

## Pn And Metal Semiconductor Junctions

Semiconductor Device Physics and Design teaches readers how to approach device design from the point of view of someone who wants to improve devices and can see the opportunity and challenges. It begins with coverage of basic physics concepts, including the physics behind polar heterostructures and strained heterostructures. The book then details the important devices ranging from p-n diodes to bipolar and field effect devices. By relating device design to device performance and then relating device needs to system use the student can see how device design works in the real world.

The second edition of the text that offers an introduction to the principles of solar cells and LEDs, revised and updated The revised and updated second edition of Principles of Solar Cells, LEDs and Related Devices offers an introduction to the physical concepts required for a comprehensive understanding of p-n junction devices, light emitting diodes and solar cells. The author – a noted expert in the field – presents information on the semiconductor and junction device fundamentals and extends it to the practical implementation of semiconductors in both photovoltaic and LED devices. In addition, the text offers information on the treatment of a range of important semiconductor materials and device structures including OLED devices and organic solar cells. This second edition contains a new chapter on the quantum mechanical description of the electron that will make the book accessible to students in any engineering discipline. The text also includes a new chapter on bipolar junction and junction field effect transistors as well as expanded chapters on solar cells and LEDs that include more detailed information on high efficiency devices. This important text: Offers an introduction to solar cells and LEDs, the two most important applications of semiconductor diodes Provides a solid theoretical basis for p-n junction devices Contains updated information and new chapters including better coverage of LED out-coupling design and performance and improvements in OLED efficiency Presents student problems at the end of each chapter and worked example problems throughout the text Written for students in electrical engineering, physics and materials science and researchers in the electronics industry, Principles of Solar Cells, LEDs and Related Devices is the updated second edition that offers a guide to the physical concepts of p-n junction devices, light emitting diodes and solar cells.

A thorough introduction to fundamental principles and applications From its beginnings in metallurgy and ceramics, materials science now encompasses such high-tech fields as microelectronics, polymers, biomaterials, and nanotechnology. Electronic Materials Science presents the fundamentals of the subject in a detailed fashion for a multidisciplinary audience. Offering a higher-level treatment than an undergraduate textbook provides, this text benefits students and practitioners not only in electronics and optical materials science, but also in additional cutting-edge fields like polymers and biomaterials. Readers with a basic understanding of physical chemistry or physics will appreciate the text's sophisticated presentation of today's materials science. Instructive derivations of important formulae, usually omitted in an introductory text, are included here. This feature offers a useful glimpse into the foundations of how the discipline understands such topics as defects, phase equilibria, and mechanical properties. Additionally, concepts such as reciprocal space, electron energy band theory, and thermodynamics enter the discussion earlier and in a more robust fashion than in other texts. Electronic Materials Science also features: \* An orientation towards industry and academia drawn from the author's experience in both arenas \* Information on applications in semiconductors, optoelectronics, photocells, and nanoelectronics \* Problem sets and important references throughout \* Flexibility for various pedagogical needs Treating the subject with more depth than any other introductory text, Electronic Materials Science prepares graduate and upper-level undergraduate students for advanced topics in the discipline and gives scientists in associated disciplines a clear review of the field and its leading technologies.

Describing space-charge effects in semiconductors, this text moves from basic principles to advanced application in semiconducting devices. It uses detailed analyses of the transport, Poisson, and continuity equations to show the behavior of solution curves.

Electronic Circuits covers all important aspects and applications of modern analog and digital circuit design. The basics, such as analog and digital circuits, on operational amplifiers, combinatorial and sequential logic and memories, are treated in Part I, while Part II deals with applications. Each chapter offers solutions that enable the reader to understand ready-made circuits or to proceed quickly from an idea to a working circuit, and always illustrated by an example. Analog applications cover such topics as analog computing circuits. The digital sections deal with AD and DA conversion, digital computing circuits, microprocessors and digital filters. This edition contains the basic electronics for mobile communications. The accompanying CD-ROM contains PSPICE software, an analog-circuit-simulation package, plus simulation examples and model libraries related to the book topics.

