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*This collection  
of articles and  
surveys is  
devoted to  
Harmonic  
Analysis,*

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*related Partial  
Differential  
Equations and  
Applications  
and in  
particular to  
the fields of  
research to  
which Richard  
L. Wheeden made  
profound  
contributions.  
The papers deal*

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*with Weighted  
Norm*

*inequalities  
for classical  
operators like  
Singular  
integrals,  
fractional  
integrals and  
maximal  
functions that  
arise in  
Harmonic*

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*Analysis. Other papers deal with applications of Harmonic Analysis to Degenerate Elliptic equations, variational problems, Several Complex variables,*

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*Potential  
theory, free  
boundaries and  
boundary  
behavior of  
functions.  
Moment Theory  
is not a new  
subject;  
however, in  
classical  
treatments, the  
ill-posedness*

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*of the problem  
is not taken  
into account -  
hence this  
monograph.*

*Assuming a  
"true" solution  
to be uniquely  
determined by a  
sequence of  
moments (given  
as integrals)  
of which only*

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*finitely many  
are  
inaccurately  
given, the  
authors  
describe and  
analyze several  
regularization  
methods and  
derive  
stability  
estimates.  
Mathematically,*

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*the task often consists in the reconstruction of an analytic or harmonic function, as is natural from concrete applications discussed (e.g. inverse heat conduction problems,*



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*Cauchy's  
problem for the  
Laplace  
equation,  
gravimetry).*  
*The book can be  
used in a  
graduate or  
upper  
undergraduate  
course in  
Inverse  
Problems, or as*

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*supplementary  
reading for a  
course on  
Applied Partial  
Differential  
Equations.  
The present  
volume gives a  
systematic  
treatment of  
potential  
functions. It  
takes its*

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*origin in two  
courses, one  
elementary and  
one advanced,  
which the  
author has  
given at  
intervals  
during the last  
ten years, and  
has a two-fold  
purpose first,  
to serve as an*

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*introduction  
for students  
whose  
attainments in  
the Calculus  
include some  
knowledge of  
partial  
derivatives and  
multiple and  
line integrals  
and secondly,  
to provide the*

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*reader with the  
fundamentals of  
the subject, so  
that he may  
proceed  
immediately to  
the  
applications,  
or to - the  
periodical  
literature of  
the day. It is  
inherent in the*

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*nature of the  
subject that  
physical  
intuition and  
illustration be  
appealed to  
freely, and  
this has been  
done. However,  
in order that  
the ok may  
present sound  
ideals to the*

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*student, and also serve the mathematician, both for purposes of reference and as a basis for further developments, the proofs have been given by rigorous methods. This*

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*has led, at a number of points, to results either not found elsewhere, or not readily accessible. Thus, Chapter IV contains a proof for the general regular region of the*



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*divergence  
theorem Gauss,  
or Greens  
theorem on the  
reduction of  
volume to  
surface  
integrals. The  
treatment of  
the fundamental  
existence  
theorems in  
Chapter XI by*

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*means of  
integral  
equations meets  
squarely the  
difficulties  
incident to the  
discontinuity  
of the kernel,  
and the same  
chapter gives  
an account of  
the most recent  
developments*

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*with respect to  
the Pirichlet  
problem.*

*Exercises are  
introduced in  
the conviction  
that no mastery  
of a  
mathematical  
subject is  
possible  
without working  
with it. They*

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*are designed primarily to illustrate or extend the theory, although the desirability of requiring an occasional concrete numerical result has not been lost sight*

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of.

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

*Classical  
Potential*

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*Theory  
Potential  
Theory in  
Applied  
Geophysics  
Logarithmic  
Potentials with  
External Fields  
Potential  
Theory on  
Locally Compact  
Abelian Groups  
Complex*

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advance made by Kerzman and Stein in 1976. The book provides a fast track to understanding the Riemann Mapping Theorem. The Dirichlet and Neumann problems for the Laplace operator are solved, the Poisson kernel is constructed, and



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the inhomogenous Cauchy-Reimann equations are solved concretely and efficiently using formulas stemming from the Kerzman-Stein result. These explicit formulas yield new numerical methods for computing the classical objects of

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Four new chapters have been added to this second edition: two on quadrature domains and another two on

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provide up-to-date coverage of new developments, methods and applications.

