UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Matematica e Informatica		
ACADEMIC YEAR	2017/2018		
MASTER'S DEGREE (MSC)	MATHEMATICS		
INTEGRATED COURSE	MATHEMATICAL PHYSICS		
CODE	03299		
MODULES	Yes		
NUMBER OF MODULES	2		
SCIENTIFIC SECTOR(S)	MAT/07		
HEAD PROFESSOR(S)	SAMMARTINO MARCO	Professore Ordinario	Univ. di PALERMO
OTHER PROFESSOR(S)	RICCI VALERIA	Ricercatore	Univ. di PALERMO
	SAMMARTINO MARCO	Professore Ordinario	Univ. di PALERMO
CREDITS	12		
PROPAEDEUTICAL SUBJECTS			
MUTUALIZATION			
YEAR	1		
TERM (SEMESTER)	Annual		
ATTENDANCE	Not mandatory		
EVALUATION	Out of 30		
TEACHER OFFICE HOURS	**RICCI VALERIA**		
	Tuesday 17:30 19:30	Dipartimento di Matematica e Informatica, via Archirafi 34.Fuori dal periodo delle lezioni si invitano gli studenti ad effettuare la prenotazione del ricevimento tramite il portale.	
	SAMMARTINO MARCO		
	Tuesday 16:00 18:00	Dipartimento di Ingegneria, Edificio 8, ex Dipartimento di Metodi e Modelli Matematici, 1^o piano	
	Wednesday 13:00 14:00	Dipartimento di Ingegneria, Edificio 8, ex Dipartimento di Metodi e Modelli Matematici, 1^o piano	

DOCENTE: Prof. MARCO SAMMARTINO

PREREQUISITES	Multivariate differential calculus. Linear algebra.
LEARNING OUTCOMES	Knowledge Knowledge of the theory of the mechanics of continuous media as a model for the description of evolutive processes through systems of PDE's. Derivation, as specific examples of continuous media in particular regimes, of the fundamental equations of mathematical physics. Knowledge of the fundamental solutions of the Laplace equation, of the heat equation and wave equation. Elements of spectral theory and of the Fourier transform. Representation of the solution of some of the PDE's of mathematica physics in terms of eigenfunctions. Knowledge of the theory of Sobolev spaces. Elements of the theory of elliptic, parabolic, hyperbolic and of fluid dynamics equations. Understanding Capability of reading and understanding advanced textbooks of mathematical modeling and to consult research papers putting them in the context of the general theory. Capability of applying knowledge and understanding. Capability of applying the main techniques of qualitative analysis to PDE's that share the same structure with the equations introduced in the course. Capability of giving a mathematical formulation to practical problems and derive proofs using the most classical mathematical techniques. Autonomous judgement The full understanding of the fundamental concepts introduced in the course will make the student able at formulating conjectures on the possible behaviors of the solutions of some of the main equations of mathematica physics, and capable of visualizing some possible path leading to the rigorous proof of these conjectures. He will get the capability of a critical reading of the scientific literature and of modeling and formalizing problems that are new to him-her. These goals will be reached through the participation to lessons and through the preparation of seminars on topics related to those presented during the course. Communication skills The student will acquire the capability to explain how one can construct a model representing real life processes with the use of general physical principles and with the use of the appropriate mathematical concepts. The student will acquire the capability to explain, also to a mathematician non expert of the PDE's theory, the motivations behind a well-posedness theorem and the main steps leading to the proof of such a result. Leaning skills ideally, at the end of the course, the student will be able to understand a substantial part of the scientific literature on PDE's. The course will contribute to shape a flexible mentality so that it will be easier, for the student, to begin a research program.
ASSESSMENT METHODS	The exam consists in a final viva voce exam. The exam will test the depth of the knowledge acquired by the student, his capability of expressing correctly. The evaluation will be give according to the following criteria: a) The student does not have an acceptable knowledge of the most important topics of the course (failed); b) acceptable knowledge of the most important topics of the course, basic capability of applying the knowledge, primitive knowledge of the language of the PDE's(18-21); c) satisfactory knowledge of the main topics of the course, good skills in the use of the technical language, and fully satisfactory capability of solving the problems that have been addressed during the exercises sessions (22-24); d) full understanding of the main topics; good skills in the use of the technical language, and satisfactory capability of solving newly proposed problems; (25-28) e) very good understanding of the theory of PDEs of Mathematical Physics, very good use of the technical language, and fully satisfactory capability of applying the theory to newly proposed problems. (29-30 e lode) The students are allowed to give a midterm exam. The midterm exam consists in a seminar on a specific topic covered during the first modulus. The grade is expressed on a scale of thirty. In this case the final grade will be the average of the final exam and of the midterm exam.
TEACHING METHODS	The course consists in theoretical lessons and exercise sessions. The topics of the course are addressed and discussed during theoretical lessons. Exercise sessions are used to solve exercises where students learn on the application of

