UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Linear Algebra and Geometry

2021-1-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^n and their representations. Distance and orthogonality in R^n
- 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

A good knowledge of mathematics studied in higher school.

Teaching form

The course is organized in Lectures (48 hours, 6 CFU) and Exercise classes (24hours, 2CFU). Definitions, results and relevant theorems will be presented in Lectures, providing examples and problems making use of the notions introduced. Exercises related to the subject matters covered in the lectures are presented and solved during Exercise classes. In order to encourage student participation, some exercises are left for the students to solve.

Due to the current health emergency, Lectures and Exercises will be held in a mixed mode that will balance a possible partial presence in the lecture room and a combination of recorded lectures or exercises, either synchronous or asynchronous. Lessons and Exercises taking place in the lecture room will be recorded and made available on the e-learning website.

A tutor will aid the students in solving the exercises published on the e-learning website; the delivery method will be specified according to the current health situation.

Textbook and teaching resource

Reference book:

- S. Lang, Algebra Lineare, Boringhieri, III edizione.

Other resources:

- M. Abate, Geometria, McGraw Hill, 2002.

Lecture notes on e-learning webpage.

Semester

First semester.

Assessment method

Written and oral exam

The written exam consists of two parts:

a. exercises (with open-ended questions) which allow the teachers to evaluate the student's ability to apply the theory in solving problems;

b. a theoretical question where the student is asked to give complete definitions, statements of theorems and/or provide examples and motivations.

The examination lasts two hours. The total score (33 points) is divided into 27 points for the exercises and 6 points for the theoretical part. The test is evaluated in terms of correctness. completeness, accuracy and clarity of the solutions.

Oral exam.

Students are admitted to the oral test only if the written exam's score is at least 15 points. This test consists in a first part given by the discussion of the written test and in a second part consisting in the verification by the teachers of knowledge and mastery of definitions, theorems and proofs in the program. Both parts are taken into account in forming the final mark, which is the average of the written and oral exam's scores. The test is evaluated in terms of correctness, completeness, accuracy and clarity of the answers. The exam is passed if the final score is at least 18 points.

Pending the current health emergency, the oral exam will be held online through WebEx or analogous, with access made available on the e-learning website. The procedures for carrying out the written test will be established later on.

Due to the current health situation, mid term examinations are not planned.

Exercises assigned during the tutoring sessions and submitted on line will be assessed and will contribute the the final mark.

Office hours

By appointment. Due to the current health emergency, student reception will be carried out online through WebEx or analogous.