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37F - JAX RONNIE

This is a first year graduate text on electromagnetic field theory emphasizing mathematical approaches, problem solving and physical interpretation. Examples deal with guidance, propagation, radiation and scattering of electromagnetic waves, metallic and dielectric wave guides, resonators, antennas and radiating structures, Cerenkov radiation, moving media, plasmas, crystals, integrated optics, lasers and fibers, remote sensing, geophysical probing, dipole antennas and stratified media.
Much progress has been made in scattering theory since the publication of the first edition of this book fifteen years ago, and it is time to update it. Needless to say, it was impossible to incorporate all areas of new develop ment. Since among the newer books on scattering theory there are three excellent volumes that treat the subject from a much more abstract mathe matical point of view (Lax and Phillips on electromagnetic scattering, Amrein, Jauch and Sinha, and Reed and Simon on quantum scattering), I have refrained from adding material concerning the abundant new mathe matical results on time-dependent formulations of scattering theory. The only exception is Dollard's beautiful "scattering into cones" method that connects the physically intuitive and mathematically clean wave-packet description to experimentally accessible scattering rates in a much more satisfactory manner than the older procedure. Areas that have been substantially augmented are the analysis of the three-dimensional Schrodinger equation for non central potentials (in Chapter 10), the general approach to multiparticle reaction theory (in Chapter 16), the specific treatment of three-particle scattering (in Chapter 17), and inverse scattering (in Chapter 20). The additions to Chapter 16 include an introduction to the two-Hilbert space approach, as well as a derivation of general scattering-rate formulas. Chapter 17 now contains a survey of various approaches to the solution of three--particle problems, as well as a discussion of the Efimov effect.
Electromagnetic Scattering is a collection of studies that aims to discuss methods, state of the art, applications, and future research in electromagnetic scattering. The book covers topics related to the subject, which includes low-frequency electromagnetic scattering; the uniform asymptomatic theory of electromagnetic edge diffraction; analyses of problems involving high frequency diffraction and imperfect half planes; and multiple scattering of waves by periodic and random distribution. Also covered in this book are topics such as theories of scattering from wire grid and mesh structures; the electromagnetic inverse problem; computational methods for transmission of waves; and developments in the use of complex singularities in the electromagnetic theory. Engineers and physicists who are interested in the study, developments, and applications of electromagnetic scattering will find the text informative and helpful.
A review of theories developed for the study of acoustic, elastic and electromagnetic wave scattering from randomly rough surfaces, and a comprehensive summary of the latest techniques. Different theories are illustrated by experimental data.With applications in radar, sonar, ultrasonics and optics this book will be invaluable to graduate students, researchers and engineers.

Electromagnetic (EM) wave scattering is of fundamental importance to antenna and radar design engineering, and the increasing interest in metamaterials has created a need for new approaches to solving scattering problems for characterizing engineered media. This book lays the theoretical foundation for new computer programs in computational electromagnetics (CEM) and meets the need of today s researchers. This book represents over 30 years of the author s experience teaching this topic, with extensive lectures notes expanded to include advanced concepts and mathematical solutions to cover moderneffects on metamaterials and related advanced complexities.Problems and solutions at the end of each chapter help to reinforce concepts and highlight applications. This is an ideal text for advanced graduate students and researchers in EM and applied physics."
It has now been almost ten years since our first book on scattering theory ap peared [32]. At that time we claimed that "in recent years the development of integral equation methods for the direct scattering problem seems to be nearing completion, whereas the use of such an approach to study the inverse scattering problem has progressed to an extent that a 'state of the art' survey appears highly desirable". Since we wrote these words, the inverse scattering problem for acoustic and electromagnetic waves has grown from being a few theoreti cal considerations with limited numerical implementations to a weH developed mathematical theory with tested numerical algorithms. This maturing of the field of inverse scattering theory has been based on the realization that such problems are in general not only nonlinear but also improperly posed in the sense that the solution does not depend continuously on the measured data. This was emphasized in [32] and treated with the ideas and tools available at that time. Now, almost ten years later, these initial ideas have developed to the extent that a monograph summarizing the mathematical basis of the field seems appropriate. This book is oUf attempt to write such a monograph. The inverse scattering problem for acoustic and electromagnetic waves can broadly be divided into two classes, the inverse obstacle problem and

the inverse medium problem.

This book provides the first coherent account of a well-known approach to the problem of light scattering by small anisotropic particles. In this extended second edition the authors have encompassed all the new topics arising from their recent studies of cosmic dust grains. Thus many chapters were deeply revised and new chapters were added. The book addresses a wide spectrum of applications.