	theoretical mechanics and on its subtleties. Possibly, written tests will be administered .

MODULE
SUPERIOR MECHANICS

Prof. MARCO SAMMARTINO

SUGGESTED BIBLIOGRAPHY

Libro di testo
1) L.C.Evans, Partial Differential Equations (Graduate Studies in Mathematics, V. 19) , American Mathematical Society 1998. Capitoli 2,5,6
2) I.Stakgold, Green's Functions and Boundary Value Problems (Second Edition), John Wiley and Sons 1998. Capitolo 2
3) A.Majda A.Bertozzi, Vorticity and Incompressible Flows, Canbridge University Press, 2002. Capitoli 1,3

Testi di consultazione
4) R.McOwen, Partial Differential Equations, Prentice-Hall 1996.

AMBIT	50399-Formazione modellistico-applicativa
INDIVIDUAL STUDY (Hrs)	94
COURSE ACTIVITY (Hrs)	56

EDUCATIONAL OBJECTIVES OF THE MODULE

The goals of the course are the following
a) The introduction of some the techniques for the qualitative analysis of PDE, like Fourier transform, function spaces, operator theory;
b) To prove some of the fundamental existence and regularity theorems for linear elliptic equations;
c) To prove some of the fundamental existence and regularity theorems for Stokes and Navier-Stokes equations.

SYLLABUS

Hrs	Frontal teaching
8	Distributions, Fourier series, Fourier transform.
6	Differential equations in the sense of distributions .
6	Sobolev spaces, weak solutions.
6	Introduction to the theory of second order elliptic equations.
6	Introduction to the mathematics theory of fluid dynamics.

Hrs	Practice
8	Exercises on distributions.
8	Exercises on Fourier series and Fourier transform and applications to the PDE's of Mathematical Physiscs.
8	Exercises on the use of fundamental solutions of some of the PDE's of Mathematica Physics.

MODULE
FUNDAMENTALS OF MATHEMATICAL PHYSICS

Prof.ssa VALERIA RICCI

SUGGESTED BIBLIOGRAPHY

W.Strauss, Partial Differential Equations, John Wiley & Sons, 1992
F. John, Partial Differential Equations, Springer, 1982

Come testo di consultazione si consiglia anche
S. Salsa, Equazioni a derivate parziali, Springer, 2010
Ulteriori testi di consultazione potranno essere consigliati a principio e durante il corso

AMBIT	50399-Formazione modellistico-applicativa
INDIVIDUAL STUDY (Hrs)	94
COURSE ACTIVITY (Hrs)	56

EDUCATIONAL OBJECTIVES OF THE MODULE

The main goal of the course is to describe the fundamentals of the classical theory of PDE (transport, Laplace, heat and wave equations). Among the topics covered in this course are: the method of characteristics; the notion of integral solution to first order equations; the well-posedness of PDE problems (in particular for the Laplace, heat and wave equations); the fundamental solutions to the Laplace, wave and heat equation; the mixed problems in bounded domains; the maximum principles for elliptic and parabolic PDE and their use in PDE's methods; the classification of linear second order PDE.

SYLLABUS

Hrs	Frontal teaching
10	Conservation laws and transport equations.
10	Heat equation
10	Laplace's equation
10	Wave equation

Hrs	Practice
5	Exercises and examples on parabolic equations
5	Exercises and examples on elliptic equations
6	Exercises and examples on hyperbolic equations