

## Electrical Induction Motor Winding Design Software

The basic theory, principle of operation and characteristics of transformers, three-phase induction motors, single-phase induction motors, synchronous machines and dc machines are dealt with in Appendices to provide the background for the design of these machines. Provides coverage of Motor Current Signature Analysis (MCSA) for cage induction motors This book is primarily for industrial engineers. It has 13 chapters and contains a unique data base of 50 industrial case histories on the application of MCSA to diagnose broken rotor bars or unacceptable levels of airgap eccentricity in cage induction motors with ratings from 127 kW (170 H.P.) up to 10,160 kW (13,620 H.P.). There are also unsuccessful case histories, which is another unique feature of the book. The case studies also illustrate the effects of mechanical load dynamics downstream of the motor on the interpretation of current signatures. A number of cases are presented where abnormal operation of the driven load was diagnosed. Chapter 13 presents a critical appraisal of MCSA including successes, failures and lessons learned via industrial case histories. The case histories are presented in a step by step format, with predictions and outcomes supported by current spectra and photographic evidence to confirm a correct or incorrect diagnosis The case histories are presented in detail so readers fully understand the diagnosis The authors have 108 years of combined experience in the installation, maintenance, repair, design, manufacture, operation and condition monitoring of SCIMs There are 10 questions at the end of chapters 1 to 12 and answers can be obtained via the publisher Current Signature Analysis for Condition Monitoring of Cage Induction Motors serves as a reference for professional engineers, head electricians and technicians working with induction motors. To obtain the solutions manual for this book, please send an email to [pressbooks@ieee.org](mailto:pressbooks@ieee.org). William T. Thomson is Director and Consultant with EM Diagnostics Ltd, in Scotland. Prof. Thomson received a BSc (Hons) in Electrical Engineering in 1973 and an MSc in 1977 from the University of Strathclyde. He has published 72 papers on condition monitoring of induction motors in a variety of engineering journals such as IEEE Transactions (USA), IEE Proceedings (UK), and also at numerous International IEEE and IEE conferences. He is a senior member of the IEEE, a fellow of the IEE (IET) in the UK and a Chartered Professional Engineer registered in the UK. Ian Culbert was a Rotating Machines Specialist at Iris Power Qualitrol since April 2002 until his very untimely death on 8th September, 2015. At this company he provided consulting services to customers, assisted in product development, trained sales and field service staff and reviewed stator winding partial discharge reports. He has co-authored two books on electrical machine insulation design, evaluation, aging, testing and repair and was principal author of a number of Electric Power Research Institute reports on motor repair. Ian was a Registered Professional Engineer in the Province of Ontario, Canada and a Senior Member of IEEE.

A unique guide to the integration of three-phase induction motors with the emphasis on conserving energy • The energy-saving principle and technology for induction motor is a new topic, and there are few books currently available; this book provides a guide to the technology and aims to bring about significant advancement in research, and play an important role in improving the level of motor energy saving • Includes new and innovative topics such as a case study of energy saving in beam pumping system, and reactive compensation as a means of energy saving • The authors have worked in this area for 20 years and this book is the result of their accumulated research and expertise. It is unique in its integration of three-phase induction motors with the emphasis on conserving energy • Integrates the saving-energy principle, technology, and method of induction motors with on-site experiences, showing readers how to meet the practical needs and to apply the theory into practice. It also provides case studies and analysis which can help solve problems on-site

