
We are witness to the emergence a new generation of power engineers, focused on providing electric energy in a deregulated environment. To educate this new breed, textbooks must take a comprehensive approach to electrical energy and encourage problem solving using modern tools. Updated to reflect recent trends and new areas of emphasis, Mohamed El-Hawary's Electrical Energy Systems, Second Edition shifts the teaching of electrical energy and electric power toward a sustainable and reliable paradigm. Discussions ranging from the technical aspects of generation, transmission, distribution, and utilization to power system components, theory, protection, and the energy control center culminate in the most modern and complete introduction to effects of deregulating electric power systems, blackouts and their causes, and minimizing their effects. The author prepares students for real-world challenges by including numerous examples, problems, and MATLAB® scripts, teaching students to use industry-standard problem-solving tools. This edition also features an entirely new chapter on the present and future of electric energy systems, which highlights new challenges facing system designers and operators in light of modern events and transformations impacting the field. Providing convenience for instructors in addition to a thoroughly modern education for students, Electrical Energy Systems, Second Edition sets a new benchmark for the education of electric power engineering focused on sustainable development and operation of new power systems. Reflecting the changes to the all-important short circuit calculations in three-phase power systems according to IEC 60909-0 standard, this new edition of the practical guide retains its proven and unique concept of explanations, calculations and real-life examples of short circuits in electrical networks. It has also been completely revised and expanded by 20% to include the standard-compliant prevention of short circuits in electrical networks for photovoltaic and wind energy. By understanding the theory any software allows users to perform all the necessary calculations with ease so they can work on the design and application of low- and high-voltage power systems. This book is a practitioner's guide intended for students, electrical engineers, engineers in power technology, the electrotechnical industry, engineering consultants, energy suppliers, chemical engineers and physicists in industry. This textbook, in its second edition aims to provide undergraduate students of Electrical Engineering with a unified treatment of all aspects of modern power systems, including generation, transmission and distribution of electric power, load flow studies, economic considerations, fault analysis and stability, high voltage phenomena, system protection, power control, and so on. The text systematically deals with the fundamental techniques in power systems, coupled with adequate analytical techniques and reference to practices in the field. Special emphasis is placed on the latest developments in power system engineering. The book will be equally useful to the postgraduate students specialising in power systems and practising engineers as a reference. NEW TO THIS EDITION • Chapters on Elements of Electric Power Generation and Power System Economics are thoroughly updated. • A new Chapter on Control of Active and Reactive Power is added. With its focus on the requirements and procedures of tendering and project contracting, this book enables the reader to adapt the basics of power systems and equipment design to special tasks and engineering projects, e.g. the integration of renewable energy sources. Describes the use of power system component models and efficient computational techniques in the development of a new generation of programs representing the steady and dynamic states of electrical power systems. Presents main computational and transmission system developments. Derives steady state models of a.c. and d.c. power systems plant components, describes a general purpose phase a.c. load flow program emphasizing Newton Fast Decoupled Algorithm, and more. Considers all aspects of the power system in the dynamic state. A newly updated guide to the protection of power systems in the 21st century Power System Protection, 2nd Edition combines brand new information about the technological and business developments in the field of power system protection that have occurred since the last edition was published in 1998. The new edition includes updates on the effects of short circuits on: Power quality Multiple setting groups Quadrilateral distance relay characteristics Loadability It also includes comprehensive information about the impacts of business changes, including deregulation, disaggregation of power systems, dependability, and security issues. Power System Protection provides the analytical basis for design, application, and setting of power system protection equipment for today's engineer. Updates from protection engineers with distinct specializations contribute to a comprehensive work covering all aspects of the field. New regulations and new components included in modern power protection systems are discussed at length. Computer-based protection is covered in-depth, as is the impact of renewable energy systems connected to distribution and transmission systems. A comprehensive review of the theory and practice for designing, operating, and optimizing electric distribution
systems, revised and updated Now in its second edition, Electric Distribution Systems has been revised and updated and continues to provide a two-tiered approach for designing, installing, and managing effective and efficient electric distribution systems. With an emphasis on both the practical and theoretical approaches, the text is a guide to the underlying theory and concepts and provides a resource for applying that knowledge to problem solving. The authors— noted experts in the field— explain the analytical tools and techniques essential for designing and operating electric distribution systems. In addition, the authors reinforce the theories and practical information presented with real-world examples as well as hundreds of clear illustrations and photos. This essential resource contains the information needed to design electric distribution systems that meet the requirements of specific loads, cities, and zones. The authors also show how to recognize and quickly respond to problems that may occur during system operations, as well as revealing how to improve the performance of electric distribution systems with effective system automation and monitoring. This updated edition: • Contains new information about recent developments in the field particularly in regard to renewable energy generation • Clarifies the perspective of various aspects relating to protection schemes and accompanying equipment • Includes illustrative descriptions of a variety of distributed energy sources and their integration with distribution systems • Explains the intermittent nature of renewable energy sources, various types of energy storage systems and the role they play to improve power quality, stability, and