Universidad Zaragoza

Academic Year/course: 2024/25

26907 - Algebra II

Syllabus Information

Academic year: 2024/25
Subject: 26907 - Algebra II
Faculty / School: 100 - Facultad de Ciencias
Degree: 447 - Degree in Physics
ECTS: 6.0
Year: 1
Semester: Second semester
Subject type: Basic Education
Module:

1. General information

The description of physical systems often resorts to linear algebra, the physical quantities being represented by linear operators on vector spaces. This subject follows the path of "Algebra I" (which is assumed to have already been taken), with the objective of providing the student with a set of useful tools for the description of the states and admissible transformations of physical systems.

These tools are also extremely useful for the description of systems outside Physics (e.g., Economics, Biology, Data Science, etc.). It is intended that students master the abstract concepts, and also the analytical and computational resolution of the problems.

The objectives are:

O1. Analyse the relationship between (multi)linear applications and matrices, through the choice of the basis of the vector space. Understand the important role of eigenvalues and eigenvectors.

O2. Calculate functions of applications, through the study of their canonical form

O3. Understand the role of the scalar product and the concept of orthogonality

O4. Understand the importance of isometries on vector spaces

2. Learning results

Upon completion of the subject, the students will be able to:

- perform simple operations with matrices also using numerical tools
- determine the characteristic polynomial, the generalized proper subspaces, as well as the canonical form of an operator
- obtain the exponential function of an operator and apply it to the solution of oscillator problems
- orthonormalize a given basis by means of Gram's -Schmidt procedure
- relate, by means of the exponential function, the unitary and orthonormal transformations to the hermitic and symmetric operators

This will allow them to know the properties of the eigenvalues and eigenvectors of relevant operators in physics (projectors, self-adjoint, hermitic, symmetric, orthogonal,...), and to use the invariance groups of the different scalar products (complex, real Euclidean, Minkowski) in both their finite and infinitesimal versions, throughout the other subjects.

3. Syllabus

1. Complex vector spaces and their endomorphisms

2: Multilinear applications

3: Properties of endomorphisms

4: Operator functions

5: Vector spaces with scalar product

6: Endomorphisms on vector spaces with scalar product

There are notes written by the teachers and available on the web page on the Moodle platform. All information on the subject is presented on the first day of class, and is provided permanently on the Moodle page of the subject.

4. Academic activities

- Master classes, that provide theorems and proofs, organized or in accordance with the development of the program. (38 hours)

- Exercise sessions, to consolidate theoretical understanding through relevant examples and problems. (12 hours)

- Practical computer programming of linear algebra problems, extending the scope of class exercises (10 hours: 4 sessions of 2 hours each and an introductory session of 2 hours each, throughout the four-month period)

- Self-assessment tests (optional) in Moodle, which allow students to evaluate their level of understanding.

- Individual work at home (study, solution of the proposed exercises and assignments, preparation for the computer exercises) 85 computer hours)

- Evaluation sessions (5 hours)

5. Assessment system

The student must demonstrate the knowledge achieved through the following evaluation activities:

In the face-to-face modality:

1) (70% of the grade) Completion of a final test of theory and problems.

2) (15% of the grade) Evaluation of the computer-based practice sessions.

3) (15% of the grade) Continuous evaluation of the student's learning through the resolution of problems, questions and other activities proposed by the teacher of the subject. Two Moodle tests will be included throughout the term.

In the non-face-to-face modality:

In the event that the student does not want continuous evaluation, or does not reach the cut-off grade in section 2, the evaluation activities will be:

1) Final test of theory and problems (85% of the grade).

2b) Final practical test with computer (15% of the grade).

It will be necessary to achieve a grade of 4 out of 10 in each of the sections 1 and 2 (or 2b) and to achieve an overall grade of 5 out of 10 (globally, in the 3 sections of the face-to-face modality or in the two of the non face-to.facel modality), in order to pass the subject. The final grade will be the most favourable for the student, between those calculated according to the two modalities.

6. Sustainable Development Goals

4 - Quality Education