Course Guide
34155 Lineal algebra and geometry II

COURSE DATA

Data Subject	
Code	34155
Name	Lineal algebra and geometry II
Cycle	Grade
ECTS Credits	9.0
Academic year	2023 - 2024

Study (s)

Degree	Center	Acad. year	Period
1107 - Degree in Mathematics	Faculty of Mathematics	2	Second term

Subject-matter

Degree	Subject-matter	Character
1107 - Degree in Mathematics	5 - Linear algebra and geometry	Obligatory

Coordination

Name	Department
ESTEBAN ROMERO, RAMON	363 - Mathematics
PEREZ CALABUIG, VICENT	363 - Mathematics
PEREZ RAMOS, M DOLORES	363 - Mathematics

SUMMARY

The conducting thread of this subject is the study of the concepts of linear or quadratic algebra that are invariant under a reference change for further applications, especially to the Euclidean affine space.

In Linear Algebra it is natural to refer the concepts (linear maps, bilinear forms, scalar products,...) to bases, because their behaviour on bases allows us to deduce properties of their behaviour on each element. This leads us to a matricial algebra.

However, the geometric-linear concepts are independent on the bases they are referred to. Therefore we must analyse what happens when the basis, or the reference system if an affine space is considered, is changed.

We treat the following topics:

1.- Given a vector space, the common properties of the coordinate matrices of the same endomorphism are characterised. In particular, we give a characterisation of the conjugacy classes of automorphisms of a vector space.

2.- When the vector space has an Euclidean metric, it has an orthonormal basis, and the transformations preserving the metric are interesting, that is, the isometries, and how a change of orthonormal basis affects the analytic expression of each Euclidean structure/map.

3.- The third part of the programme deepens into the study of the Euclidean affine space, which is the space that better approximates the ordinary geometry and physics.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

To have studied the subject of Linear algebra and geometry I. Moreover, it is convenient that the student has also followed the subject of Algebraic structures.

OUTCOMES

1107 - Degree in Mathematics

- Capacity for analysis and synthesis.
- Capacity for criticism.
- Solve problems that require the use of mathematical tools.
- Learn autonomously.
- Possess and understand the mathematical knowledge.
- Expressing mathematically in a rigorous and clear manner.
- Reason logically and identify errors in the procedures.
- Capacity of abstraction and modeling.
- Knowing the time and the historical context in which occurred the great contributions of women and men in the development of mathematics.
- Visualize and interpret the solutions obtained.

LEARNING OUTCOMES

- To recognise the diagonalisable endomorphisms and matrices.
- To dominate the calculation of the canonical forms of the endomorphisms of fector spaces of low dimension.
- To dominate the calculation of the orthogonal complement subspaces.
- To dominate the calculation of the canonical forms of symmetric and orthogonal endomorphisms.
- To recognise the Euclidean affine space as an idoneous model for metric geometry.
- To dominate the tecniques of metric calculations in low dimensions.
- To dominate the classification of movements and quadrics in Euclidean affine spaces of low.

DESCRIPTION OF CONTENTS

1. Preliminaries

2. Endomorphism theory. Canonical forms. Invariant factors. Elementary divisors.

3. Matrices over K[x]

4. Orthogonal congruence in symmetric and orthogonal matrices.

5. Metric classification of the movements of an Eucliden affine space.

6. Quadrics and conics. Metric classification.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	45,00	100
Classroom practices	34,00	100
Other activities	11,00	100
Preparation of evaluation activities	35,00	0
Preparing lectures	50,00	0
Preparation of practical classes and problem	50,00	0
TOTAL	**225,00**	

TEACHING METHODOLOGY

The presencial work will consist basicly in the attendance to magistral lectures given by the teacher in charge of this part of the teaching.

Special attention will be paid to the motivation of the interventions of the students by motivating and solving questions.

The practical presencial lectures will have two times: one in which the teacher solves some “typical” or “motivating” problem and another one in which the students, working in groups, solve the problems assigned by the teacher.

EVALUATION

The assessment of the learning of the knowledges and competences obtained by the students will be made in a continous way along the term and will consist of the following assessment blocks:

1.- **Theory and practice**

The assessment will be done in two stages:

- Continous assessment of the participation in the practical and theoretical lectures and the presentation of results in practical sessions. Moreover, if the teachers consider it suitable, they can prepare tests along the term. This assessment will have a weight of 10 % (one point) of the final mark.

- Final assessment consisting in theoretical-practical exams, whose weight in the final mark is the 80 %

(eight points) of the final score.

In order to pass the subject it will be necessary to obtain a minimum mark of 4 points over 10 in the exam.

2. **Seminars**

The participation and the attendance in the sessions of the seminars will be assessed and their weight on the final score is one point, that is, 10 % of the final score.

SECOND CALL: The mark obtained in the continous assessment and the seminar sessions will be used for the second call. The continous assessment and the seminars will not be recoverable.

REFERENCES

Basic

- Referència b1: T. W. Hungerford; Algebra, Springer; 1974
  Referència b2: B. Jacob, Algebra; Freeman and Co.; 1990
  Referència b3: N. Jacobson; Lectures in Abstract Algebra II; Freeman and Co., 1985
  Referència b4: J. Sancho San Román; Álgebra lineal y geometría; Octavio y Felex, 1985
  Referència b5: K. Spindler; Abstract algebra with applications, vol. I; Marcel Dekker, 1994
  Referència b6: R. López Machí, J. Martínez Verduch; Polinomios, matrices y cuádricas; Publicacions Universitat de València, 2016
  Referència b7: A. Ballester-Bolinches, R. Esteban-Romero, V. Pérez-Calabuig; A note on the rational canonical form of an endomorphism of a vector space of finite dimension; Operators and Matrices, 12 (3), 823-836, 2018; doi:10.7153/oam-2018-12-49
  Referència b8: D. S. Dummit, R. M. Foote; Abstract Algebra, 3rd ed.; Wiley, 2004