UNIVERSITÀ DI PAVIA

Anno Accademico 2020/2021

FUNCTIONAL ANALYSIS

Enrollment year	2019/2020
Academic year	2020/2021
Regulations	DM270
Academic discipline	MAT/05 (MATHEMATICAL ANALYSIS)
Department	DEPARTMENT OF MATHEMATICS "FELICE CASORATI"
Course	MATHEMATICS
Curriculum	PERCORSO COMUNE
Year of study	2°
Period	1st semester (01/10/2020 - 20/01/2021)
ECTS	9
Lesson hours	78 lesson hours
Language	Italian
Activity type	WRITTEN AND ORAL TEST
Teacher	MORA MARIA GIOVANNA (titolare) - 9 ECTS
Prerequisites	A very good knowledge of multivariable differential calculus, measure theory and Lebesgue integration is required, as well as a basic knowledge of linear algebra and topology.
Learning outcomes	At the end of the course students will know the main results and principles of abstract Functional Analysis. Through the exercise sessions students will learn how to apply the theoretical results to explicit problems. Moreover, they will be able to work autonomously on the formulation and the analysis of problems of Mathematical Analysis in spaces of infinite dimension.
Course contents	Norms and scalar products. Normed spaces. Bounded linear operators. Topological dual space. Banach spaces. Hahn-Banach Theorem: analytical and geometric forms and their consequences. Baire Lemma. Banach-Steinhaus Theorem.

	Open Mapping Theorem, Closed Graph Theorem, and their consequences. Weak* topology, weak topology, and their properties. Banach-Alaoglu Theorem. Reflexive spaces. Separable spaces. L^p spaces. Reflexivity and separability of L^p. Riesz Representation Theorem. Approximation by convolution. Ascoli-Arzelà Theorem. Fréchet-Kolmogorov Theorem. Hilbert spaces. Projection on a convex closed set. Riesz Representation Theorem for the dual space. Lax-Milgram Theorem. Complete orthonormal systems. Compact operators. Adjoint of a bounded operator. The Fredholm Alternative. Spectrum of a compact operator. Spectral decomposition of a compact self-adjoint operator. Integral operators. Application to Sturm-Liouville problems.
Teaching methods	Lectures and exercise sessions. Exercises will be assigned to students a few days in advance, before being discussed in the exercise session. Lecture notes will be provided on the KIRO webpage.
Reccomended or required readings	H. Brézis: Functional analysis, Sobolev spaces and partial differential equations. Springer, 2011. G. Gilardi: Analisi Funzionale. Mc Graw Hill, 2014.
Assessment methods	The exam consists into a written test and an oral exam. In the written test students will be asked to solve some exercises and to present the statement and proof of a theorem in 3 hours. Students will be admitted to the oral exam only if they obtain a score of at least 15/30 in their written test. The written test outcomes will be communicated to students by email. The oral exam will concern results, proofs, examples discussed in the course.
Further information	
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile