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# *Microwave Filters For Communication Systems Fundamentals Design And Applications*

An investigation into the design of active microwave filters is presented. These filters are potentially useful as they enable future filters for communication systems to be realisable in monolithic form. The active filters described in this thesis are based upon a negative resistance method with minimum frequency limitation. Measured

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results for varactor tuned active bandpass and bandstop filters realised in microstrip are presented. These filters exhibited infinite small signal Q factor. Their large signal behaviour including intermodulation performance has been characterised using experimental techniques and computer simulation ..

Michael Hrobak studied hybrid integrated front end modules for high frequency measurement equipment and especially for synthetic automatic test systems. Recent developments of innovative, critical millimeter-wave components like frequency

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multipliers, directional couplers, filters, triple balanced mixers and power detectors are illustrated by the author separately and in combination.

This book presents a broad range of deep-learning applications related to vision, natural language processing, gene expression, arbitrary object recognition, driverless cars, semantic image segmentation, deep visual residual abstraction, brain-computer interfaces, big data processing, hierarchical deep learning networks as game-playing artefacts using regret matching, and building GPU-accelerated deep learning

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frameworks. Deep learning, an advanced level of machine learning technique that combines class of learning algorithms with the use of many layers of nonlinear units, has gained considerable attention in recent times. Unlike other books on the market, this volume addresses the challenges of deep learning implementation, computation time, and the complexity of reasoning and modeling different type of data. As such, it is a valuable and comprehensive resource for engineers, researchers, graduate students and Ph.D. scholars.

This book describes a full range

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of contemporary techniques for the design of transmitters and receivers for communications systems operating in the range from 1 through to 300 GHz. In this frequency range there is a wide range of technologies that need to be employed, with silicon ICs at the core but, compared with other electronics systems, a much greater use of more specialist devices and components for high performance – for example, high Q-factor/low loss and good power efficiency. Many text books do, of course, cover these topics but what makes this book timely is the rapid adoption of

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millimetre-waves (frequencies from 30 to 300 GHz) for a wide range of consumer applications such as wireless high definition TV, “ 5G ” Gigabit mobile internet systems and automotive radars. It has taken many years to develop low-cost technologies for suitable transmitters and receivers, so previously these frequencies have been employed only in expensive military and space applications. The book will cover these modern technologies, with the follow topics covered; transmitters and receivers, lumped element filters, transmission lines and S-parameters, RF MEMS, RFICs

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Systems Fundamentals Design and MMICs, and many others. In addition, the book includes

extensive line diagrams to illustrate circuit diagrams and block diagrams of systems, including diagrams and photographs showing how circuits are implemented practically. Furthermore, case studies are also included to explain the salient features of a range of important wireless communications systems. The book is accompanied with suitable design examples and exercises based on the Advanced Design System – the industry leading CAD tool for wireless design. More

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importantly, the authors have been working with Keysight Technologies on a learning & teaching initiative which is designed to promote access to industry-standard EDA tools such as ADS. Through its University Educational Support Program, Keysight offers students the opportunity to request a student license, backed up with extensive classroom materials and support resources. This culminates with students having the chance to demonstrate their RF/MW design and measurement expertise through the Keysight RF & Microwave Industry-Ready



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There have been significant advances in the synthesis and physical realization of microwave filter networks over the last three decades. This book provides a coherent and readable description of system requirements and constraints for microwave filters, fundamental considerations in the theory and design of microwave filters, up-to-date modern synthesis techniques with examples and technology considerations in the choice of hardware.

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22 February 1994

Microwave Filters for

Communications Systems

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Compact Bandpass Filters Using

Dual-mode Microstrip Closed-

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**The book proposes new technologies and discusses innovative solutions to various problems in the field of communication, circuits, and systems, as reflected in high-quality papers presented at International Conference on Communication, Circuits, and Systems (IC3S 2020) held at KIIT, Bhubaneswar, India from 16-18 October 2020. It brings together**

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**new works from academicians, scientists, industry professionals, scholars, and students together to exchange research outcomes and open up new horizons in the areas of signal processing, communications, and devices.**

**This authoritative resource presents current practices for the design of RF and microwave filters. This one-stop reference provides readers with essential and practical information in order to design their own filter design software**

