

Free ebook Electromagnetic and thermal modeling of a permanent magnet (PDF)

comprehensive design text for permanent magnets and their application rare earth permanent magnets presents the discussion of the metallurgy and properties of rare earth permanent magnet alloys the monograph initially provides the elementary aspects of magnetism to enable the reader sufficient understanding of permanent magnetism the book then discusses the rare earth elements and their alloys with cobalt copper and iron the magnetic properties of various intermetallic compounds relevant to permanent magnets a detailed account of cast permanent magnets of the co cu sm and co cu ce systems and their modifications the important methods of making and manufacturing rare earth permanent magnets by powder metallurgy methods and comparisons between the well known permanent magnets and the new rare earth materials this text will be of value to students materials engineers and scientists the advent of rare earth permanent magnets repm has brought the realization of novel magnetic structures that are not practicable otherwise so different are these remarkable materials from the earlier magnets that conventional design wisdom is inadequate to fully exploit their unique characteristics indeed the conventional wisdom can lead to error or to the employment of cumbersome procedures that are quite unnecessary for repm s the salutary characteristics stem from two basic attributes of rare earth materials 1 large intrinsic moments per unit volume and 2 extraordinarily high resistance to demagnetization by external or internal demagnetization fields the approaches to magnetic design fall into four broad main types 1 analogy of magnetic configurations to electrical circuits 2 analytical solutions through maxwell s equations 3 reduction of permanent magnet arrays to distributions of pole densities or current sheets and inserting these distributions into coulomb s law or the biot savart law and 4 brute force computer solution of a tentative configuration via two or three dimensional finite element analysis we discuss all these approaches and employ them to solve illustrative examples permanent magnets play an increasingly important role in modern society because they are vital components of numerous domestic and industrial devices the last few decades have witnessed a quite extraordinary development in the use of hard magnetic materials especially after the advent of rare earth permanent magnets the rare earth permanent magnets are unequalled because they combine a high magnetization with an extraordinary magnetic hardness which allows the use of such magnets having the extreme shapes and small dimensions as required in modern devices modern permanent magnets provides an update on the status and recent technical developments that have occurred in the various families of permanent magnets produced today the book gives an overview of the key advances of permanent magnet materials that have occurred in the last twenty years sections cover the history of permanent magnets their fundamental properties an overview of the important families of permanent magnets coatings used to protect permanent magnets and the various tests used to confirm specifications are discussed finally the major applications for each family of permanent magnets and the size of the market is provided the book also includes an appendix that provides a glossary of magnetic terms to assist the readers in better understanding the technical terms used in other chapters this book is an ideal resource for materials scientists and engineers working in academia and industry r d provides an in depth overview of all of the important families of permanent magnets produced today includes background information on the fundamental properties of permanent magnets major applications of each family of permanent magnets and advances in coatings and coating technology reviews the fundamentals of permanent magnet design a guide to permanent magnet property selection and design in magnetolectric devices provides a unified and comprehensive treatment of permanent magnetism from its origins to its use in modern energy conversion devices presents the history of permanent magnetism and describes the properties of permanent magnet systems emphasizing the new rare earth magnets covers all major types of permanent magnets and their typical applications aspects of design circuit solutions device parameters and measurements the book provides both the theoretical and the applied background needed to predict magnetic fields the theoretical presentation is reinforced with over 60 solved examples of practical engineering applications such as the design of magnetic components like solenoids which are electromagnetic coils that are moved by electric currents and activate other devices such as circuit breakers other design applications would be for permanent magnet structures such as bearings and couplings which are hardware mechanisms used to fashion a temporary connection between two wires this book is written for use as a text or reference by researchers engineers professors and students engaged in the research development study and manufacture of permanent magnets and electromechanical devices it can serve as a primary or supplemental text for upper level courses in electrical engineering on electromagnetic theory electronic and magnetic materials and electromagnetic engineering the late 1980s saw the beginning of the pm brushless machine era with the invention of high energy density permanent magnets pm and the development of power electronics although induction motors are now the most popular electric motors the impact of pm brushless machines on electromechanical drives is significant today pm machines come second to induction machines replacement of electromagnetic field excitation systems by pms brings the following benefits no electrical energy is absorbed by the field excitation system and thus there are no excitation losses causing substantial increase in efficiency higher power density kw kg and or torque density nm kg than electromagnetic excitation better dynamic performance than motors with electromagnetic excitation higher magnetic flux density in the air gap simplification of construction and maintenance less expensive for some types of machines modern permanent magnet electric machines theory and control serves as a textbook for undergraduate power engineering students who want to supplement and expand their knowledge in the fundamentals of magnetism soft magnetic materials permanent magnets pms calculation of magnetic circuits with pms modern pm brushed dc machines and their controls modern pm brushless dc motors and drive control and modern pm generators