In one complete volume, this essential reference presents an in-depth overview of the theoretical principles and techniques of electrical machine design. This timely new edition offers up-to-date theory and guidelines for the design of electrical machines, taking into account recent advances in permanent magnet machines as well as synchronous reluctance machines. New coverage includes: Brand new material on the ecological impact of the motors, covering the eco-design principles of rotating electrical machines An expanded section on the design of permanent magnet synchronous machines, now reporting on the design of tooth-coil, high-torque permanent magnet machines and their properties Large updates and new material on synchronous reluctance machines, air-gap inductance, losses in and resistivity of permanent magnets (PM), operating point of loaded PM circuit, PM machine design, and minimizing the losses in electrical machines> End-of-chapter exercises and new direct design examples with methods and solutions to real design problems> A supplementary website hosts two machine design examples created with MATHCAD: rotor surface magnet permanent magnet machine and squirrel cage induction machine calculations. Also a MATLAB code for optimizing the design of an induction motor is provided Outlining a step-by-step sequence of machine design, this book enables electrical machine designers to design rotating electrical machines. With a thorough treatment of all existing and emerging technologies in the field, it is a useful manual for professionals working in the diagnosis of electrical machines and drives. A rigorous introduction to the theoretical principles and techniques makes the book invaluable to senior electrical engineering students, postgraduates, researchers and university lecturers involved in electrical drives technology and electromechanical energy conversion. This comprehensive, up-to-date introduction to Electrical Machines is designed to meet the needs of undergraduate electrical engineering students. It presents the essential principles of rotating machines and transformers. The emphasis is on the performance, though the book also introduces the salient features of electrical machine design. The book provides accessible, student-friendly coverage of dc machines, transformers, three-phase induction motor, single-phase induction motor, fractional horsepower motors, and synchronous machines. The clear writing style of the book enhanced by illustrative figures and simplified explanations of the fundamentals, makes it an ideal text for gaining a thorough understanding of the subject of electrical machines. Key Features Include: •Detailed coverage of the construction of electrical machines. •Lucid explanations of the principles of operation of electrical machines. •Methods of testing of electrical machines. •Performance calculations of electrical machines. •Wealth of diverse solved examples in each chapter to illustrate the application of theory to practical problems. •Salient features of design of electrical machines. •Objective type questions to help students prepare for competitive exams.

This book presents the selected results of the XI Scientific Conference Selected Issues of Electrical Engineering and Electronics (WZEE) which was held in Rzeszów and Czarna, Poland on September 27-30, 2013. The main aim of the Conference was to provide academia and industry to discuss and present the latest technological advantages and research results and to integrate the new interdisciplinary scientific circle in the field of electrical engineering, electronics and mechatronics. The Conference was organized by the Rzeszów Division of Polish Association of Theoretical and Applied Electrical Engineering (PTETiS) in cooperation with Rzeszów University of Technology, the Faculty of Electrical and Computer Engineering and Rzeszów University, the Faculty of Mathematics and Natural Sciences.

Developments in power electronics and digital control have made the rugged, low-cost, high-performance induction machine the popular choice of electric generator/motor in many industries. As the induction machine proves to be an efficient power solution for the flexible, distributed systems of the near future, the dynamic worldwide market continues to grow. It is imperative that engineers have a solid grasp of the complex issues of analysis and design associated with these devices. The Induction Machines Design Handbook, Second Edition satisfies this need, providing a comprehensive, self-contained, and up-to-date reference on single- and three-phase induction machines in constant and variable speed applications. Picking up where the first edition left off, this book taps into the authors' considerable field experience to fortify and summarize the rich existing literature on the subject. Without drastically changing the effective logical structure and content of the original text, this second edition acknowledges notable theoretical and practical developments in the field that have occurred during the eight years since the first publication. It makes corrections and/or improvements to text, formulae, and figures. New material

includes: Introduction of more realistic specifications and reworked numerical calculations in some of the examples Changes in terminology Discussion of some novel issues, with illustrative results from recent literature New and updated photos Data on new mild magnetic materials (metglass) An industrial "sinusoidal" two-phase winding Illustrations of finite element method airgap flux density Enhanced presentations of unbalanced voltage and new harmonic-rich voltage supply IM performance Discussion of stator (multiconductor) winding skin effect by finite element method Broad coverage of induction machines includes applications, principles and topologies, and materials, with numerical examples, analysis of transient behavior waveforms and digital simulations, and design sample cases. The authors address both standard and new subjects of induction machines in a way that will be both practically useful and inspirational for the future endeavors of professionals and students alike.

A single comprehensive resource for the design, application, testing, and maintenance of rotating machines Filling a long-standing gap in the field, *Electrical Insulation for Rotating Machines* covers, in one useful volume, all aspects of the design, deterioration, testing, and repair of the electrical insulation used in motors and generators. Lucidly written by leading experts, this authoritative reference provides both historical background important to understanding machine insulation design and the most up-to-date information on new machines and how to select insulation systems for them. Coverage includes such key topics as: Types of rotating machines, windings, and rotor and stator winding construction Evaluating insulation materials and systems Stator winding and rotor winding insulation systems in current use Failure mechanisms and repair Testing and monitoring Maintenance strategies Detailing over 30 different rotor and stator winding failure processes and reviewing almost 25 different tests and monitors used to assess winding insulation condition, *Electrical Insulation for Rotating Machines* will help machine users avoid unnecessary machine failures, reduce maintenance costs, and inspire greater confidence in the design of future machines.