Heterojunctions and Metal Semiconductor Junctions Elsevier

E se non che di cid son vere prove A nd were it not for the true evidence Per piti e piti autori, che sa, ra. nno Of many authors who will be Per i miei versi nominati altrove, Mentioned elsewhere in my rhyme Non presterei alla penna 10. mana I would not lend my hand to the pen Per nota1' cid ch'io vidi, can temenza And describe my observations, for fear ehe non fosse do. altri casso e van 0; That they would be rejected and in vane; Mala lor chiara. e vera. esperienza But these authors' clear and true experience Mi assicura. nel dir, come persone Encourages me to report, since they Degne di fede ad ogni gra. n sentenza. Should always be trusted for their word. [From " Dittamondo", by Fazio degli Uberti] Heterojunction interfaces, the interfaces between different semiconducting materials, have been extensively explored for over a quarter of a century. The justification for this effort is clear - these interfaces could become the building blocks of many novel solid-state devices. Other interfaces involving semiconductors are already widely used in technology, These are, for example, metal-semiconductor and insulator-semiconductor junctions and hOII1ojunctions. In comparison, the present applications of heterojunction interfaces are limited, but they could potentially become much more extensive in the near future. The path towards the widespread use of heterojunctions is obstructed by several obstacles.

A textbook introducing the physical concepts required for a comprehensive understanding of p-n junction devices, light emitting diodes and solar cells. Semiconductor devices have made a major impact on the way we work and live. Today semiconductor p-n junction diode devices are experiencing substantial growth: solar cells are used on an unprecedented scale in the renewable energy industry; and light emitting diodes (LEDs) are revolutionizing energy efficient lighting. These two emerging industries based on p-n junctions make a significant contribution to the reduction in fossil fuel consumption. Principles of Solar Cells, LEDs and Diodes covers the two most important applications of semiconductor diodes - solar cells and LEDs - together with quantitative coverage of the physics of the p-n junction. The reader will gain a thorough understanding of p-n junctions as the text begins with semiconductor and junction device fundamentals and extends to the practical implementation of semiconductors in both photovoltaic and LED devices. The treatment of a range of important semiconductor materials and device structures is also presented in a readable manner. Topics are divided into the following six chapters; • Semiconductor Physics • The PN Junction Diode • Photon Emission and Absorption • The Solar Cell • Light Emitting Diodes • Organic Semiconductors, OLEDs and Solar Cells Containing student problems at the end of each chapter and worked example problems throughout, this textbook is intended for senior level undergraduate students doing courses in electrical engineering, physics and materials science. Researchers working on solar cells and LED devices, and those in the electronics industry would also benefit from the background information the book provides. In addition to the topics discussed in the First Edition, this Second Edition contains introductory treatments of superconducting materials and of ferromagnetism. I think the book is now more balanced because it is divided perhaps 60% - 40% between devices (of all kinds) and materials (of all kinds). For the physicist interested in solid state applications, I suggest that this ratio is reasonable. I have also rewritten a number of sections in the interest of (hopefully) increased clarity. The aims remain those stated

in the Preface to the First Edition; the book is a survey of the physics of a number of solid state devices and materials. Since my object is a discussion of the basic ideas in a number of fields, I have not tried to present the "state of the art," especially in semiconductor devices. Applied solid state physics is too vast and rapidly changing to cover completely, and there are many references available to recent developments. For these reasons, I have not treated a number of interesting areas. Among the lacunae are superlattices, heterostructures, compound semiconductor devices, ballistic transistors, integrated optics, and light wave communications. (Suggested references to those subjects are given in an appendix. ) I have tried to cover some of the recent revolutionary developments in superconducting materials.