reliability • Written for engineers in electric utilities, regulators, and consultants working with electric distribution systems planning and projects, the second edition of Electric Distribution Systems offers an updated text to both the theoretical underpinnings and practical applications of electrical distribution systems. Most textbooks that deal with the power analysis of electrical engineering power systems focus on generation or distribution systems. Filling a gap in the literature, Modern Power System Analysis, Second Edition introduces readers to electric power systems, with an emphasis on key topics in modern power transmission engineering. Throughout, the book Shipboard Electrical Power Systems addresses new developments in this growing field. Focused on the trend toward electrification to power commercial shipping, naval, and passenger vessels, this book helps new or experienced engineers master cutting-edge methods for power system design, control, protection, and economic use of power. Provides Basic Transferable Skills for Managing Electrical Power on Ships or on Land This groundbreaking book is the first volume of its kind to illustrate optimization of all aspects of shipboard electrical power systems. Applying author Mukund Patel’s rare combination of industrial and educational work experiences and insight, it offers solutions to meet the increasing demand for large, fast, efficient, and reconfigurable ships to compete in international markets. For 30 years, Professor Patel was an engineer for companies including General Electric, Lockheed Martin, and Westinghouse Electric, and in the past 15 years he has been an engineering professor at the U.S. Merchant Marine Academy. That varied experience helped him zero in on the specialized multidimensional knowledge an engineer requires—and that is what sets his book apart. Compiles Critical, Hard-to-Find Information on Power System Design, Analysis, and Operation The global shortage of power engineers is not deterring countries from heavily investing in construction of new power plants and grids. Consequent growth in university electrical power programs is satisfying the demand for engineers, but novice graduates require accelerated understanding and practical experience before entering the thriving maritime segment. Ideal for readers with limited electrical experience, wide-ranging coverage includes power system basics, power generation, electrical machines, power distribution, batteries, and marine industry standards. This book is an invaluable tool for engineers working on ships, as well as in ports, industrial power plants, refineries, and other similar environments. A clear explanation of the technology for producing and delivering electricity Electric Power Systems explains and illustrates how the electric grid works in a clear, straightforward style that makes highly technical material accessible. It begins with a thorough discussion of the underlying physical concepts of electricity, circuits, and complex power that serves as a foundation for more advanced material. Readers are then introduced to the main components of electric power systems, including generators, motors and other appliances, and transmission and distribution equipment such as power lines, transformers, and circuit breakers. The author explains how a whole power system is managed and coordinated, analyzed mathematically, and kept stable and reliable. Recognizing the economic and environmental implications of electric energy production and public concern over disruptions of service, this book exposes the challenges of producing and delivering electricity to help inform public policy decisions. Its discussions of complex concepts such as reactive power balance, load flow, and stability analysis, for example, offer deep insight into the complexity of electric grid operation and demonstrate how and why physics constrains economics and politics. Although this survival guide includes mathematical equations and formulas, it discusses their meaning in plain English and does not assume any prior familiarity with particular notations or technical jargon. Additional features include: * A glossary of symbols, units, abbreviations, and acronyms * Illustrations that help readers visualize processes and better understand complex concepts * Detailed analysis of a case study, including a Web reference to the case, enabling readers to test the consequences of manipulating various parameters With its clear discussion of how electric grids work, Electric Power Systems is appropriate for a broad readership of professionals, undergraduate and graduate students, government agency managers, environmental advocates, and consumers. A solid, quantitative, practical introduction to a wide range of renewable energy systems—in a completely updated, new edition The second edition of Renewable and Efficient Electric Power Systems provides a solid, quantitative, practical introduction to a wide range of renewable energy systems. For each topic, essential theoretical background is introduced, practical engineering considerations associated with designing systems and predicting their performance are provided, and methods for evaluating the economics of these systems are presented. While the book focuses on the fastest growing, most promising wind and solar technologies, new material on tidal and wave power, small-scale hydroelectric power, geothermal and biomass systems is introduced. Both supply-side and demand-side technologies are blended in the final chapter, which introduces the emerging smart grid. As the fraction of our power generated by renewable resources increases, the role of demand-side management in helping maintain grid balance is explored. Renewable energy systems have become mainstream technologies and are now, literally, big business. Throughout this edition, more depth has been provided on the financial analysis of large-scale conventional and renewable energy projects. While grid-connected systems dominate the market today, off-grid systems are beginning to have a significant impact on emerging economies where electricity is a scarce commodity. Considerable attention is paid to the economics of all of these systems. This edition has been completely rewritten, updated, and reorganized. New material has been presented both in the form of new topics as well as in greater depth in some areas. The section on the fundamentals of electric power has been enhanced, making this edition a much better bridge to the more advanced courses in power that are returning to many electrical engineering programs. This includes an introduction to phasor
