UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

CONSIGLIO INTERCLASSE IN MATEMATICA

COURSE OF STUDY	**TWO-YEAR MASTER OF SCIENCE PROGRAMME IN MATHEMATICS**
ACADEMIC YEAR	**2023-2024**
ACADEMIC SUBJECT	**FOURIER ANALYSIS AND PARTIAL DIFFERENTIAL EQUATIONS**

General information	
Term	First semester (September 25, 2023 – December 22, 2023)
European Credit Transfer and Accumulation System credits (ECTS)	4
SSD	MAT/05 – Mathematical Analysis
Language	English
Mode of attendance	Not mandatory

Lecturers		
Name and surname	Marcello D'Abbicco (instructor of record)	Annunziata Loiudice
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Department and office	Department of Mathematics room 36 second floor	Department of Mathematics room 35 second floor
Virtual meeting room		
Web page	https://www.dm.uniba.it/it/members/dabbicco	https://www.dm.uniba.it/it/members/loiudice
Office hours		

Work schedule				
	Total	Lectures	Hands-on learning	Self-study
Hours	100	32		68
ECTS credits	4	4		

Learning objectives	
	Acquiring language and techniques of modern analysis, especially interpolation theorems, maximal functions, Lp-bounded operators, Riesz potential theory, singular integral operators, multipliers theorems, application to linear and semilinear evolution equations; homogeneous Lie groups and sublaplacians, Heisenberg group and the Kohn Laplacian, Haar measures.

Course prerequisites	
	Knowledge of classical analysis of one and several variables, general topology, linear algebra, Lebesgue measure and integration theory, L^p spaces, Fourier transform, elementary theory of tempered distributions.

Syllabus	
Course contents	Weak Lp-spaces. Weak (p,q) convergence. Marcinkiewicz interpolation theorem. Hardy-Littlewood maximal function. Diadic maximal function. Calderón-Zygmund decomposition. Poisson kernels, P.V. 1/x, Hilbert

	transform. Riesz-Kolmogorov theorem. Multipliers. Riesz transforms. Riesz and Bessel potentials, fractional Sobolev spaces. Hardy-Littlewood-Sobolev theorem and Sobolev embedding theorems. Mikhlin-Hörmander multiplier theorems. Analysis on Lie groups. Haar measures. Homogeneous groups, stratified groups and their Sublaplacians. The Heisenberg group and the Kohn Laplacian. Homogeneous norms. The fundamental solution for Sublaplacians. Representation formulas. Hardy-Littlewood-Sobolev Theorem and Sobolev-type embeddings on groups. Lp estimates for wave equation and other homogeneous evolution equations, and for evolution equations with dissipation terms. Applications of Lp estimates to the study of Fujita exponent for nonlinear problems. Test function method for nonexistence of global solutions.
Reference books	J. Duoandikoetxea, Fourier Analysis, Graduate Studies in Mathematics, Vol 29, AMS, 2000. M.R. Ebert, M. Reissig, Methods for Partial Differential Equations, Birkhäuser Basel, 2018. L. Grafakos, Classical Fourier analysis. Third edition. Graduate Texts in Mathematics, 249. Springer, New York, 2014
Additional course materials	Lecture notes
Repository	Lecture notes can be required via email

Expected learning outcomes	
Knowledge and understanding	Acquiring fundamental concepts in advanced modern real analysis and Fourier Analysis, acquiring mathematical proof techniques and learn the applications to linear and semilinear partial differential equations.
Applying knowledge and understanding	The acquired theoretical knowledge is useful in large part of mathematics and its applications.
Soft skills	*Making judgements*: Ability to analyze the consistency of the logical arguments used in a proof, problem solving skills should be supported by the capacity in evaluating the consistency of the found solution with the theoretical knowledge, find the most elegant, short, formally correct and complete strategies to solve complex mathematical problems.
	Communication skills: Students should acquire the mathematical language and formalism that are necessary to read and comprehend textbooks, to expound the acquired knowledge, and to describe, analyze and solve problems.
	Learning skills: Acquiring suitable learning methods, supported by text consultation and by solving the questions suggested during the course.

Teaching methods	
	Lectures, with the use of slides and notes provided by the instructor.

Assessment	
Assessment methods	Oral test
Evaluation criteria	• *Knowledge and understanding*: correct and complete discussion, appropriate use of the mathematical tools in the proofs, correct answer to the questions during the oral test • *Applying knowledge and understanding*: correct tools used to completely solve the problems • *Making judgement*: best tools to solve the question or problem proposed

	• *Communication skills*: formally correct mathematical language, clarity of the exposition and of the answers • *Learning skills*: correct solutions to the proposed questions
Grading policy	The exam is sufficient with 18/30 mark. The exam is sufficient if the student can clearly present the main topics, statements and proofs discussed in the course, and can show a good comprehension of them, answering correctly and completely to the questions. A higher evaluation is achieved if the student can discuss all topics presented in the lectures and can autonomously and correctly answer to questions about a more deep study of the treated topics.

Further information	