Presenting current issues in electric motor design, installation, application, and performance, this second edition serves as the most authoritative and reliable guide to electric motor utilization and assessment in the commercial and industrial sectors. Covering topics ranging from motor energy and efficiency to computer-aided design and equipment selection, this reference assists professionals in all aspects of electric motor maintenance, repair, and optimization. It has been expanded by more than 40 percent to explore the most influential technologies in the field including electronic controls, superconducting generators, recent analytical tools, new computing capabilities, and special purpose motors.

Many of the earliest books, particularly those dating back to the 1900s and before, are now extremely scarce and increasingly expensive. We are republishing these classic works in affordable, high quality, modern editions, using the original text and artwork.

This book covers the various function principles of small motors, including rotating field machines, commutator machines, recent developments in the use of electronics in motors and the relationship between the motor and its driven load.

Generously illustrated with over 1600 display equations and more than 145 drawings, diagrams and photographs, this book is a handy, single-source reference suited to readers with a wide span of educational backgrounds and technical experience. Comprehensive in both scope and depth this manual covers all significant aspects of the field, such as Amperes Law and Faraday's Law, emphasizing basic explanations of motor behaviour, derives all important equations and relationships required to analyze, design and apply polyphase induction motors, uses worldwide SI units or international MKS system of units as well as practical units used in the US and shows how to apply working equations to real-life situations with numerical examples... and more.

The third edition of *Induction Machines Handbook* comprises two volumes, *Induction Machines Handbook: Steady State Modeling and Performance* and *Induction Machines Handbook: Transients, Control Principles, Design and Testing*. The promise of renewable (hydro and wind) energy via cage-rotor and doubly fed variable speed generators e-transport propulsion, i-home appliances makes this third edition state of the art tool, conceived with numerous case studies, timely for both Academia and Industry. The first volume offers a thorough treatment of steady state modeling and performance of induction machines, the most used electric motors (generators) in rather constant or variable speed drives for even lower energy consumption and higher productivity in basically all industries, from home appliances, through robotics to e-transport and wind energy conversion. The second volume presents a practical up to date treatment of intricate issues with induction machine (IM) required for design and testing both in rather constant and variable speed (with power electronics) drives. It contains ready to use in industrial design and testing knowledge with numerous case studies to facilitate thorough assimilation of new knowledge.

This book is a comprehensive set of articles reflecting the latest advances and developments in mathematical modeling and the design of electrical machines for different applications. The main models discussed are based on the: i) Maxwell–Fourier method (i.e., the formal resolution of Maxwell's equations by using the separation of variables method and the Fourier's series in 2-D or 3-D with a quasi-Cartesian or polar coordinate system); ii) electrical, thermal and magnetic equivalent circuit; iii) hybrid model. In these different papers, the numerical method and the experimental tests have been used as comparisons or validations.

Electric power engineering has always been an integral part of electrical engineering education. Providing a unique alternative to existing books on the market, this text presents a concise and rigorous exposition of the main fundamentals of electric power engineering. Contained in a single volume, the materials can be used to teach three separate courses — electrical machines, power systems and power electronics, which are in the mainstream of the electrical engineering curriculum of most universities worldwide. The book also highlights an in-depth review of electric and magnetic circuit theory with emphasis on the topics which are most relevant to electric power engineering. Contents: Review of Electric and Magnetic Circuit Theory: Basic Electric Circuit Theory Analysis of Electric Circuits with Periodic Non-sinusoidal Sources Magnetic Circuit Theory Power Systems: Introduction to Power Systems Fault Analysis Transformers Synchronous Generators Power Flow Analysis and Stability of Power Systems Induction Machines Power Electronics: Power Semiconductor Devices Rectifiers Inverters DC-to-DC Converters (Choppers) Keywords: Power Systems; Electrical Machines; Power Electronics