competition in the generation and retail of electricity has changed the ways in which power systems function. The design and operation reflect the evolution of these markets and the large scale deployment of generation from renewable energy sources. The introduction of questions, that will assist the reader. With all these features, this is an indispensable text for graduate and postgraduate electrical engineering students. As well as specialists without a technical background directly related to power engineering. After laying out the basics for a steady-state analysis, as well as discussions related to grid integration of renewable power sources. The book is designed to be used as reference, review, or self-study for practitioners and consultants, or for students from related engineering disciplines that need to learn more about power systems. Includes comprehensive coverage of the analysis of power systems, useful as a one-stop resource. Features a large number of worked examples and objective questions (with answers) to help apply the material discussed in the book. Offers foundational content that provides background and review for the understanding and analysis of more specialized areas of electric power engineering This is a comprehensive textbook for the new trend of distributed power generation systems and renewable energy sources in electric power systems. It covers the complete range of topics from fundamental concepts to major technologies as well as advanced topics for power consumers. An Instructor's Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department -- to obtain the manual, send an email to ipline@wiley.com The electrical power supply is about to change; future generation will increasingly take place in and near local neighborhoods with diminishing reliance on distant power plants. The existing grid is not adapted for this purpose as it is largely a remnant from the 20th century. Can the grid be transformed into a intelligent and flexible grid that is future proof? This revised edition of Electrical Power System Essentials contains not only an accessible, broad and up-to-date overview of alternating current (AC) power systems, but also end-of-chapter exercises in every chapter, aiding readers in their understanding of the material introduced. With an original approach the book covers the generation of electric energy from thermal power plants as from renewable energy sources and treats the incorporation of power electronic devices and FACTS. Throughout there are examples and case studies that back up the theory or techniques presented. The authors set out information on mathematical modelling and equations in appendices rather than integrated in the main text. This unique approach distinguishes it from other text books on Electrical Power Systems and makes the resource highly accessible for undergraduate students and readers without a technical background directly related to power engineering. After laying out the basics for a steady-state analysis of the three-phase power system, the book examines: generation, transmission, distribution, and utilization of electric energy wind energy, solar energy and hydro power power system protection and circuit breakers power system control and operation the organization of electricity markets and the changes currently taking place system blackouts future developments in power systems, HVDC connections and smart grids. The book is supplemented by a companion website from which teaching materials can be downloaded. The search for clean, renewable energy sources has yielded enormous growth and new developments in these technologies in a few short years, driving down costs and encouraging utilities in many nations, both developed and developing, to add and expand wind and solar power capacity. The first, best-selling edition of Wind and Solar Power Systems prov This book will give readers a thorough understanding of the fundamentals of power system analysis and their applications. Both the basic and advanced topics have been thoroughly explained and supported through several solved examples. Important Features of the Book: Load Flow and Optimal System Operation have been discussed in detail. Automatic Generation Control (AGC) of Isolated and Interconnected Power Systems have been discussed and explained clearly. AGC in Restructured Environment of Power System has been Introduced. Sag and Tension Analysis have been discussed in detail. Contains over 150 illustrative examples, practice problems and objective-type questions, that will assist the reader. With all these features, this is an indispensable text for graduate and postgraduate electrical engineering students. GATE, AMIE and UPSC engineering services along with practicing engineers would also find this book extremely useful. A new edition of the classic text explaining the fundamentals of competitive electricity markets—now updated to reflect the evolution of these markets and the large scale deployment of generation from renewable energy sources. The introduction of competition in the generation and retail of electricity has changed the ways in which power systems function. The design and operation notation, more emphasis on reactive power as well as real power, more on power converter and inverter electronics, and more material on generator technologies. Realizing that many students, as well as professionals, in this increasingly important field may have modest electrical engineering backgrounds, early chapters develop the skills and knowledge necessary to understand these important topics without the need for supplementary materials. With numerous completely worked examples throughout, the book has been designed to encourage self-instruction. The book includes worked examples for virtually every topic that lends itself to quantitative analysis. Each chapter ends with a problem set that provides additional practice. This is an essential resource for a mixed audience of engineering and other technology-focused individuals. The second edition of Steven W. Blume’s bestseller provides a comprehensive treatment of power technology for the non-electrical engineer working in the electric power industry This book aims to give non-electrical professionals a fundamental understanding of large interconnected electrical power systems, better known as the “Power Grid”, with regard to terminology, electrical concepts, design considerations, construction practices, industry standards, control room operations for both normal and emergency conditions, maintenance, consumption, telecommunications and safety. The text begins with an overview of the terminology and basic electrical concepts commonly used in the industry then it examines the generation, transmission and distribution of power. Other topics discussed include energy management, conservation of electrical energy, consumption characteristics and regulatory aspects to help readers understand modern electric power systems. This second edition features: New sections on renewable energy, regulatory changes, new measures to improve system reliability, and smart technologies used in the power grid system. Updated practical examples, photographs, drawing, and illustrations to help the reader gain a better understanding of the material. “Optional supplementary reading” sections within most chapters to elaborate on certain concepts by providing additional detail or background. Electric Power System Basics for the Nonelectrical Professional, Second Edition, gives business professionals in the industry and entry-level engineers a strong introduction to power technology in non-technical terms. Steve W. Blume is Founder of Applied Professional Training, Inc., APT