Plasma Scattering of Electromagnetic Radiation covers the theory and experimental application of plasma scattering. The book discusses the basic properties of a plasma and of the interaction of radiation with a plasma; the relationship between the scattered power spectrum and the fluctuations in plasma density; and the incoherent scattering of low-temperature plasma. The text also describes the constraints and problems that arise in the application of scattering as a diagnostic technique; the characteristic performance of various dispersion elements, image dissectors, and detectors; and the general scattered spectrum for an unmagnetized, low-temperature, quasi-equilibrium plasma. The application of the general scattered spectrum for a magnetized plasma; the scattering from a high-temperature plasma; and the scattering from unstable plasmas are also encompassed. Plasma physicists and people involved in the study of electromagnetic radiation will find the book invaluable.

A timely and authoritative guide to the state of the art of wavescattering Scattering of Electromagnetic Waves offers in three volumes acomplete and up-to-date treatment of wave scattering by randomdiscrete scatterers and rough surfaces. Written by leadingscientists who have made important contributions to wave scatteringover three decades, this new work explains the principles, methods,and applications of this rapidly expanding, interdisciplinaryfield. It covers both introductory and advanced material andprovides students and researchers in remote sensing as well asimaging, optics, and electromagnetic theory with a one-stopreference to a wealth of current research results. Plus, Scatteringof Electromagnetic Waves contains detailed discussions of bothanalytical and numerical methods, including cutting-edge techniquesfor the recovery of earth/land parametric information. The three volumes are entitled respectively Theories andApplications, Numerical Simulation, and Advanced Topics. In thefirst volume, Theories and Applications, Leung Tsang (University ofWashington) Jin Au Kong (MIT), and Kung-Hau Ding (Air ForceResearch Lab) cover: * Basic theory of electromagnetic scattering * Fundamentals of random scattering * Characteristics of discrete scatterers and rough surfaces * Scattering and emission by layered media * Single scattering and applications * Radiative transfer theory and solution techniques * One-dimensional random rough surface scattering

As relevant today as it was when it was first published 20 years ago, this book is a classic in the field. Nowhere else can you find more complete coverage of radiation and scattering of waves. The chapter: Asympotic Evaluation of Integrals is considered the definitive source for asympotic techniques. This book is essential reading for engineers, physicists and others involved in the fields of electromagnetics and acoustics. It is also an indispensable reference for advanced engineering courses.

This self-contained book gives fundamental knowledge about scattering and diffraction of electromagnetic waves and fills the gap between general electromagnetic theory courses and collections of engineering formulas. The book is a tutorial for advanced students learning the mathematics and physics of electromagnetic scattering and curious to know how engineering concepts and techniques relate to the foundations of electromagnetics

The inverse scattering problem is central to many areas of science and technology such as radar and sonar, medical imaging, geophysical exploration and nondestructive testing. This book is devoted to the mathematical and numerical analysis of the inverse scattering problem for acoustic and electromagnetic waves. In this third edition, new sections have been added on the linear sampling and factorization methods for solving the inverse scattering problem as well as expanded treatments of iteration methods and uniqueness theorems for the inverse obstacle problem. These additions have in turn required an expanded presentation of both transmission eigenvalues and boundary integral equations in Sobolev spaces. As in the previous editions, emphasis has been given to simplicity over generality thus providing the reader with an accessible introduction to the field of inverse scattering theory. Review of earlier editions: “Colton and Kress have written a scholarly, state of the art account of their view of direct and inverse scattering. The book is a pleasure to read as a graduate text or to dip into at leisure. It suggests a number of open problems and will be a source of inspiration for many years to come.” SIAM Review, September 1994 “This book should be on the desk of any researcher, any student, any teacher interested in scattering theory.” Mathematical Intelligencer, June 1994

Aimed at physicists and engineers conducting theoretical research or designing microwave and millimetre-wave devices, this study explores methods of calculating microwave absorption in waveguides, resonators and periodic structures.