the book can help students learn more about electrical machines and can serve as a prescribed text for teaching elective undergraduate courses such as modern permanent magnet electrical machines since the book is written in a simple scientific language and without redundant mathematics it can also be used by practicing engineers and managers employed in electrical machinery or electromagnetic device industries the present study complements the study on patents patent applications and other literature on rare earth metals based permanent magnets by frits andriessen and marten terpstra published by elsevier applied science in 1989 and complements in part the book on nd fe permanent magnets edited by lv mitchell which was the result of a workshop organized by the commission of the european communities and held in brussels on 25 october 1984 the difference between the content of the first book and that of the present study is that the first is more specifically directed to various kinds and compositions of alloys used in newly developed magnets while the present book emphasises the improvements obtained when using particular alloys the study edited by mitchell deals more specifically with the economic physical and chemical aspects of rare earth metals based magnet alloys their properties compared with the more common and classical magnets such as ferro cobalt alloy magnets and their applications to various fields of technology from the present study it has become apparent that there exist only a few patents and patent applications covering a specific use of particular magnets having specific properties to a circuit arrangement device or electric motor this appears to be due to the fact that every manufacturer of such circuits or arrangements applying magnets naturally wants to employ the most effective magnets covering the design and applications of permanent magnets this study lists properties of over 400 materials and presents diverse magnet information needed to design products rather than present theory appendices provide demagnetisation curves and magnetic physical properties co authored by a world renowned expert in the field permanent magnet motor technology design and applications second edition demonstrates the construction of pm motor drives and supplies ready to implement solutions for common roadblocks the author presents fundamental equations and calculations to determine and evaluate system performance efficiency and reliability explores modern computer aided design of pm motors including the finite element approach and covers how to select pm motors to meet the specific requirements of electrical drives the numerous examples models and diagrams provided in each chapter give the reader a clear understanding of motor operations and characteristics the importance of permanent magnet pm motor technology and its impact on electromechanical drives has grown exponentially since the publication of the bestselling second edition the pm brushless motor market has grown considerably faster than the overall motion control market this rapid growth makes it essential for electrical and electromechanical engineers and students to stay up to date on developments in modern electrical motors and drives including their control simulation and cad reflecting innovations in the development of pm motors for electromechanical drives permanent magnet motor technology design and applications third edition demonstrates the construction of pm motor drives and supplies ready to implement solutions to common roadblocks along the way this edition supplies fundamental equations and calculations for determining and evaluating system performance efficiency reliability and cost it explores modern computer aided design of pm motors including the finite element approach and explains how to select pm motors to meet the specific requirements of electrical drives the numerous examples models and diagrams provided in each chapter facilitate a lucid understanding of motor operations and characteristics this 3rd edition of a bestselling reference has been thoroughly revised to include chapters on high speed motors and micromotors advances in permanent magnet motor technology additional numerical examples and illustrations an increased effort to bridge the gap between theory and industrial applications modified research results the growing global trend toward energy conservation makes it quite possible that the era of the pm brushless motor drive is just around the corner this reference book will give engineers researchers and graduate level students the comprehensive understanding required to develop the breakthroughs that will push this exciting technology to the forefront the permanent magnet guide and reference is a practical source of information about permanent magnetic products their specification and application originally released in 1987 the newest version expands on the latest development of new materials and changes within the magnet industry while not a replacement for textbooks on the science of magnetism it is intended to inform both producers and users of permanent magnets as simply and expeditiously as effective communication permits the permanent magnet guide and reference is useful for engineers new to the field of magnetism assisting them in the performance of responsibilities of inspection specification and use it will also help management teams of businesses incorporating magnets in their products to appreciate decisions regarding their acquisition and use including benefits and limitations of each material purchasing and sales personnel will appreciate interacting with vendors and customers from a position of knowledge and understanding quality assurance can benefit from the information regarding test and evaluation all parties benefit from communicating with a standard vocabulary terminology and symbols numerous references are cited for those desiring to delve further into specific areas magnetic materials and their applications discusses the principles and concepts behind magnetic materials and explains their applications in the fields of physics and engineering the book covers topics such as the principal concepts and definitions related to magnetism types of magnetic materials and their electrical and mechanical properties and the different factors influencing magnetic behavior the book also covers topics such as permanent magnet materials magnetic materials in heavy current engineering and the different uses of magnetic materials the text is recommended for physicists and electrical engineers who would like to know more about magnetic materials and their applications in the field of electronics axial flux permanent magnet afpm brushless machines are modern electrical machines with a lot of advantages over their conventional counterparts this timeless and revised second edition deals with the analysis construction design control and applications of afpm machines the authors present their own research results as well as significant research contributions made by others there is a growing number of applications that require fast rotating machines motivation for this

