METODI MATEMATICI APPLICATI ALLA FISICA

FIS/01 - 6 CFU - 1° Semester

Teaching Staff

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LEARNING OBJECTIVES

The aim of the course is to provide adequate knowledge and skills in the field of mathematical methods applied to physics, as a tool for the treatment and modeling of geophysical problems.

At the end of the course, the student will have acquired inductive and deductive reasoning skills, will be able to schematize a phenomenon in terms of physical quantities, will be able to critically deal with the studied subjects, set a problem and solve it with analytical methods, taking care of them, with due rigor, both mathematical and physical aspects. The student will apply the scientific method to the study of natural phenomena and will be able to critically evaluate analogies and differences between physical systems and the methodologies to be used. He will also be able to use the appropriate mathematical tools, with due rigor, in the modeling of geophysical problems.

COURSE STRUCTURE

lectures accompanied by exercises

DETAILED COURSE CONTENT

Differential and integral calculus for functions of several variables
Functions of several variables: limits and continuity - Differentiation of functions of several variables: partial and directional derivates - Differential and differentiable functions - Higher order derivatives and lemma Schwartz - Differential operators: gradient, divergence, curl, laplacian - Implicit functions - Bound and free maximum and minimum of several variable functions - Integral calculus for functions of one variable: Peano-Jordan measure and Lebesgue measure - Riemann integral - Indefinite integral - Fundamental theorem of calculus - Improper integral - Integral calculus for functions of several variables: double and triple integrals - Change of variables - Reduction formulas - Integrals depending on a parameter: Leibinz rule - Notes on line integrals and surface: linear and quadratic differential forms -

divergence theorem - Theorem Stokes - Green identity.

Numerical Serie and series of functions

Numerical series - General theorems on numerical series - Various examples of series - The convergence criteria of the positive series - Series for alternating and Leibnitz criterion - AQbsolutely convergent series - Series of functions - Pointwise and uniform convergence - Taylor series and Mac Laurin - Mac Laurin expansion of some elementary functions - Power series - Multipole expansion of Newtonian type potentials - Legendre polynomials.

Elementi of Fourier analysis

Fourier Series - convergence of the Fourier series - uniqueness theorem - Examples and applications of Fourier series - transformed and its fundamental properties - transform of the convolution of functions - Laplace transform as a special case of the Fourier transform - Some Fourier and of considerable Laplace.

Ordinary differential equations (ODE)

General information on differential equations - The Cauchy problem - Differential equations of the first order - The first order differential equations with separable variables - Cauchy's theorem on the existence and uniqueness of the solution - Linear equations of the first order and second order - Physical applications: free oscillations, damped and forced.

Fundamental equations of the theory of elasticity

Volume and surface forces - Efforts and deformations: elastic moduli - Stress tensor - Tensor of solid deformation - Relationship between the stresses and strains: the law of Hooke- The equation of motion of elastic solids - Waves longitudinal and transverse in solids - Waves in fluids.

Differential equazions PDE (PDE)

General information on partial differential equations - Linear second order PDE and their classification - Laplace equation and Poisson: theorem of uniqueness - Formula Green - Functions harmonics and their property - The mean value theorem - Potential masses extended in space - Wave equation: D'Alembert solution - Equation of vibrating strings: endless rope and over - Fourier method - Heat equation: the principal-solution of the Cauchy - unlimited and limited sheet problem - Solution by Laplace transform - Numerical methods for PDE solution.

The italicized topics covered in the discussion as optional studies.

TEXTBOOK INFORMATION

A. Avantaggiati Institutions of Mathematics, C.E.A.

M. Bramanti, C.D. Pagani, S. Salsa, Mathematical Analysis Vol. 1 and 2, Zanichelli

Guido Cosenza: Mathematical methods of physics, Bollati Basic Books

Giampaolo Cicogna: Mathematical methods of physics, Springer