Global, LLC. APT College, LLC and APT Corporate Training Services, LLC, USA. Steve is a registered professional engineer and certified NERC Reliability Coordinator with a Master's degree in Electrical Engineering specializing in power and a Bachelor's degree specializing in Telecommunications. He has more than 25 years’ experience teaching electric power system basics to non-electrical professionals. Steve’s engineering and operations experience includes generation, transmission, distribution, and electrical safety. He is an active senior member in IEEE and has published two books in power systems through IEEE and Wiley. Power Systems Analysis, Second Edition, describes the operation of the interconnected power system under steady state conditions and under dynamic operating conditions during disturbances. Written at a foundational level, including numerous worked examples of concepts discussed in the text, it provides an understanding of how to keep power flowing through an interconnected grid. The second edition adds more information on power system stability, excitation system, and small disturbance analysis, as well as discussions related to grid integration of renewable power sources. The book is designed to be used as reference, review, or self-study for practitioners and consultants, or for students from related engineering disciplines that need to learn more about power systems. Includes comprehensive coverage of the analysis of power systems, useful as a one-stop resource. Features a large number of worked examples and objective questions (with answers) to help apply the material discussed in the book. Offers foundational content that provides background and review for the understanding and analysis of more specialized areas of electric power engineering This is a comprehensive textbook for the new trend of distributed power generation systems and renewable energy sources in electric power systems. It covers the complete range of topics from fundamental concepts to major technologies as well as advanced topics for power consumers. An Instructor's Manual presenting detailed solutions to all the problems in the book is available from the Wiley editorial department -- to obtain the manual, send an email to ipline@wiley.com. The electrical power supply is about to change; future generation will increasingly take place in and near local neighborhoods with diminishing reliance on distant power plants. The existing grid is not adapted for this purpose as it is largely a remnant from the 20th century. Can the grid be transformed into an intelligent and flexible grid that is future proof? This revised edition of Electrical Power System Essentials contains not only an accessible, broad and up-to-date overview of alternating current (AC) power systems, but also end-of-chapter exercises in every chapter, aiding readers in their understanding of the material introduced. 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of successful competitive electricity markets requires a sound understanding of both power systems engineering and underlying economic principles of a competitive market. This extensively revised and updated edition of the classic text on power system economics explains the basic economic principles underpinning the design, operation, and planning of modern power systems in a competitive environment. It also discusses the economics of renewable energy sources in electricity markets, the provision of incentives, and the cost of integrating renewables in the grid. Fundamentals of Power System Economics, Second Edition looks at the fundamental concepts of microeconomics, organization, and operation of electricity markets, market participants’ strategies, operational reliability and ancillary services, network congestion and related LMP and transmission rights, transmission investment, and generation investment. It also expands the chapter on generation investments—discussing capacity mechanisms in more detail and the need for capacity markets aimed at ensuring that enough generation capacity is available when renewable energy sources are not producing due to lack of wind or sun. Retains the highly praised first edition’s focus and philosophy on the principles of competitive electricity markets and application of basic economics to power system operating and planning. Includes an expanded chapter on power system operation that addresses the challenges stemming from the integration of renewable energy sources. Addresses the need for additional flexibility and its provision by conventional generation, demand response, and energy storage. Discusses the effects of the increased uncertainty on system operation. Broadens its coverage of transmission investment and generation investment. Updates end-of-chapter problems and accompanying solutions manual Fundamentals of Power System Economics, Second Edition is essential reading for graduate and undergraduate students, professors, practicing engineers, as well as all others who want to understand how economics and power system engineering interact. Grid converters are the key player in renewable energy integration. The high penetration of renewable energy systems is calling for new more stringent grid requirements. As a consequence, the grid converters should be able to exhibit advanced functions like: dynamic control of active and reactive power, operation within a wide range of voltage and frequency, voltage ride-through capability, reactive current injection during faults, grid services support. This book explains the topologies, modulation and control of grid converters for both photovoltaic and wind power applications. In addition to power electronics, this book focuses on the specific applications in photovoltaic wind power systems where grid condition is an essential factor. With a review of the most recent grid requirements for photovoltaic and wind power systems, the book discusses these other relevant issues: modern grid inverter topologies for photovoltaic and wind turbines islanding detection methods for photovoltaic systems synchronization techniques based on second order generalized integrators (SOGI) advanced synchronization techniques with robust operation under grid unbalance condition grid filter design and active damping techniques power control under grid fault conditions, considering both positive and negative sequences Grid Converters for Photovoltaic and Wind Power Systems is intended as a coursebook for graduated students with a background in electrical engineering and also for professionals in the evolving renewable energy industry. For people from academia interested in adopting the course, a set of slides is available for download from the website. www.wiley.com/go/grid_converters We are witness to the emergence a new generation of power engineers, focused on providing electric energy in a deregulated environment. To educate this new breed, textbooks must take a comprehensive approach to electrical energy and encourage problem solving using modern tools. Updated to reflect recent trends and new areas of emphasis, Mohamed El-Hawary's Electrical Energy Systems, Second Edition shifts the teaching of electrical energy and electric power toward a sustainable and reliable paradigm. 