The purpose of this book is to provide the reader with a self-contained treatment of fundamental solid state and semiconductor device physics. The material presented in the text is based upon the lecture notes of a one-year graduate course sequence taught by this author for many years in the Department of Electrical Engineering of the University of Florida. It is intended as an introductory textbook for graduate students in electrical engineering. However, many students from other disciplines and backgrounds such as chemical engineering, materials science, and physics have also taken this course sequence, and will be interested in the material presented herein. This book may also serve as a general reference for device engineers in the semiconductor industry. The present volume covers a wide variety of topics on basic solid state physics and physical principles of various semiconductor devices. The main subjects covered include crystal structures, lattice dynamics, semiconductor statistics, energy band theory, excess carrier phenomena and recombination mechanisms, carrier transport and scattering mechanisms, optical properties, photoelectric effects, metal-semiconductor devices, the p-n junction diode, bipolar junction transistor, MOS devices, photonic devices, quantum effect devices, and high speed III-V semiconductor devices. The text presents a unified and balanced treatment of the physics of semiconductor materials and devices. It is intended to provide physicists and materials scientists with more device backgrounds, and device engineers with a broader knowledge of fundamental solid state physics. This volume is a collection of papers written by the authors who were selected among the members of a project on "Metal-Semiconductor Interfaces" sponsored by the Ministry of Education, Science and Culture of Japan (MON-BUSHO). The M-S Interface is a problem which stems from the 1930's when the concept of surface states was first proposed by Tamm, shortly later by Shockley, and then clearly by Bardeen in 1947 to catalyze the invention of the transistor, and still exists today when one can count almost one billion M-S interfaces or contacts in a Si chip whose size is less than 1 cm square. Consequently, there have been plenty of research activities all over the world, especially over the last 15 years. The "M-S Interfaces" project was composed of four research branches to tackle the following subjects to be reported in the book: Theoretical Approaches, Initial Stage of M-S Interface Formation, Interface Structure of M-S Systems, Realization and Control of Contact Characterization, and Novel Characterization Techniques of Buried Interfaces.

With the advance of semiconductors and ubiquitous computing, the use of system-on-a-chip (SoC) has become an essential technique to reduce product cost. With this progress and continuous reduction of feature sizes, and the development of very large-scale integration (VLSI) circuits, addressing the harder problems requires fundamental understanding of circuit and layout design issues. Furthermore, engineers can often develop their physical intuition to estimate the behavior of circuits rapidly without relying predominantly on computer-aided design (CAD) tools. Introduction to VLSI Systems: A Logic, Circuit, and System Perspective addresses the need for teaching such a topic in terms of a logic, circuit, and system design perspective. To achieve the above-mentioned goals, this classroom-tested book focuses on: Implementing a digital system as a full-custom integrated circuit Switch logic design and useful paradigms that may apply to various static and dynamic logic families The fabrication and layout designs of complementary metal-oxide-semiconductor (CMOS) VLSI Important issues of modern CMOS processes, including deep submicron devices, circuit optimization, interconnect modeling and optimization, signal integrity, power integrity, clocking and timing, power dissipation, and electrostatic discharge (ESD) Introduction to VLSI Systems builds an understanding of integrated circuits from the bottom up, paying much attention to logic circuit, layout, and system designs. Armed with these tools, readers can not only comprehensively understand the features and limitations of modern VLSI technologies, but also have enough background to adapt to this ever-changing field.

A modern and concise treatment of the solid state electronic devices that are fundamental to electronic systems and information technology is provided in this book. The main devices that comprise semiconductor integrated circuits are covered in a clear manner accessible to the wide range of scientific and engineering disciplines that are impacted by this technology. Catering to a wider audience is becoming increasingly important as the field of electronic materials and devices becomes more interdisciplinary, with applications in biology, chemistry and electro-mechanical devices (to name a few) becoming more prevalent. Updated and state-of-the-art advancements are included along with emerging trends in electronic devices and their applications. In addition, an appendix containing the relevant physical background will be included to assist readers from different disciplines and provide a review for those more familiar with the area. Readers of this book can expect to derive a solid foundation for understanding modern electronic devices and also be prepared for future developments and advancements in this far-reaching area of science and technology.