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**package, ultimately saving time and money. Essential building blocks for each type of filter are presented including network theory, transmission lines, and coupling mechanisms. This book presents a detailed discussion of the Low Pass Filter prototype, which is then extended to other configurations such as high pass, band pass, band stop, diplexers, and multiplexers. Microwave Network Theory and Transmission Line Coupling Mechanisms are presented along with a comprehensive discussion of the characteristics of**

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**commonly used  
transmission lines such as  
waveguides, Striplines, and  
Microstrip lines. Numerous  
design examples are  
presented to demonstrate  
an inclusive design  
methodology.**

**This is the first truly  
comprehensive and most  
up-to-date handbook  
available on modern  
reflector antennas and feed  
sources for diversified  
space and ground  
applications. There has  
never been such an all-  
encompassing reflector  
handbook in print, and no  
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**offers coverage of such recent research developments. The Handbook consists of three volumes. Volume III focuses on the range of reflector antenna applications, including space, terrestrial, and radar. The intent of this book volume is to provide practical applications and design information on reflector antennas used for several communications systems. This book covers recent developments of reflector antennas used for satellite communications, terrestrial communications, and**

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**remote sensing applications. New subjects are introduced for the first time, including satellite antennas, Terahertz antennas, PIM, multipaction, corona, deployable mesh reflector antennas, and mechanical aspects of reflector antennas. In addition, this book contains a separate topic on integrated feed assembly for reflector antennas covering analysis, design, fabrication, and test.**

**Handbook of Microwave Component Measurements Second Edition is a fully**



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**updated, complete reference to this topic, focusing on the modern measurement tools, such as a Vector Network Analyzer (VNA), gathering in one place all the concepts, formulas, and best practices of measurement science. It includes basic concepts in each chapter as well as appendices which provide all the detail needed to understand the science behind microwave measurements. The book offers an insight into the best practices for ascertaining the true nature of the device-under-**

**test (DUT), optimizing the time to setup and measure, and to the greatest extent possible, remove the effects of the measuring equipment from that result. Furthermore, the author writes with a simplicity that is easily accessible to the student or new engineer, yet is thorough enough to provide details of measurement science for even the most advanced applications and researchers. This welcome new edition brings forward the most modern techniques used in industry today, and recognizes that**

**more new techniques have developed since the first edition published in 2012.**

**Whilst still focusing on the VNA, these techniques are also compatible with other vendor's advanced equipment, providing a comprehensive industry reference.**

**With the development of mobile 4G communication system, people's requirements for the speed of wireless communication are rapidly increasing. In order to meet this need, the research and development of the fifth generation (5G) wireless**

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**systems has been carried out. Compared with previous generation (1G~4G), 5G will have significant improvements in transmission rate, latency, mobility and so on. The book “Microwave/RF Components for 5G Front-End Systems” is outlines the simulation, design, and fabrication of microwave components including Antennas, Filters, and Power Amplifiers for 5G wireless communications. In addition, exhaustive reviews have been presented, classifying the various types and**

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**applications of  
reconfigurable antennas,  
Filters and amplifiers for  
current and future wireless  
networks.**

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**for 5G Front-End Systems**  
**Mission-Oriented Sensor**  
**Networks and Systems: Art**  
**and Science**  
**Colloquium on "Microwave**  
**Filters and Antennas for**  
**Personal Communication**  
**Systems**  
**Volume 2: Advances**

The fundamentals needed to design and realize microwave and RF filters. Microwave and RF filters play an important role in communication systems and, owing to the proliferation of radar, satellite, and mobile wireless systems, there is a need for design methods that can satisfy the ever-increasing demand for accuracy, reliability, and shorter

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development times. Beginning with a brief review of scattering and chain matrices, filter approximations and synthesis, waveguides and transmission lines, and fundamental electromagnetic equations, the book then covers design techniques for microwave and RF filters operating across a frequency range from 1 GHz to 35 GHz. Each design chapter: Is dedicated to only one filter and is organized by the type of filter response Provides several design examples, including the analysis and modeling of the structures discussed and the methodologies employed Offers practical information on the actual performance of the filters and

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common difficulties encountered during construction Concludes with the construction technique, pictures of the inside and outside of the filter, and the measured performances Advanced Design Techniques and Realizations of Microwave and RF Filters is an essential resource for wireless and telecommunication engineers, as well as for researchers interested in current microwave and RF filter design practices. It is also appropriate as a supplementary textbook for advanced undergraduate courses in filter design.