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Providing convenience for instructors in addition to a thoroughly modern education for students, Electrical Energy Systems, Second Edition sets a new benchmark for the education of electric power engineering focused on sustainable development and operation of new power systems. In power system engineering, practically all results of modern control theory can be applied. Such an application will result in a more economical, more convenient and higher service quality operation and in less inconvenience in the case of abnormal conditions. For its analytical treatment, control system design generally requires the determination of a mathematical model from which the control strategy can be derived. While much of the control theory postulates that a model of the system is available, it is also necessary to have a suitable technique to determine the models for the process to be controlled. It is therefore essential to model and identify power system components using both physical relationships and experimental or normal operating data. The objective of system identification is the determination of a mathematical model that characterizes the operation of a system in some form. The available information is either system output or a function of the system output. The input may be a known function applied for the purpose of identification, or an unknown function which could possibly be monitored, or a combination of both. The planning of the operation and control of isolated or interconnected power systems present a large variety of challenging problems. Solving these requires the application of several mathematical techniques from various sources at the appropriate process step. Moreover, the knowledge of optimization techniques and optimal control methods is essential to understand the multi-level approach that is used. Operation and Control in Power Systems is an introductory course text for undergraduate students in electrical and mechanical engineering. In fifteen chapters, it deals with the operation and control of power systems, ranging from load flow analysis to economic operation, optimal load flow, unit commitment, load frequency, interconnected systems, voltage and reactive power control and advanced topics. Various models that are needed in analysis and control are discussed and presented through out the book. This second edition has been extended with mathematical support material and with methods to prevent voltage collapse. It also includes more advanced topics in power system control, such as the effect of shunt compensators, controllable VAR generation and switching converter type VAR generators. Featuring extensive calculations and examples, this reference discusses theoretical and practical aspects of short-circuit currents in ac and dc systems, load flow, and harmonic analyses to provide a sound knowledge base for modern computer-based studies that can be utilized in real-world applications. Presenting more than 2300 figures, tables, and The second edition of the highly acclaimed Wind Power in Power Systems has been thoroughly revised and expanded to reflect the latest challenges associated with increasing wind power penetration levels. Since its first release, practical experiences with high wind power
penetration levels have significantly increased. This book presents an overview of the lessons learned in integrating wind power into power systems and provides an outlook of the relevant issues and solutions to allow even higher wind power penetration levels. This includes the development of standard wind turbine simulation models. This extensive update has 23 brand new chapters in cutting-edge areas including offshore wind farms and storage options, performance validation and certification for grid codes, and the provision of reactive power and voltage control from wind power plants. Key features: Offers an international perspective on integrating a high penetration of wind power into the power system, from basic network interconnection to industry deregulation; Outlines the methodology and results of European and North American large-scale grid integration studies; Extensive practical experience from wind power and power system experts and transmission systems operators in Germany, Denmark, Spain, UK, Ireland, USA, China and New Zealand; Presents various wind turbine designs from the electrical perspective and models for their simulation, and discusses industry standards and world-wide grid codes, along with power quality issues; Considers concepts to increase penetration of wind power in power systems, from wind turbine, power plant and power system redesign to smart grid and storage solutions. Carefully edited for a highly coherent structure, this work remains an essential reference for power system engineers, transmission and distribution network operator and planner, wind turbine designers, wind project developers and wind energy consultants dealing with the integration of wind power into the distribution or transmission network. Up-to-date and comprehensive, it is also useful for graduate students, researchers, regulation authorities, and policy makers who work in the area of wind power and need to understand the relevant power system integration issues. Presents practical methods for detecting, diagnosing and correcting fluid power problems within a system. The work details the design, maintenance, and troubleshooting of pneumatic, hydraulic and electrical systems and components. This second edition stresses: developments in understanding the complex interactions of components within a fluid power system; cartridge valve systems, proportional valve and servo-systems, and compressed air drying and filtering; noise reduction and other environmental concerns; and more. This work should be of interest to mechanical, maintenance, manufacturing, system and machine design, hydraulic, pneumatic, industrial, chemical, electrical and electronics, lubrication, plastics processing, automotive, process control, and power system engineers; manufacturers of hydraulic and pneumatic machinery; systems maintenance personnel; and upper-level undergraduate and graduate students in these disciplines. The protection which is installed on an industrial power system is likely to be subjected to more difficult conditions than the protection on any other kind of power system. Starting with the many simple devices which are employed and covering the whole area of industrial power system protection, this book aims to help achieve a thorough understanding of the protection necessary. Vital aspects such as the modern cartridge fuse, types of relays, and the role of the current transformer are covered and the widely used inverse definite-minimum time overcurrent relay, the theory of the Merz-Price protection system and the development of the high-impedance relay system are critically examined. This new edition has come about in response to the dramatic change from the use of electro-magnetic relays to electronic and micro-processor relays which figure in practically all new