(b) $U(\theta, \phi) = \cos^{181.34}(\theta); U_{max} = 1, \theta = 0^\circ$

$$P_{rad} = \int_0^{2\pi} \int_0^{\pi/2} U(\theta, \phi) \sin\theta \, d\theta \, d\phi = 2\pi \int_0^{\pi/2} \cos^{181.34}(\theta) \sin\theta \, d\theta$$

$$= 2\pi \left[-\frac{\cos^{182.34}(\theta)}{182.34} \right]_0^{\pi/2} = \left[-0 + \frac{1}{182.34} \right] 2\pi = \frac{2\pi}{182.34} = 0.03446$$

$$D_0 = \frac{4\pi U_{max}}{P_{rad}} = \frac{4\pi(1)}{2\pi}(182.34) = 2(182.34) = 364.68$$

$$\boxed{D_0 = 364.68 = 25.62 \text{ dB}}$$

(c) *Kraus' Approximation (2.27):*

$$D_0 \simeq \frac{41,253}{\Theta_{1d}\Theta_{2d}} = \frac{41,253}{(10)(10)} = 412.53 = 26.15 \text{ dB}$$

$$\boxed{D_0 \simeq 412.53 = 26.15 \text{ dB}}$$

(d) *Tai & Pereira (2.30b):*

$$D_0 \simeq \frac{72,815}{\Theta_{1d}^2 + \Theta_{2d}^2} = \frac{72,815}{2(10)^2} = \frac{72,815}{200} = 364.075 = 25.61 \text{ dB}$$

$$\boxed{D_0 \simeq 364.075 = 25.61 \text{ dB}}$$

2.10.

$$U(\theta, \phi) = \begin{cases} 1 & 0^\circ \leq \theta \leq 20^\circ \\ 0.342 \csc(\theta) & 20^\circ \leq \theta \leq 60^\circ \\ 0 & 60^\circ \leq \theta \leq 180^\circ \end{cases} \quad 0^\circ \leq \phi \leq 360^\circ$$

$$P_{rad} = \int_0^{2\pi} \int_0^\pi U(\theta, \phi) \sin\theta \, d\theta \, d\phi$$

$$= 2\pi \left[\int_0^{20^\circ} \sin\theta \, d\theta + \int_{20^\circ}^{60^\circ} 0.342 \csc(\theta) \times \sin\theta \, d\theta \right]$$

$$= 2\pi \left\{ -\cos\theta \Big|_0^{\pi/9} + 0.342 \cdot \theta \Big|_{\pi/9}^{\pi/3} \right\}$$

$$= 2\pi \left\{ \left[-\cos\left(\frac{\pi}{9}\right) + 1 \right] + 0.342\left(\frac{\pi}{3} - \frac{\pi}{9}\right) \right\}$$

$$= 2\pi \left\{ [-0.93969 + 1] + 0.342\pi\left(\frac{2}{9}\right) \right\}$$

$$= 2\pi [0.06031 + 0.23876] = 1.87912$$

$$D_0 = \frac{4\pi U_{max}}{P_{rad}} = \frac{4\pi(1)}{1.87912} = 6.68737 = 8.25255 \text{ dB}$$

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R Bogdan

Problems Solutions Antenna Theory Balanis:

