COURSE DATA

DATA SUBJECT

Code: 34237
Name: Algebra and geometry II
Cycle: Undergraduate Studies
ECTS Credits: 6
Academic year: 2026-27

STUDY (S)

Degree	Center	Acad. year	Period
1105 - Degree in Physics	Facultat de Física	1	Second quarter
1929 - Double Degree Program in Physics and Chemistry	Facultat de Química	1	Second quarter

SUBJECT-MATTER

Degree	Subject-matter	Character
1105 - Degree in Physics	Mathematics	BASIC
1929 - Double Degree Program in Physics and Chemistry	Primer Curso (Obligatorio)	COMPULSORY

COORDINATION

PERUCHO PLA MANEL

MARTI PUIG JOSE MARIA

TORRES FORNÉ ALEJANDRO

SUMMARY

Objectives:
To acquire basic knowledge of mathematics in the area of algebra and geometry, essential for studies in Physics.

Descriptor of the subject in the curriculum (Algebra and Geometry I and II):

Complex numbers. Algebraic structures. Vector spaces. Matrices and determinants. Systems of linear equations. Linear operators. Diagonalization. Euclidean geometry. Tensors.

Relationship with other materials prior, concurrent and future: instrumental course, a primary to study physics in any of their specialities. Complementary to other subjects of Mathematics and Mathematical

Methods.

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PREVIOUS KNOWLEDGE

RELATIONSHIP TO OTHER SUBJECTS OF THE SAME DEGREE

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

OTHER REQUIREMENTS

Secondary school Mathematics:
Vector spaces. Matrices. Determinants. Linear equation systems. Vectors. Geometry. Metric problems. Successions and numerical series. Function limits. Continuity. Derivatives. Taylor developments. Integration.

COMPETENCES / LEARNING OUTCOMES

1105 - Degree in Physics

Apply acquired knowledge to professional activities: know how to solve problems and develop and defend arguments in a clear and structured manner, drawing on that knowledge.

Be able to understand and master the use of the most commonly used mathematical and numerical methods.

Communicate effectively, both orally and in writing, adapting to the characteristics of the situation and the audience.

Communication Skills (written and oral): Being able to communicate information, ideas, problems and solutions through argumentation and reasoning which are characteristic of the scientific activity, using basic concepts and tools of physics.

Contribute to designing, developing and implementing solutions that address social demands, taking the Sustainable Development Goals as a reference.

Convey information, ideas, problems and solutions to both specialist and non-specialist audiences.

Demonstrate critical and self-critical thinking within the field of study, considering aspects such as professional ethics, moral values and the social implications of the different activities carried out.

Demonstrate knowledge and understanding of social inequalities based on sex and gender within this specific field of study; integrate the different needs and preferences based on sex and gender into the design of solutions and problem solving.

Demonstrate knowledge based on advanced textbooks and informed by current developments at the forefront of the field of study.

Develop the tools, habits and learning techniques necessary to undertake further studies with a high degree

of independence.

Foreign Language skills: Have improved command of English (or other foreign languages of interest) through: use of the basic literature, written and oral communication (scientific and technical English), participation in courses, study abroad via exchange programmes, and recognition of credits at foreign universities or research centres.

Gather and interpret relevant data to form judgements including reflection on relevant social, scientific or ethical issues relating to activities or projects.

Interpret and perform calculations independently, using both small-scale and large-scale computing systems, including the development of software. Problem-solving and IT skills

Learn autonomously, making informed decisions in different contexts, issuing judgements based on experimentation and analysis and transferring knowledge to new situations.

Modelling & Problem solving skills: be able to identify the essentials of a process / situation and to set up a working model of the same; be able to perform the required approximations so as to reduce a problem to an approachable one. Critical thinking to construct physical models.

Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.

Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.

Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.

Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.

To know how to apply the knowledge acquired to professional activity, to know how to
solve problems and develop and defend arguments, relying on this knowledge.

Understand and master the use of the most commonly used mathematical and numerical methods.

DESCRIPTION OF CONTENTS

Matrix NxM (definition and operations; transposed and adjoint). Determinant of a matrix (definition and calculation, properties). Inverse of a matrix (definition and calculation. Range of a matrix). Resolution of

1. Matrices, determinants and linear equations

linear equations (Cramers rule).

2. Linear operators

Linear operators. Matrix of a linear operator. Adjoint operator (matrix representation). Normal operators (self-adjoint and unitary operators, change of base). Projector representation.