installations. Therefore, although the theory and usage are the same, the application can be much improved owing to the increased range and accuracy and the added facilities provided with the modern relays. This book reflects the change and explains the technical advantages. An up to date account of renewable sources of electricity generation and their integration into power systems With the growth in installed capacity of renewable energy (RE) generation, many countries such as the UK are relying on higher levels of RE generation to meet targets for reduced greenhouse gas emissions. In the face of this, the integration issue is now of increasing concern, in particular to system operators. This updated text describes the individual renewable technologies and their power generation characteristics alongside an expanded introduction to power systems and the challenges posed by high levels of penetrations from such technologies, together with an account of technologies and changes to system operation that can ease RE integration. Features of this edition: Covers power conditioning, the characteristics of RE generators, with emphasis on their time varying nature, and the use of power electronics in interfacing RE sources to grids Outlines up to date RE integration issues such as power flow in networks supplied from a combination of conventional and renewable energy sources Updated coverage of the economics of power generation and the role of markets in delivering investment in sustainable solutions Considers the challenge of maintaining power balance in a system with increasing RE input, including recent moves toward power system frequency support from RE sources Offers an insightful perspective on the shape of future power systems including offshore networks and demand side management Includes worked examples that enhance this edition’s suitability as a textbook for introductory courses in RE systems technology Firmly established as an essential reference, the Second Edition of Renewable Energy in Power Systems will prove a real asset to engineers and others involved in both the traditional power and fast growing renewables sector. This text should also be of particular benefit to students of electrical power engineering and will additionally appeal to non-specialists through the inclusion of background material covering the basics of electricity generation. Computer applications yield more insight into system behavior than is possible by using hand calculations on system elements. Computer-Aided Power Systems Analysis: Second Edition is a state-of-the-art presentation of basic principles and software for power systems in steady-state operation. Originally published in 1985, this revised edition explores power systems from the point of view of the central control facility. It covers the elements of transmission networks, bus reference frame, network fault and contingency calculations, power flow on transmission networks, generator base power setting, and state estimation from on-line measurements. The author develops methods used for full-scale networks. In the process of coding and execution, the user learns how the methods apply to actual networks, develops an understanding of the algorithms, and becomes familiar with the process of varying the parameters of the program. Intended for users with a background that includes AC circuit theory, some basic control theory, and a first course in electronic machinery, this book contains material based upon the author’s experience both in the field and in the classroom, as well as many Institute of Electrical and Electronic Engineers (IEEE) publications. His mathematical approach and complete explanations allow readers to develop a solid foundation in power systems analysis. This second edition includes a CD-ROM with stand-alone software to perform computations of all principles covered in the chapters. Executable programs include 0,1,2 conversions, double-hung shielded transmission line parameters, zero and positive bus impedance computations for unbalanced faults, power flow, unit commitment, and state estimation. This book provides a comprehensive practical treatment of the modelling of electrical power systems, and the theory and practice of fault analysis of power systems covering detailed and advanced theories as well as modern industry practices. The continuity and quality of electricity delivered safely and economically by today’s and future’s electrical power networks are important for both developed and developing economies. The correct modelling
of power system equipment and correct fault analysis of electrical networks are pre-requisite to ensuring safety and they play a critical role in the identification of economic network investments. Environmental and economic factors require engineers to maximise the use of existing assets which in turn require accurate modelling and analysis techniques. The technology described in this book will always be required for the safe and economic design and operation of electrical power systems. The book describes relevant advances in industry such as in the areas of international standards developments, emerging new generation technologies such as wind turbine generators, fault current limiters, multi-phase fault analysis, measurement of equipment parameters, probabilistic short-circuit analysis and electrical interference. *A fully up-to-date guide to the analysis and practical troubleshooting of short-circuit faults in electricity utilities and industrial power systems *Covers generators, transformers, substations, overhead power lines and industrial systems with a focus on best-practice techniques, safety issues, power system planning and economics *North American and British / European standards covered Since publication of the first edition of Computer Relaying for Power Systems in 1988, computer relays have been widely accepted by power engineers throughout the world and in many countries they are now the protective devices of choice. The authors have updated this new edition with the latest developments in technology and applications such as adaptive relaying, wide area measurements, signal processing, new GPS-based measurement techniques and the application of artificial intelligence to digital relays. New material also includes sigma-delta and oversampling A/D converters, self-polarizing and cross-polarizing in transmission lines protection and optical current and voltage transformers. Phadke and Thorp have been working together in power systems engineering for more than 30 years. Their impressive work in the field has been recognized by numerous awards, including the prestigious 2008 Benjamin Franklin Medal in Electrical Engineering for their pioneering contributions to the development and application of microprocessor controllers in electric power systems. Provides the student with an understanding of computer relaying. Authored by international authorities in computer relaying. Contents include relaying practices, mathematical basis for protective relaying algorithms, transmission line relaying, protection of transformers, machines and buses, hardware organization in integrated systems, system