

Free Potential Theory Book

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introduction to fundamentals of potential functions covers the force of gravity fields of force potentials harmonic functions electric images and green s function sequences of harmonic functions fundamental existence theorems the logarithmic potential and much more detailed proofs rigorously worked out 1929 edition

from its origins in newtonian physics potential theory has developed into a major field of mathematical research this book provides a comprehensive treatment of classical potential theory it covers harmonic and subharmonic functions maximum principles polynomial expansions green functions potentials and capacity the dirichlet problem and boundary integral representations the first six chapters deal concretely with the basic theory and include exercises the final three chapters are more advanced and treat topological ideas specifically created for potential theory such as the fine topology the martin boundary and minimal thinness the presentation is largely self contained and is accessible to graduate students the only prerequisites being a reasonable grounding in analysis and several variables calculus and a first course in measure theory the book will prove an essential reference to all those with an interest in potential theory and its applications

the first six chapters of this book are revised versions of the same chapters in the author's 1969 book introduction to potential theory at the time of the writing of that book i had access to excellent articles books and lecture notes by m brelot the clarity of these works made the task of collating them into a single body much easier unfortunately there is not a similar collection relevant to more recent developments in potential theory a newcomer to the subject will find the journal literature to be a maze of excellent papers and papers that never should have been published as presented in the opinion column of the august 2008 issue of the notices of the american mathematical society m nathanson of lehman college cuny and cuny graduate center said it best when i read a journal article i often find mistakes whether i can fix them is irrelevant the literature is unreliable from time to time someone must try to find a path through the maze in planning this book it became apparent that a deficiency in the 1969 book would have to be corrected to include a discussion of the neumann problem not only in preparation for a discussion of the oblique derivative boundary value problem but also to improve the basic part of the subject matter for the end users engineers physicists etc

potential theory is the broad area of mathematical analysis encompassing such topics as harmonic and subharmonic functions

potential theory presents a clear path from calculus to classical potential theory and beyond with the aim of moving the reader into the area of mathematical research as quickly as possible the subject matter is developed from first principles using only calculus commencing with the inverse square law for gravitational and electromagnetic forces and the divergence theorem the author develops methods for constructing solutions of laplace's equation on a region with prescribed values on the boundary of the region the latter half of the book addresses more advanced material aimed at those with the background of a senior undergraduate or beginning graduate course in real analysis starting with solutions of the dirichlet problem subject to mixed boundary conditions on

the simplest of regions methods of morphing such solutions onto solutions of poisson s equation on more general regions are developed using diffeomorphisms and the perron wiener brelot method culminating in application to brownian motion in this new edition many exercises have been added to reconnect the subject matter to the physical sciences this book will undoubtedly be useful to graduate students and researchers in mathematics physics and engineering

the subject of this book is the interplay between function space theory and potential theory a crucial step in classical potential theory is the identification of the potential energy of a charge with the square of a hilbert space norm this leads to the dirichlet space of locally integrable functions whose gradients are square integrable more recently a generalized potential theory has been developed which has an analogous relationship to the standard banach function spaces sobolev spaces besov spaces etc that appear naturally in the study of partial differential equations a surprisingly large part of classical potential theory has been extended to this nonlinear setting the extensions are sometimes surprising usually they are nontrivial and have required new methods

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during the last few decades the subject of potential theory has not been overly popular in the mathematics community neglected in favor of more abstract theories it has been taught primarily where instructors have ac tively engaged in research in this field this situation has resulted in a scarcity of english language books of standard shape size and quality covering potential theory the current book attempts to fill that gap in the literature since the rapid development of high speed computers the remarkable progress in highly advanced electronic measurement concepts and most of all the significant impact of satellite technology the flame of interest in potential theory has burned much brighter the realization that more and more details of potential functions are adequately visualized by zooming in procedures of modern approximation theory has added powerful fuel to the flame it seems as if all of a sudden harmonic kernel functions such as splines and or wavelets provide the impetus to offer appropriate means of assimilating and

assessing the readily increasing flow of potential data reducing it to comprehensible form and providing an objective basis for scientific interpretation classification testing of concepts and solutions of problems involving the laplace operator

this book bridges the gap between the classic texts on potential theory and modern books on applied geophysics introductory chapters discuss potential theory with emphasis on those aspects particularly important to earth scientists such as laplace s equation newtonian potential magnetic and electrostatic fields conduction of heat and spherical harmonic analysis later chapters apply these theoretical concepts specifically to the interpretation of gravity and magnetic anomalies with emphasis on anomalies caused by crustal and lithospheric sources the book is ideal for graduate students and researchers in applied geophysics

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