The improvement of electrical energy efficiency is fast becoming one of the most essential areas of sustainability development, backed by political initiatives to control and reduce energy demand. Now a major topic in industry and the electrical engineering research community, engineers have started to focus on analysis, diagnosis and possible solutions. Owing to the complexity and cross-disciplinary nature of electrical energy efficiency issues, the optimal solution is often multi-faceted with a critical solutions evaluation component to ensure cost effectiveness. This single-source reference brings a practical focus to the subject of electrical energy efficiency, providing detailed theory and practical applications to enable engineers to find solutions for electroefficiency problems. It presents power supplier as well as electricity user perspectives and promotes routine implementation of good engineering practice. Key features include: a comprehensive overview of the different technologies involved in electroefficiency, outlining monitoring and control concepts and practical design techniques used in industrial applications; description of the current standards of electrical motors, with illustrative case studies showing how to achieve better design; up-to-date information on standardization, technologies, economic realities and energy efficiency indicators (the main types and international results); coverage on the quality and efficiency of distribution systems (the impact on distribution systems and loads, and the calculation of power losses in distribution lines and in power transformers). With invaluable practical advice, this book is suited to practicing

electrical engineers, design engineers, installation designers, M&E designers, and economic engineers. It equips maintenance and energy managers, planners, and infrastructure managers with the necessary knowledge to properly evaluate the wealth of electrical energy efficiency solutions for large investments. This reference also provides interesting reading material for energy researchers, policy makers, consultants, postgraduate engineering students and final year undergraduate engineering students. Basic Consideration in Design \* Electrical Materials \* Magnetic Circuit Calculations \* Heating and Cooling H Design of Transformers \* Review Questions of Transformer Design H Armature Winding for D.C. Machines \* Design of D.C. Machines H Design of D.C. Motor Starter H Review Questions in Design of D.C. Machines H A.C. Armature Winding H Design of 3-Phase Induction Motors \* Single phase Induction Motors \* Review Questions of Induction Motors \* Design of Synchronous Machines \* Short Questions on Design of Synchronous Machines \* Computer Aided Design of Electrical Machines \* Design of Lifting Magnets \* Viva-voce Questions \* Appendix \* Standard Specifications and Design Data.

In two editions spanning more than a decade, The Electrical Engineering Handbook stands as the definitive reference to the multidisciplinary field of electrical engineering. Our knowledge continues to grow, and so does the Handbook. For the third edition, it has grown into a set of six books carefully focused on specialized areas or fields of study. Each one represents a concise yet definitive collection of key concepts, models, and equations in its respective domain, thoughtfully gathered for convenient access. Combined, they constitute the most comprehensive, authoritative resource available. Circuits, Signals, and Speech and Image Processing presents all of the basic information related to electric circuits and components, analysis of circuits, the use of the Laplace transform, as well as signal, speech, and image processing using filters and algorithms. It also examines emerging areas such as text to speech synthesis, real-time processing, and embedded signal processing. Electronics, Power Electronics, Optoelectronics, Microwaves, Electromagnetics, and Radar delves into the fields of electronics, integrated circuits, power electronics, optoelectronics, electromagnetics, light waves, and radar, supplying all of the basic information required for a deep understanding of each area. It also devotes a section to electrical effects and devices and explores the emerging fields of microlithography and power electronics. Sensors, Nanoscience, Biomedical Engineering, and Instruments provides thorough coverage of sensors, materials and nanoscience, instruments and measurements, and biomedical systems and devices, including all of the basic information required to thoroughly understand each area. It explores the emerging fields of sensors, nanotechnologies, and biological effects. Broadcasting and Optical Communication Technology explores communications, information theory, and devices, covering all of the basic information needed for a thorough understanding of these areas. It also examines the emerging areas of adaptive estimation and optical communication. Computers, Software Engineering, and Digital Devices examines digital and logical devices, displays, testing, software, and computers, presenting the fundamental concepts needed to ensure a thorough understanding of each field. It treats the emerging fields of programmable logic, hardware description languages, and parallel computing in detail. Systems, Controls, Embedded Systems, Energy, and Machines explores in detail the fields of energy devices, machines, and systems as well as control systems. It provides all of the fundamental concepts needed for thorough, in-depth understanding of each area and devotes special attention to the emerging area of embedded systems. Encompassing the work of the world's foremost experts in their respective specialties, The Electrical Engineering Handbook, Third Edition remains the most convenient, reliable source of information available. This edition features the latest developments, the broadest scope of coverage, and new material on nanotechnologies, fuel cells, embedded systems, and biometrics. The engineering community has relied on the Handbook for more than twelve years, and it will continue to be a platform to launch the next wave of advancements. The Handbook's latest incarnation features a protective slipcase, which helps you stay organized without overwhelming your bookshelf. It is an attractive addition to any collection, and will help keep each volume of the Handbook as fresh as your latest research.

