Linear Algebra

Academic Year: (2019 / 2020) **Review date: 11-12-2019**

Department assigned to the subject: Mathematics Department

Coordinating teacher: ROMERO MARTIN, RAUL

Type: Basic Core ECTS Credits : 6.0

Year : 1 Semester : 1

Branch of knowledge: Engineering and Architecture

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Elementary notions on mathematics, including:
- Solution of linear systems (at least 3 equations)
- Evaluation of functions (in particular, of polynomial functions)
- Vectors in R^2 and R^3. Elementary euclidean geometry in R^2 and R^3 (inner product, euclidean distance, modulus of a vector)
- Basic matrix theory.

OBJECTIVES

By the end of this subject, students will be able to have:
1. Knowledge and understanding of the mathematical principles of linear algebra underlying Mechanical Engineering;
2. The ability to apply their knowledge and understanding to identify, formulate and solve mathematical problems of linear algebra using established methods;
3. The ability to select and use appropriate tools and methods to solve mathematical problems using linear algebra;
4. The ability to combine theory and practice to solve mathematical problems of linear algebra.

DESCRIPTION OF CONTENTS: PROGRAMME

Lecture 0. Introduction to Complex Numbers.
0.1. Definition. Sum and Product.
0.2. Conjugate, Modulus and Argument.
0.3. Complex Exponential.
0.4. Powers and Roots of Complex Numbers.

Lecture 1. Systems of Linear Equations.
1.1. Introduction to Systems of Linear Equations.
1.2. Row Reduction and Echelon Forms.
1.3. Vector Equations.
1.4. The Matrix Equation Ax=b.
1.5. Solution Sets of Linear Systems.
1.6. Linear Independence.
1.7. Introduction to Linear Transformations.
1.8. The Matrix of a Linear Transformation.

Lecture 2. Matrix Algebra.
2.1. Matrix Operations.
2.2. The Inverse of a Matrix.
2.3. Block-Partitioned Matrices.

Lecture 3. Determinants.
3.1. Introduction to Determinants.
3.2. Properties of Determinants.

Lecture 4. Vector Spaces.
4.1. Vector Spaces and Subspaces.
4.2. Null Space and Column Space of a Matrix.
4.3. Linearly Independent Sets and Bases.

4.4. Coordinate Systems.
4.5. The Dimension of a Vector Space.
4.6. Rank.
4.7. Change of Basis.

Lecture 5. Eigenvalues and Eigenvectors.
5.1. Introduction to Eigenvalues and Eigenvectors.
5.2. The Characteristic Equation.
5.3. Diagonalization of Square Matrices.

Lecture 6. Orthogonality and Least Squares.
6.1. Inner Product, Norm, and Orthogonality.
6.2. Orthogonal Sets.
6.3. Orthogonal Projections.
6.4. The Gram-Schmidt Method and the QR Factorization.
6.5. Least-Squares Problems.

Lecture 7. Symmetric Matrices.
7.1. Diagonalization of Symmetric Matrices.

LEARNING ACTIVITIES AND METHODOLOGY

The teaching methodology is based on the "flipped classroom" approach, and it will consist of:
- Theoretical and practical videos, that the student should visualize before attending the classes.
- Solving exercises and problems sessions. These sessions should be participative, and the students are expected to take an active part in these sessions.
- The weekly planning of the course, together with the necessary material, will be available to the students in advance, allowing the students to prepare the classes beforehand.

The methodology will also contain:
- Solving exercises by the student, which will serve as self-assessment and to acquire the necessary skills.
- Tutorial sessions, individual and voluntary, in which students will have the possibility to consult the teacher their doubts and questions on the subject. The time and place of these sessions will be set by the teacher at the beginning of the course.

ASSESSMENT SYSTEM

- Continuous evaluation (40%): It will consist of: (a) A mid-term test, (b) resolution of on-line tests, (c) weekend on-line tests and (d) a final on-line test.
- Final exam: It will test the global knowledge and understanding of the subject by the student. Its percentage in the final grade will be 60%.

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

BASIC BIBLIOGRAPHY

- D.C. Lay Linear Algebra and its Applications, Fourth Edition, Pearson, 2012

ADDITIONAL BIBLIOGRAPHY

- B. Noble, J.W. Daniel Applied Linear Algebra, 3rd Edition, Pearson, 1987
- G. Strang Linear Algebra and Its Applications, 4th Edition, Thomson, 2006
- L.E. Spence, A.J. Insel, S.H. Friedberg Elementary Linear Algebra. A Matrix Approach, 2nd Edition, Pearson, 2007