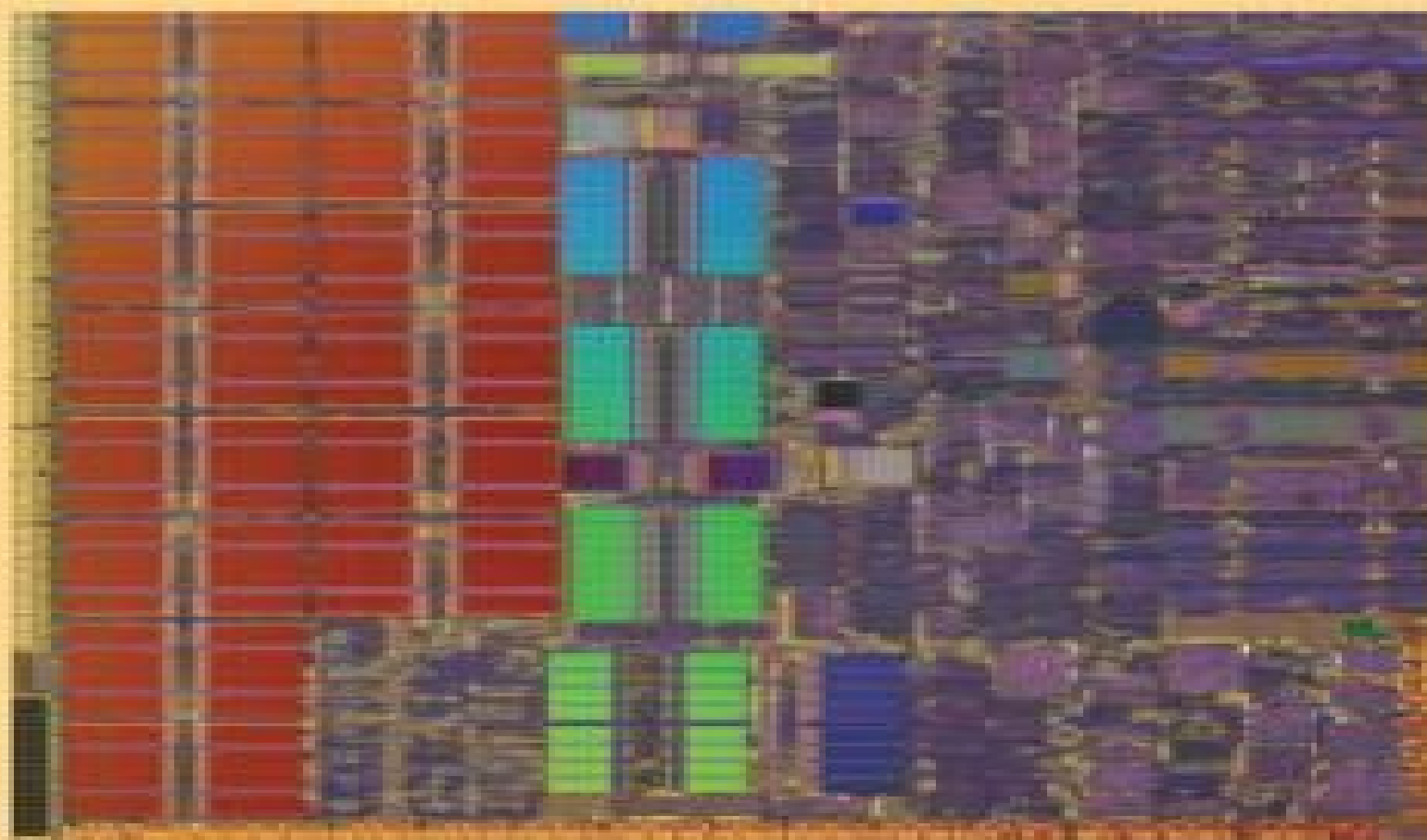


# SOLID STATE ELECTRONIC DEVICES

SIXTH  
EDITION



BEN G. STREETMAN • SANJAY BANERJEE

Prentice Hall Series in Solid State Physical Electronics, Nick Holonyak, Jr., Series Editor

# Solid State Electronic Devices 4th Ed

**Richard C. Dorf**



### **Solid State Electronic Devices 4th Ed:**

*Solid-State Electronic Devices* Christo Papadopoulos, 2013-11-19 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

**Solid State Electronic Devices** Ben G. Streetman, 1995 Aiming to provide students with a sound understanding of existing devices in order to develop the basic tools with which they can later learn about applications and the latest devices this study incorporates the basics of semiconductor materials and conduction processes in solids