thesis comes from a project in which downsized spindles for micro machining have been researched the thesis focuses on analysis and design of high speed pm machines and uses a practical design of a high speed spindle drive as a test case phenomena both mechanical and electromagnetic that take precedence in high speed permanent magnet machines are identified and systematized the thesis identifies inherent speed limits of permanent magnet machines and correlates those limits with the basic parameters of the machines the analytical expression of the limiting quantities does not only impose solid constraints on the machine design but also creates the way for design optimization leading to the maximum mechanical and or electromagnetic utilization of the machine the models and electric drive concepts developed in the thesis are evaluated in a practical setup rare earth iron permanent magnets combine the magnetization of iron or cobalt with the anisotropy of a light rare earth in intermetallic compounds which exhibit nearly ideal hysteresis the rare earth iron magnets are indispensable components in a vast range of electronic and electromechanical devices this book covers the principles of permanent magnetism magnet processing and applications in a series of interlocking chapters written by experts in each area based on the findings of the concerted european action on magnets it is a definitive account of the field designed to be read by physicists materials scientists and electrical engineers rapidly solidified neodymium iron boron permanent magnets details the basic properties of melt spun ndfeb materials and the entire manufacturing process for rapidly solidified ndfeb permanent magnets it covers the manufacturing process from the commercial production of the melt spun or rapidly solidified powder to the production and properties of both isotropic bonded nd and hot deformed anisotropic ndfeb magnets in addition the book discusses the development and history of bonded rare earth transition metal magnets and the discovery of the ndfeb compound also covering melt spun ndfeb alloys and detailing the magnetization process and spring exchange theory the book goes over the production of melt spinning development the operation of a melt spinner the processing of melt spun powder commercial grades of ndfeb magnetic powder and gas atomized ndfeb magnetic powders lastly the book touches on the major application and design advantages of bonded nd magnets features a unique perspective as the author is not only the inventor of ndfeb magnetic powder but also played a key role in developing many of the technologies covered provides a comprehensive look at the history fundamental properties production processes design and applications of bonded ndfeb magnets includes discussion of the rare earth supply challenge politics and systems as it impacts bonded ndfeb magnets interest in permanent magnet synchronous machines pmsms is continuously increasing worldwide especially with the increased use of renewable energy and the electrification of transports this book contains the successful submissions of fifteen papers to a special issue of energies on the subject area of permanent magnet synchronous machines the focus is on permanent magnet synchronous machines and the electrical systems they are connected to the presented work represents a wide range of areas studies of control systems both for permanent magnet synchronous machines and for brushless dc motors are presented and experimentally verified design studies of generators for wind power wave power and hydro power are presented finite element method simulations and analytical design methods are used the presented studies represent several of the different research fields on permanent magnet machines and electric drives commences with a review of the fundamental concepts of magnetostatics and the analysis of solutions to problems in simple geometrics followed by the design of magnetic structures the third section analyzes two major aspects of the magnetic structures and demagnetization properties of actual magnetic material offers a number of practical uses for permanent magnets particularly to magnetic resonance imaging and also includes industrial machinery high energy accelerators and free electron lasers permanent magnet synchronous pms motors stand at the forefront of electric motor development due to their energy saving capabilities and performance potential this book is a timely advancement along that path as the first comprehensive self contained and thoroughly up to date book devoted solely to the control of pms motors the process of high temperature phase transition of rare earth permanent magnet alloys is revealed by photographs taken by high voltage tem the relationship between the formation of nanocrystal and magnetic properties is discussed in detail which effects alloys composition and preparation process the experiment results verified some presumptions and were valuable for subsequent scientific research and creating new permanent magnet alloys the publication is intended for researchers engineers and managers in the field of material science metallurgy and physics prof shuming pan is senior engineer of beijing general research institute of non ferrous metal dynamic analysis and maximum stepping rate prediction for permanent magnet motor despite two decades of massive strides in research and development on control strategies and their subsequent implementation most books on permanent magnet motor drives still focus primarily on motor design providing only elementary coverage of control and converters addressing that gap with information that has largely been disseminated only in journals and at conferences permanent magnet synchronous and brushless dc motor drives is a long awaited comprehensive overview of power electronic converters for permanent magnet synchronous machines and control strategies for variable speed operation it introduces machines power devices inverters and control and addresses modeling implementation control strategies and flux weakening operations as well as parameter sensitivity and rotor position sensorless control suitable for both industrial and academic audiences this book also covers the simulation low cost inverter topologies and commutation torque ripple of pm brushless dc motor drives simulation of the motor drives system is illustrated with matlab codes in the text this book is divided into three parts fundamentals of pm synchronous and brushless dc machines power devices inverters pm synchronous motor drives and brushless dc motor drives with regard to the power electronics associated with these drive systems the author explores use of the standard three phase bridge inverter for driving the machine power factor correction and inverter control introduces space vector modulation step by step and contrasts with pwm details dead time effects in the inverter and its compensation discusses new power converter topologies being considered for low cost drive systems in pm brushless dc motor drives this reference is dedicated exclusively to pm ac machines with a timely