3. Spectral theory

Eigenvalues and eigenvectors. Eigenvalues and eigenvectors of normal operators (self-adjoint and unitary operators). Diagonalization of an operator (Change of base. Function of an operator). Spectral decomposition of a normal operator.

4. Tensors. Algebraic theory

Dual space. Multilinear applications. Covariant and contravariant tensors. Change of base formula. Symmetric and antisymmetric tensors.

5. Affine space

Affine space (introduction, Cartesian coordinates). Change of reference in the affine space. Orthogonal transformations in the affine space (rotations and reflections in two and three dimensions). Curvilinear coordinate systems (polar coordinates, cylindrical and spherical coordinates).

6. Spatial analytic geometry

Position problems and metric problems in the three-dimensional space (definition of lines and planes, use of vectors to find distances and angles). Introduction to quadratic forms.

WORKLOAD

PRESENCIAL ACTIVITIES

Activity	Hours
Tutorials	15,00
Theory	45,00
Total hours	**60,00**

NON PRESENCIAL ACTIVITIES

Activity	Hours
Attendance at other activities	0,00
Individual or group project	10,00
Independent study and work	55,00
Preparation of lessons	15,00
Preparation for assessment activities	10,00
Resolution of case studies	0,00
Total hours	**90,00**

TEACHING METHODOLOGY

Contact teaching (40%)

Theoretical and practical classes: It addresses the conceptual and formal matter and resolution of problems or cases as the application of theoretical concepts. They are based on lectures and mainly the use of dialogued teaching tools as graphical representation of solutions, design presentations, etc.

Group tutoring sessions in small working groups, focused on active student participation: dealing with doubts in theoretical concepts and problem solving, reinforcement in areas of greatest difficulty, conceptual questionnaires, experimental demonstrations relevant to studied cases, and associated with an ongoing evaluation and monitoring the student's progress in the field.

Student's Personal work (60%):

- Study of the theoretical concepts.

- Resolution of exercises and problems, individually and in groups.

-Individual tutorials: questions addressed to the teacher on difficulties encountered in the study and resolution of problems or discussion on topics of interest, bibliography, etc.

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EVALUATION

The assessment system, for both examination calls,

1) Written examinations: One part will assess the understanding of the theoretical-conceptual and formal nature of the subject, both through theoretical questions, conceptual questions and numerical or simple particular cases. Another part will assess the applicability of the formalism, by solving problems and critical capacity regarding the results. Proper argumentations and adequate justifications will be important in both cases. The minimum mark to be got in each of the parts to pass the course is 3/10. At the same time, the minimum overall exam grade to average with the continuous evaluation grade (see point 2) is 4 out of 10.

2) Continuous assessment: assessment of exercises and problems presented by students, questions proposed and discussed in class, oral presentation of problems solved or any other method that involves an interaction with students.

3) The final mark will be the maximum of the examination mark and the examination mark weighted with the mark of the continuous assesment, with a 30% weight for the continuous assesment (and 70% for the exam).

NOTE: To pass this course, its grade may be averaged with the grade obtained in Algebra and Geometry I during the same academic year, provided that the average grade across the two courses is 5.0 out of 10 or higher, and a minimum grade of 4.0 out of 10 has been obtained in this course (compensation criteria established for this by the CAT of Physics Degree).

REFERENCES

Basic:

- J. J. Ferrando, J. M. Martí, M. Perucho, S. Planelles, "Àlgebra i Geometria", Publicacions Universitat de València (1a ed., 2024).
- K. F. Riley, M. P. Hobson, S. J. Bence, "Mathematical Methods for Physics and Engineering". Cambridge University Press (3a ed., 2006).
- D. J. E. Puertas, P. M. Marqués, "Matemática Universitaria. Álgebra". Bello (1a ed., 1973).

Additional:

- Riley, K.F., Hobson, M. P, "Student solutions manual for mathematical methods for physics and engineering". Cambridge University Press (3a ed., 2006).
- F. Granero, "Álgebra y geometría Analítica". McGraw-Hill (1a ed., 1985).
- J. De Burgos, "Curso de Álgebra y Geometría". Alhambra S.A. (1a ed., 1976).
- G. Strang, "Introduction to linear algebra". Wellesley-Cambridge Press (6a ed., 2023).
- A. G. Kurosch, "Curso de álgebra superior". Mir (1a ed., 1977).