Universidad Zaragoza

Academic Year/course: 2024/25

29505 - Fundamentals of Mathematics II

Syllabus Information

Academic year: 2024/25
Subject: 29505 - Fundamentals of Mathematics II
Faculty / School: 175 - Escuela Universitaria Politécnica de La Almunia
Degree: 625 - Bachelor's Degree in Industrial Processes' Data Engineering
ECTS: 6.0
Year: 1
Semester: Second semester
Subject type: Basic Education
Module:

1. General information

Basic mathematical methods are part of the many tools that all Engineering professionals should have. The main objective of this subject is the mastery of techniques not only theoretical, but also practical, that allow the direct application of the methods considered in the course to real problems, with realistic calculation methods that are incorporated in efficient and proven software packages.

2. Learning results

The student, in order to pass this subject, must demonstrate the following results...

- To learn the basics necessary to solve mathematical problems that may arise in Linear Algebra;

Graph theory; Differential and Integral Calculus, Numerical Methods and optimization.

- Know the reflective use of symbolic and numerical computation tools.
- Master the modeling of engineering environments under stochastic nature by means of random variables, as well as the performance of calculations in uncertainty situations.
- To know the optimization techniques associated with linear and nonlinear problems.
- Identify the fundamental elements of a graph, as well as the problems associated with network optimization.
- Possess scientific-mathematical thinking skills that allow them to ask and answer certain mathematical questions.
- Have the ability to handle mathematical language; in particular, symbolic and formal language.

3. Syllabus

The program offered to the student to help him/her achieve the expected results comprises the following contents:

1. Functions of several variables: limits and continuity.

2. Directional and partial derivatives.

3. The chain rule.

4. Differentiability and tangent plane.

5. Extremes and conditional extremes: the Lagrange multiplier method.

6. Multiple integrals: double integrals.

7. Multiple integrals: change of variables; triple integrals.

8. Linear systems: elementary operations; Gaussian elimination and rank of a matrix; characterization theorem of linear systems (Rouché-Frobenius).

9. Determinants.

10. Numerical Linear Algebra: numerical Gaussian elimination, condition number; LU, QR and LU decompositions Choleski; iterative methods.

11. Vector spaces: linear independence, dimension and basis; subspaces.

12. Optimal approximation: scalar product; distances, angles and orthogonality; orthogonal systems and subspaces; projectors and optimal approximation theorem.

13. Application to Euclidean three-dimensional geometry: affine space; distances, scalar product, vector product, mixed product; Euclidean elements: Lines, planes, spheres.

14- Diagonalization: eigenvalues and eigenvectors; spectral decomposition and matrix functions; normal matrices;

numerical computation of eigenvalues.

15- Singular values: decomposition into singular values.

4. Academic activities

Theoretical classes: The fundamental concepts that constitute the basic body of knowledge that must be learned in order to achieve the learning outcomes are presented. The theoretical concepts are complemented with detailed examples.

Practical classes: Problems are proposed to be solved using the methods and concepts considered with previously. The use of the appropriate software for each situation is permanent, so that the problem classes are at the same time practice classes with the computer. Thus, the use of the computer is naturally approached as the most convenient method of calculation, and computer techniques are integrated with abstract techniques.

5. Assessment system

The student must demonstrate achievement of the intended learning outcomes through the following assessment activities:

Written tests: There will be two written tests. They will deal with theoretical and/or practical aspects of the subject. Its weight in the final grade will be 90%.

Participation controls: In order to evaluate student participation in class, periodical controls will be carried out at class. There will be up to 2 tests consisting of practical exercises. Its total weight in the final gradewill be 10%.

Global test: Students who have not passed the course with the continuous grading system, must take a single compulsory written test equivalent to the written tests described above, whose weight in the final grade will be 100%.

Assessment criteria: The assessment criteria are the same. The following will be valued:

- understanding of the mathematical concepts used to solve the problems;
- use of strategies and efficient proceedings for their resolution,
- clear and detailed explanations;
- absence of mathematical errors in the development and the solutions,
- correct use of terminology and notation
- orginsed and clear presentation.

6. Sustainable Development Goals

5 - Gender Equality
7 - Affordable and Clean Energy