27010 - Linear Geometry

Información del Plan Docente

Academic Year	2017/18
Faculty / School	100 - Facultad de Ciencias
Degree	453 - Degree in Mathematics
ECTS	6.0
Year	2
Semester	First semester
Subject Type	Compulsory
Module	---

1.General information

1.1.Introduction

Brief introduction to the subject.
This class is part of the Mathematics Bachelor's Degree core curriculum. Basic notions and results of a geometric nature are introduced using the previously acquired knowledge of lineal algebra.
The fundamental concepts of affine and Euclidean geometry are introduced, with a special focus on the plane and space.
This subject will be divided up into two classes, one will be taught in Spanish and the other one in English. Succesful completion of this subject in the English class will be shown in your transcript (Suplemento Europeo al Título). In addition, students that complete 18 ETCS in English will automatically receive credits for the English language course Idioma Moderno Inglés B1 (24900).

1.2.Recommendations to take this course

It is recommended to have completed the *Algebra Lineal* (27000) course.
The student is encouraged to attend and actively participate in the lectures, problem sessions, and labs, as well as to complete the individual and group work load. The use of office hours is also highly recommended. Their schedule will be announced at the beginning of the course.

1.3.Context and importance of this course in the degree

This subject belongs in the Linear Algebra section. This class will provide the student a geometrical interpretation of the abstract concepts from Linear Algebra. This will be useful in a variety of other subjects throughout the Degree.

1.4.Activities and key dates

A written test will be given at the end of the semester. This test will take place during the official test period. The place and time will be announced by the *Facultad de Ciencias* before the beginning of the course.

2.Learning goals

2.1.Learning goals

In order to pass this class, the student should be able to show the following skills...

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Operate with points, vectors, distances, and angles both in affine and Euclidean spaces, as well as the corresponding reference systems, subspaces, and their transformations.
Know how to solve geometrical problems on the plane and space.
Classify plane and space isometries determining their type and characteristic elements.
Classify conics and quadrics and determine their intrinsic elements.

2.2.Importance of learning goals

The learning objectives provide basic skills within the Degree. (See Context and reasons behind the subject area in the Degree).

The fundamental concepts of affine and Euclidean geometry are introduced, with a special focus on the plane and space.

3.Aims of the course and competences

3.1.Aims of the course

This subject and its syllabus have the following goals:

Basic notions and results of a geometric nature are introduced using the previously acquired knowledge of linear algebra.
The fundamental concepts of affine and Euclidean geometry are introduced, with a special focus on the plane and space.
This will be especially useful in order to recognize geometric objects and their properties in other areas of Mathematics and Sciences, as well as in various areas of everyday life, art, architecture, etc.

3.2.Competences

Upon succesfully completion of this subject the student will improve the following abilities...
Carry out the goals described in section 2.1
CT1. Be able to clearly state, both orally and in writing, the student's reasoning, problem solving techniques, reports, etc.
CT3. Differentiate between essential and non-essential aspects of a problem, state conjectures and be able to provide reasons to either prove or refute them, identify errors or gaps in incorrect argumentations, etc.

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

The student must demonstrate that they have achived the learning objectives by means of the following evaluation activities:
Evaluation throughout the course (10%): classwork and lab exercises (2%) and evaluation of individual and group projects (8%).
Final exam (90%).
In addition, according to current bylaws, a student also has the right to show up to a final exam and complete the class upon passing the test.

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

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The general teaching methodology designed for this class is based on the following:
-Lectures
-Problem sessions in small groups
-Computer labs.
-Office hours.
-Students' individual work.

5.2.Learning tasks

The following are the main learning activities offered in this class:

1. Lectures
2. Problem sessions in small groups
3. Computer labs.
4. Office hours.
5. Students' individual work.
6. Additional support via the University virtual platform Moodle (restricted access to students). Notes, solutions to problems, and other forums are available for students to interact with their instructors.
7. Students are afforded the opportunity to submit individual homework assignments on a weekly basis. These assignments are checked by the instructor and returned on a regular basis. This process allows students to pinpoint strengths/weaknesses and helps their learning process.
8. Computer aided sessions with SageMath .

5.3.Syllabus

Class syllabus:
Chapter 1: AFFINE SPACES. Definition of affine spaces. Examples. First properties. Linear varieties and affine subspaces. Relative position of affine subspaces. New affine spaces from old. Grassmann formulas. Affine references and coordinates. Barycenter. Simple ratio. Thales, Ceva, and Menelao Theorems. Exercises.
Chapter 2: AFFINE MORPHISMS. Definition of affine morphisms. Properties of affine morphisms. Examples. Homologies on the plane. Affine morphisms in coordinates. Invariant affine subspaces. Exercises.
Chapter 3: EUCLIDEAN AFFINE SPACES AND MOTIONS. Euclidean affine space. Pythagorean Theorem. Distance between linear varieties. Definition of Euclidean motions. Examples. Gliding vector. Classification of Euclidean motions. Motions on the plane and three-dimensional space. Geometric interpretation. Exercises.
Chapter 4: QUADRICS AND AFFINE CLASSIFICATION. Equivalent quadratic polynomials. Invariants and classification theorems. Affine classification of conics. Three dimensional quadrics. Quadrics with center. Exercises.

5.4.Course planning and calendar

See the academic calendar of the Universidad de Zaragoza and the class schedules published on the School of Sciences (Facultad de Ciencias) webpage. As a general rule, there are three lecture periods and one problem session a week. The exact deadlines for turning assignments in will be announced in class and posted on a bulletin board and on the online platform (Moodle). The same will be done with the date, place and time of the final exam.

5.5.Bibliography and recommended resources

Basic reference :
- A. Reventós, Affine maps, Euclidean motions and quadrics, Springer 2011.

Complementary references :

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- Manuel Castellet, Irene Llerena. Algebra lineal y geometría. Reverté, D.L. 2000

- Luis M. Merino González, Evangelina Santos Aláez. Álgebra lineal: con métodos elementales. Los autores, D.L. 1999
- Hernández Rodríguez, Eugenio. Algebra y geometría. Wilmington, Delaware; Madrid. Addison-Wesley Iberoamericana. Universidad Autónoma, cop. 1994