The only book on the market that emphasizes machine design beyond the basic principles of AC and DC machine behavior AC electrical machine design is a key skill set for developing competitive electric motors and generators for applications in industry, aerospace, and defense. This book presents a thorough treatment of AC machine design, starting from basic electromagnetic principles and continuing through the various design aspects of an induction machine. Introduction to AC Machine Design includes one chapter each on the design of permanent magnet machines, synchronous machines, and thermal design. It also offers a basic treatment of the use of finite elements to compute the magnetic field within a machine without interfering with the initial comprehension of the core subject matter. Based on the author's notes, as well as after years of classroom instruction, Introduction to AC Machine Design: Brings to light more advanced principles of machine design—not just the basic principles of AC and DC machine behavior Introduces electrical machine design to neophytes while also being a resource for experienced designers Fully examines AC machine design, beginning with basic electromagnetic principles Covers the many facets of the induction machine design Introduction to AC Machine Design is an important text for graduate school students studying the design of electrical machinery, and it will be of great interest to manufacturers of electrical machinery.

Rapid increases in energy consumption and emphasis on environmental protection have posed challenges for the motor industry, as has the design and manufacture of highly efficient, reliable, cost-effective, energy-saving, quiet, precisely controlled, and long-lasting electric motors. Suitable for motor designers, engineers, and manufacturers, as well

A fully expanded new edition documenting the significant improvements that have been made to the tests and monitors of electrical insulation systems Electrical Insulation for Rotating Machines: Design, Evaluation, Aging, Testing, and Repair, Second Edition covers all aspects in the design, deterioration, testing, and repair of the electrical insulation used in motors and generators of all ratings greater than fractional horsepower size. It discusses both rotor and stator windings; gives a historical overview of machine insulation design; and describes the materials and manufacturing methods of the rotor and stator winding insulation systems in current use (while covering systems made over fifty years ago). It covers how to select the insulation systems for use in new machines, and explains over thirty different rotor and stator winding failure processes, including the methods to repair, or least slow down, each process. Finally, it reviews the theoretical basis, practical application, and interpretation of forty different tests and monitors that are used to assess winding insulation condition, thereby helping machine users avoid unnecessary machine failures and reduce maintenance costs. Electrical Insulation for Rotating Machines: Documents the large array of machine electrical failure mechanisms, repair methods, and test techniques that are currently available Educates owners of machines as well as repair shops on the different failure processes and shows them how to fix or otherwise ameliorate them Offers chapters on testing, monitoring, and maintenance strategies that assist in educating machine users and repair shops on the tests needed for specific situations and how to minimize motor and generator maintenance costs Captures the state of both the present and past "art" in

rotating machine insulation system design and manufacture, which helps designers learn from the knowledge acquired by previous generations. An ideal read for researchers, developers, and manufacturers of electrical insulating materials for machines, *Electrical Insulation for Rotating Machines* will also benefit designers of motors and generators who must select and apply electrical insulation in machines.

Often called the workhorse of industry, the advent of power electronics and advances in digital control are transforming the induction motor into the racehorse of industrial motion control. Now, the classic texts on induction machines are nearly three decades old, while more recent books on electric motors lack the necessary depth and detail on induction machines.

The book helps readers understand key concepts in standalone and grid connected wind energy systems and features analysis into the modeling and optimization of commonly used configurations through the implementation of different control strategies. Utilizing several electrical machinery control approaches, such as vector control and direct torque control, *Wind Power Electric Systems* equips readers with the means to understand, assess and develop their own wind energy systems and to evaluate the performance of such systems. Mathematical models are provided for each system and a corresponding MATLAB/SIMULINK example is included at the end of each section in order to demonstrate key processes and methods.

*Design And Testing Of Electrical Machines* PHI Learning Pvt. Ltd.

