of null space.

3.4 (3 days) Linear Independence, Basis and Dimension of Spaces: linear independence of a set of vectors, linear independence of matrix columns, sets of one or two vectors, sets of two or more vectors, definition of basis of a space, examples, the spanning set theorem, bases for null space, column space and row space of a matrix, rank of matrix.

2.5 (2 days) Invertible Matrices: definition, invertible matrix theorem, uniqueness of the inverse, computation of the inverse of an invertible matrix.

5.1 and 5.2 (2 days) Determinants: cofactors, definition and computation of the determinant in terms of cofactors, properties of determinants.

6.1 (2 days) Eigenvalues and Eigenvectors: definition and computation of eigenvalues and eigenvectors, complex eigenvalues and eigenvectors, properties of eigenvalues and eigenvectors.

6.2 (2 days) Similarity and Diagonalization: definition of similarity of matrices, diagonalization of matrices and its computation, eigenvalue decomposition of matrices, computation of powers of diagonalizable matrices.

10.3 (2 days) Markov Chain: definition and example of a Markov chain, transition matrix, long term limit of a Markov chain, steady state of a Markov chain.

4.1 and 4.2 (2 days) Orthogonality and Projection: orthogonality of spaces, orthogonal complement, projection of vectors, projection matrix.

4.4 (2 days) Orthonormal Bases and Gram-Schmidt: orthonormal bases, Gram-Schmidt process

7.1 (2 days) Singular Value Decomposition and Image Processing.

7.2 (3 days) Bases and Matrices in the SVD