UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Mathematical Analysis III

2324-3-E3501Q056

Aims

The course aims at providing the knowledge about the fundamental concepts and statements of advanced mathematical analysis. It will also build the skills needed to understand and use the most important proving arguments and techniques in the theory and the ability to solve exercises and deal with problems exploiting them.

Contents

Banach Spaces. Lp spaces. Hilbert spaces. Fourier series. Convolution. Fourier transform. Baire's Theorem. Open mapping Theorem. Banach Steinhaus Theorem. Dual space. weak convergence.

Detailed program

Definition of Banach space. Examples.
Definition of L ^ p (X, ?), ? positive measure.
Holder and Minkowski inequalities.
Completeness of L ^ p (X, ?).
Inclusions of spaces L ^ p (X, ?), finite ?.
Inclusions of spaces L ^ p (Z).
Relations between pointwise convergence, convergence in Lp, and in measure.
Density of Cc (Rn), Coo (Rn) and of the Schwartz space in L p (Rn).
Duality of Lp spaces (only statement).
Hilbert spaces.
Inner product.
Cauchy-Schwarz Inequality.

Hilbert space.
Points of minimum distance from a closed convex.
Projection theorem.
Bessel inequality.
Complete orthonormal systems.
Parseval formula.
Gramschmidt process.
Fourier series for functions on the thorus
Dirichlet kernel.
Convergence in L2.
Pointwise convergence.
Linear operators between normed vector spaces.
Dual space.
Baire's theorem.
The Banach-Steinhaus Theorem.
Divergence of the Fourier series.
Open Mapping Theorem.
Closed Graph Theorem.
Non surjectivity of the Fourier transform from L 1 (T) into c_0 (Z).
Weak convergence.
Fourier transform in Rn.

Fou

Prerequisites

Topology. Linear algebra. Differential calculus. Integral calculus. Measure theory. Complex numbers.

Teaching form

Lectures in the classroom using the blackboard. The Language used is italian.

Textbook and teaching resource

G.B. Folland "Real Analysis"
L. Grafakos "Classical Fourier Analysis"
W. Rudin "Real and Complex Analysis"
W. Rudin "Functional Analysis"
E.M. Stein R. Shakarchi "Functional Analysis"
E.M. Stein R. Shakarchi "Fourier Analysis"

Notes

Semester

Second semester

Assessment method

The exam consists of a written test and an oral test. During the written test, exercises are assigned to be completed and their evaluation allows for a maximum of 8 points to be added to the written score if it is higher than 12.

Written Test:

The written test consists of exercises aimed at verifying the understanding of the course content, the ability to apply the learned demonstrative techniques to problem-solving, and the clarity of exposition. Each exercise will be assigned a maximum partial score based on its difficulty and length. The student's evaluation will be based on the accuracy, completeness, rigor, clarity, and organization of the solutions. The maximum score for the written test is 33.

The proposed exercises are in line with those covered during the lessons.

Admission to the oral test is granted with a written evaluation equal to or greater than 16.

The duration of the written test is generally two hours.

Oral Test:

The oral exam consists of a discussion of the written test and theoretical questions (definitions and theorems with proofs) on the topics covered in the lectures. The oral test will assess the knowledge and understanding of the course content, as well as the ability to organize a coherent and precise exposition in a clear, effective, and well-structured manner.

Office hours

By appointment.

Sustainable Development Goals

QUALITY EDUCATION