The first comprehensive and up-to-date reference on mechatronics, Robert Bishop's *The Mechatronics Handbook* was quickly embraced as the gold standard for the field. With updated coverage on all aspects of mechatronics, *The Mechatronics Handbook, Second Edition* is now available as a two-volume set. Each installment offers focused coverage of a particular area of mechatronics, supplying a convenient and flexible source of specific information. This seminal work is still the most exhaustive, state-of-the-art treatment of the field available. *Mechatronics Systems, Sensors, and Actuators: Fundamentals and Modeling* presents an overview of mechatronics, providing a foundation for those new to the field and authoritative support for seasoned professionals. The book introduces basic definitions and the key elements and includes detailed descriptions of the mathematical models of the mechanical, electrical, and fluid subsystems that comprise mechatronic systems. New chapters include *Mechatronics Engineering Curriculum Design and Numerical Simulation*. Discussion of the fundamental physical relationships and mathematical models associated with commonly used sensor and actuator technologies complete the coverage. Features *Introduces the key elements of mechatronics and discusses new directions* *Presents the underlying mechanical and electronic mathematical models comprising many mechatronic systems* *Provides a detailed discussion of the process of physical system modeling* *Covers time, frequency, and sensor and actuator characteristics*

This book is about electric energy: its generation, its transmission from the point of generation to where it is required, and its transformation into required forms. To achieve this end, a number of devices are essential—such as generators, transmission lines, transformers, and electric motors. We discuss the design, construction, and operating characteristics of the electric devices used in the transformation to and from electric energy. This text is designed to be used in a one-semester course in electric energy conversion at the second-year level of the Bachelor of Engineering course. It is assumed that the student is familiar with the laws of thermodynamics and has taken a course in basic circuit analysis, including the application of phasors. We begin with a discussion of how humankind has successfully harnessed the energy of wind, water, the sun, biomass, animals, geothermal sources, fossils, and nuclear fission to make its life comfortable. Some of the consequences of this activity on the environment are examined. In Chapter 2, we review the basic physics of energy and its conversion. This may be, to some extent, a repetition of knowledge gained in high-school and first year university courses. However, we believe that such review is necessary to establish a suitable base from which to launch the subject of electric energy conversion.

The electrical propulsion system as the core component of solar-power Unmanned Aerial Vehicles (UAVs) for long duration flight requires high power density and stable drive technology. Brushless DC motors (BLDCM) with high power and torque density and control algorithms suitable for drive system are given preference for the application in UAVs. This dissertation is aimed at designing an improved BLDCM using only 4 interior magnet blocks to realize 8 poles compared to the conventional 8 magnet blocks structure. The performances of both BLDCM designs have been analytically determined and the motor models were verified through finite element software in ANSYS. Design and construction of the demonstrators of BLDCMs with the proposed and the conventional magnet structure have been carried out and a test bench for extensive performance comparison has been set up. Since the proposed magnet structure leads to a particularity of the magnetic circuit, the behavior of absolute and differential synchronous direct and quadrature inductances have been investigated by finite element model analysis and experiments.

Efficiency maps were generated and thermal characteristics have been measured to gain a comprehensive understanding of the two motors. To reduce the uncertainty of sensor control for BLDCM, a high speed, good linearity analog isolation circuit to measure the voltages of 270 V DC voltage to realize sensorless control strategy has been designed. The circuit combines a PI controller with fast operational amplifiers with a built-in linearizing feedback photodiode loop of a linear optocoupler. A 3D stator model was built to analyse the mechanical resonance frequencies and possible excitation by the electromagnetic radial force leading to vibration and noise for the proposed and conventional rotor structure. Analytical calculation of natural mode frequencies has also been conducted to compare and validate the accuracy of FEM simulations and impact hammer testing experimental results. Das elektrische Antriebssystem als Kernkomponente von unbemannten Solarflugzeugen (UAVs, Unmanned Aerial Vehicles) für Langzeitflüge erfordert eine hohe Leistungsdichte und robuste Antriebstechnik. Bürstenlose Gleichstrommotoren (BLDCM) mit hoher Leistungs- und Drehmomentdichte sowie dafür angepasste Regelalgorithmen werden daher bevorzugt in UAVs eingesetzt. Diese Dissertation zielt darauf ab, einen verbesserten BLDCM mit nur 4 eingebetteten Magnetblöcken zu entwerfen, um 8 Pole zu realisieren im Vergleich zu der herkömmlichen Struktur mit 8 Magnetblöcken. Das Verhalten beider BLDCM-Designs wurde analytisch ermittelt und die Motormodelle mit Hilfe von Finite-Elemente-Software in ANSYS verifiziert. Design und Konstruktion der Prototypen mit der vorgeschlagenen und der herkömmlichen Magnetstruktur wurden durchgeführt und es wurde ein Prüfstand für einen umfassenden Leistungsvergleich aufgebaut. Da die vorgeschlagene Magnetstruktur zu einem Magnetkreis führt, bei dem die entgegengesetzten Pole keine Spiegelsymmetrie aufweisen, wurden die Längs- und Querinduktivität durch Finite-Elemente-Modellanalyse und Experimente absolut und differentiell untersucht. Weiterhin wurden Wirkungsgradkennfelder erstellt und das thermische Verhalten untersucht, um ein umfassendes Verständnis der beiden Motoren zu erhalten. Um das sensorbedingte Ausfallrisiko zu eliminieren, wurde eine schnelle analoge Isolationsschaltung mit hoher Linearität und Stabilität zur Messung der gepulsten Spannungen bei 270V Gleichspannung entwickelt, um eine sensorlose Steuerungsstrategie zu realisieren. Die Schaltung verwendet einen linearen Optokoppler mit integrierter Rückkopplungsfotodiode,