The present volume gives a systematic treatment of potential functions. It takes its origin in two courses, one elementary and one advanced, which the

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author has given at intervals during the last ten years, and has a two-fold purpose: first, to serve as an introduction for students whose attainments in the Calculus include some knowledge of partial derivatives and multiple and

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line integrals; and secondly, to provide the reader with the fundamentals of the subject, so that he may proceed immediately to the applications, or to the periodical literature of the day. It is inherent in the nature of the subject that physical



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intuition and illustration be appealed to freely, and this has been done. However, that the book may present sound ideals to the student, and in order also serve the mathematician, both for purposes of reference and as a

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basis for further developments, the proofs have been given by rigorous methods. This has led, at a number of points, to results either not found elsewhere, or not readily accessible. Thus, Chapter IV contains a proof for the general regular

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region of the  
divergence theorem  
(Gauss', or Green's  
theorem) on the  
reduction of volume  
to surface integrals.  
The treatment of the  
fundamental  
existence theorems  
in Chapter XI by  
means of integral  
equations meets  
squarely the

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difficulties incident to the discontinuity of the kernel, and the same chapter gives an account of the most recent developments with respect to the Dirichlet problem.

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Moment Theory and

Some Inverse

Problems in

Potential Theory

and Heat

Conduction

In Honor of Richard

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Potential Theory in

Gravity and

Magnetic

Applications

Complex Manifolds

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without Potential  
Theory  
with an appendix on  
the geometry of  
characteristic  
classes

*This book provides  
an extensive  
treatment of  
Potential Theory for  
sub-Laplacians on  
stratified Lie groups.  
It also provides a*

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*largely self-contained presentation of stratified Lie groups, and of their Lie algebra of left-invariant vector fields. The presentation is accessible to graduate students and requires no specialized*

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geometry.*

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essential reference  
work covers all  
aspects of this  
major field of*



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Study Institute and  
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devoted to the  
publication of  
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high-level textbooks*

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*in mathematics,  
mathematical  
methods and their  
applications. Apart  
from covering  
important areas of  
current interest, a  
major aim is to  
make topics of an  
interdisciplinary  
nature accessible to  
the non-specialist.  
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*reputation*

*presenting current  
fields of research in  
pure and applied  
mathematics. While  
the editorial board of  
the Studies has  
changed with the  
years, the  
aspirations of the  
Studies are  
unchanged. In times  
of rapid growth of*

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*mathematical  
knowledge carefully  
written monographs  
and textbooks  
written by experts  
are needed more  
than ever, not least  
to pave the way for  
the next generation  
of mathematicians.  
In this sense the  
editorial board and  
the publisher of the*

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Weighted Sobolev  
Spaces  
Existence and  
Geometric  
Properties of  
Solutions of a Free  
Boundary Problem*

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*in Potential Theory  
Potential Theory on  
Infinite-dimensional  
Abelian Groups*

As the Earth's surface deviates from its spherical shape by less than 0.4 percent of its radius and today's satellite missions collect their gravitational and

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magnetic data on  
nearly spherical  
orbits, sphere-  
oriented  
mathematical  
methods and tools  
play important roles  
in studying the  
Earth's gravitational  
and magnetic field.  
Geomathematically  
Oriented Potential  
Theory presents the

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principles of space  
and surface  
potential theory  
involving Euclidean  
and spherical  
concepts. The  
authors offer new  
insight on how to  
mathematically  
handle gravitation  
and geomagnetism  
for the relevant  
observables and



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how to solve the resulting potential problems in a systematic, mathematically rigorous framework. The book begins with notational material and the necessary mathematical background. The authors then build

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the foundation of potential theory in three-dimensional Euclidean space and its application to gravitation and geomagnetism. They also discuss surface potential theory on the unit sphere along with corresponding applications.