This book presents and discusses strategies for the design and



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implementation of common-mode suppressed balanced microwave filters, including, narrowband, wideband, and ultra-wideband filters. This book examines differential-mode, or balanced, microwave filters by discussing several implementations of practical realizations of these passive components. Topics covered include selective mode suppression, designs based on distributed and semi-lumped approaches, multilayer technologies, defect ground structures, coupled resonators, metamaterials, interference techniques, and substrate integrated waveguides, among others. Divided into five parts, *Balanced Microwave*

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Filters begins with an introduction that presents the fundamentals of balanced lines, circuits, and networks. Part 2 covers balanced transmission lines with common-mode noise suppression, including several types of common-mode filters and the application of such filters to enhance common-mode suppression in balanced bandpass filters. Next, Part 3 examines wideband and ultra-wideband (UWB) balanced bandpass filters with intrinsic common-mode suppression. Narrowband and dual-band balanced bandpass filters with intrinsic common-mode suppression are discussed in Part 4. Finally, Part 5 covers other balanced circuits,

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such as balanced power dividers and combiners, and differential-mode

equalizers with common-mode

filtering. In addition, the book:

Explores a research topic of

increasing interest due to the

growing demand of balanced

transmission lines and circuits in

modern communication systems

Includes contributions from

prominent worldwide experts in the

field Provides readers with the

necessary knowledge to analyze and

synthesize balanced filters and

circuits Balanced Microwave Filters

is an important text for R&D

engineers, professionals, and

specialists working on the topic of

microwave filters. Post graduate

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students and Masters students in the field of microwave engineering and wireless communications, especially those involved in courses related to microwave filters, and balanced filters and circuits will also find it to be a vital resource.

This book addresses the true innovation in engineering design that may be promoted by blending together models and methodologies from different disciplines, and, in this book, the target was exactly to follow this approach to deliver a new disruptive architecture to deliver these next-generation mobile small cell technologies. According to this design philosophy, the work within this book resides in the intersection

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of engineering paradigms that includes “cooperation”, “network coding”, and “smart energy-aware frontends”. These technologies will not only be considered as individual building blocks, but re-engineered according to an inter-design approach resulting in the enabler for energy efficient femtocell-like services on the move. The book aims to narrow the gap between the current networking technologies and the foreseen requirements that are targeted at the future development of the 5G mobile and wireless communications networks in terms of the higher networking capacity, the ability to support more users, the lower cost per bit, the enhanced

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energy efficiency, and adaptability to new services and devices (for example, smart cities, and the Internet of things (IoT)).

This comprehensive resource provides a thorough introduction to the principles of electronic circuits operating in the radio, microwave, and millimeter-wave frequency ranges. The book highlights the fundamental physical laws of classical electromagnetics using a foundation of Maxwell's equations to give insight into the operating principles of circuit elements of all kinds, from lumped elements to transmission lines, waveguides, optical fibers, and quasi-optical structures. Standard passive system

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components like filters, splitters, couplers, hybrids, baluns, and antennas are explained to acclimate the reader to considering multiple technological solutions for common design problems. A basic overview of active circuit designs, such as amplifiers, mixers, and multipliers is also provided, along with discussion of the performance characteristics of electronic systems, including noise and linearity. Emphasis is placed on visualization and understanding of how and why electronic circuits of all frequencies are built and operate the way they do. Readers learn how to match an amplifier for optimum noise performance over the broadest bandwidth with the fewest number

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of elements and how to visualize the coupling of various modes in a mixed waveguide-type structure and avoid resonances due to trapped, higher-order modes. The book provides the tools needed to design and optimize a launcher from microstrip into waveguide, and whether the best characteristics can be achieved by incorporating matching elements in the microstrip section, the waveguide section, or both. Packed with references and examples, readers learn not only how to do the math but what the math means.

