UNIVERSITÀ DI PAVIA

Anno Accademico 2022/2023

MATHEMATICAL ANALYSIS 4

Enrollment year	2020/2021
Academic year	2022/2023
Regulations	DM270
Academic discipline	MAT/05 (MATHEMATICAL ANALYSIS)
Department	DEPARTMENT OF MATHEMATICS "FELICE CASORATI"
Course	MATHEMATICS
Curriculum	PERCORSO COMUNE
Year of study	3°
Period	1st semester (29/09/2022 - 13/01/2023)
ECTS	9
Lesson hours	78 lesson hours
Language	Italian
Activity type	WRITTEN AND ORAL TEST
Teacher	COLLI PIERLUIGI (titolare) - 9 ECTS
Prerequisites	The basics of Mathematical Analysis 1 and 2 and of Linear Algebra are supposed to be known.
Learning outcomes	The course is divided in two parts and it aims to provide a systematic exposition of the abstract measure theory, with additions on the fundamental theorem of integral calculus, and to present the definitions and first results on normed spaces, Banach and Hilbert spaces, also discussing projections and abstract Fourier series. The theory is accompanied by examples and exercises.
Course contents	Measure theory. Lebesgue measure, measurable sets and functions, Lebesgue integral, passage to the limit under the integral, different types of convergence. Product measures, Fubini and Tonelli theorems. Real measures, Hahn decomposition, Radon-Nikodym theorem, functions with bounded

	variation. Normed spaces and Banach spaces. Linear continuous operators. L^p spaces with their properties. Hilbert spaces, Riesz and projections theorems, Fourier series. Extended summary Measure theory. Lebesgue measure, sigma-algebras, measures, measurable functions, Lebesgue integral, theorems of passage to the limit under the integral, almost-everywhere and quasi-uniform convergences, convergence in measure. Product measures, Fubini and Tonelli theorems. Real measures, Hahn decomposition, absolutely continuous measures, Radon-Nikodym theorem, functions of bounded variation, absolutely continuous functions and the fundamental theorem of calculus. Normed spaces and Banach spaces: foundations of the theory. Subspaces. Linear continuous operators. Dual space. Numerous examples. L^p spaces with their properties: the Young, Hölder, Minkowski inequalities. Completeness. Hilbert spaces: Riesz and projections theorems. Fourier series: decomposition theorems, complete orthonormal systems, Riesz-Fisher theorem. Fourier series in L ^ 2_T and completeness of the system exp (ikT). Convolutions with trigonometric polynomials and Fejer kernels.
Teaching methods	Lectures and exercises in the classroom, largely run on the blackboard. Availability to discuss with students during reception hours.
Reccomended or required readings	G. Gilardi: Analisi Matematica di Base, McGraw-Hill G. Gilardi: Analisi 3, McGraw-Hill H. Brezis: Functional Analysis, Springer in addition to the educational resources available on the course web page.
Assessment methods	The exam consists of a written test with 2 hours of time (during which it is not allowed the use of notes, texts, minicomputers, ...) plus oral examination. The result of the written test is not binding to participate in the oral test and the success of the examination, but of course it is an important element of judgment for the final evaluation.
Further information	The teachers are available to the students to provide them with indications and suggestions for the selection of texts and educational material, as well as proposals for exercises, exam tests and theoretical support material.
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile