

Linear Geometry

Code: 100095
ECTS Credits: 6

2025/2026

Degree	Type	Year
Mathematics	OB	2

Contact

Name: Eduardo Gallego Gómez

Email: eduardo.gallego@uab.cat

Teachers

Eduardo Gallego Gómez

Florent Nicolas Balacheff

Teaching groups languages

You can view this information at the [end](#) of this document.

Prerequisites

In order to successfully follow this course, the student must be familiarized with the concepts and techniques of linear algebra that are the content of the first year course "Àlgebra Lineal".

It is also very important to have the notions of the course "Fonaments de les Matemàtiques" perfectly acquired.

Objectives and Contextualisation

The main goal of the course is to present to most fundamental notions in projective, affine and euclidean geometry.

On the one hand, the students will get familiar with the use of synthetic arguments in geometry (those that do not require the use of coordinates), thus deepening in their ability to construct and expose mathematical arguments.

On the other hand, the analytical viewpoint will also be important: the student will learn to perform computations in coordinates, always looking for the most efficient and simple way to carry them on.

Competences

- Actively demonstrate high concern for quality when defending or presenting the conclusions of one's work.
- Apply critical spirit and thoroughness to validate or reject both one's own arguments and those of others.
- Assimilate the definition of new mathematical objects, relate them with other contents and deduce their properties.
- Identify the essential ideas of the demonstrations of certain basic theorems and know how to adapt them to obtain other results.
- Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
- Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.
- Use computer applications for statistical analysis, numeric and symbolic calculus, graphic display, optimisation or other purposes to experiment with Mathematics and solve problems.

Learning Outcomes

1. Actively demonstrate high concern for quality when defending or presenting the conclusions of one's work.
2. Apply critical spirit and thoroughness to validate or reject both one's own arguments and those of others.
3. Classify conic and quadric sections and find their notable elements.
4. Classify planar and spatial isometries, determining the type and characteristic elements.
5. Know how to resolve planar and spatial geometric problems.
6. Operate with points, vectors, distances and angles in relative and Euclidian spaces and with the corresponding systems of reference, subspaces and transformations
7. Students must be capable of applying their knowledge to their work or vocation in a professional way and they should have building arguments and problem resolution skills within their area of study.
8. Students must have and understand knowledge of an area of study built on the basis of general secondary education, and while it relies on some advanced textbooks it also includes some aspects coming from the forefront of its field of study.

Content

Affine Geometry

- Affine spaces
- Coordinate systems
- Linear varieties
- Simple ratio
- Affine maps

Euclidean Geometry

- Euclidean vector spaces and euclidean affine spaces
- Distances, angles and volumes
- Orthogonal maps and isometries

Projective Geometry

- Projective spaces, affine charts.
- Double ratio
- Duality

Quadrics

- Projective and affine classification of conics and quadrics

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
exercises	15	0.6	
lessons	30	1.2	
seminars	8	0.32	
Type: Autonomous			
problem solving	41	1.64	
study	30	1.2	
test oriented study	10	0.4	

There will be 30 theory lectures and 15 problems lectures. Moreover there will be 4 seminar sessions (2 hours each). Attendance to these activities is highly recommended.

The student will periodically receive some problems lists and should try to solve them individually. Some of these problems are easily solved applying the concepts acquired in the theory lectures. Others, however, demand of a higher mathematical creativity level and may represent a good challenge to the student.

During the seminar sessions the students will work in little groups on the solution of some exercises with the help of the professor.

In any case, simply attending the lectures is completely insufficient to acquire this course's skills. A substantial amount of individual work is necessary.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Assessment

Continuous Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Exam #1	40%	4	0.16	2, 3, 4, 1, 6, 8, 7, 5
Exam #2	40%	4	0.16	2, 3, 4, 1, 6, 8, 7, 5
Handovers and other activities	20%	4	0.16	2, 3, 4, 1, 6, 8, 7, 5
Second chance exam	80%	4	0.16	2, 3, 4, 1, 6, 8, 7, 5

During the semester the students will hand over some exercises and/or will carry out ACME activities. These handovers and activities have an overall weight of 20% in the global mark, and there is no second chance for them.

There will be two exams, with a weight of 40% each.

In case the global mark is smaller than 5, the student will have the possibility to take a second chance exam. The mark in this second chance exam will be at most 7.5 and will replace the mark obtained in the two exams.

The students who opt for the unique evaluation mode will do a final exam which will evaluate all the contents of the course. The global mark of the course will be the resulting one of this exam. If this mark is below 5, the student will have the possibility to participate in the second chance exam, with a maximum mark of 7.5.

The students will obtain the "Non-assessable" qualification when the evaluation activities carried out have a weighting of less than 50%.

Bibliography

Euclid, *"Elements of Geometry"*

D. Hilbert, *"Grundlagen der Geometrie"*

R. Hartshorne, *"Geometry: Euclid and beyond"*

A. Reventós, *"Geometria Projectiva"*

A. Reventós, *"Afinitats, moviments i quàdriques"*

J. Kock, *"Lliçons de geometria afí."* [<https://mat.uab.cat/~kock/docencia/GL/>]

J. Agudé, *"Un curs de geometria lineal"* [<http://mat.uab.cat/~aguade/teaching.html>]

Software

At some point SageMath might be used.

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this [link](#). To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(PAUL) Classroom practices	1	Catalan	first semester	morning-mixed
(PAUL) Classroom practices	2	Catalan	first semester	morning-mixed
(SEM) Seminars	1	Catalan	first semester	morning-mixed
(SEM) Seminars	2	Catalan	first semester	morning-mixed

(TE) Theory	1	Catalan	first semester	morning-mixed
-------------	---	---------	----------------	---------------