emphasis on control and standard and low cost converter topologies widely used for teaching at the doctoral level and for industrial audiences both in the u s and abroad it will be a welcome addition to any engineer s library permanent magnet reluctance and self synchronous motors discusses the theory design and control of permanent magnet materials the book describes permanent magnets and their applications to electric machines as well as their performance characteristics and limitations it presents the performance and calculations of pm commutator motors and an approach to their design permanent magnet synchronous motors finite element calculations design methodologies and rectangular and sinusoidal current control are discussed it presents reluctance motors their topologies and performance analyses as well as reluctance synchronous motors with very large rotor saliency ratios and their vector control numerical examples and data of practical interest are provided throughout the book the book will be very useful to engineers involved in the design and manufacturing of permanent magnet and reluctance motors and high performance drives as well as electrical engineering students and educators this book introduces and illustrates modeling sensing and control methods for analyzing designing and developing spherical motors it systematically presents models for establishing the relationships among the magnetic fields position orientation and force torque while also providing time efficient solutions to assist researchers and engineers in studying and developing these motors in order to take full advantage of spherical motors compact structure in practical applications sensing and control methods that utilize their magnetic fields and eliminate the need to install external sensors for feedback are proposed further the book investigates for the first time spherical motors force torque manipulation capability and proposes algorithms enabling the ball joint like end effector for haptic use based on these motors hybrid position force actuation modes while systematically presenting approaches to their design sensing and control the book also provides many examples illustrating the implementation issues readers may encounter to reduce the emissions of greenhouse gasses and maintain environmental sustainability electric vehicles play a vital role in a modern energy efficient environment permanent magnet synchronous motors pmsms are widely employed in electric vehicle technology due to their high dynamic response better torque speed characteristics noiseless operation high power density high efficiency and power factor as compared to other conventional motor drives this book demonstrates the development of various control strategies and illustrates the dynamic performance intensification of a pmsm drive to ensure the faster dynamic behaviour and flexibility in control under various operating conditions the performance of a pmsm drive has been explained finally control strategies have been executed through mathematical modelling and illustration of several case studies for optimal operation features introduces performance indicators in a self controlled pmsm machine to justify the dynamic behaviour discusses comparative performance study and optimization of the drive performance provides a detailed comparative performance analysis between classical and fuzzy logic controllers in a pmsm drive includes illustrations and case studies using mathematical modelling and real time test results discusses the state of the art in solar powered energy efficient pmsm drives with various issues this book is aimed at researchers graduate students and libraries in electrical engineering with specialization in electric vehicles a presentation of the theory of brushless d c drives to help engineers appreciate the potential of such motors and apply them more widely by taking into account developments in permanent magnet materials power semiconductors electronic control and motor design written for electrical electronics mechanical engineers responsible for designing specifying motors the book provides details of brushless dc synchronous motors as well as both radial axial motor topologies beginning with a discussion of the fundamentals of generic motor design it logically progresses to a set of more advanced yet easily understandable concepts for designing brushless permanent magnet motors in addition the author fully explains techniques for magnetic modeling circuit analysis shows how magnetic circuit analysis applies to motor design describes all major aspects of motor operation design in simple mathematical terms develops rigorous design equations for radial flux axial flux motors illustrates basic motor drive schemes all common motor design terms are clearly defined a wealth of charts tables equations are included this book focuses on the analytical modeling of fractional slot concentrated wound fscw interior permanent magnet ipm machines and establishes a basis for their magnetic and electrical analysis aiming at the precise modeling of fscw ipm machines magnetic and electrical characteristics it presents a comprehensive mathematical treatment of the stator magneto motive force mmf the ipm rotor non homogeneous magnetic saturation and its airgap flux density the fscw stator spatial mmf harmonics are analytically formulated providing a basis on which a novel heuristic algorithm is then proposed for the design of optimal winding layouts for multiphase fscw stators with different slot pole combinations in turn the proposed mathematical models for the fscw stator and the ipm rotor are combined to derive detailed mathematical expressions of its operational inductances electromagnetic torque torque ripple and their respective subcomponents as a function of the machine geometry and design parameters lastly the proposed theories and analytical models are validated using finite element analysis and experimental tests on a prototype fscw ipm machine from an early age children are often fascinated by magnets on their refrigerator or in toys they play with however do they know how those magnets actually work they will after reading this volume readers expand their knowledge of magnets as they learn how magnets work and what magnets can be used for in everyday life the accessible and age appropriate main text is presented alongside extra features such as detailed sidebars informative fact boxes a comprehensive glossary and bold full color photographs these elements work together to create an exciting reading and learning experience no standard work of reference dealing with dc linear motor in all its aspects has ever been published however a considerable amount of literature in the form of published papers dealing with this subject and also an amount of hitherto unpublished work particularly of an industrial or applied nature has been accumulated during the last 25 years an attempt has been made to collate all this information and present it in a comprehensive and orderly manner in this unique volume this book has been designed to be useful to two main categories of readers namely electrical and mechanical engineers in the user industries

and post graduates and students embracing mechanical and electrical engineers this concise book presents the basic concepts of magnetism and magnetic properties pertinent to permanent magnetic materials emphasis is placed on hexaferrite materials for permanent magnet applications with m type ferrites as the focal point the relatively high metallicity of magnetic materials for practical applications imposes limitations for their efficient use accordingly magnetic oxides with ferromagnetic properties emerged as the most widely used magnetic materials for practical applications owing to their characteristic high resistivity and low eddy current losses chemical stability simplicity of production in mass quantities and other favorable characteristics an important class of these oxides is the class of hexagonal ferrites developed in the early 1950 s which dominated the world market of permanent magnet applications since the end of the 1980 s among these ferrites the magnetoplumbite m type hexaferrite is produced nowadays in large quantities at very competitive low prices thus providing the permanent magnet market with probably the most cost effective magnetic material

Permanent Magnets in Theory and Practice 1977 comprehensive design text for permanent magnets and their application

Permanent Magnet Materials and Their Application 1996-06-28 rare earth permanent magnets presents the discussion of the metallurgy and properties of rare earth permanent magnet alloys the monograph initially provides the elementary aspects of magnetism to enable the reader sufficient understanding of permanent magnetism the book then discusses the rare earth elements and their alloys with cobalt copper and iron the magnetic properties of various intermetallic compounds relevant to permanent magnets a detailed account of cast permanent magnets of the co cu sm and co cu ce systems and their modifications the important methods of making and manufacturing rare earth permanent magnets by powder metallurgy methods and comparisons between the well known permanent magnets and the new rare earth materials this text will be of value to students materials engineers and scientists

