NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF SCIENCES
PHYSICS PROGRAM

CF251 – LINEAR ALGEBRA

I. GENERAL INFORMATION

CODE	**:**	CF251 Linear Algebra
SEMESTER	**:**	3
CREDITS	**:**	5
HOURS PER WEEK	**:**	7 (Theory – Practice)
CONDITION	**:**	Compulsory
PREREQUISTES	**:**	CM142 Vector Calculus II

II. COURSE DESCRIPTION

The course prepares students in the understanding and application of advanced concepts of vector spaces, matrixes, linear transformation, internal product spaces, determinant function and matrix canonical forms. Diverse problems related to engineering applications are analyzed and solved.

III. COURSE OUTCOMES

1. Understand and analyze vector spaces and orthogonal bases and apply them to analytic geometry.
2. Apply matrices and linear transformations to solve engineering problems.
3. Calculate the eigenvalues and eigenvectors of a matrix.
4. Represent a matrix in its canonical forms including diagonalization.

IV. COURSE CONTENTS

1. GENERAL VECTOR SPACES

Definition and examples / Sub-spaces. Properties / Sum and direct sum / Linear independence / Internal product / Orthogonal bases / Gram-Schmidt Orthogonalization / Geometry applications / Distance form a point to a linear variety / Distance between two lines / Quotient spaces.

2. LINEAR TRANSFORMATIONS AND MATRICES

Definition and examples / Fundamental theorem of linear transformations / Algebra of linear transformations / Space of linear transformations / Dual space / Linear transformation transpose / Dual base matrices / Computation of the inverse of a matrix / Step reduced matrix / Equivalence by rows / Canonic base / Linear equations system / Homogeneous equations / Non-homogeneous equations / Inconsistent systems / Base change matrix / Similar matrixes / Rank theorem.

3. DETERMINANTS

Determinant function / Determinant existence and uniqueness / Properties / Computation methods / Determinant of a linear transformation / Co-factor, minor and adjoint matrix / Determinant and matrix rank / Applications / Grammian.

4. INTERNAL PRODUCT SPACES

Definition / Examples / Distances and norms / Properties / Isometrics / Orthogonality / Orthogonal set / Projection theorem / Representation theorem.

5. MATRIX CANONIC FORMS

Eigenvalues and eigenvectors / Matrix triangulation / Cayley-Hamilton theorem / Diagonalization criteria / Nilpotente matrix / Jordan canonical form / Matrix exponential.

V. METHODOLOGY

The course takes place in theory and practice sessions. In theory sessions, the instructor presents the concepts, theorems and applications. In practice sessions, different kinds of problems are solved and the solutions are analyzed. Active participation of students is encouraged in all sessions.

VI. GRADING SYSTEM

The Final Grade (PF) is calculated with the following formula:

PF = (EP + EF + PP) / 3

ME: Mid-term exam EF: Final Exam
PP: Average of quizzes

VII. BIBLIOGRAPHY

1. **P. HALMOS**
   Finite-Dimensional Vector Spaces
   Continental Editions, 2005.
2. **HOFFMAN KUNGE**
   Linear Algebra
   Prentice Hall Editions 2010.
3. **LANG SERGE**
   Linear Algebra
   Adisson Wesley Editions. 2010