UNIVERSITY OF NICOSIA
ΠΑΝΕΠΙΣΤΗΜΙΟ ΛΕΥΚΩΣΙΑΣ

University of Nicosia, Cyprus

Course Code	**Course Title**	**ECTS Credits**
MATH-281	Linear Algebra II	6
Department	**Semester**	**Prerequisites**
Mathematics	Fall, Spring	MATH-280, MATH-190
Type of Course	**Field**	**Language of Instruction**
Elective	Mathematics	English
Level of Course	**Year of Study**	**Lecturer(s)**
1st Cycle	2nd	Dr. N. Papanicolaou
Mode of Delivery	**Work Placement**	**Co-requisites**
Face-to-face	N/A	None

Objectives of the Course:

The main objectives of the course are to:

- Remind students of the fundamental theory of finite dimensional vector spaces and matrix eigenvalues and eigenvectors .
- Extend the fundamental theory of Matrices to the complex domain and cover Hermitian, Normal and Unitary Matrices.
- Further develop eigenvalues and eigenvectors and Matrix diagonalization.
- Introduce applications such matrix exponentials.
- Present the Cayley-Hamilton theorem.
- Develop the theory of finite-dimensional inner product spaces.
- Provide students with the necessary skills to construct orthonormal bases and orthogonal complements.
- Introduce QR-decomposition and the method of least squares.

Learning Outcomes:

After completion of the course students are expected to be able to:

1. Identify and use Hermitian, Normal and Unitary Matrices.
2. Diagonalize square matrices and use the decomposition to find matrix powers.
3. Apply the Cayley-Hamilton theorem to compute the exponential of a matrix.
4. Compute the Jordan canonical form.
5. Calculate the norm of a vector and the distance between two vectors
6. Apply the Gram-Schmidt orthonormalization process to construct orthonormal bases of vector spaces; identify orthogonal complements.
7. Compute the QR factorization of a square matrix.
8. Utilize the Least Squares method to solve linear systems of equations.

Course Contents:

1. Review of fundamental Linear Algebra concepts
    - Review of vector spaces.
    - Review of eigenvalues and eigenvectors.
2. Matrices with complex entries
    - Introduction to complex numbers and their arithmetic
    - Hermitian, normal and unitary matrices
    - Complex eigenvalues and eigenvectors
    - The Cayley-Hamilton theorem
3. Applications of eigenvalues and eigenvectors
    - Matrix diagonalization
    - Matrix powers
    - The exponential of a matrix
    - Jordan Canonical form
4. Inner-product Spaces
    - Inner product, vector norm and distance
    - Coordinates and change of base
    - Orthogonal and orthonormal bases and Gram-Schmidt orthonormalization
    - Orthogonal subspaces and direct sums
    - Orthogonal Projections
    - Orthogonal Matrices and the QR-decomposition
    - Least squares solutions of linear systems

Learning activities and Teaching Methods:

Lectures, Exercises, Assignments and Tests.

Assessment Methods:

2 Mid-Term Exams; Final Exam; Class Participation.

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
W. Cheney and D. Kincaid	Linear Algebra: Theory and Applications	Jones and Bartlett Learning (2^{nd} Edn.)	2010	1-449-61352-7

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
B. Kolman and D. Hill	Introductory Linear Algebra: An applied first course.	Prentice Hall	2005	0-131-27773-1
H. Anton and C. Rorres	Elementary Linear Algebra with Applications.	Wiley (9^{th} Edn.)	2005	0-471-66959-8