Linear algebra

Academic Year: (2022 / 2023) **Review date: 08/04/2022 18:08:08**

Department assigned to the subject: Mathematics Department

Coordinating teacher: RASCON DIAZ, CARLOS

Type: Basic Core ECTS Credits : 6.0

Year : 1 Semester : 1

Branch of knowledge: Engineering and Architecture

OBJECTIVES

The student will become familiar with the concepts of:

1- Linear systems.
2- The algebra of matrices and vectors.
3- Vector subspaces in Rn.
4- Complex numbers.

The student will acquire the skills to be able:

1- Calculate the solution of a system of linear equations
2- Discuss the existence and uniqueness of solutions of a system of linear equations
3- Operate with vectors and matrices
4- Calculate the inverse of a matrix
5- Calculate bases of vector subspaces
6- Calculate own values and vectors of a matrix
7- Calculate an orthonormal base from any basis
8- Solve least-squares problems
9- Calculate a unitary diagonalization of a normal matrix

DESCRIPTION OF CONTENTS: PROGRAMME

1. Complex numbers
- Number sets
- The need for complex numbers
- Binomial form of complex numbers
- Graphical representation
- Operations
- Conjugate, module and argument
- Polar form of a complex number
- Roots of complex numbers
- Exponential of a complex number
- Solving equations
2. Systems of linear equations
- Introduction to linear systems
- Geometric interpretation
- Existence and uniqueness
- Matrix notation
- Gaussian elimination
- Equivalence by rows, echelon form
- Resolution of linear systems
- Homogeneous systems
- Simultaneous resolution
- Systems with parameters

3. The vector space Cn
- Vectors
- Vector subspaces
- Linear combinations
- Subspace spanned by a set
- Column and row spaces
- The matrix equation Ax=b
- Null space
- Revisiting linear systems
- Linear independence
- Base of a vector subspace
- Dimension of a vector subspace
- Bases of Col A, Row A and Nul A
- Rank of a matrix
- Coordinate systems
- Introduction to linear transformations
4. Matrix algebra
- Operations with matrices
- Transposition of a matrix
- Conjugated transposition of a matrix
- Inverse of a matrix
- Block matrices
- Determinants
5. Eigenvalues and eigenvectors
- Eigenvectors and eigenvalues
- The characteristic equation
- Diagonalization
- Change of basis
- Linear transformations between vector spaces
- Abstract vector spaces
6. Orthogonality
- Scalar product and module
- Orthogonal sets
- Unitary matrices
- Orthogonal complement
- Orthogonal projections
- The Gram-Schmidt process
- Least squares problems
- Singular value decomposition

LEARNING ACTIVITIES AND METHODOLOGY

The teaching methodology will include
- Theory classes, where the knowledge that students must acquire will be presented. A textbook (Linear Algebra and its Applications, by David C. Lay) will be followed to facilitate its development. Students will receive the course syllabus and are expected to prepare classes in advance.
- Resolution of exercises by the student that will serve as self-evaluation and to acquire the necessary skills.
- Problem classes, in which the problems proposed to the students are developed and discussed.
- The teacher may pose problems and work to solve individually or in group.
- The teacher will set his schedule of individual tutorials. There will be no group tutoring.

ASSESSMENT SYSTEM

% end-of-term-examination/test:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

- Continuous evaluation: It corresponds to 40% of the final mark. At the beginning of the course, the theory teacher will choose one of these:
1) Mid-term exams held along the course to assess the student's progression.
2) Students must hand in the proposed problems, in the problem class.

- Final exam: It corresponds to 60% of the final mark. It helps assess the student's general understanding of the subject.

ATTENTION: To pass the subject, the student MUST pass the final exam.

% end-of-term-examination/test:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- David C. Lay Linear algebra and its applications, Addison Wesley, 2014

ADDITIONAL BIBLIOGRAPHY

- B. Noble and J. W. Daniel Applied Linear Algebra, 3rd ed., Prentice Hall, 1988

- G. Strang Linear algebra and its applications, 4th ed., Brooks/Cole, 2005

- J. Rojo Álgebra lineal, McGraw-Hill, 2007

- J. Rojo Ejercicios y problemas de algebra lineal, McGraw-Hill, 2004

- L. Spence, A. Insel, and S. Friedberg Elementary Linear Algebra. A Matrix Approach, Prentice Hall, 2000