The scattering of acoustic and electromagnetic waves by periodic sur faces plays a role in many areas of applied physics and engineering. Opti cal diffraction gratings date from the nineteenth century and are still widely used by spectroscopists. More recently, diffraction gratings have been used as coupling devices for optical waveguides. Trains of surface waves on the oceans are natural diffraction gratings which influence the scattering of electromagnetic waves and underwater sound. Similarly, the surface of a crystal acts as a diffraction grating for the scattering of atomic beams. This list of natural and artificial diffraction gratings could easily be extended. The purpose of this monograph is to develop from first principles a theory of the scattering of acoustic and electromagnetic waves by periodic surfaces. In physical terms, the scattering of both time-harmonic and transient fields is analyzed. The corresponding mathematical model leads to the study of boundary value problems for the Helmholtz and d'Alembert wave equations in plane domains bounded by periodic curves. In the formal ism adopted here these problems are intimately related to the spectral analysis of the Laplace operator, acting in a Hilbert space of functions defined in the domain adjacent to the grating.

This book gives a detailed overview of the theory of electromagnetic wave scattering on single, homogeneous, but nonspherical particles. Beside the systematically developed Green’s function formalism of the first edition this second and enlarged edition contains additional material regarding group theoretical considerations for nonspherical particles with boundary symmetries, an iterative T-matrix scheme for approximate solutions, and two additional but basic applications. Moreover, to demonstrate the advantages of the group theoretical approach and the iterative solution technique, the restriction to axisymmetric scatterers of the first edition was abandoned.

International Series of Monographs in Electromagnetic Waves, Volume 11: Electromagnetic Wave Theory, Part 1 covers the proceedings of an International Scientific Radio Union (U.R.S.I.) Symposium on Electromagnetic Wave Theory. The book contains 61 chapters that are organized into three sections. The first section presents papers about wave propagation, which includes lateral waves; terrestrial waveguides; and plane waves in dissipative media. Next, the title reviews studies about wave guides, including basic properties of periodic waveguides; theoretical investigation of non-uniform waveguides; and waves in a coaxial line partially filled with plasma. The last section covers topics about surface waves, such as a dielectric prism in the corner of overmoded waveguide; lasers and optical communication systems; and microwave and laser resonators. The text will be of great use to researchers and practitioners of disciplines that study or utilize electromagnetic wave technologies, such as electrotechnics and electrical engineering.

A timely and authoritative guide to the state of the art of wave scattering Scattering of Electromagnetic Waves offers in three volumes a complete and up-to-date treatment of wave scattering by random discrete scatterers and rough surfaces. Written by leading scientists who have made important contributions to wave scattering over three decades, this new work explains the principles, methods, and applications of this rapidly expanding, interdisciplinary field. It covers both introductory and advanced material and provides students and researchers in remote sensing as well as imaging, optics, and electromagnetic theory with a one-stop reference to a wealth of current research results. Plus, Scattering of Electromagnetic Waves contains detailed discussions of both analytical and numerical methods, including cutting-edge techniques for the recovery of earth/land parametric information. The three volumes are entitled respectively Theories and Applications, Numerical Simulation, and Advanced Topics. In the first volume, Theories and Applications, Leung Tsang (University of Washington) Jin Au Kong (MIT), and Kung-Hau Ding (Air Force Research Lab) cover: * Basic theory of electromagnetic scattering * Fundamentals of random scattering * Characteristics of discrete scatterers and rough surfaces * Scattering and emission by layered media * Single scattering and applications * Radiative transfer theory and solution techniques * One-dimensional random rough surface scattering

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One of the most methodical treatments of electromagnetic wave propagation, radiation, and scattering—including new applications and ideas Presented in two parts, this book takes an analytical approach on the subject and emphasizes new ideas and applications used today. Part one covers fundamentals of electromagnetic wave propagation, radiation, and scattering. It provides ample end-of-chapter problems and offers a 90-page solution manual to help readers check and comprehend their work. The second part of the book explores up-to-date applications of electromagnetic waves—including radiometry, geophysical remote sensing and imaging, and biomedical and signal processing applications. Written by a world renowned authority in the field of electromagnetic research, this new edition of Electromagnetic Wave Propagation, Radiation, and Scattering: From Fundamentals to Applications presents detailed applications with useful appendices, including mathematical formulas, Airy function, Abel's equation, Hilbert transform, and Riemann surfaces. The book also features newly revised material that focuses on the following topics: Statistical wave theories—which have been extensively applied to topics such as geophysical remote sensing, bio-electromagnetics, bio-optics, and bio-ultrasound imaging Integration of several distinct yet related disciplines, such as statistical wave theories, communications, signal processing, and time reversal imaging New phenomena of multiple scattering, such as coherent scattering and memory effects Multiphysics applications that combine theories for different physical phenomena, such as seismic coda waves, stochastic wave theory, heat diffusion, and temperature rise in biological and other media Metamaterials and solitons in optical fibers, nonlinear phenomena, and porous media Primarily a textbook for graduate courses in electrical engineering, Electromagnetic Wave Propagation, Radiation, and Scattering is also ideal for graduate students in bioengineering, geophysics, ocean engineering, and geophysical remote sensing. The book is also a useful reference for engineers and scientists working in fields such as geophysical remote sensing, bio–medical engineering in optics and ultrasound, and new materials and integration with signal processing.