Rare Earth Permanent Magnets 1973-01-28 the advent of rare earth permanent magnets repm has brought the realization of novel magnetic structures that are not practicable otherwise so different are these remarkable materials from the earlier magnets that conventional design wisdom is inadequate to fully exploit their unique characteristics indeed the conventional wisdom can lead to error or to the employment of cumbersome procedures that are quite unnecessary for repm s the salutary characteristics stem from two basic attributes of rare earth materials 1 large intrinsic moments per unit volume and 2 extraordinarily high resistance to demagnetization by external or internal demagnetization fields the approaches to magnetic design fall into four broad main types 1 analogy of magnetic configurations to electrical circuits 2 analytical solutions through maxwell s equations 3 reduction of permanent magnet arrays to distributions of pole densities or current sheets and inserting these distributions into coulomb s law or the biot savart law and 4 brute force computer solution of a tentative configuration via two or three dimensional finite element analysis we discuss all these approaches and employ them to solve illustrative examples

A Permanent Magnet Circuit Design Primer 1996-07-01 permanent magnets play an increasingly important role in modern society because they are vital components of numerous domestic and industrial devices the last few decades have witnessed a quite extraordinary development in the use of hard magnetic materials especially after the advent of rare earth permanent magnets the rare earth permanent magnets are unequalled because they combine a high magnetization with an extraordinary magnetic hardness which allows the use of such magnets having the extreme shapes and small dimensions as required in modern devices

Permanent Magnetic Materials and their Applications 1999-01-10 modern permanent magnets provides an update on the status and recent technical developments that have occurred in the various families of permanent magnets produced today the book gives an overview of the key advances of permanent magnet materials that have occurred in the last twenty years sections cover the history of permanent magnets their fundamental properties an overview of the important families of permanent magnets coatings used to protect permanent magnets and the various tests used to confirm specifications are discussed finally the major applications for each family of permanent magnets and the size of the market is provided the book also includes an appendix that provides a glossary of magnetic terms to assist the readers in better understanding the technical terms used in other chapters this book is an ideal resource for materials scientists and engineers working in academia and industry r d provides an in depth overview of all of the important families of permanent magnets produced today includes background information on the fundamental properties of permanent magnets major applications of each family of permanent magnets and advances in coatings and coating technology reviews the fundamentals of permanent magnet design

Modern Permanent Magnets 2022-01-27 a guide to permanent magnet property selection and design in magnetoelectric devices provides a unified and comprehensive treatment of permanent magnetism from its origins to its use in modern energy conversion devices presents the history of permanent magnetism and describes the properties of permanent magnet systems emphasizing the new rare earth magnets covers all major types of permanent magnets and their typical applications aspects of design circuit solutions device parameters and measurements

Advances in Permanent Magnetism 1990-04-02 the book provides both the theoretical and the applied background needed to predict magnetic fields the theoretical presentation is reinforced with over 60 solved examples of practical engineering applications such as the design of magnetic components like solenoids which are electromagnetic coils that are moved by electric currents and activate other devices such as circuit breakers other design applications would be for permanent magnet structures such as bearings and couplings which are hardware mechanisms used to fashion a temporary connection between two wires this book is written for use as a text or reference by researchers engineers professors and students engaged in the research development study and manufacture of permanent magnets and electromechanical devices it can serve as a primary or supplemental text for upper level courses in electrical engineering on electromagnetic theory electronic and magnetic materials and electromagnetic engineering

Permanent Magnets and Their Application 1962 the late 1980s saw the beginning of the pm brushless machine era with the invention of high energy density permanent magnets pm and the development of power electronics although induction motors are now the most popular electric motors the impact of pm brushless machines on electromechanical drives is significant today pm machines come second to induction machines replacement of electromagnetic field excitation systems by pms brings the following benefits no electrical energy is absorbed by the field excitation system and thus there are no excitation losses causing substantial increase in efficiency higher power density kw kg and or torque density nm kg than electromagnetic excitation better dynamic performance than motors with electromagnetic excitation higher magnetic flux density in the air

gap simplification of construction and maintenance less expensive for some types of machines modern permanent magnet electric machines theory and control serves as a textbook for undergraduate power engineering students who want to supplement and expand their knowledge in the fundamentals of magnetism soft magnetic materials permanent magnets pms calculation of magnetic circuits with pms modern pm brushed dc machines and their controls modern pm brushless dc motors and drive control and modern pm generators the book can help students learn more about electrical machines and can serve as a prescribed text for teaching elective undergraduate courses such as modern permanent magnet electrical machines since the book is written in a simple scientific language and without redundant mathematics it can also be used by practicing engineers and managers employed in electrical machinery or electromagnetic device industries

Permanent Magnet and Electromechanical Devices 2001-09-05 the present study complements the study on patents patent applications and other literature on rare earth metals based permanent magnets by frits andriessen and marten terpstra published by elsevier applied science in 1989 and complements in part the book on nd fe permanent magnets edited by lv mitchell which was the result of a workshop organized by the commission of the european communities and held in brussels on 25 october 1984 the difference between the content of the first book and that of the present study is that the first is more specifically directed to various kinds and compositions of alloys used in newly developed magnets while the present book emphasises the improvements obtained when using particular alloys the study edited by mitchell deals more specifically with the economic physical and chemical aspects of rare earth metals based magnet alloys their properties compared with the more common and classical magnets such as ferro cobalt alloy magnets and their applications to various fields of technology from the present study it has become apparent that there exist only a few patents and patent applications covering a specific use of particular magnets having specific properties to a circuit arrangement device or electric motor this appears to be due to the fact that every manufacturer of such circuits or arrangements applying magnets naturally wants to employ the most effective magnets

Modern Permanent Magnet Electric Machines 2022-12-05 covering the design and applications of permanent magnets this study lists properties of over 400 materials and presents diverse magnet information needed to design products rather than present theory appendices provide demagnetisation curves and magnetic physical properties

