METADATA

Title: Partial Differential Equations

Other Titles: -

Language: Greek

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ISBN: 978-618-228-084-3

Subject: MATHEMATICS AND COMPUTER SCIENCE

Keywords: Equations of elliptic type / Potential theory / Equations of parabolic type / Diffusion equations / Equations of hyperbolic type

Bibliographic Reference: Dassios, G., Kyriaki, K., & Vafeas, P. (2023). Partial Differential Equations [Undergraduate textbook]. Kallipos, Open Academic Editions. http://dx.doi.org/10.57713/kallipos-317

Abstract

The basic characteristic of the Partial Differential Equations (PDEs) is due to the fact that their solutions can be functions of many variables, which they can be used to describe real life phenomena, where the involved quantities are usually depended on the three special dimensions plus the time. At a first level of investigation, the PDEs are classified in three major categories based on the dependence of their solutions on time. That gives us the elliptic equations, with solutions independent of time, the parabolic equations, with solutions depending irreversibly on time, and the hyperbolic equations, with solutions that depend reversibly on time. The basic physical phenomena, described by these three types of equations, are the theories of potentials (elliptic equations), the diffusion processes (parabolic equations) and the theories of vibrations and wave propagation (hyperbolic equations). The present book is focused on the methods of solutions of these three types of PDEs in different geometrical domains, such as the geometry described by the cartesian, the cylindrical, the spherical and the polar coordinate systems. For domains with not so simple geometries the solutions demand more sophisticated techniques such as the Green's functions and the construction of integral representations, and these techniques are analytically contained in separate chapters. In any case the book is built around the spectral theory of eigensolutions and the related eigenexpansions. Besides the classical spectral methods, the reader can also find introductory analyses for first order equation via the method of characteristics, for integral transforms, for the Kelvin inversion method as well as for energy topics associated with physical problems. Finally, the book is written in such a way that emphasizes the connection between the mathematical methods of producing solutions and their physical interpretation.

The Project is funded by the National Development Programme 2021-2025 of the Ministry of Education and Religious Affairs and implemented by the Special Account for Research Funds of the National Technical University of Athens and the Hellenic Academic Libraries Link.