This book is an introduction to the principles of semiconductor physics, linking its scientific aspects with practical applications. It is addressed to both readers who wish to learn semiconductor physics and those seeking to understand semiconductor devices. It is particularly well suited for those who want to do both. Intended as a teaching vehicle, the book is written in an expository manner aimed at conveying a deep and coherent understanding of the field. It provides clear and complete derivations of the basic concepts of modern semiconductor physics. The mathematical arguments and physical interpretations are well balanced: they are presented in a measure designed to ensure the integrity of the delivery of the subject matter in a fully comprehensible form. Experimental procedures and measured data are included as well. The reader is generally not expected to have background in quantum mechanics and solid state physics beyond the most elementary level. Nonetheless, the presentation of this book is planned to bring the student to the point of research/design capability as a scientist or engineer. Moreover, it is sufficiently well endowed with detailed knowledge of the field, including recent developments bearing on submicron semiconductor structures, that the book also constitutes a valuable reference resource. In Chapter 1, basic features of the atomic structures, chemical nature and the macroscopic properties of semiconductors are discussed. The band structure of ideal semiconductor crystals is treated in Chapter 2, together with the underlying one-electron picture and other fundamental concepts. Chapter 2 also provides the requisite background of the tight binding method and the k.p-method, which are later used extensively. The electron states of shallow and deep centers, clean semiconductor surfaces, quantum wells and superlattices, as well as the effects of external electric and

magnetic fields, are treated in Chapter 3. The one- or multi-band effective mass theory is used wherever this method is applicable. A summary of group theory for application in semiconductor physics is given in an Appendix. Chapter 4 deals with the statistical distribution of charge carriers over the band and localized states in thermodynamic equilibrium. Non-equilibrium processes in semiconductors are treated in Chapter 5. The physics of semiconductor junctions (pn-, hetero-, metal-, and insulator-) is developed in Chapter 6 under conditions of thermodynamic equilibrium, and in Chapter 7 under non-equilibrium conditions. On this basis, the most important electronic and opto-electronic semiconductor devices are treated, among them uni- and bi-polar transistors, photodetectors, solar cells, and injection lasers. A summary of group theory for applications in semiconductors is given in an Appendix.

Modern Semiconductor Devices for Integrated Circuits, First Edition introduces readers to the world of modern semiconductor devices with an emphasis on integrated circuit applications. KEY TOPICS: Electrons and Holes in Semiconductors; Motion and Recombination of Electrons and Holes; Device Fabrication Technology; PN and Metal–Semiconductor Junctions; MOS Capacitor; MOS Transistor; MOSFETs in ICs—Scaling, Leakage, and Other Topics; Bipolar Transistor. MARKET: Written by an experienced teacher, researcher, and expert in industry practices, this succinct and forward-looking text is appropriate for anyone interested in semiconductor devices for integrated circuits, and serves as a suitable reference text for practicing engineers.

Physics of Semiconductor Devices covers both basic classic topics such as energy band theory and the gradual-channel model of the MOSFET as well as advanced concepts and devices such as MOSFET short-channel effects, low-dimensional devices and single-electron transistors. Concepts are introduced to the reader in a simple way, often using comparisons to everyday-life experiences such as simple fluid mechanics. They are then explained in depth and mathematical developments are fully described. Physics of Semiconductor Devices contains a list of problems that can be used as homework assignments or can be solved in class to exemplify the theory. Many of these problems make use of Matlab and are aimed at illustrating theoretical concepts in a graphical manner.

Solid Surfaces, Interfaces and Thin Films examines both experimental and theoretical aspects of surface, interface and thin film physics. Coverage of magnetic thin films has been expanded, and now includes giant magnetoresistance and the spin-transfer torque mechanism.

This new edition of the well-received introduction to solid-state physics provides a comprehensive overview of the basic theoretical and experimental concepts of materials science. Experimental aspects and laboratory details are highlighted in separate panels that enrich text and emphasize recent developments. Notably, new material in the third edition includes sections on important new devices, aspects of non-periodic structures of matter, phase transitions, defects, superconductors and nanostructures. Students will benefit significantly from solving the exercises given at the end of each chapter. This book is intended for university students in physics, materials science and electrical engineering. It has been thoroughly updated to maintain its relevance and usefulness to students and professionals.