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Focusing on the state of the art, this book breaks new geomathematical grounds in gravitation and geomagnetism. It explores modern sphere-oriented potential theoretic methods as well as classical space potential theory.

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Classical potential theory can be roughly characterized as the study of Newtonian potentials and the Laplace operator on the Euclidean space  $\mathbb{R}^3$ . It was discovered around 1930 that there is a profound connection between classical

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potential 3 theory  
and the theory of  
Brownian motion in  
JR . The Brownian  
motion is  
determined by its  
semigroup of  
transition  
probabilities, the  
Brownian  
semigroup, and the  
connection between  
classical potential

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theory and the theory of Brownian motion can be described analytically in the following way: The Laplace operator is the infinitesimal generator for the Brownian semigroup and the Newtonian potential kernel is the "integral" of the

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Brownian semigroup with respect to time. This connection between classical potential theory and the theory of Brownian motion led Hunt (cf. Hunt [2]) to consider general "potential theories" defined in terms of certain stochastic processes or

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equivalently in terms of certain semi groups of operators on spaces of functions. The purpose of the present exposition is to study such general potential theories where the following aspects of classical potential theory are



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preserved: (i) The theory is defined on a locally compact abelian group. (ii) The theory is translation invariant in the sense that any translate of a potential or a harmonic function is again a potential, respectively a harmonic function;

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this property of classical potential theory can also be expressed by saying that the Laplace operator is a differential operator with constant coefficients.

The book systematically develops the nonlinear potential

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theory connected with the weighted Sobolev spaces, where the weight usually belongs to Muckenhoupt's class of  $A_p$  weights. These spaces occur as solutions spaces for degenerate elliptic partial differential equations. The

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Sobolev space theory covers results concerning approximation, extension, and interpolation, Sobolev and Poincaré inequalities, Maz'ya type embedding theorems, and isoperimetric inequalities. In the

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chapter devoted to potential theory, several weighted capacities are investigated.

Moreover, "Kellogg lemmas" are established for various concepts of thinness.

Applications of potential theory to weighted Sobolev

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spaces include  
quasi continuity of  
Sobolev functions,  
Poincaré  
inequalities, and  
spectral synthesis  
theorems.

This book  
introduces the  
principles of  
gravitational,  
magnetic,  
electrostatic, direct

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current electrical and electromagnetic fields, with detailed solutions of Laplace and electromagnetic wave equations by the method of separation of variables.

Discussion includes behaviours of the scalar and vector potential and the

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nature of the solutions of these boundary value problems, along with the use of complex variables and conformal transformation, Green's theorem, Green's formula and Green's functions.

Multiscale Potential  
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An Analytic and  
Probabilistic  
Approach to  
Balayage  
Quantum Potential  
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Prague, July 19-24,  
1987  
Report - Naval Ship  
Research and  
Development

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Center

**There has been a considerable revival of interest in potential theory during the last 20 years. This is made evident by the appearance of new mathematical disciplines in that period which**

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**now-a-days are considered as parts of potential theory. Examples of such disciplines are: the theory of Choquet capacities, of Dirichlet spaces, of martingales and Markov processes, of integral**

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**representation in  
convex compact  
sets as well as  
the theory of  
harmonic spaces.  
All these theories  
have roots in  
classical  
potential theory.  
The theory of  
harmonic spaces,  
sometimes also  
called axiomatic  
theory of**

**harmonic functions, plays a particular role among the above mentioned theories. On the one hand, this theory has particularly close connections with classical potential theory. Its main notion is that of a**

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**harmonic  
function and its  
main aim is the  
generalization  
and unification  
of classical  
results and  
methods for  
application to an  
extended class of  
elliptic and  
parabolic second  
order partial  
differential**

**equations. On the other hand, the theory of harmonic spaces is closely related to the theory of Markov processes. In fact, all important notions and results of the theory have a probabilistic**

**interpretation.**

**Although the  
analysis of  
scattering for  
closed bodies of  
simple geometric  
shape is well  
developed,  
structures with  
edges, cavities,  
or inclusions  
have seemed,  
until now,  
intractable to**