   Antenna Theory Constantine A. Balanis,2005-04-04 The discipline of antenna theory has experienced vast technological changes In response Constantine Balanis has updated his classic text Antenna Theory offering the most recent look at all the necessary topics New material includes smart antennas and fractal antennas along with the latest applications in wireless communications Multimedia material on an accompanying CD presents PowerPoint viewgraphs of lecture notes interactive review questions Java animations and applets and MATLAB features Like the previous editions Antenna Theory Third Edition meets the needs of electrical engineering and physics students at the senior undergraduate and beginning graduate levels and those of practicing engineers as well It is a benchmark text for mastering the latest theory in the subject and for better understanding the technological applications An Instructor s Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department   **Antenna Theory** Constantine A. Balanis,2016-02-01 Updated with color and gray scale illustrations a companion website housing supplementary material and new sections covering recent developments in antenna analysis and design This book introduces the fundamental principles of antenna theory and explains how to apply them to the analysis design and measurements of antennas Due to the variety of methods of analysis and design and the different antenna structures available the applications covered in this book are made to some of the most basic and practical antenna configurations Among these antenna configurations are linear dipoles loops arrays broadband antennas aperture antennas horns microstrip antennas and reflector antennas The text contains sufficient mathematical detail to enable undergraduate and beginning graduate students in electrical engineering and physics to follow the flow of analysis and design Readers should have a basic knowledge of undergraduate electromagnetic theory including Maxwell s equations and the wave equation introductory physics and differential and integral calculus Presents new sections on flexible and conformal bowtie Vivaldi antenna antenna miniaturization antennas for mobile communications dielectric resonator antennas and scale modeling Provides color and gray scale figures and illustrations to better depict antenna radiation characteristics Includes access to a companion website housing MATLAB programs Java based applets and animations Power Point notes Java based interactive questionnaires and a solutions manual for instructors Introduces over 100 additional end of chapter problems Antenna Theory Analysis and Design Fourth Edition is designed to meet the needs of senior undergraduate and beginning graduate level students in electrical engineering and physics as well as practicing engineers and antenna designers Constantine A Balanis received his BSEE degree from the Virginia Tech in 1964 his MEE degree from the University of Virginia in 1966 his PhD in Electrical Engineering from The Ohio State University in 1969 and an Honorary Doctorate from the Aristotle University of Thessaloniki in 2004 From 1964 to 1970 he was with the NASA Langley Research Center in Hampton VA and from 1970 to 1983 he was with the Department of Electrical Engineering of West Virginia University In 1983 he joined Arizona State University and is now Regents Professor of Electrical Engineering Dr Balanis is

also a life fellow of the IEEE   Soft Computing and its Engineering Applications Kanubhai K. Patel,Gayatri Doctor,Atul Patel,Pawan Lingras,2022-05-06 This book constitutes the refereed proceedings of the Third International Conference on Soft Computing and its Engineering Applications icSoftComp 2021 held in Changa India in December 2021 Due to the COVID 19 pandemic the conference was held online The 29 full papers and 4 short papers presented were carefully reviewed and selected from 247 submissions The papers present recent research on theory and applications in fuzzy computing neuro computing and evolutionary computing   **Phased Arrays for Radio Astronomy, Remote Sensing, and Satellite Communications** Karl F. Warnick,Rob Maaskant,Marianna V. Ivashina,David B. Davidson,Brian D. Jeffs,2018-07-26 Discover a modern approach to the analysis modeling and design of high sensitivity phased arrays Network theory numerical methods and computational electromagnetic simulation techniques are uniquely combined to enable full system analysis and design optimization Beamforming and array signal processing theory are integrated into the treatment from the start Digital signal processing methods such as polyphase filtering and RFI mitigation are described along with technologies for real time hardware implementation Key concepts from interferometric imaging used in radio telescopes are also considered A basic development of theory and modeling techniques is accompanied by problem sets that guide readers in developing modeling codes that retain the simplicity of the classical array factor method while incorporating mutual coupling effects and interactions between elements Combining current research trends with pedagogical material suitable for a first year graduate course this is an invaluable resource for students teachers researchers and practicing RF microwave and antenna design engineers   **Modern Electromagnetic Scattering Theory with Applications** Andrey V. Osipov,Sergei A. Tretyakov,2017-04-17 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   **Conformal Array Antenna Theory and Design** Lars Josefsson,Patrik Persson,2006-02-10 This is the first comprehensive treatment of conformal antenna arrays from an engineering perspective While providing a thorough foundation in theory the authors of this publication provide a wealth of hands on instruction for practical analysis and design of conformal antenna arrays Thus you get the knowledge you need alongside the practical know how to design antennas that are integrated into such structures aircrafts or skyscrapers   **Electromagnetics, Microwave Circuit and Antenna Design for Communications Engineering** Peter Russer,2003 If you re looking for a clear comprehensive overview of basic electromagnetics principles and applications to antenna and microwave circuit design for communications this authoritative book is your best choice Including concise explanations of all required mathematical concepts needed to fully comprehend the material the book is your complete resource for understanding electromagnetics in current emerging and future