Improving the Properties of Permanent Magnets 2012-12-06 co authored by a world renowned expert in the field permanent magnet motor technology design and applications second edition demonstrates the construction of pm motor drives and supplies ready to implement solutions for common roadblocks the author presents fundamental equations and calculations to determine and evaluate system performance efficiency and reliability explores modern computer aided design of pm motors including the finite element approach and covers how to select pm motors to meet the specific requirements of electrical drives the numerous examples models and diagrams provided in each chapter give the reader a clear understanding of motor operations and characteristics

Permanent Magnet Design and Application Handbook 1995 the importance of permanent magnet pm motor technology and its impact on electromechanical drives has grown exponentially since the publication of the bestselling second edition the pm brushless motor market has grown considerably faster than the overall motion control market this rapid growth makes it essential for electrical and electromechanical engineers and students to stay up to date on developments in modern electrical motors and drives including their control simulation and cad reflecting innovations in the development of pm motors for electromechanical drives permanent magnet motor technology design and applications third edition demonstrates the construction of pm motor drives and supplies ready to implement solutions to common roadblocks along the way this edition supplies fundamental equations and calculations for determining and evaluating system performance efficiency reliability and cost it explores modern computer aided design of pm motors including the finite element approach and explains how to select pm motors to meet the specific requirements of electrical drives the numerous examples models and diagrams provided in each chapter facilitate a lucid understanding of motor operations and characteristics this 3rd edition of a bestselling reference has been thoroughly revised to include chapters on high speed motors and micromotors advances in permanent magnet motor technology additional numerical examples and illustrations an increased effort to bridge the gap between theory and industrial applications modified research results the growing global trend toward energy conservation makes it quite possible that the era of the pm brushless motor drive is just around the corner this reference book will give engineers researchers and graduate level students the comprehensive understanding required to develop the breakthroughs that will push this exciting technology to the forefront

Permanent Magnet Motor Technology 2002-01-22 the permanent magnet guide and reference is a practical source of information about permanent magnetic products their specification and application originally released in 1987 the newest version expands on the latest development of new materials and changes within the magnet industry while not a replacement for textbooks on the science of magnetism it is intended to inform both producers and users of permanent magnets as simply and expeditiously as effective communication permits the permanent magnet guide and reference is useful for engineers new to the field of magnetism assisting them in the performance of responsibilities of inspection specification and use it will also help management teams of businesses incorporating magnets in their products to appreciate decisions regarding their acquisition and use including benefits and limitations of each material purchasing and sales personnel will appreciate interacting with vendors and customers from a position of knowledge and understanding quality assurance can benefit from the information regarding test and evaluation all parties benefit from communicating with a standard vocabulary terminology and symbols numerous references are cited for those desiring to delve further into specific areas

Permanent Magnet Motor Technology 2009-08-25 magnetic materials and their applications discusses the principles and concepts behind magnetic materials and explains their

applications in the fields of physics and engineering the book covers topics such as the principal concepts and definitions related to magnetism types of magnetic materials and their electrical and mechanical properties and the different factors influencing magnetic behavior the book also covers topics such as permanent magnet materials magnetic materials in heavy current engineering and the different uses of magnetic materials the text is recommended for physicists and electrical engineers who would like to know more about magnetic materials and their applications in the field of electronics

Permanent Magnet Guide and Reference 2022-10-18 axial flux permanent magnet afpm brushless machines are modern electrical machines with a lot of advantages over their conventional counterparts this timeless and revised second edition deals with the analysis construction design control and applications of afpm machines the authors present their own research results as well as significant research contributions made by others

Magnetic Materials and Their Applications 2013-10-22 there is a growing number of applications that require fast rotating machines motivation for this thesis comes from a project in which downsized spindles for micro machining have been researched the thesis focuses on analysis and design of high speed pm machines and uses a practical design of a high speed spindle drive as a test case phenomena both mechanical and electromagnetic that take precedence in high speed permanent magnet machines are identified and systematized the thesis identifies inherent speed limits of permanent magnet machines and correlates those limits with the basic parameters of the machines the analytical expression of the limiting quantities does not only impose solid constraints on the machine design but also creates the way for design optimization leading to the maximum mechanical and or electromagnetic utilization of the machine the models and electric drive concepts developed in the thesis are evaluated in a practical setup

Nd-Fe Permanent Magnets 1985 rare earth iron permanent magnets combine the magnetization of iron or cobalt with the anisotropy of a light rare earth in intermetallic compounds which exhibit nearly ideal hysteresis the rare earth iron magnets are indispensable components in a vast range of electronic and electromechanical devices this book covers the principles of permanent magnetism magnet processing and applications in a series of interlocking chapters written by experts in each area based on the findings of the concerted european action on magnets it is a definitive account of the field designed to be read by physicists materials scientists and electrical engineers

Axial Flux Permanent Magnet Brushless Machines 2008-03-26 rapidly solidified neodymium iron boron permanent magnets details the basic properties of melt spun ndfeb materials and the entire manufacturing process for rapidly solidified ndfeb permanent magnets it covers the manufacturing process from the commercial production of the melt spun or rapidly solidified powder to the production and properties of both isotropic bonded nd and hot deformed anisotropic ndfeb magnets in addition the book discusses the development and history of bonded rare earth transition metal magnets and the discovery of the ndfeb compound also covering melt spun ndfeb alloys and detailing the magnetization process and spring exchange theory the book goes over the production of melt spinning development the operation of a melt spinner the processing of melt spun powder commercial grades of ndfeb magnetic powder and gas atomized ndfeb magnetic powders lastly the book touches on the major application and design advantages of bonded nd magnets features a unique perspective as the author is not only the inventor of ndfeb magnetic powder but also played a key role in developing many of the technologies covered provides a comprehensive look at the history fundamental properties production processes design and applications of bonded ndfeb magnets includes discussion of the rare earth supply challenge politics and systems as it impacts bonded ndfeb magnets