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**analytical  
methods. This  
two-volume set  
describes a  
breakthrough in  
analytical  
techniques for  
accurately  
determining  
diffraction from  
classes of  
canonical  
scatterers  
In recent years**

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**approximation  
theory and the  
theory of  
orthogonal  
polynomials have  
witnessed a  
dramatic  
increase in the  
number of  
solutions of  
difficult and  
previously  
untouchable  
problems. This is**

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**due to the  
interaction of  
approximation  
theoretical  
techniques with  
classical  
potential theory  
(more precisely,  
the theory of  
logarithmic  
potentials, which  
is directly related  
to polynomials  
and to problems**

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**in the plane or  
on the real line).  
Most of the  
applications are  
based on an  
extension of  
classical  
logarithmic  
potential theory  
to the case when  
there is a weight  
(external field)  
present. The list  
of recent**

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**developments is quite impressive and includes: creation of the theory of non-classical orthogonal polynomials with respect to exponential weights; the theory of orthogonal polynomials with**

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**respect to  
general  
measures with  
compact support;  
the theory of  
incomplete  
polynomials and  
their widespread  
generalizations,  
and the theory of  
multipoint Pade  
approximation.  
The new  
approach has**

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**produced long  
sought solutions  
for many  
problems; most  
notably, the  
Freud problems  
on the  
asymptotics of  
orthogonal  
polynomials with  
a respect to  
weights of the  
form  $\exp(-|x|)$ ;  
the "1/9-th"**

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**conjecture on  
rational  
approximation of  
 $\exp(x)$ ; and the  
problem of the  
exact asymptotic  
constant in the  
rational  
approximation of  
 $\ln x$ . One aim of  
the present book  
is to provide a  
self-contained  
introduction to**



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**the**

**aforementioned  
"weighted"  
potential theory  
as well as to its  
numerous  
applications. As a  
side-product we  
shall also fully  
develop the  
classical theory  
of logarithmic  
potentials.**

**Brownian Motion**

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**and Classical  
Potential Theory  
is a six-chapter  
text that  
discusses the  
connection  
between  
Brownian motion  
and classical  
potential theory.  
The first three  
chapters of this  
book highlight  
the developing**

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**properties of  
Brownian motion  
with results from  
potential theory.  
The subsequent  
chapters are  
devoted to the  
harmonic and  
superharmonic  
functions, as well  
as the Dirichlet  
problem. These  
topics are  
followed by a**

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**discussion on the  
transient  
potential theory  
of Green  
potentials, with  
an emphasis on  
the Newtonian  
potentials, as  
well as the  
recurrent  
potential theory  
of logarithmic  
potentials. The  
last chapters**

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**deal with the  
application of  
Brownian motion  
to obtain the  
main theorems of  
classical  
potential theory.  
This book will be  
of value to  
physicists,  
chemists, and  
biologists.  
Markov  
processes and**

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**potential theory  
Classical  
Potential Theory  
and Its  
Probabilistic  
Counterpart  
Field Analysis  
and Potential  
Theory  
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Value Problem in  
Potential Theory  
Harmonic  
Analysis, Partial**

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Equations and  
Applications**  
*This self-  
contained  
text/reference  
provides a  
basic  
foundation for  
practitioners,  
researchers,  
and students*

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***interested in  
any of the  
diverse areas  
of multiscale  
(geo)potential  
theory. New  
mathematical  
methods are  
developed  
enabling the  
gravitational  
potential of a***



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***planetary body  
to be modeled  
using a  
continuous  
flow of  
observations  
from land or  
satellite  
devices.  
Harmonic  
wavelets  
methods are***

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***introduced, as well as fast computational schemes and various numerical test examples. Presented are multiscale approaches for numerous geoscientific***

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including  
geoidal  
determination,  
magnetic field  
reconstruction  
, deformation  
analysis, and  
density  
variation  
modelling  
With exercises***

