

## SUBJECT TEACHING GUIDE

### G35 - Mathematics I: Linear Algebra and Geometry

Degree in Physics

Degree in Physics

Academic year 2023-2024

1. IDENTIFYING DATA					
Degree	Degree in Physics Degree in Physics			Type and Year	Core. Year 1 Core. Year 1
Faculty	Faculty of Sciences				
Discipline	Subject Area: Basic Mathematics for Science Basic Module				
Course unit title and code	G35 - Mathematics I: Linear Algebra and Geometry				
Number of ECTS credits allocated	6	Term	Semester based (1)		
Web					
Language of instruction	Spanish	English Friendly	Yes	Mode of delivery	Face-to-face

Department	DPTO. MATEMATICAS, ESTADISTICA Y COMPUTACION				
Name of lecturer	CECILIA VALERO REVENGA				
E-mail	cecilia.valero@unican.es				
Office	Facultad de Ciencias. Planta: + 0. DESPACHO DE PROFESORES (0058)				
Other lecturers					

3.1 LEARNING OUTCOMES
- To use mathematical language
- To know important examples
- None
- To revisit the concepts of analytic geometry and of linear equations system solving , in the new, advanced framework of Linear Algebra and Euclidean and Affine Geometry

#### 4. OBJECTIVES

To acquire specific knowledge about linear equations systems properties . Learning it by processing, in some autonomous way, the information transmitted by the professor. To reach a certain familiarity with basic concepts of Linear Algebra and Affine and Euclidean Geometry. To understand the framework and the abstract language related to linear equations systems and to the geometry of points, lines, planes...

To know some simple and prototypical (for this subject) proofs (for instance: proving the validity of Gram - Schmidt procedure). To be able to prove, rigorously, some statements of geometric kind, concerning solutions of linear equations systems or their transformations.

To feel at ease with Linear Algebra basic tools and processes . To be able of some logic reasoning within an abstract context and to develop certain geometry vision in the plane and in the three dimensional space. To be able to digest some abstract notions (eg. that of subspace, linear application, orthogonality, etc.) and to apply them in a two and three -dimensional context.

To be able to solve problems in the geometrical context associated to vector spaces , scalar product, notion of distance.. To solve Linear Algebra and Geometry problems by using mathematical software programs , such as SAGE. To conceive Linear Algebra as a basic tool for solving many elementary problems.

To be able to complete the received information on the subject , by searching for complementary material or clarifications through textbooks or visiting recommended web pages. To develop the capacity to read mathematics texts .

#### 6. COURSE ORGANIZATION

##### CONTENTS

1	Vector Spaces 1.1 Definition of vector space. First examples. 1.2 Vector subspaces. Linear combinations. 1.3 Linear independence. Bases. 1.4 Sum and intersection of subspaces. Direct sum.
2	Linear Applications and matrices. 2.1 Linear Application. Definition and examples. 2.2. Kernel and image. Dimension formula. 2.3 Linear application types. Isomorphisms. 2.4 Matrix associated to a linear application. 2.5 Base change. Equivalent matrices.  Endomorphism Theory 3.1 Eigenvalues and eigenvectors. 3.2. Minimal polynomial of an endomorphism 3.3. Invariant subspaces.
3	The theory of endomorphisms 3.4 Nilpotent endomorphisms. Jordan canonical form. Euclidean Geometry 4.1 Scalar product and orthogonality. 4.2 Orthogonal projections and applications: least squares approximation and overdetermined systems. 4.4 Isometries between vector spaces. 4.5 Orthogonal transformations in 2 and 3 dimensional spaces. 4.6 Affine Space.
4	Final exam

7. ASSESSMENT METHODS AND CRITERIA				
Description	Type	Final Eval.	Reassessn	%
34% weight in the final mark. About four hours exam, in Jan. /Feb. If needed, there is a second opportunity in September.	Written exam	No	Yes	60,00
33% weight in the final mark. About four hours exam, in Oct. /Nov. If needed, there is a second opportunity in next exams.	Written exam	No	Yes	40,00
TOTAL				100,00
Observations				
None				
Observations for part-time students				
None				

8. BIBLIOGRAPHY AND TEACHING MATERIALS
BASIC
L. González Vega y C. Valero: Álgebra Lineal y Geometría. Universidad de Cantabria.
Francisco José Marcellán Español, Jorge Arvesu Carballo, Jorge Sánchez Ruiz: Problemas resueltos de Álgebra Lineal. Editorial Paraninfo. 2015.