An accessible guide to how semiconductor electronics work and how they are manufactured, for professionals and interested readers with no electronics engineering background Semiconductor Basics is an accessible guide to how semiconductors work. It is written for readers without an electronic engineering background. Semiconductors are the basis for almost all modern electronic devices. The author—an expert on the topic—explores the fundamental concepts of what a semiconductor is, the different types in use, and how they are different from conductors and insulators. The book has a large number of helpful and illustrative drawings, photos, and figures. The author uses only simple arithmetic to help understand the device operation and applications. The book reviews the key devices that can be constructed using semiconductor materials such as diodes and transistors and all the large electronic systems based on these two component such as computers, memories, LCDs and related technology like Lasers LEDs and infrared detectors. The text also explores integrated circuits and explains how they are fabricated. The author concludes with some projections about what can be expected in the future. This important book: Offers an accessible guide to semiconductors using qualitative explanations and analogies, with minimal mathematics and equations Presents the material in a well-structured and logical format Explores topics from device physics fundamentals to transistor formation and fabrication and the operation of the circuits to build electronic devices and systems Includes information on practical applications of p-n junctions, transistors, and integrated circuits to link theory and practice Written for anyone interested in the technology, working in semiconductor labs or in the semiconductor industry, Semiconductor Basics offers clear explanations about how semiconductors work and its manufacturing process.

The present-day semiconductor technology would be inconceivable without extensive use of Schottky barrier junctions. In spite of an excellent book by Professor E.H. Rhoderick (1978) dealing with the basic principles of metal semiconductor contacts and a few recent review articles, the need for a monograph on "Metal-Semiconductor Schottky Barrier Junctions and Their Applications" has long been felt by students, researchers, and technologists. It was in this context that the idea of publishing such a monograph by Mr. Ellis H. Rosenberg, Senior Editor, Plenum Publishing Corporation, was considered very timely. Due to the numerous and varied applications of Schottky barrier junctions, the task of bringing it out, however, looked difficult in the beginning. After discussions at various levels, it was deemed appropriate to include only those typical applications which were extremely rich in R&D and still posed many challenges so that it could be brought out in the stipulated time frame. Keeping in view the larger interest, it was also considered necessary to have the different topics of Schottky barrier junctions written by experts.

Provides a multidisciplinary introduction to quantum mechanics, solid state physics, advanced devices, and fabrication Covers wide range of topics in the same style and in the same notation Most up to date developments in semiconductor physics and nano-engineering Mathematical derivations are carried through in detail with emphasis on clarity Timely application areas such as biophotonics , bioelectronics

Module 1 Syllabus (2019 onwards) Introduction to Semiconductor, energy bands in solids, concept of effective mass, density of states, Fermi levels. PN Junction. Diode equation and diode equivalent circuit, Breakdown in diodes, Zener diode, Tunnel diode, Metal semiconductor junction — Ohmic and Schottky contacts, Characteristics and equivalent circuits of JFET, MOSFET. Low dimensional semiconductor devices — quantum wells, quantum wires, quantum dots. High Electron Mobility Transistor (HEMT), Solar cells — I-V characteristics, fill factor and efficiency, LED, LCD and flexible display devices. Emerging materials for future Devices: Graphene, Carbon Nano tubes (CNT), ZnO, SiC etc.

The 1st edition of the book "Light-Emitting Diodes" was published in 2003. The 2nd edition was published in 2006. The current 3rd edition of the book, a substantial expansion of the second edition, has 37 Chapters and includes a thorough discussion of white

light-emitting diodes (LEDs), phosphor materials used in white LEDs, an expanded discussion of the various efficiencies encountered in the context of LEDs, and packaging materials and device technology. The background of light, color science, and human vision is provided as well. In the current edition, the fully colored illustrations are highly beneficial given the prominent role of light and color in the field of LEDs. The book is intended to be a comprehensive discussion of LEDs, particularly the physics, chemistry, and engineering associated with LEDs. It is published in electronic format in order to make the book affordable and easily accessible to a wide readership.