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Electromagnetic Radiation, Scattering, and Diffraction Discover a graduate-level text for students specializing in electromagnetic wave radiation, scattering, and diffraction for engineering applications In Electromagnetic Radiation, Scattering and Diffraction, distinguished authors Drs. Prabhakar H. Pathak and Robert J. Burkholder deliver a thorough exploration of the behavior of electromagnetic fields in radiation, scattering, and guided wave environments. The book tackles its subject from first principles and includes coverage of low and high frequencies. It stresses physical interpretations of the electromagnetic wave phenomena along with their underlying mathematics. The authors emphasize fundamental principles and provide numerous examples to illustrate the concepts contained within. Students with a limited undergraduate electromagnetic background will rapidly and systematically advance their understanding of electromagnetic wave theory until they can complete useful and important graduate-level work on electromagnetic wave problems. Electromagnetic Radiation, Scattering and Diffraction also serves as a practical companion for students trying to simulate problems with commercial EM software and trying to better interpret their results. Readers will also benefit from the breadth and depth of topics, such as: Basic equations governing all electromagnetic (EM) phenomena at macroscopic scales are presented systematically. Stationary and relativistic moving boundary conditions are developed. Waves in planar multilayered isotropic and anisotropic media are analyzed. EM theorems are introduced and applied to a variety of useful antenna problems. Modal techniques are presented for analyzing guided wave and periodic structures. Potential theory and Green's function methods are developed to treat interior and exterior EM problems. Asymptotic High Frequency methods are developed for evaluating radiation Integrals to extract ray fields. Edge and surface diffracted ray fields, as well as surface, leaky and lateral wave fields are obtained. A collective ray analysis for finite conformal antenna phased arrays is developed. EM beams are introduced and provide useful basis functions. Integral equations and their numerical solutions via the method of moments are developed. The fast multipole method is presented. Low frequency breakdown is studied. Characteristic modes are discussed. Perfect for graduate students studying electromagnetic theory, Electromagnetic Radiation, Scattering, and Diffraction is an invaluable resource for professional electromagnetic engineers and researchers working in this area.

A systematic and accessible treatment of light scattering and transport in disordered media from first principles.

The Scattering of Light and other Electromagnetic Radiation covers the theory of electromagnetic scattering and its practical applications to light scattering. This book is divided into 10 chapters that particularly present examples of practical applications to light scattering from colloidal and macromolecular systems. The opening chapters survey the physical concept of electromagnetic waves and optics. The subsequent chapters deal with the theory of scattering by spheres and infinitely long cylinders. These topics are followed by discussions on the application of light scattering to the determination of the size distribution of colloidal particles. The last chapters are devoted to the Rayleigh-Debye scattering and the scattering by liquids, as well as the concept of anisotropy. These chapters also describe the effect upon light scattering of partial orientation of anisotropic particles in electrical and magnetic fields and in viscous flow. This book is of value to physical chemists and physical chemistry researchers, teachers, and students.

A self-contained, accessible introduction to the basic concepts, formalism and recent advances in electromagnetic scattering, for researchers and graduate students.

This book presents the development of electromagnetic theory in the field of scattering for a wide range of objects. Highly useful worked examples are included throughout the book to support the analysis of electromagnetic wave scattering processes.

This book is the first complete and comprehensive description of the modern Physical Theory of Diffraction (PTD) based on the concept of elementary edge waves (EEWs). The theory is demonstrated with the example of the diffraction of acoustic and electromagnetic waves at perfectly reflecting objects. The derived analytic expressions clearly explain the physical structure of the scattered field and describe in detail all of the reflected and diffracted rays and beams, as well as the fields in the vicinity of caustics and foci. Shadow radiation, a new fundamental component of the field, is introduced and proven to contain half of the total scattered power.

This volume crosses the boundaries of physics' traditional subdivisions to treat scattering theory within the context of classical electromagnetic radiation, classical particle mechanics, and quantum mechanics. Includes updates on developments in three-particle collisions, scattering by noncentral potentials, and inverse scattering problems. 1982 edition.