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the design in various ways The mathematical problems associated with attempts to optimize p formance can become quite sophisticated even for simple physical structures   Partial Discharges in Hydroelectric Generators Victor Dmitriev,Rodrigo M. S. Oliveira,Ronaldo F. Zampolo,Paulo R. Moutinho de Vilhena,Fernando de Souza Brasil,Martim Felipe Fernandes,2023-12-01 Effective implementation of predictive maintenance programs in power plants requires the online condition monitoring of electrical generators This book offers a comprehensive guide on the measurement detection and interpretation of partial discharges in hydroelectric generators It covers a range of essential topics such as the physics of partial discharge phenomenon various types of defects and partial discharge patterns sensors and acquisition procedures signal processing techniques automatic classification of discharge types and correlation between partial discharge occurrence and ozone generation Numerical modelling of partial discharges and calculation of the associated radiating electromagnetic fields are also discussed To aid understanding the book provides theoretical explanations practical examples and functional Python code on Google s Colaboratory platform This book is a valuable resource for anyone seeking a deep understanding of partial discharges in hydroelectric generators Presents in depth theory with examples Provides experimental data illustrating effects of PD in machine components Includes functional Python and C code examples

Computational Electromagnetics Raj Mittra,2013-08-20 Emerging Topics in Computational Electromagnetics in Computational Electromagnetics presents advances in Computational Electromagnetics This book is designed to fill the existing gap in current CEM literature that only cover the conventional numerical techniques for solving traditional EM problems The book examines new algorithms and applications of these algorithms for solving problems of current interest that are not readily amenable to efficient treatment by using the existing techniques The authors discuss solution techniques for problems arising in nanotechnology bioEM metamaterials as well as multiscale problems They present techniques that utilize recent advances in computer technology such as parallel architectures and the increasing need to solve large and complex problems in a time efficient manner by using highly scalable algorithms   **Advances in Distributed Computing and Machine Learning** Umakanta Nanda,Asis Kumar Tripathy,Jyoti Prakash Sahoo,Mahasweta Sarkar,Kuan-Ching Li,2024-08-02 This book is a collection of peer reviewed best selected research papers presented at the Fifth International Conference on Advances in Distributed Computing and Machine Learning ICADCML 2024 organized by School of Electronics and Engineering VIT AP University Amaravati Andhra Pradesh India during 5 6 January 2024 This book presents recent innovations in the field of scalable distributed systems in addition to cutting edge research in the field of Internet of Things IoT and blockchain in distributed environments   *Computational Electromagnetics for RF and Microwave Engineering* David B. Davidson,2010-10-28 This hands on introduction to computational electromagnetics CEM links theoretical coverage of the three key methods the FDTD MoM and FEM to open source MATLAB codes freely available online in 1D 2D and 3D together with many practical hints and tips gleaned from the author s 25 years of experience in the field Updated and

