COURSE DATA

DATA SUBJECT

Code: 36587
Name: Linear Algebra and Geometry II P-M
Cycle: Undergraduate Studies
ECTS Credits: 9
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1928 - Double Degree Program Physics-Mathematics	Facultat de Ciències Matemàtiques	2	First quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1928 - Double Degree Program Physics-Mathematics	Segundo Curso (Obligatorio)	COMPULSORY

COORDINATION

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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.

COMPETENCES / LEARNING OUTCOMES

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

PRESENCIAL ACTIVITIES

Activity	Hours
Theory	45,00
Other activities	11,00
Classroom practices	34,00
Total hours	**90,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	0,00
Independent study and work	0,00
Preparation of lessons	100,00
Preparation for assessment activities	35,00
Resolution of case studies	0,00
Total hours	**135,00**

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

- T. W. Hungerford; Algebra, Springer; 1974.
- B. Jacob, Algebra; Freeman and Co.; 1990.
- N. Jacobson; Lectures in Abstract Algebra II; Freeman and Co., 1985.
- J. Sancho San Román; Álgebra lineal y geometría; Octavio y Felex, 1985.
- K. Spindler; Abstract algebra with applications, vol. I; Marcel Dekker, 1994.
- R. López Machí, J. Martínez Verduch; Polinomios, matrices y cuádricas; Publicacions Universitat de València, 2016.
- 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.
- D. S. Dummit, R. M. Foote; Abstract Algebra, 3rd ed.; Wiley, 2004.