This book presents the latest developments in semiconducting materials and devices, providing up-to-date information on the science, processes, and applications in the field. A wide range of topics are covered, including optoelectronic devices, metal–semiconductor junctions, heterojunctions, MISFETs, LEDs, semiconductor lasers, photodiodes, switching diodes, tunnel diodes, Gunn diodes, solar cells, varactor diodes, IMPATT diodes, and advanced semiconductors. Detailed attention is paid to advanced and futuristic materials. In addition, clear explanations are provided of, for example, electron theories, high-field effects, the Hall effect, transit-time effects, drift and diffusion, breakdown mechanisms, equilibrium and transient conditions, switching, and biasing. The book is designed to meet the needs of undergraduate engineering students and will also be very useful for postgraduate students; it will assist in preparation for examinations at colleges and universities and for other examinations in engineering. Practice questions are therefore presented in both essay and multiple choice format, and many solved examples and unsolved problems are included.

The book contains a summary of our knowledge of power semiconductor structures. It presents first a short historic introduction (Chap. 1) as well as a brief selection of facts from solid state physics, in particular those related to power semiconductors (Chap. 2). The book deals with diode structures in Chap. 3. In addition to fundamental facts in pn-junction theory, the book covers mainly the important processes of power structures. It describes the emitter efficiency and function of microleaks (shunts). the p +p and n + n junctions, and in particular the recent theory of the pin, pvn and p1tn junctions, whose role appears to be decisive for the forward mode not only of diode structures but also of more complex ones. For power diode structures the reverse mode is the decisive factor in pn-junction breakdown theory. The presentation given here uses engineering features (the multiplication factor M and the experimentally detected laws for the volume and surface of crystals), which condenses the presentation and makes the mathematical apparatus simpler. The discussion of diode structures is complemented by data on the tunnel phenomenon as well as on the properties of the semiconductor metal contact which forms the outer layers of the diode or more complex structure. A separate chapter (Chap. 4) is devoted to the two-transistor equivalent of the four layer structure and the solution of the four-layer structure in various modes. This presentation is also directed mainly towards the power aspect and the new components.

Technology of Quantum Devices offers a multi-disciplinary overview of solid state physics, photonics and semiconductor growth and fabrication. Readers will find up-to-date coverage of compound semiconductors, crystal growth techniques, silicon and compound semiconductor device technology, in addition to intersubband and semiconductor lasers. Recent findings in quantum tunneling transport, quantum well intersubband photodetectors (QWIP) and quantum dot photodetectors (QWDIP) are described, along with a thorough set of sample problems.

Praise for the First Edition "The book goes beyond the usual textbook in that it provides more specific examples of real-world defect physics ... an easy reading, broad introductory overview of the field" ?Materials Today "... well written, with clear, lucid explanations ..." ?Chemistry World This revised edition provides the most complete, up-to-date coverage of the fundamental knowledge of semiconductors, including a new chapter that expands on the latest technology and applications of semiconductors. In addition to inclusion of additional chapter problems and worked examples, it provides more detail on solid-state lighting (LEDs and laser diodes). The authors have achieved a unified overview of dopants and defects, offering a solid foundation for experimental methods and the theory of defects in semiconductors. Matthew D. McCluskey is a professor in the Department of Physics and Astronomy and Materials Science Program at Washington State University (WSU), Pullman, Washington. He received a Physics Ph.D. from the University of California (UC), Berkeley. Eugene E. Haller is a professor emeritus at the University of California, Berkeley, and a member of the National Academy of Engineering. He received a Ph.D. in Solid State and Applied Physics from the University of Basel, Switzerland.

Heterojunctions and Metal-Semiconductor Junctions discusses semiconductor-semiconductor heterojunctions and metal-semiconductor heterojunctions, which are of significant practical importance today and also of considerable scientific interest, with worthwhile problems still to be explored and understood. Many classes of heterojunctions are believed to have new and valuable applications. Although some aspects of heterojunction behavior remain areas for continued scientific and technological study, the main outlines of the subject are clear. This book comprises nine chapters, and begins with an introduction to semiconductor heterojunctions. Succeeding chapters then discuss semiconductor p-n heterojunction models and diode behavior; heterojunction transistors; isotype (n-n, p-p) heterojunctions; optical properties of heterojunctions and heterojunction lasers; metal-semiconductor barriers; metal-semiconductor junction behavior; high yield photoemissive cathodes; and fabrication of heterojunctions. This book will be of interest to practitioners in the fields of applied physics.