How can one determine the physical properties of the medium or the geometrical properties of the domain by observing electromagnetic waves? To answer this fundamental problem in mathematics and physics, this book leads the reader to the frontier of inverse scattering theory for electromagnetism. The first three chapters, written comprehensively, can be used as a textbook for undergraduate students. Beginning with elementary vector calculus, this book provides fundamental results for wave equations and Helmholtz equations, and summarizes the potential theory. It also explains the cohomology theory in an easy and straightforward way, which is an essential part of electromagnetism related to geometry. It then describes the scattering theory for the Maxwell equation by the time-dependent method and also by the stationary method in a concise, but almost self-contained manner. Based on these preliminary results, the book proceeds to the inverse problem for the Maxwell equation. The chapters for the potential theory and elementary cohomology theory are good introduction to graduate students. The results in the last chapter on the inverse scattering for the medium and the determination of Betti numbers are new, and will give a current scope for the inverse spectral problem on non-compact manifolds. It will be useful for young researchers who are interested in this field and trying to find new problems.

This book explores the development of electromagnetic theory in the field of scattering. Solutions to applied problems of electromagnetic wave scattering are presented and include resonant electromagnetic wave scattering, solved by the integral equation method, and 2D and 3D scattering problems, solved by the asymptotical (short wave) method. The book provides worked examples throughout for analysis of the electromagnetic wave scattering processes by different objects. The key audience for this book includes researchers in the field of electromagnetic scattering and designers of radar and radio equipment.

Electromagnetic Wave Scattering by Aerial and Ground Radar Objects presents the theory, original calculation methods, and computational results of the scattering characteristics of different aerial and ground radar objects. This must-have book provides essential background for computing electromagnetic wave scattering in the presence of different kinds of irregularities, as well as Summarizes fundamental electromagnetic statements such as the Lorentz reciprocity theorem and the image principle Contains integral field representations enabling the study of scattering from various layered structures Describes scattering computation techniques for objects with surface fractures and radar-absorbent coatings Covers elimination of "terminator discontinuities" appearing in the method of physical optics in general bistatic cases Includes radar cross-section (RCS) statistics and high--range resolution profiles of assorted aircrafts, cruise missiles, and tanks Complete with radar backscattering diagrams, echo signal amplitude probability distributions, and other valuable reference material, Electromagnetic Wave Scattering by Aerial and Ground Radar Objects is ideal for scientists, engineers, and researchers of electromagnetic wave scattering, computational electrodynamics, and radar detection and recognition algorithms.

Electromagnetic wave theory is based on Maxwell's equations, and electromagnetic boundary-value problems must be solved to understand electromagnetic scattering, propagation, and radiation. Electromagnetic theory finds practical applications in wireless telecommunications and microwave engineering. This book is written as a text for a two-semester graduate course on electromagnetic wave theory. As such, Electromagnetic Wave Theory for Boundary-Value Problems is intended to help students enhance analytic skills by solving pertinent boundary-value problems. In particular, the techniques of Fourier transform, mode matching, and residue calculus are utilized to solve some canonical scattering and radiation problems.

Advances in space-borne remote sensing have significantly changed the mankind viewpoint how to observe our own Earth planet. Great amount of remote sensing data and images presents new resources to quantitatively describe and monitor our Earth environment, atmosphere, oceanic and land surfaces. In remote sensing, electromagnetic (EM) scattering, emission and wave propagation, as interaction with the Earth environment, lay the physical basis for understanding and extracting geoscientific information. Study of electromagnetic waves with remote sensing application has become an active and interdisciplinary area. This book presents some new progress on the theoretical and numerical approaches for information retrieval of the remote sensing via EM scattering and emission. We begin in Chapter 1 with the vector radiative transfer (VRT) theory for inhomogeneous scatter media. The VRT takes account of multiple scattering, emission and propagation of random scatter media, and quantitatively leads to insights of elucidating and understanding EM wave-terrain surface interaction. Meanwhile, it is extensively applicable to carrying out data interpretation and validation, and to solving the inverse problem, e.g. iteratively, physically or statistically. In Chapter 1, iterative solutions of multiple scattering and emission from inhomogeneous dense scatter media, and inhomogeneous non-spherical scatter media are discussed. Three-dimensional VRT equation (3D-VRT) for spatially inhomogeneous random scatter media for high resolution observation is also investigated. The polarimetric imagery of synthetic aperture radar (SAR) technology is one of most important advances in space-borne microwave remote sensing during recent decades.