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Book Review: An Elementary Course in Partial Differential Equations By T.Amarnath Narosa Publishing House Pvt. Ltd. ISBN 978-81-7319-519-8

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This book was first published in 1997, with the second edition being revised and publicized by 2003. This book is meant to be a coursebook for a one-semester course on Partial Differential Equations (PDE). Although this book is for the graduate students of Mathematics, students of Physics and Engineering would also find the text beneficial. However, those from physics would require a certain level of understanding of mathematical concepts to digest the essence of this text truly. The author has attempted to present many topics in a comprehensive, rigorous manner yet precise and straightforwardly.

The book comprises two chapters, each having various sections with an additional add-on for Fourier Transforms and Integrals.

The first chapter is dedicated to the study of first-order PDE. It begins with an introduction to curves and surfaces and segues to the formation of the first-order PDE. The author highlights several essential topics on first-order equations, such as the linear equations, integral surface problems, compatible systems, Charpit's method, and some standard types. But the Charpit's approach has not been highlighted under the section on Non-Linear PDEs despite being a method to solve a nonlinear problem which might lead to the confusion of a reader who is not well-versed in the concepts of Mathematics. The author also tries to establish an understanding of the Pfaffian Differential Equations, Jacobi method, and Quasi Linear Equations through the integral characteristic curves, which is a two-parameter family of characteristic curves and Monge's Cone in the Non-Linear Case, and also about the characteristic strips. Nonetheless, it was pretty disappointing to witness the lack of geometrical explanations in the text and new innovative ideas to solve the first-order PDE. The author has stuck with the traditional solving methods, but there is a distinct lack of modern understanding of the solutions. The quasi-linear equation chapter comprises mainly theory and suffers from the lack of sufficient explained problems for the reader's comprehension.

The second chapter is wholly devoted to the second-order PDE in a semi-linear form, with the definitions of regular. It then starts with the problem of transverse vibrations of a string for the derivation of the one-dimensional wave equation. Similarly, in the same manner, the heat conduction equation has also been derived, but the boundary conditions of the problems have not been specified, which might lead to an incomplete understanding of the problems, resulting in incorrect solutions. The following section is about the classification of the second-order PDE, which is the canonical form of solving the PDE with variable coefficients. Then the problem of vibrations of Infinite String with initial conditions whose solution is d'Alembert's solution with the properties of characteristics, then the vibrations of a semi-infinite string restricting to one limit to be finite and then vibrations of a finite string with both at finite limits are given. The heat conduction problems of different types have also been provided. Further, the text explains the solutions using Riemann's method with a notable application of Green's Theorem. In the method of separation of variables, an example of wave equations has been provided with the uniqueness property. Furthermore, the author has defined the Laplace equations and has established the boundary value problems and their uniqueness property, and their necessary and sufficient conditions. Then there are many different Dirichlet and Neumann problems for different geometrical shapes. Nevertheless, there is a scarcity of geometrical explanations to aid a better understanding. The text provides basic knowledge of Green's functions and Duhamel's principle for non-homogeneous differential equations. The text is then extended to the study of n-variables, families of equipotential surfaces, and Kelvin's Inversion Theorem in the spherical coordinates.

There are two appendices in the text, of which the first is devoted to necessary formulas for the Fourier and Integral transforms, and the second of which is dedicated to a small number of additional problems.

As a text manual that is meant for a one-semester course on PDE, many examples and exercise problems are provided. However, it would have been helpful to include the diagrammatic representations of a few physics phenomena problems to aid the readers from applied mathematical backgrounds, a few increases in the solved problems, and detailed explanations for some of the theoretical parts. Considering all-around, the author has provided thorough and rigorous explanations for many of the significant introductory concepts of PDE concisely. This book might also be beneficial for those preparing for the competitive exams and those who are a novice in applied mathematics, particularly those who have an affinity for mathematical modelling.

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DECLARATION OF COMPETING INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

REFERENCE

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