Microwave and Millimeter Wave Circuits and Systems:  
Emerging Design, Technologies and



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Applications provides a wide spectrum of current trends in the design of microwave and millimeter circuits and systems. In addition, the book identifies the state-of-the-art challenges in microwave and millimeter wave circuits systems design such as behavioral modeling of circuit components, software radio and digitally enhanced front-ends, new and promising technologies such as substrate-integrated-waveguide (SIW) and wearable electronic systems, and emerging applications such as tracking of moving targets using ultra-wideband radar, and new generation satellite navigation systems. Each chapter treats a selected problem and

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challenge within the field of Microwave and Millimeter wave circuits, and contains case studies and examples where appropriate. Key Features: Discusses modeling and design strategies for new appealing applications in the domain of microwave and millimeter wave circuits and systems Written by experts active in the Microwave and Millimeter Wave frequency range (industry and academia) Addresses modeling/design/applications both from the circuit as from the system perspective Covers the latest innovations in the respective fields Each chapter treats a selected problem and challenge within the field of Microwave and

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Millimeter wave circuits, and contains casestudies and examples where appropriate This book serves as an excellent reference for engineers, researchers, research project managers and engineers working in R&D, professors, and post-graduates studying related courses. It will also be of interest to professionals working in product development and PhD students.

[Wireless Power Transfer Handbook of Reflector Antennas and Feed Systems Volume III: Applications of Reflectors Microwave Filters for Communication Systems Microwave Filters and Antennas for](#)

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**The first of its kind, this work offers a detailed insight into a range of design procedures for dual-band and tri-band microstrip**

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**filters, from theory to practical design. Originating from the FP7 MultiWaveS project, this comprehensive resource includes the most recent results from several well-established research groups, as well as detailed coverage of competing approaches, ranging from the conventional approach to advanced multilayer fabrication technologies, and the development and application of several novel geometries and concepts. In-depth coverage of basic theoretical foundations, detailed design procedures and rules, and comparisons of measured and simulated results enable you to select the optimal approach for your purposes and designs, making this an**

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**invaluable resource for both students and industry professionals in the field of microwave engineering.**

**An in-depth look at the state-of-the-art in microwave filter design, implementation, and optimization Thoroughly revised and expanded, this second edition of the popular reference addresses the many important advances that have taken place in the field since the publication of the first edition and includes new chapters on Multiband Filters, Tunable Filters and a chapter devoted to Practical Considerations and Examples. One of the chief constraints in the evolution of wireless communication systems is the scarcity of the available**

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frequency spectrum, thus making frequency spectrum a primary resource to be judiciously shared and optimally utilized. This fundamental limitation, along with atmospheric conditions and interference have long been drivers of intense research and development in the fields of signal processing and filter networks, the two technologies that govern the information capacity of a given frequency spectrum. Written by distinguished experts with a combined century of industrial and academic experience in the field, Microwave Filters for Communication Systems: Provides a coherent, accessible description of system requirements and constraints for

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**microwave filters Covers fundamental considerations in the theory and design of microwave filters and the use of EM techniques to analyze and optimize filter structures Chapters on Multiband Filters and Tunable Filters address the new markets emerging for wireless communication systems and flexible satellite payloads and A chapter devoted to real-world examples and exercises that allow readers to test and fine-tune their grasp of the material covered in various chapters, in effect it provides the roadmap to develop a software laboratory, to analyze, design, and perform system level tradeoffs including EM based tolerance and sensitivity analysis**



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**for microwave filters and multiplexers for practical applications. Microwave Filters for Communication Systems provides students and practitioners alike with a solid grounding in the theoretical underpinnings of practical microwave filter and its physical realization using state-of-the-art EM-based techniques.**

**"An in-depth look at the state-of-the-art in microwave filter design, implementation, and optimization Thoroughly revised and expanded, this second edition of the popular reference addresses the many important advances that have taken place in the field since the publication of the first edition and includes new chapters on Multiband**

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**Filters, Tunable Filters and a chapter devoted to Practical Considerations and Examples. One of the chief constraints in the evolution of wireless communication systems is the scarcity of the available frequency spectrum, thus making frequency spectrum a primary resource to be judiciously shared and optimally utilized. This fundamental limitation, along with atmospheric conditions and interference have long been drivers of intense research and development in the fields of signal processing and filter networks, the two technologies that govern the information capacity of a given frequency spectrum. Written by distinguished experts with a**

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**combined century of industrial and academic experience in the field, Microwave Filters for Communication Systems: Provides a coherent, accessible description of system requirements and constraints for microwave filters Covers fundamental considerations in the theory and design of microwave filters and the use of EM techniques to analyze and optimize filter structures Chapters on Multiband Filters and Tunable Filters address the new markets emerging for wireless communication systems and flexible satellite payloads and A chapter devoted to real-world examples and exercises that allow readers to test and fine-tune their grasp of the**