sowie einen PI-Regler mit schnellen Operationsverstärkern im Rückkopplungspfad. Ein 3D-Statormodell wurde erstellt, um die mechanischen Resonanzfrequenzen und die mögliche Anregung durch die elektromagnetische Radialkraft zu analysieren, die zu Vibrationen und Geräuschen bei der vorgeschlagenen und herkömmlichen Rotorstruktur führt. Es wurde auch eine analytische Modalanalyse durchgeführt, um die Genauigkeit von FEM-Simulationen und experimentellen Ergebnissen mit dem Impulshammer zu vergleichen und zu validieren.

This book includes my lecture notes for electrical machines course. The book is divided to different learning parts · Part 1- Apply basic physical concepts to explain the operation and solve problems related to electrical machines. · Part 2- Explain the principles underlying the performance of three-phase electrical machines. · Part 3- Analyse, operate and test three-phase induction machines. · Part 4- Investigate the performance, design, operation, and testing of the three-phase synchronous machine. Part1: Apply basic physical concepts to explain the operation and solve problems related to electrical machines. Describe the construction of simple magnetic circuits, both with and without an air gap. Explain the basic laws which govern the electrical machine operation, such as Faraday's Law, Ampere-Biot-Savart's Law, and Lenz's Law. Apply Faraday's Law of electromagnetic induction, Ampere-Biot-Savart's Law, and Lenz's Law to solve for induced voltage and currents in relation to simple magnetic circuits with movable parts. Illustrate the principle of the electromechanical energy conversion in magnetic circuits with movable parts. Part 2: Explain the principles underlying the performance of three-phase electrical machines. Compare and contrast concentric and distributed windings in three-phase electrical machines. Identify the advantages of distributed windings applied to three-phase machines. Explain how the pulsating and rotating magnetic fields are produced in distributed windings. Calculate the synchronous speed of a machine based on its number of poles and frequency of the supply. Describe the process of torque production in multi-phase machines. Part 3: Analyse, operate and test three-phase induction machines. Calculate the slip of an induction machine given the operating and synchronous speeds. Calculate and compare between different torques of a three-phase induction machine, such as the locked rotor or starting torque, pull-up torque, breakdown torque, full-load torque or braking torque. Develop and manipulate the equivalent circuit model for the three-phase induction machine. Analyse, and test experimentally, the torque-speed and current-speed characteristics of induction machines. and discuss the effects of varying such motor parameters as rotor resistance, supply voltage and supply frequency on motor torque-speed characteristics. Perform no-load and blocked rotor tests in order to determine the equivalent circuit parameters of an induction machine. Explore various techniques to start an induction motor. Identify the applications of the three-phase induction machines in industry and utility. Classify the insulations implemented in electrical machines windings and identify the factors affecting them. Part4. Investigate the performance, design, operation, and testing of the three-phase synchronous machine. Describe the construction of three-phase synchronous machines, particularly the rotor, stator windings and the rotor saliency. Develop and manipulate an equivalent circuit model for the three-phase synchronous machine. Sketch the phasor diagram of a non-salient poles synchronous machine operating at various modes operation, such as no-load operation, motor operation, and generator operation. Investigate the influence of the rotor saliency on machine performance. Perform open and short circuit tests in order to determine the equivalent circuit parameters of a synchronous machine. Identify the applications of the three-phase synchronous machines in industry and utility List and explain the conditions of parallel operation of a group of synchronous generators. Evaluate the performance of the synchronous condenser and describe the power flow control between a synchronous condenser and the utility in both modes: over and under excited. Explain the principles of controlling the output voltage and frequency of a synchronous generator.