Limits, Modeling and Design of High-Speed Permanent Magnet Machines 2012-10-31 interest in permanent magnet synchronous machines pmsms is continuously increasing worldwide especially with the increased use of renewable energy and the electrification of transports this book contains the successful submissions of fifteen papers to a special issue of energies on the subject area of permanent magnet synchronous machines the focus is on permanent magnet synchronous machines and the electrical systems they are connected to the presented work represents a wide range of areas studies of control systems both for permanent magnet synchronous machines and for brushless dc motors are presented and experimentally verified design studies of generators for wind power wave power and hydro power are presented finite element method simulations and analytical design methods are used the presented studies represent several of the different research fields on permanent magnet machines and electric drives

Rare-earth Iron Permanent Magnets 1996 commences with a review of the fundamental concepts of magnetostatics and the analysis of solutions to problems in simple geometrics followed by the design of magnetic structures the third section analyzes two major aspects of the magnetic structures and demagnetization properties of actual magnetic material offers a number of practical uses for permanent magnets particularly to magnetic resonance imaging and also includes industrial machinery high energy accelerators and free electron lasers

Rapidly Solidified Neodymium-Iron-Boron Permanent Magnets 2017-10-24 permanent magnet synchronous pms motors stand at the forefront of electric motor development due to their energy saving capabilities and performance potential this book is a timely advancement along that path as the first comprehensive self contained and thoroughly up to date book devoted solely to the control of pms motors

Permanent Magnet Synchronous Machines 2019-08-20 the process of high temperature phase transition of rare earth permanent magnet alloys is revealed by photographs taken by high voltage tem the relationship between the formation of nanocrystal and magnetic properties is discussed in detail which effects alloys composition and preparation

process the experiment results verified some presumptions and were valuable for subsequent scientific research and creating new permanent magnet alloys the publication is intended for researchers engineers and managers in the field of material science metallurgy and physics prof shuming pan is senior engineer of beijing general research institute of non ferrous metal

Structures of Permanent Magnets 1993-10-04 dynamic analysis and maximum stepping rate prediction for permanent magnet motor

Permanent Magnets in Theory and Practice 1987 despite two decades of massive strides in research and development on control strategies and their subsequent implementation most books on permanent magnet motor drives still focus primarily on motor design providing only elementary coverage of control and converters addressing that gap with information that has largely been disseminated only in journals and at conferences permanent magnet synchronous and brushless dc motor drives is a long awaited comprehensive overview of power electronic converters for permanent magnet synchronous machines and control strategies for variable speed operation it introduces machines power devices inverters and control and addresses modeling implementation control strategies and flux weakening operations as well as parameter sensitivity and rotor position sensorless control suitable for both industrial and academic audiences this book also covers the simulation low cost inverter topologies and commutation torque ripple of pm brushless dc motor drives simulation of the motor drives system is illustrated with matlab codes in the text this book is divided into three parts fundamentals of pm synchronous and brushless dc machines power devices inverters pm synchronous motor drives and brushless dc motor drives with regard to the power electronics associated with these drive systems the author explores use of the standard three phase bridge inverter for driving the machine power factor correction and inverter control introduces space vector modulation step by step and contrasts with pwm details dead time effects in the inverter and its compensation discusses new power converter topologies being considered for low cost drive systems in pm brushless dc motor drives this reference is dedicated exclusively to pm ac machines with a timely emphasis on control and standard and low cost converter topologies widely used for teaching at the doctoral level and for industrial audiences both in the u s and abroad it will be a welcome addition to any engineer s library

Control of Permanent Magnet Synchronous Motors 2018 permanent magnet reluctance and self synchronous motors discusses the theory design and control of permanent magnet materials the book describes permanent magnets and their applications to electric machines as well as their performance characteristics and limitations it presents the performance and calculations of pm commutator motors and an approach to their design permanent magnet synchronous motors finite element calculations design methodologies and rectangular and sinusoidal current control are discussed it presents reluctance motors their topologies and performance analyses as well as reluctance synchronous motors with very large rotor saliency ratios and their vector control numerical examples and data of practical interest are provided throughout the book the book will be very useful to engineers involved in the design and manufacturing of permanent magnet and reluctance motors and high performance drives as well as electrical engineering students and educators

Rare Earth Permanent-Magnet Alloys' High Temperature Phase Transformation 2014-12-01 this book introduces and illustrates modeling sensing and control methods for analyzing designing and developing spherical motors it systematically presents models for establishing the relationships among the magnetic fields position orientation and force torque while also providing time efficient solutions to assist researchers and engineers in studying and developing these motors in order to take full advantage of spherical motors compact structure in practical applications sensing and control methods that utilize their magnetic fields and eliminate the need to install external sensors for feedback are proposed further the book investigates for the first time spherical motors force torque manipulation capability and proposes algorithms enabling the ball joint like end effector for haptic use based on these motors hybrid position force actuation modes while systematically presenting approaches to their design sensing and control the book also provides many examples illustrating the implementation issues readers may encounter