This book explores the scientific basis of the photovoltaic effect, solar cell operation, various types of solar cells, and the main process used in their manufacture. It addresses a range of topics, including the production of solar silicon; silicon-based solar cells and modules; the choice of semiconductor materials and their production-relevant costs and performance; device structures, processing, and manufacturing options for the three major thin-film PV technologies; high-performance approaches for multi-junction, concentrator, and space applications; and new types of organic polymer and dye-sensitized solar cells. The book also presents a concept for overcoming the efficiency limit of today's solar cells. Accessible for beginners, while also providing detailed information on the physics and technology for experts, the book is a valuable resource for researchers, engineers, and graduate students in fields such as physics, materials, energy, electrical and electronic engineering and microelectronics.

Interface and surface science have been important in the development of semiconductor physics right from the beginning on. Modern device concepts are not only based on p-n junctions, which are interfaces between regions containing different types of dopants, but take advantage of the electronic properties of semiconductor insulator interfaces, heterojunctions between distinct semiconductors, and metal semiconductor contacts. The latter ones stood almost at the very beginning of semiconductor physics at the end of the last century. The rectifying properties of metal-semiconductor contacts were first described by Braun in 1874. A physically correct explanation of unilateral conduction, as this deviation from Ohm's law was called, could not be given at that time. A prerequisite was Wilson's quantum theory of electronic semi-conductors which he published in 1931. A few years later, in 1938,

Schottky finally explained the rectification at metal-semiconductor contacts by a space-

This book is intended as an introduction to the application of physical theory to the study of semiconductors and transistor devices. The book is based on lecture courses given by the authors to second and third year honours students in the Electronics Department of Southampton University, England. Some elementary knowledge of physics, circuit theory, and vector methods is assumed. The book deals almost exclusively with the theoretical aspects, but references are given to experimental work. The first two chapters discuss classical atomic theory and quantum mechanical applications to electron energy levels in atoms, in particular the hydrogen atom, and in one-dimensional crystalline solids leading to the distinctions between metals, insulators, and semiconductors. Chapter 3 deals with statistical mechanics in some detail, so that the reader can appreciate the historical background leading to the Fermi Dirac statistics for electrons in metals and semiconductors, and in chapter 4 these statistics are applied to determine the current carrier density in various types of semiconductor. Equations for drift and diffusion currents are obtained in chapter 5, and the results applied to uniform and graded impurity semiconductors in chapter 6. Current flow across p-n junctions is analysed in chapter 7, and the p-n-p transistor theory is developed in chapter 8. The discussion is limited to p-n-p transistors, but similar results apply for the n-p-n transistor.

