



UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Fisica e Chimica - Emilio Segrè		
ACADEMIC YEAR	2023/2024		
MASTER'S DEGREE (MSC)	PHYSICS		
SUBJECT	ADVANCED MATHEMATICS FOR PHYSICS		
TYPE OF EDUCATIONAL ACTIVITY	D		
AMBIT	20534-A scelta dello studente		
CODE	23367		
SCIENTIFIC SECTOR(S)	MAT/07		
HEAD PROFESSOR(S)	BAGARELLO FABIO	Professore Ordinario	Univ. di PALERMO
OTHER PROFESSOR(S)			
CREDITS	6		
INDIVIDUAL STUDY (Hrs)	102		
COURSE ACTIVITY (Hrs)	48		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	1		
TERM (SEMESTER)	2° semester		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	BAGARELLO FABIO Tuesday 11:00 13:00 Stanza nr. 14, Edificio 8, Secondo piano, ex Dipartimento di Metodi e Modelli Matematici Thursday 11:00 13:00 Stanza nr. 14, Edificio 8, Secondo piano, ex Dipartimento di Metodi e Modelli Matematici		

DOCENTE: Prof. FABIO BAGARELLO

PREREQUISITES	It is required a good knowledge of Functional Analysis, Operator theory and all what discussed in the first level course "Istituzioni di Metodi Matematici per la Fisica".
LEARNING OUTCOMES	Knowledge and comprehension: the student will learn how to deal with some mathematical aspects of problems relevant for them. In particular the student will study some useful aspects of Hilbert spaces, and some special classes of bounded and unbounded operators which are relevant in physics. Also, some insight on distribution theory, Fourier and other classes of integral transforms, and group theory will also be proposed. Ability of: the abstract mathematical results introduced all along the teaching will be used in the solution of concrete problems in applied mathematics, quantum mechanics, dynamical systems and so on. Autonomy of judgement: The student will be able to evaluate the degree of difficulty of the problem to be solved, and the best way to solve it. This will be achieved via an a-priori analysis of the problem itself. Communication skills: The student will be able to discuss all the topics taught during the course.
ASSESSMENT METHODS	The examination consists in a written part, where a certain number of exercises are proposed and must be solved, and an oral part, where the student is required to explain the written composition and to answer to some, more theoretical, questions. As for the grades: 30-30 and laude: Excellent. Full knowledge and understanding of concepts and methods of the discipline, excellent analytical skills even in solving original problems; excellent communication and learning skills. 27-29: Very good. Very good knowledge and understanding of concepts and methods of the discipline; very good communication skills; very good capability of concepts and methods applications. 24-26: Good. Good knowledge of main concepts and methods of the discipline; good communication skills; good autonomy for applying concepts and methods for solving original problems. 21-23: Satisfying. Sufficient knowledge of main concepts and methods of the discipline; satisfying communication skills; sufficient judgment autonomy. 18-20: Acceptable: acceptable knowledge of concepts and methods of the discipline; acceptable communication skills; acceptable judgement autonomy
EDUCATIONAL OBJECTIVES	The aim of the course is to provide students with advanced mathematical tools that allow a rigorous approach to concrete problems that one very often meet in the description of physical processes. The students, thanks to a full understanding the tools described in the course, will be able to choose the most appropriate strategy to overcome any mathematical obstacles encountered during their study.
TEACHING METHODS	We have around 32 hours of theory plus 24 hours of practice.
SUGGESTED BIBLIOGRAPHY	Textbooks : 1. Fabio Bagarello, Metodi matematici per fisici e ingegneri, Zanichelli, 2019 ISBN: 9788808520357 Chapters: 2.9-2.10-3.5-3.6-3.10-7.7-8.1-8.2-8.3-8.5-8.6 2. Fabio Bagarello: Internal notes for Physics students Further reading: Robert D. Richtmyer, Principles of advanced mathematical physics, vol 1, Springer-Verlag ISBN: 978-3-642-51076-2 S. Reed, B. Simon, Methods of modern mathematical physics, Vol I: Functional analysis, Academic, New York (1972) ISBN: 9780125850506

SYLLABUS

Hrs	Frontal teaching
8	Hilbert spaces and their direct sums and tensor products. Sobolev spaces. Banach spaces.
12	Special classes of bounded operators. Spectral theory of bounded operators Unbounded operators Non self-adjoint operators and deformed commutation relations
5	Fourier transform and distributions. Delta sequences and their use
15	Coherent states. Frames. Gabor and Wavelet transforms. Multi-resolution analysis. Path integral
5	More on Groups theory