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***at the end of  
each chapter,  
the book may  
be used as a  
textbook for  
graduate-level  
courses in geo  
mathematics,  
applied  
mathematics,  
and  
geophysics.***

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***The work is also an up-to-date reference text for geoscientists, applied mathematicians, and engineers.***

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Processes and  
Potential  
Theory***

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comprises  
eleven survey  
papers based  
on survey  
lectures  
delivered at  
the  
Conference in  
Prague in July  
1987, which  
covered***

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of potential  
theory,  
including its  
applications in  
other areas.  
The survey  
papers deal  
with both  
classical and  
abstract  
potential***

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***theory and its  
relations to  
partial  
differential  
equations,  
stochastic  
processes and  
other branches  
such as  
numerical  
analysis and  
topology. A***



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the  
conference, is  
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***Surveys and  
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Applications  
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variety of  
applicable  
theoretical material  
and approaches in

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the calculations for diatomic systems in their ground states. The volume covers the descriptions and illustrations of modern calculations. Chapter I discusses the calculation of the interaction potential for large

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and small values of the internuclear distance  $R$

(separated and united atom limits).

Chapter II covers the methods used for intermediate values of  $R$ , which in principle means any values of  $R$ .

The Hartree-Fock



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and configuration interaction schemes described here have been the most used of all the methods. Semiempirical theories and methods constitute the subject of the last chapter. The book will be of value to physicists

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and students of physics.

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much as a prior knowledge of little more than vector addition and multiplication is assumed on the part of the reader, selected portions are suitable as an undergraduate text in vector analysis; at the same time

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the level of  
development is  
such that it may  
serve as a text for  
advanced graduate  
students, teachers  
and all  
professionally  
mature researchers  
in the areas of  
communication  
electromagnetics,

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plasma physics,  
electromagnetic  
compatibility,  
magnetics and  
geomagnetism. And  
for students,  
teachers and all  
professionals  
concerned with the  
foundations of  
classical  
electromagnetic

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theory as embodied in the Maxwell-Lorentz equations, the work offers a novel approach and logical development free from many of the difficulties inherent in the conventional treatment. Over 400 exercises of

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varying degrees of difficulty are spread throughout the text.

Potential theory grew out of mathematical physics, in particular out of the theory of gravitation and the theory of

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electrostatics.

Mathematical  
physicists such as  
Poisson and Green  
introduced some of  
the central ideas of  
the subject. A  
mathematician  
with a general  
knowledge of  
analysis may find it  
useful to begin his



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study of classical potential theory by looking at its physical origins.

Sections 2, 5 and 6 of these Notes give in part heuristic arguments based on physical considerations.

These heuristic arguments suggest

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mathematical  
theorems and  
provide the  
mathematician  
with the problem of  
finding the proper  
hypotheses and  
mathematical  
proofs. These Notes  
are based on a one-  
semester course  
given by the author

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at Brown

University in 1971.  
On the part of the  
reader, they  
assume a  
knowledge of Real  
Function Theory to  
the extent of a first  
year graduate  
course. In addition  
some elementary  
facts regarding

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harmonic functions are assumed as known. For convenience we have listed these facts in the Appendix. Some notation is also explained there. Essentially all the proofs we give in the Notes are for

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Euclidean 3-space  
 $R^3$  and Newtonian  
potentials  $\sim$ .

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"Here is a  
momentous work  
by Doob, one of the  
masters, in which  
Part 1 develops the  
potential theory  
associated with  
Laplace's equation

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and the heat equation, and Part 2 develops those parts (martingales and Brownian motion) of stochastic process theory which are closely related to Part 1". --G.E.H. Reuter in Short Book Reviews

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During the  
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The second aim  
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by using it to

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to be beyond the scope of this book to treat further topics such as duality, ideal boundary and integral representation, energy and Dirichlet forms. The

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subject matter  
of this book  
originates in  
the relation  
between  
classical  
potential  
theory and the  
theory of  
Brownian  
motion. Both  
theories are

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linked with  
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However, the  
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the papers of  
S. KAKUTANI



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