relaying and control, and developments in new relaying principles. Features numerous solved examples to explain several of the more complex topics, as well as a problem at the end of each chapter. Includes an updated list of references and a greatly expanded subject index. "Risk Assessment of Power Systems closes the gap between risk theory and real-world application. As a leading authority in power system risk evaluation for more than fifteen years and the author of a considerable number of papers and more than fifty technical reports on power system risk and reliability evaluation, Wenyan Li is uniquely qualified to present this material. Following the models and methods developed from the author's hand-on experience, readers learn how to evaluate power system risk in planning, design, operations, and maintenance activities to keep risk at targeted levels." --BOOK JACKET. A practical, application-oriented text that presents analytical results for the better modeling and control of power converters in the integration of green energy in electric power systems. The combined technology of power semiconductor switching devices, pulse width modulation algorithms, and control theories are being further developed along with the performance improvement of power semiconductors and microprocessors so that more efficient, reliable, and cheaper electric energy conversion can be achieved within the next decade. Integration of Green and Renewable Energy in Electric Power Systems covers the principles, analysis, and synthesis of closed loop control of pulse width modulated converters in power electronics systems, with special application emphasis on distributed generation systems and uninterruptible power supplies. The authors present two versions of a documented simulation test bed for homework problems and projects based on Matlab/Simulink, designed to help readers understand the content through simulations. The first consists of a number of problems and projects for classroom teaching convenience and learning. The second is based on the most recent work in control of power converters for the research of practicing engineers and industry researchers. Addresses a combination of the latest developments in control technology of pulse width modulation algorithms and digital control methods. Projects and problems have detailed mathematical modeling, control design, solution steps, and results. Uses a significant number of tables, circuit and block diagrams, and waveform plots with well-designed, class-tested problems/solutions and projects designed for the best teaching-learning interaction. Provides computer simulation programs as examples for ease of understanding and platforms for the projects. Covering major power-conversion applications that help professionals from a variety of industries, Integration of Green and Renewable Energy in Electric Power Systems provides practical, application-oriented system analysis and synthesis that is instructional and inspiring for practicing electrical engineers and researchers as well as undergraduate and graduate students. Grid converters are the key player in renewable energy integration. The high penetration of renewable energy systems is calling for new more stringent grid requirements. As a consequence, the grid converters should be able to exhibit advanced functions like: dynamic control of active and reactive power, operation within a wide range of voltage and frequency, voltage ride-through capability, reactive current injection during faults, grid services support. This book explains the topologies, modulation and control of grid converters for both photovoltaic and wind power applications. In addition to power electronics, this book focuses on the specific applications in photovoltaic wind power systems where grid condition is an essential factor. With a review of the most recent grid requirements for photovoltaic and wind power systems, the book discusses these other relevant issues: modern grid inverter topologies for photovoltaic and wind turbines islanding detection methods for photovoltaic systems synchronisation techniques based on second order generalized integrators (SOGI) advanced synchronisation techniques with robust operation under grid unbalance condition grid filter design and active damping techniques power control under grid fault conditions, considering both positive and negative sequences. Grid Converters for Photovoltaic and Wind Power Systems is intended as a coursebook for graduated students with a background in electrical engineering and also for professionals in the evolving renewable energy industry. For people from academia interested in adopting the course, a set of slides is available for download from the website. www.wiley.com/go/grid_converters. The second edition of this must-have reference covers power quality issues in four parts, including new discussions related to renewable energy systems. The first part of the book provides background on causes, effects, standards, and measurements of power quality and harmonics. Once the basics are established, the authors move on to harmonic modeling of power systems, including components and apparatus (electric machines). The final part of the book is devoted to power quality mitigation approaches and devices, and the fourth part extends the analysis to power quality solutions for renewable energy systems. Throughout the book worked examples and exercises provide practical applications, and tables, charts, and graphs offer useful data for the modeling and analysis of power quality issues. Provides theoretical and practical insight into power quality problems of electric machines and systems. 134 practical application (example)
problems with solutions 125 problems at the end of chapters dealing with practical applications 924 references, mostly journal articles and conference papers, as well as national and international standards and guidelines Initial material for this book was developed over a period of several years through the introduction in the mid-seventies of a graduate-level course en titled, "Control and Operation of Interconnected Power Systems," at the Georgia Institute of Technology. Subsequent involvement with the utility industry and in teaching continuing education courses on modern power sys tem control and operation contributed to the complimentary treatment of the dynamic aspects of this overall topic. In effect, we have evolved a textbook that provides a thorough understanding of fundamentals as needed by a graduate student with a prior back ground in power systems analysis at the undergraduate level, and in system theory concepts normally provided at the beginning of the graduate level in electrical engineering. It is also designed to provide the depth needed both by the serious graduate student and the power industry engineer involved in the activities of energy control centers and short-term operations planning. As explained in Chapter 2, the entire book can be covered in a two quarter course sequence. The bulk of the material may be covered in one semester. For a two-semester offering, we recommend that students be in involved in some project work to further