Dynamic Analysis of Permanent Magnet Stepping Motors 1969 to reduce the emissions of greenhouse gasses and maintain environmental sustainability electric vehicles play a vital role in a modern energy efficient environment permanent magnet synchronous motors pmsms are widely employed in electric vehicle technology due to their high dynamic response better torque speed characteristics noiseless operation high power density high efficiency and power factor as compared to other conventional motor drives this book demonstrates the development of various control strategies and illustrates the dynamic performance intensification of a pmsm drive to ensure the faster dynamic behaviour and flexibility in control under various operating conditions the performance of a pmsm drive has been explained finally control strategies have been executed through mathematical modelling and illustration of several case studies for optimal operation features introduces performance indicators in a self controlled pmsm machine to justify the dynamic behaviour discusses comparative performance study and optimization of the drive performance provides a detailed comparative performance analysis between classical and fuzzy logic controllers in a pmsm drive includes illustrations and case studies using mathematical modelling and real time test results discusses the state of the art in solar powered energy efficient pmsm drives with various issues this book is aimed at researchers graduate students and libraries in electrical engineering with specialization in electric vehicles

Permanent Magnet Synchronous and Brushless DC Motor Drives 2017-12-19 a presentation of the theory of brushless d c drives to help engineers appreciate the potential of such motors and apply them more widely by taking into account developments in permanent magnet materials power semiconductors electronic control and motor design

Permanent Magnet Reluctance & Self Synchronous Motors 1993-03-17 written for electrical electronics mechanical engineers responsible for designing specifying motors the book provides details of brushless dc synchronous motors as well as both radial axial motor topologies beginning with a discussion of the fundamentals of generic motor design it logically progresses to a set of more advanced yet easily understandable concepts for designing brushless permanent magnet motors in addition the author fully explains techniques for magnetic modeling circuit analysis shows how magnetic circuit analysis applies to motor design describes all major aspects of motor operation design in simple mathematical terms develops rigorous design equations for radial flux axial flux motors illustrates basic motor drive schemes all common motor design terms are clearly defined a wealth of charts tables equations are included

Magnetic Materials 1951 this book focuses on the analytical modeling of fractional slot concentrated wound fscw interior permanent magnet ipm machines and establishes a basis for their magnetic and electrical analysis aiming at the precise modeling of fscw ipm machines magnetic and electrical characteristics it presents a comprehensive mathematical treatment of the stator magneto motive force mmf the ipm rotor non homogeneous magnetic saturation and its airgap flux density the fscw stator spatial mmf harmonics are analytically formulated providing a basis on which a novel heuristic algorithm is then proposed for the design of optimal winding layouts for multiphase fscw stators with different slot pole combinations in turn the proposed mathematical models for the fscw stator and the ipm rotor are combined to derive detailed mathematical expressions of its operational inductances electromagnetic torque torque ripple and their respective subcomponents as a function of the machine geometry and design parameters lastly the proposed theories and analytical models are validated using finite element analysis and experimental tests on a prototype fscw ipm machine

Attraction and Repulsion 1967 from an early age children are often fascinated by magnets on their refrigerator or in toys they play with however do they know how those magnets actually work they will after reading this volume readers expand their knowledge of magnets as they learn how magnets work and what magnets can be used for in everyday life the accessible and age appropriate main text is presented alongside extra features such as detailed sidebars informative fact boxes a comprehensive glossary and bold full color photographs these elements work together to create an exciting reading and learning experience

Permanent Magnet Spherical Motors 2018-03-20 no standard work of reference dealing with dc linear motor in all its aspects has ever been published however a considerable amount of literature in the form of published papers dealing with this subject and also an amount of hitherto unpublished work particularly of an industrial or applied nature has been accumulated during the last 25 years an attempt has been made to collate all this information and present it in a comprehensive and orderly manner in this unique volume this book has been designed to be useful to two main categories of readers namely electrical and mechanical engineers in the user industries and post graduates and students embracing mechanical and electrical engineers

Control Strategies of Permanent Magnet Synchronous Motor Drive for Electric Vehicles 2022-09-19 this concise book presents the basic concepts of magnetism and magnetic properties pertinent to permanent magnetic materials emphasis is placed on hexaferrite materials for permanent magnet applications with m type ferrites as the focal point the relatively high metallicity of magnetic materials for practical applications imposes limitations for their efficient use accordingly magnetic oxides with ferromagnetic properties emerged as the most widely used magnetic materials for practical applications owing to their characteristic high resistivity and low eddy current losses chemical stability simplicity of production in mass quantities and other favorable characteristics an important class of these oxides is the class of hexagonal ferrites developed in the early 1950 s which dominated the world market of permanent magnet applications since the end of the 1980 s among these ferrites the magnetoplumbite m type hexaferrite is produced nowadays in large quantities at very competitive low prices thus providing the permanent magnet market with probably the most cost effective magnetic material

Brushless Permanent-magnet and Reluctance Motor Drives 1989

Brushless Permanent-magnet Motor Design 1994

Advanced Theory of Fractional-Slot Concentrated-Wound Permanent Magnet Synchronous Machines 2018-03-27

Magnetism 2019-07-15

Permanent Magnets 1944

Permanent-Magnet DC Linear Motors 1996-02-22

Hexaferrite Permanent Magnetic Materials 2016-10-10

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