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material covered in various chapters, in effect it provides the roadmap to develop a software laboratory, to analyze, design, and perform system level tradeoffs including EM based tolerance and sensitivity analysis for microwave filters and multiplexers for practical applications. Microwave Filters for Communication Systems provides students and practitioners alike with a solid grounding in the theoretical underpinnings of practical microwave filter and its physical realization using state-of-the-art EM-based techniques"-- Microwave filters have important role in many wireless and communication systems such as satellite and cellular mobile

**organizations. In such kind of systems, factors such as compact size, low cost, light weight, high performance, and low loss in designing of microwave filters are of primary importance. In comparison with waveguide filters, microstrip filters are smaller and in such applications mentioned before there are needs to have smaller microstrip filters. In this thesis, filters using dual-mode ring resonators is proposed, because they can be designed easier than the other kind of microwave filters and are more compact. In this thesis, a new compact form of dual-mode microstrip octagonal loop resonator filter is proposed in two forms; conventional and compact. These structures are**

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designed to operate at WiMax frequency of 2.3 GHz with a 5% fractional bandwidth. The new dual-mode resonator will be produced by adding a rectangular patch inside the loop resonator. The experimental results and simulated values are presented and show good agreement. The filter is fabricated on CER-10 substrate having a relative dielectric constant of 10 and 0.64 mm thickness. The primary dimension of the filter is 15.8 mm x 15.8 mm and the measured minimum insertion loss is 1.68 dB and return loss is better than -20 dB. After minimization and compressing the filter structure, the final dimension is reduced to 9.1 mm x 9.1 mm. The minimum

**insertion loss in this structure is 1.52 dB and the return loss is better than -20 dB. In the final design in addition to size reduction (about 42%), feed lines structure is changed from orthogonal to straight line form, which are more desirable in microwave networks. This new design is reduced in size by approximately 25% compared to the conventional square loop dual-mode filter. By using meander square loop structure more reduction in size (about 27%) can be achieved but this filter configuration has a weak frequency response including high passband insertion loss (more than 2.6 dB) and return loss less than -12 dB at the same center frequency. Therefore its**

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performance is less than the dual-mode filter proposed in this thesis. Apart from WiMax, this model of filters is also useful for WLAN and mobile communication applications, because it is compact in size, low loss and has good performance due to its elliptic response with sharp and adequate fractional bandwidth. This new book primarily addresses the needs of practicing RF and microwave engineers engaged with the design of distributed filters for telecommunication and sensing applications, with particular emphasis on the space sector. This is a contemporary and comprehensive approach to the design of microwave filters with helical resonators. The very



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**detailed step-by-step approach used throughout the book allows**

**you to quickly familiarize with the basic concepts of microwave filter design and confidently engage with the design of helical resonator filters. In particular, several examples that present the design of filters for a wide frequency and applications range would provide a very useful tool at hand for the filter designer. Presenting you with cutting-edge design guidance, this is a complete reference for helical filter design.**

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Wireless Power Transfer is the second edition of a well received first book, which published in 2012. It represents the state-of-the-art at the time of writing, and addresses a unique subject of great international interest in terms of research. Most of the chapters are contributed by the main author, though as in the first edition several chapters are

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contributed by other authors. The authors of the various chapters are experts in their own right on the specific topics within wireless energy transfer. Compared to the first edition, this new edition is more comprehensive in terms of the concepts discussed, and the range of current industrial applications which are presented, such as those of magnetic induction. From the eleven chapters of the first edition, this second edition has expanded to twenty chapters. More chapters on the theoretical foundations and applications have been included. This new edition also contains chapters which deal with techniques for reducing power losses in wireless power transfer systems. In this regard, specific

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chapters discuss impedance matching methods, frequency splitting and how to deploy systems based on frequency splitting. A new chapter on multi-dimensional wireless power transfer has also been added. The design of wireless power transfer systems based on bandpass filtering approach has been included, in addition to the two techniques using couple mode theory and electronic circuits. The book has retained chapters on how to increase efficiency of power conversion and induction, and also how to control the power systems. Furthermore, detailed techniques for power relay, including applications, which were also discussed in the first edition, have been updated and kept. The

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book is written in a progressive manner, with a knowledge of the first chapters making it easier to understand the later chapters. Most of the underlying theories covered in the book are clearly relevant to inductive near field communications, robotic control, robotic propulsion techniques, induction heating and cooking and a range of mechatronic systems.

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