extensively revised this second edition includes a new chapter on 1D FEM analysis and extended 3D treatments of the FDTD MoM and FEM with entirely new 3D MATLAB codes Coverage of higher order finite elements in 1D 2D and 3D is also provided with supporting code in addition to a detailed 1D example of the FDTD from a FEM perspective With running examples through the book and end of chapter problems to aid understanding this is ideal for professional engineers and senior undergraduate graduate students who need to master CEM and avoid common pitfalls in writing code and using existing software **Personal Wireless Communications** Pedro Cuenca,Luis Orozco-Barbosa,2006-09-30 This book constitutes the refereed proceedings of the IFIP TC6 11th International Conference on Personal Wireless Communications PWC 2006 The book presents 25 revised full papers and 13 revised short papers carefully reviewed and selected from 100 submissions The papers are organized in topical sections on mobile and wireless networking QoS ad hoc security wireless LAN cross layer design wireless sensor networks physical layer and mobile and wireless applications **Antenna Synthesis through the Characteristics of Desired Amplitude** Mykhaylo I. Andriychuk,2019-09-12 The book is devoted to the synthesis problems that arise in the theory and design of radiating systems antennas The characteristics of desired amplitude are data placed into a synthesis problem A synthesis problem belongs to a class of inverse problems and its aim is to determine a distribution of current or fields in an antenna which produces the amplitude radiation characteristic as close as possible to the desired one Freedom of choice of phase distribution of the desired radiation pattern RP is used as an additional possibility of better approximation to such RPs This book studies various different types of antennas and arrays as the radiation systems under consideration A special class of problems related to acoustic and electromagnetic scattering on a set of bodies particles of small size is also discussed while the constructive procedures of creating inhomogeneous materials with specific properties are proposed **Boundary Integral Equations** George C. Hsiao,Wolfgang L. Wendland,2021-03-26 This is the second edition of the book which has two additional new chapters on Maxwell s equations as well as a section on properties of solution spaces of Maxwell s equations and their trace spaces These two new chapters which summarize the most up to date results in the literature for the Maxwell s equations are sufficient enough to serve as a self contained introductory book on the modern mathematical theory of boundary integral equations in electromagnetics The book now contains 12 chapters and is divided into two parts The first six chapters present modern mathematical theory of boundary integral equations that arise in fundamental problems in continuum mechanics and electromagnetics based on the approach of variational formulations of the equations The second six chapters present an introduction to basic classical theory of the pseudo differential operators The aforementioned corresponding boundary integral operators can now be recast as pseudo differential operators These serve as concrete examples that illustrate the basic ideas of how one may apply the theory of pseudo differential operators and their calculus to obtain additional properties for the corresponding boundary integral operators These two different approaches are complementary to each other Both serve as the mathematical

foundation of the boundary element methods which have become extremely popular and efficient computational tools for boundary problems in applications This book contains a wide spectrum of boundary integral equations arising in fundamental problems in continuum mechanics and electromagnetics The book is a major scholarly contribution to the modern approaches of boundary integral equations and should be accessible and useful to a large community of advanced graduate students and researchers in mathematics physics and engineering   *Mesh Methods for Boundary-Value Problems and Applications* Ildar B. Badriev,Victor Banderov,Sergey A. Lapin,2022-09-14 This book gathers papers presented at the 13th International Conference on Mesh Methods for Boundary Value Problems and Applications which was held in Kazan Russia in October 2020 The papers address the following topics the theory of mesh methods for boundary value problems in mathematical physics non linear mathematical models in mechanics and physics algorithms for solving variational inequalities computing science and educational systems Given its scope the book is chiefly intended for students in the fields of mathematical modeling science and engineering However it will also benefit scientists and graduate students interested in these fields   *Explorations in Computational Physics* Devang Patil,2025-02-20 Explorations in Computational Physics delves into the intricate world of computational physics offering a comprehensive guide from fundamental theories to cutting edge applications This book serves as an indispensable companion for both novice learners and seasoned researchers We cover a diverse array of topics meticulously unfolding layers of computational techniques and their applications in various branches of physics From classical mechanics simulations elucidating celestial mechanics to quantum mechanics computations unraveling atomic and subatomic realms the book navigates through the vast landscape of computational methodologies with clarity and precision Furthermore we delve into electromagnetic field simulations statistical mechanics and thermodynamics equipping readers with tools to model complex physical phenomena with accuracy and efficiency High performance computing techniques data analysis and visualization methodologies are elucidated empowering readers to harness modern computational resources in their research With lucid explanations illustrative examples and insightful discussions on emerging technologies like quantum computing and artificial intelligence Explorations in Computational Physics fosters a deeper understanding of computational methodologies and their transformative impact on physics research

Electromagnetics of Body Area Networks Douglas H. Werner,Zhi Hao Jiang,2016-09-06 The book is a comprehensive treatment of the field covering fundamental theoretical principles and new technological advancements state of the art device design and reviewing examples encompassing a wide range of related sub areas In particular the first area focuses on the recent development of novel wearable and implantable antenna concepts and designs including metamaterial based wearable antennas microwave circuit integrated wearable filtering antennas and textile and or fabric material enabled wearable antennas The second set of topics covers advanced wireless propagation and the associated statistical models for on body in body and off body modes Other sub areas such as efficient numerical human body modeling techniques artificial

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