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Algebra

Academic Year: (2023 / 2024)   **Review date: 18/05/2023 14:51:17**

Department assigned to the subject: Mathematics Department

Coordinating teacher: HERNANDO OTER, PEDRO JOSE

Type: Basic Core ECTS Credits : 6.0

Year : 1 Semester : 2

Branch of knowledge: Engineering and Architecture

LEARNING OUTCOMES

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- Use elementary mathematical tools of linear algebra to solve problems and propose, validate and interpret models of simple real-life situations.
- Recognise the presence of the underlying Mathematics of Nature, Science and Technology, develop some analytic and abstraction skills, mathematical intuition and rigorous and logical thought.
- Competent use of matrix computations and solution of linear systems of equations, in particular Gauss' method and its applications.
- Competent use of elementary properties of complex numbers.
- Know the basic properties of finite-dimensional vector spaces and linear transformations.
- Use of appropriate computer tools.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Complex numbers.
Number sets. Need for complex numbers. Binomial form of complex numbers. Graphical representation. Operations. Conjugates, modulus and argument. Polar form. Roots of complex numbers. Complex exponentiation. Solution of equations.

2. Systems of linear equations.
Geometrical interpretation. Matrix notation. Gaussian elimination. Row equivalence. Row echelon forms. Resolution of linear systems. Homogeneous systems.

3. Vector spaces.
Vector spaces and subspaces. Linear combination. Dependence and linear independence. Range and dimension. Generator set and bases.

4. Matrix algebra.
Operations with matrices. Transpose of a matrix. Conjugate transpose of a matrix. Inverse of a matrix. Range and determinants. Fundamental subspaces of a matrix. Col A, Row A and Ker A bases.

5. Linear transformations.
Operations. Image and core. Associated subspaces. Types of transformations. Rank-nullity theorem.

6. Bases.
Matrix associated to a base. Systems of coordinates. Change of basis and linear applications.

7. Orthogonality and least squares.
Scalar product and modulus. Orthogonal sets. Unitary matrices. Orthogonal complement. Orthogonal projection. Gram-Schmidt process. Least squares problems.

8. Introduction to spectral theory.
Eigenvalues and eigenvectors. Characteristic equation. Similarity of matrices. Diagonalisation.

Applications.

9. Symmetric and normal matrices.
Unit similarity. Orthogonal and unitary diagonalization.

LEARNING ACTIVITIES AND METHODOLOGY

Learning activities:
Classroom:
Participatory lectures, problem sessions in class, individual and/or small group tutorials, exams. Each mathematical concept will be illustrated with examples and the corresponding theory will be developed. Active student participation will be encouraged and fostered as an important part of the learning process.
Outside classroom:
Individual and independent work and study.

Methodology:
Expositional method: lectures given by teacher supported, if necessary, by computer materials (PowerPoint/Beamer presentations, videos, etc.). They provide transfer of knowledge and activation of cognitive processes in students.
Problem-based learning: active learning through problem solving, facing students with new situations in which they must find information and apply the newly acquired knowledge to solve these problems.

Face-to-face activities	Nº hours
Lectures	24
Problem sessions	24
Office hours (tutorials)	4
Assessment	4

ASSESSMENT SYSTEM

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

Assessment shall be based on the following criteria:
- Two midterm exams (40%)
- Final exam (60%)

BASIC BIBLIOGRAPHY

- J. Arvesú, R. Álvarez, F. Marcellán Algebra lineal y aplicaciones, Síntesis, 1999

- Strang, G. Introduction to linear algebra, Wellesley-Cambridge Press, 1993

- Strang, G. Algebra lineal y sus aplicaciones, Addison-Wesley Iberoamericana.

- Treil, Sergei Linear algebra done wrong, Disponible en la pagina web del autor.

ADDITIONAL BIBLIOGRAPHY

- E. Hernández Álgebra y geometría, Addison-Wesley/UAM, 1994

- L. Merino, E. Santos Álgebra lineal con métodos elementales, Thomson-Paraninfo, 2006

- M. Castellet, I. Llerena Algebra linear y geometría, Ed. Reverté, 1991

- S. Grossman Algebra lineal con aplicaciones, McGraw Hill, 1992