Passive Circuit Components and Electron Ballistics  
Passive circuit components : Resistors : Fixed and variable - Tolerance - Colour coding ; Capacitors : Fixed and variable - Dissipation factor - Characteristics and applications of various types of capacitors; Inductors : Fixed and variable - Energy stored in a magnetic field - Q factor - Mutual coupled coils.  
Electron ballistics : Charged particles - Force, Field intensity, potential and energy - Two dimensional motion of electron - Force in magnetic field - Motion in a magnetic field - Parallel and perpendicular electric and magnetic fields - Electrostatic deflection and Magnetic deflection in a Cathode Ray Tube - Principles and applications of CRO.  
Semiconductor Diodes and Special Diodes  
Semiconductor diodes : Classification of semiconductors - Conductivity of semiconductors - Carrier concentration in intrinsic semiconductor - Mass - Action law - Properties of intrinsic semiconductors - Variation in semiconductor parameters with temperature - Drift and diffusion currents - Carrier life time - Continuity equation - Theory of PN junction diode - Energy band structure of open circuited PN junction - Quantitative theory of PN diode currents - Diode current equation - Diode resistance - Transition or space charge capacitance - Diffusion capacitance - Effect of temperature of PN junction diodes - Junction diode switching characteristics - Breakdown in PN junction diodes - PN diode applications - Clipper - Clampers.  
Special diodes : Zener diode - Backward diode - Varactor diode - Step recovery diode - Point-contact diode - Tunnel diode - PIN diodes - Laser diode ; Photoconductive sensors - Photovoltaic sensors - Photoemissive sensors - Light emitters - Liquid Crystal Display (LCD) - Nixie tube - Alphanumeric displays - Optocoupler.  
Bipolar Junction Transistors and Field Effect Transistors  
Bipolar Junction Transistors : Construction - Transistor biasing - Operation of NPN transistor - Operation of PNP transistor - Types of configuration - Breakdown in transistors - Ebers-Moll model - Transistor switching times.  
Field Effect Transistors : Construction of N-channel JFET - Operation of N-channel JFET - Characteristic Parameters of the JFET - Expression for saturation drain current - Slope of the transfer characteristics at IDSS - Comparison of JFET and BJT - Applications of JFET - Metal oxide semiconductor field effect transistor (MOSFET) - Enhancement MOSFET - Depletion MOSFET - Comparison of MOSFET with JFET - Handling precautions for MOSFET - Comparison of N-with P-channel MOSFETs - Comparison of N-with P-Channel.  
Integrated Circuit Fabrication  
Introduction to mass technology - Manufacturing process - Construction of a bipolar transistor - Monolithic diodes - Integrated resistors - Monolithic capacitors - Inductors - Thin and thick film technology - Definition of LSI, MSI, VLSI circuits - VLSI Design rules and layout technique - Introduction to fast VLSI circuits.  
Metal Semiconductor Contacts and Power Control Devices  
Metal semiconductor contacts : Energy band diagram of metal semiconductor junction - Schottky diode and ohmic contacts - GTO.  
Power control devices : PNP diode (Shockley diode) - SCR - Thyristor ratings - LASCR (Light Activated SCR) - TRIAC - DIAC - Characteristics and equivalent circuit of UJT - Intrinsic stand-off ratio.

Microelectronics is a challenging course to many undergraduate students and is often described as very messy. Before taking this course, all the students have learned circuit analysis, where basically all the problems can be solved by applying Kirchhoff's. Aimed primarily at the undergraduate students pursuing courses in semiconductor physics and semiconductor devices, this text emphasizes the physical understanding of the underlying principles of the subject. Since engineers use semiconductor devices as circuit elements, device models commonly used in the circuit simulators, e.g. SPICE, have been discussed in detail. Advanced topics such as lasers, heterojunction bipolar transistors, second order effects in BJTs, and MOSFETs are also covered. With such in-depth coverage and a practical approach, practising engineers and PG students can also use this book as a ready reference. Trapping effects in III-V devices pose a great challenge to any microwave device modeler. Understanding their physical origins is of prime importance to create physics-related reliable device models. The treatment of trapping phenomena is commonly beyond the classical higher-education level of communication engineers. This book provides any basic material needed to understand trapping effects occurring primarily in GaAs and GaN power HEMT devices. As the text material covers interdisciplinary topics such as crystal defects and localized charges, trap centers and trap dynamics, deep-level transient spectroscopy, and trap centers in passivation layers, the book will be of interest to graduate students of electrical engineering, communication engineering, and physics as well as materials, device, and circuit engineers in research and industry.

This 40-page handbook uses insight to explain how PN, zener, and Schottky diodes and bipolar-junction transistors (BJTs) block and conduct current. It starts with how solids and semiconductors behave and how adding impurity dopant atoms alters their behavior. With these concepts in hand, the material then details the operating modalities, characteristics, and response of PN and metal-semiconductor junction diodes and BJTs, including electrostatic behavior, band diagrams, current-voltage translations, capacitances, recovery time, breakdown mechanisms, structural variations, and more. Illustrative figures, equations, and examples complement discussions throughout.

This book is meant for the undergraduate students of Electronics, Electrical, Instrumentation and Computer Science Engineering for the courses on Basic Electronics/Electronic Devices and Circuits. It gives detailed description of the operation and characteristics of modern active and passive electronic devices. Logical organization of the chapters, simple language, wide variety of problems with their step by step solutions for every concept makes this book a perfect offering on the subject.

[Copyright: 99e4f09c9f1a73503968f0d6179a3c48](https://www.pdfdrive.com/99e4f09c9f1a73503968f0d6179a3c48)