Electric Generators Handbook, Second Edition: Two-Volume Set supplies state-of-the-art tools necessary to design, validate, and deploy the right power generation technologies to fulfill tomorrow's complex energy needs. The first volume, Synchronous Generators, explores large- and medium-power synchronous generator topologies, steady state, modeling, transients, control, design, and testing. Numerous case studies, worked-out examples, sample results, and illustrations highlight the concepts. Fully revised and updated to reflect the last decade's worth of progress in the field, the Second Edition adds coverage of high-power wind generators with fewer or no PMs, PM-assisted DC-excited salient pole synchronous generators, autonomous synchronous generators' control, line switching parameter identification for isolated grids, synthetic back-to-back load testing with inverter supply, and more. The second volume, Variable Speed Generators, provides extensive coverage of variable speed generators in distributed generation and renewable energy applications around the world. Numerous design and control examples illustrate the exposition. Fully revised and updated to reflect the last decade's worth of progress in the field, the Second Edition adds material on doubly fed induction generator control under unbalanced voltage sags and nonlinear loads, interior permanent magnet claw-pole-alternator systems, high power factor Vernier PM generators, PM-assisted reluctance synchronous motors/generators for electric hybrid vehicles, and more.

A comprehensive text, combining all important concepts and topics of Electrical Machines and featuring exhaustive simulation models based on MATLAB/Simulink Electrical Machine Fundamentals with Numerical Simulation using MATLAB/Simulink provides readers with a basic understanding of all key concepts related to electrical machines (including working principles, equivalent circuit, and analysis). It elaborates the fundamentals and offers numerical problems for students to work through. Uniquely, this text includes simulation models of every type of machine described in the book, enabling students to design and analyse machines on their own. Unlike other books on the subject, this book meets all the needs of students in electrical machine courses. It balances analytical treatment, physical explanation, and hands-on examples and models with a range of difficulty levels. The authors present complex ideas in simple, easy-to-understand language, allowing students in all engineering disciplines to build a solid foundation in the principles of electrical machines. This book: Includes clear elaboration of fundamental concepts in the area of electrical machines, using simple language for optimal and enhanced learning Provides wide coverage of topics, aligning with the electrical machines syllabi of most international universities Contains extensive numerical problems and offers MATLAB/Simulink simulation models for the covered machine types Describes MATLAB/Simulink modelling procedure and introduces the modelling environment to novices Covers magnetic circuits, transformers, rotating machines, DC machines, electric vehicle motors, multiphase machine concept, winding design and details, finite element analysis, and more Electrical Machine Fundamentals with Numerical Simulation using MATLAB/Simulink is a well-balanced textbook perfect for undergraduate students in all engineering majors. Additionally, its comprehensive treatment of electrical machines makes it suitable as a reference for researchers in the field.

The text starts with basic functionality and the role of electrical machines in their typical applications. The effort of applying coordinate transforms is justified by obtaining a more intuitive, concise and easy-to-use model. Mathematics reduced to a necessary minimum, priority is given to bringing up the system view and explaining the use and external characteristics of machines on their electrical and mechanical ports. The aspects of machine design and construction are of secondary importance. Covering the most relevant concepts relating to machine size, torque and power, the book explains the losses and secondary effects, outlining cases and conditions where some secondary phenomena are neglected. While the goal of developing and using machine mathematical models, equivalent circuits and mechanical characteristics persists through the book, the focus is kept on physical insight of electromechanical conversion process. Design and construction of practical

machines is discussed to the extent needed to understand the principles of operation, power losses and cooling, and the problems of power supply and control of electric machines. Details such as the slot shape and the disposition of permanent magnets are covered and their effects on the machine parameters and performance.

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