UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Linear Algebra and Geometry

2223-1-E3501Q051

Aims

In line with the educational objectives of the Degree in Mathematics, the course aims to provide an introduction to linear algebra with applications to geometry, essential to prepare the student to understand the mathematics that will be taught in other courses.
Students are expected to gain knowledge of fundamental notions on vector spaces, diagonalization of endomorphisms and scalar products. They are also expected to gain the ability to reproduce the proofs presented in the course, to solve easy problems using the techniques they have learned, and to delve further, with or without guidance, into some of the results presented during the course.

Contents

Vector spaces; systems of linear equations and affine geometry. Linear maps, matrices; diagonalization of an endomorphism. Scalar products.

Detailed program

- Matrix calculus.
- Systems of linear equations.
- Affine subspaces of R? and their representations. Distance and orthogonality in R?
- Vector spaces.
- Linear maps and matrices.
- Determinants.
- Eigenvalues, eigenvectors, characteristic polynomial, diagonalization.
- Dual space.

- Scalar and Hermitian products; Sylvester Theorem.
- Self-adjoint, orthogonal, unitary operators.
- Spectral Theorem.

Prerequisites

Good knowledge of high school mathematics.

Teaching form

The course is organized in Lectures (48 hours, 6 CFU) and Exercise classes (24hours, 2CFU). Definitions, results, and relevant theorems will be discussed in Lectures, providing examples and problems making use of the notions introduced. Exercises on the subject matters covered in the lectures are presented and solved during Exercise classes.

Some exercise sets will be made available regularly on the e-learning website to encourage participation.

A tutor will provide students with support in solving the exercises published on the e-learning website.

Teaching activies will be held in presence or remotely according to how the health situation evolves.

Textbook and teaching resource

Reference books:

- M. Abate, Geometria, McGraw Hill, 2002.
- S. Lang, Algebra Lineare, Boringhieri, III edizione.
- E. Schlesinger, Algebra lineare e geometria, Zanichelli 2017

Lecture notes on the e-learning webpage.

Semester

First semester.

Assessment method

Written and oral exams, evaluated on the basis of correctness, completeness, precision, and clarity of the answers.

- **Written exam.** It consists of two parts:

1. exercises (with open-ended questions) for evaluating the ability to apply the theoretical results in solving problems;
2. a theoretical question where the student is asked to answer by giving definitions, statements of theorems, and provide examples and motivations.

The examination lasts two hours. The maximum score is 33 points: up to 27 for the exercises, and up to 6 for the theoretical question. The passing score of the written exam is 15 points.

- **Oral exam.** Having passed the written exam is required to attain the oral exam. It consists of two parts: in the first part the written exam is discussed, in the second part is required to answer questions to evaluate knowledge of definitions, theorems, and proofs. Together with the score of the written part, both parts are taken into account in forming the final score.

During the course, exercises will be assigned; their evaluation will give right to a bonus that concurs both to reaching the threshold for admission to the oral exam and to the final evaluation. This bonus expires after the first two exam calls.

The exam is passed if the final score is at least 18 points.

Scoring at least 21 in the written exam yields the **exemption from the oral exam**. In this case, the final score will be the minimum between S and 25, being S the score of the written part increased by the score gained with homework.

Office hours

By appointment.

Sustainable Development Goals

QUALITY EDUCATION