their depth of understanding. Utility and consulting industry engineers should concentrate on the more advanced concepts and developments usually available at the latter half of each chap ter. In response to new developments in the field, practical teaching experience, and readers' suggestions, the authors of the warmly received Reliability Evaluation of Engineering Systems have updated and extended the work providing extended coverage of fault trees and a more complete examination of probability distribution, among other things without disturbing the original's concept, structure, or style. Electric Power Systems: Advanced Forecasting Techniques and Optimal Generation Scheduling helps readers develop their skills in modeling, simulating, and optimizing electric power systems. Carefully balancing theory and practice, it presents novel, cutting-edge developments in forecasting and scheduling. The focus is on understanding and solving pivotal problems in the management of electric power generation systems. Methods for Coping with Uncertainty and Risk in Electric Power Generation Outlining real-world problems, the book begins with an overview of electric power generation systems. Since the ability to cope with uncertainty and risk is crucial for power generating companies, the second part of the book examines the latest methods and models for self-scheduling, load forecasting, short-term electricity price forecasting, and wind power forecasting. Toward Optimal Coordination between Hydro, Thermal, and Wind Power Using case studies, the third part of the book investigates how to achieve the most favorable use of available energy sources. Chapters in this section discuss price-based scheduling for generating companies, optimal scheduling of a hydro producer, hydro-thermal coordination, unit commitment with wind generators, and optimal optimization of multigeneration systems. Written in a pedagogical style that will appeal to graduate students, the book also expands on research results that are useful for engineers and researchers. It presents the latest techniques in increasingly important areas of power system operations and planning. Most textbooks that deal with the power analysis of electrical engineering power systems focus on generation or distribution systems. Filling a gap in the literature, Modern Power System Analysis, Second Edition introduces readers to electric power systems, with an emphasis on key topics in modern power transmission engineering. Throughout, the book familiarizes readers with concepts and issues relevant to the power utility industry. A Classroom-Tested Power Engineering Text That Focuses on Power Transmission Drawing on the author's industry experience and more than 42 years teaching courses in electrical machines and electric power engineering, this book explains the material clearly and in sufficient detail, supported by extensive numerical examples and illustrations. New terms are defined when they are first introduced, and a wealth of end-of-chapter problems reinforce the information presented in each chapter. Topics covered include: Power system planning Transmission line parameters and the steady-state performance of transmission lines Disturbance of system components Symmetrical components and sequence impedances Analysis of balanced and unbalanced faults—including shunt, series, and simultaneous faults Transmission line protection Load-flow analysis Designed for senior undergraduate and graduate students as a two-semester or condensed one-semester text, this classroom-tested book can also be used for self-study. In addition, the detailed explanations and useful appendices make this updated second edition a handy reference for practicing power engineers in the electrical power utility industry. What's New in This Edition 35 percent new material Updated and expanded material throughout Topics on transmission line structure and equipment Coverage of overhead and underground power transmission Expanded discussion and examples on power flow and substation design Extended impedance tables and expanded coverage of per unit systems in the appendices New appendix containing additional solved problems using MATLAB® New glossary of modern power system analysis terminology Technological advances and changes in government policy and regulation have altered the electric power industry in recent years and will continue to impact it for quite some time. Fully updated with the latest changes to regulation, structure, and technology, this new edition of Understanding Electric Power Systems offers a real-world view of the industry, explaining how it operates, how it is structured, and how electricity is regulated and priced. It includes extensive references for the reader and will be especially useful to lawyers, government officials, regulators, engineers, and students, as well as the general public. The book explains the physical functioning of electric power systems, the electric power business in today's environment, and the related institutions, including recent changes in the roles of the Federal Energy Regulatory Commission and the North American Reliability Company. Significant changes that are affecting the industry are covered in this new edition, including: The expanded role of the federal government in the planning and operation of the nation's electric utilities New energy laws and a large number of FERC regulations implementing these laws Concerns over global warming and potential impacts on the electric industry Pressures for expansion of the electric grid and the implementation of "smart-grid" technologies The growing importance of various energy-storage technologies and renewable energy sources New nuclear generation technologies The 2009 economic stimulus package Decision Making Applications in Modern Power Systems presents an enhanced decision-making framework for power systems. Designed as an introduction to enhanced electricity system analysis using decision-making tools, it provides an overview of the different elements, levels and actors involved within an integrated framework for decision-making in the power sector. In addition, it presents a state-of-play on current energy systems, strategies, alternatives, viewpoints and priorities in support of decision-making in the electric power sector, including discussions of energy storage and smart grids. As a practical training guide on theoretical developments and the application of advanced methods for practical electrical energy engineering problems, this reference is ideal for use in establishing medium-term and long-term strategic plans for the electric power and energy sectors. Provides panoramic coverage of state-of-the-art energy systems, strategies and priorities in support of electrical power decision-making Introduces innovative research outcomes, programs, algorithms
and approaches to address challenges in understanding, creating and managing complex techno-socio-economic engineering systems. Includes practical training on theoretical developments and the application of advanced methods for realistic electrical energy engineering problems.

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