UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Fisica e Chimica - Emilio Segrè
ACADEMIC YEAR	2021/2022
BACHELOR'S DEGREE (BSC)	PHYSICS
SUBJECT	PRINCIPLES OF MATHEMATICAL METHODS FOR PHYSICS
TYPE OF EDUCATIONAL ACTIVITY	C
AMBIT	10699-Attività formative affini o integrative
CODE	19745
SCIENTIFIC SECTOR(S)	MAT/07
HEAD PROFESSOR(S)	BAGARELLO FABIO Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	6
INDIVIDUAL STUDY (Hrs)	94
COURSE ACTIVITY (Hrs)	56
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	3
TERM (SEMESTER)	1° 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 convenient, for a better comprehension, a background in linear vector spaces and analytic functions.
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 learn notions of Fourier and Laplace transforms, Hilbert spaces and operators on them, and distributions. 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 teached 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; sufficientjudgment 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	Textbook: Fabio Bagarello, Metodi matematici per fisici e ingegneri, Zanichelli, 2019 ISBN: 9788808520357 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
9	Hilbert spaces, Scalar product and norm, Inequalities involving vectors, Total sets of vectors, L^2 spaces, Trigonometric and exponential total sets in L^2(-\Pi,\Pi), Orthogonal polynomials
4	Fourier transform in L^1 and in L^2; Inverse Fourier transform and Plancherel theorem
4	Laplace transform, Inverse transform, Analiticity of the transform, Convergence abscissa
5	Functional spaces and continuous functionals; Dirac delta
6	Operators: definition and main properties. Norms. Self-adjoint, invertible and unitary operators. Projection operators. Eigenvalues and eigenvectors
1	Green's function
3	Briefs on Groups theory

Hrs	Practice
8	Schwarz inequality and applications, Orthonormalization procedure, Functions in L^2, Total sets, Construction of orthogonal polynomias

Hrs	Practice
3	Fourier transform: examples. Role of the complex integration
3	Laplace transform: their computation and their relevance in the solution of some differential equations
2	Weak limits and weak derivatives. Applications of the Dirac delta
4	Operators: examples in quantum mechanics. Canonical commutation and anti-commutation relations and their extensions
2	Green functions, applications
2	Some application of group theory