UNIVERSITÀ DEGLI STUDI DI PALERMO

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| **DEPARTMENT** | Fisica e Chimica - Emilio Segrè |
| **ACADEMIC YEAR** | 2020/2021 |
| **MASTER'S DEGREE (MSC)** | PHYSICS |
| **SUBJECT** | MATHEMATICAL METHODS FOR PHYSICS |
| **TYPE OF EDUCATIONAL ACTIVITY** | C |
| **AMBIT** | 20901-Attività formative affini o integrative |
| **CODE** | 05076 |
| **SCIENTIFIC SECTOR(S)** | MAT/07 |
| **HEAD PROFESSOR(S)** | SAMMARTINO MARCO Professore Ordinario Univ. di PALERMO |
| **OTHER PROFESSOR(S)** | |
| **CREDITS** | 6 |
| **INDIVIDUAL STUDY (Hrs)** | 94 |
| **COURSE ACTIVITY (Hrs)** | 56 |
| **PROPAEDEUTICAL SUBJECTS** | |
| **MUTUALIZATION** | |
| **YEAR** | 1 |
| **TERM (SEMESTER)** | 1° semester |
| **ATTENDANCE** | Not mandatory |
| **EVALUATION** | Out of 30 |
| **TEACHER OFFICE HOURS** | **SAMMARTINO MARCO**<br>Tuesday 16:00 18:00 Dipartimento di Ingegneria, Edificio 8, ex Dipartimento di Metodi e Modelli Matematici, 1^o piano<br>Wednesday 13:00 14:00 Dipartimento di Ingegneria, Edificio 8, ex Dipartimento di Metodi e Modelli Matematici, 1^o piano |

**DOCENTE:** Prof. MARCO SAMMARTINO

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| **PREREQUISITES** | Differential Calculus. Linear algebra. |
| **LEARNING OUTCOMES** | Knowledge and Understanding capabilities<br>The student will acquire the knowledge of some of the mathematical methods needed for the most classical problems of Mathematical Physics. Distribution theory, Fourier analysis, Hilbert spaces, spectral theory of operators. Understanding the physical meaning of some initial and boundary value problems.<br><br>The capability of applying knowledge<br>The student will be able to give a mathematical description, based on PDE, of problems arising in Physics. He/she will be able to give a solution, maybe approximated, of these equations. The student will be able to apply the distribution theory to differential problems. He/she will be able to write the Green function associated with differential problems.<br><br>Making judgments<br>The student is able to understand which mathematical tool, among the many introduced, is the most appropriate for the analysis of the differential problems under scrutiny.<br><br>Communication skills<br>The student is able to elucidate, to a high school class, the physical meaning of a simple differential problem and to give a qualitative picture of the solution method.<br><br>Learning skills<br>The student should be able to understand the most advanced texts of Mathematical Methods for Physics, for example, those concerning the spectral theory of operators, or those concerning integral equations. |
| **ASSESSMENT METHODS** | The final exam consists of a written test and of a viva voce exam. In the written test it will be asked 1) to solve initial or boundary value problems; 2) to solve problems concerning distribution theory and Fourier analysis.<br>The student will be allowed to give two midterms test, instead of the final written test.<br><br>The viva voce exam will test the depth of the knowledge acquired by the student, his capability of expressing correctly. The student will be asked also to discuss the solutions he/she gave in the written test. Both oral and written test will be part of the evaluation of the student, with equal weight. The evaluation will be given 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 Mathematical Methods for Physics(18-21); c) satisfactory knowledge of the main topics of the course, good skills in the use of the technical language, and satisfactory capability of solving only the most simple problems of Mathematical Methods for Physics (22-24); d) good knowledge of the main topics of the course, very good skills in the use of the technical language, and fully satisfactory capability of solving all the proposed problems (25-27); e) excellent knowledge of the main topics of the course, and capability to analyze and communicate all the subtleties of Mathematical Methods for Physics, and excellent capability of solving all the proposed problems (29-30 cum laude); |
| **EDUCATIONAL OBJECTIVES** | The educational objectives are the following:<br>1. To make the student aware that, for the analysis and the solution of some of the most classical problems of Physics (e.g. propagation of discontinuities, shock waves, or diffusion or potential theory problems for point sources) one needs mathematical concepts and tools not covered in typical Calculus courses.<br>2. To give the student a good theoretical knowledge of the more advanced differential calculus, like the distribution theory, Fourier analysis, spectral theory.<br>3. To make the student capable of practical use of these tools aimed at the solution of physics motivated problems. |
| **TEACHING METHODS** | The course consists of 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. Written tests, mirroring the final written exam, will be administered . |
| **SUGGESTED BIBLIOGRAPHY** | Libri di testo<br>I.Stakgold, Green's Functions and Boundary Value Problems (Second Edition), John Wiley and Sons 1998<br>F.W.Byron and R.W.Fuller, Mathematics of Classical and Quantum Physics, Dover publications 1992.<br><br>Libri di consultazione |

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| | L.C.Evans, Partial Differential Equations (Graduate Studies in Mathematics, V. 19), American Mathematical Society 1998.<br>W.A.Strauss: Partial Differential Equations, an introduction, Wiley |

## SYLLABUS

| Hrs | Frontal teaching |
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| 6 | Distribution theory. |
| 6 | Fourier series and Fourier transforms in the distribution sense. |
| 6 | Differential equations in the distribution sense |
| 4 | Spectral theory |
| 4 | Compact operators. Integral operators. |
| 6 | Fundamental solutions: second ordere ODE, diffusion equation, Laplace equation, Schrodinger equation. |

| Hrs | Practice |
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| 4 | Exercises and examples of distributions. |
| 4 | Exercises and examples of Fourier series and Fourier transforms. |
| 8 | Examples and exercises on the resolution of PDE of Mathematical Physics. |
| 4 | Examples and exercises on the adjoint and the spectrum of an operator. |
| 4 | Examples and exercises on solving PDEs with the fundamental solution method. |