**The Physics of Instabilities in Solid State Electron Devices** Harold L. Grubin, V.V. Mitin, E. Schöll, M.P. Shaw, 2013-11-11 The past three decades have been a period where useful current and voltage instabilities in solids have progressed from exciting research problems to a wide variety of commercially available devices Materials and electronics research has led to devices such as the tunnel Esaki diode transferred electron Gunn diode avalanche diodes real space transfer devices and the like These structures have proven to be very important in the generation amplification switching and processing of microwave signals up to frequencies exceeding 100 GHz In this treatise we focus on a detailed theoretical understanding of devices of the kind that can be made unstable against circuit oscillations large amplitude switching events and in some cases internal rearrangement of the electric field or current density distribution The book is aimed at the semiconductor device physicist engineer and graduate student A knowledge of solid state physics on an elementary or introductory level is assumed

Furthermore we have geared the book to device engineers and physicists desirous of obtaining an understanding substantially deeper than that associated with a small signal equivalent circuit approach We focus on both analytical and numerical treatment of specific device problems concerning ourselves with the mechanism that determines the constitutive relation governing the device the boundary conditions contact effects and the effect of the local circuit environment

**The Electronics Handbook** Jerry C. Whitaker, 2018-10-03 During the ten years since the appearance of the groundbreaking bestselling first edition of *The Electronics Handbook* the field has grown and changed tremendously With a focus on fundamental theory and practical applications the first edition guided novice and veteran engineers along the cutting edge in

the design production installation operation and maintenance of electronic devices and systems Completely updated and expanded to reflect recent advances this second edition continues the tradition The Electronics Handbook Second Edition provides a comprehensive reference to the key concepts models and equations necessary to analyze design and predict the behavior of complex electrical devices circuits instruments and systems With 23 sections that encompass the entire electronics field from classical devices and circuits to emerging technologies and applications The Electronics Handbook Second Edition not only covers the engineering aspects but also includes sections on reliability safety and engineering management The book features an individual table of contents at the beginning of each chapter which enables engineers from industry government and academia to navigate easily to the vital information they need This is truly the most comprehensive easy to use reference on electronics available *Electronic, Magnetic, and Optical Materials, Second Edition* Pradeep Fulay, Jung-Kun Lee, 2016-11-18 This book integrates materials science with other engineering subjects such as physics chemistry and electrical engineering The authors discuss devices and technologies used by the electronics magnetics and photonics industries and offer a perspective on the manufacturing technologies used in device fabrication The new addition includes chapters on optical properties and devices and addresses nanoscale phenomena and nanoscience a subject that has made significant progress in the past decade regarding the fabrication of various materials and devices with nanometer scale features **Introduction to Applied Solid State Physics** R. Dalven, 2012-12-06 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 VLSI Handbook** Wai-Kai Chen, 2019-07-17 Over the years the fundamentals of VLSI technology have evolved to include a wide range of topics and a broad range of practices To encompass such a vast amount of knowledge The VLSI Handbook focuses on the key concepts models and equations that enable the electrical engineer to analyze design and predict the behavior of very large scale integrated circuits It provides the most up to date information on IC technology you can find Using frequent examples the Handbook stresses the

fundamental theory behind professional applications Focusing not only on the traditional design methods it contains all relevant sources of information and tools to assist you in performing your job This includes software databases standards seminars conferences and more The VLSI Handbook answers all your needs in one comprehensive volume at a level that will enlighten and refresh the knowledge of experienced engineers and educate the novice This one source reference keeps you current on new techniques and procedures and serves as a review for standard practice It will be your first choice when looking for a solution

**Electronics, Power Electronics, Optoelectronics, Microwaves, Electromagnetics, and Radar** Richard C. Dorf, 2018-10-03 In two editions spanning more than a decade The Electrical Engineering Handbook stands as the definitive reference to the multidisciplinary field of electrical engineering Our knowledge continues to grow and so does the Handbook For the third edition it has expanded into a set of six books carefully focused on a specialized area or field of study Electronics Power Electronics Optoelectronics Microwaves Electromagnetics and Radar represents a concise yet definitive collection of key concepts models and equations in these areas thoughtfully gathered for convenient access Electronics Power Electronics Optoelectronics Microwaves Electromagnetics and Radar delves into the fields of electronics integrated circuits power electronics optoelectronics electromagnetics light waves and radar supplying all of the basic information required for a deep understanding of each area It also devotes a section to electrical effects and devices and explores the emerging fields of microlithography and power electronics Articles include defining terms references and sources of further information Encompassing the work of the world's foremost experts in their respective specialties Electronics Power Electronics Optoelectronics Microwaves Electromagnetics and Radar features the latest developments the broadest scope of coverage and new material in emerging areas

**The Physics of Semiconductors** Kevin F. Brennan, 1999-02-13 Modern fabrication techniques have made it possible to produce semiconductor devices whose dimensions are so small that quantum mechanical effects dominate their behavior This book describes the key elements of quantum mechanics statistical mechanics and solid state physics that are necessary in understanding these modern semiconductor devices The author begins with a review of elementary quantum mechanics and then describes more advanced topics such as multiple quantum wells He then discusses equilibrium and nonequilibrium statistical mechanics Following this introduction he provides a thorough treatment of solid state physics covering electron motion in periodic potentials electron phonon interaction and recombination processes The final four chapters deal exclusively with real devices such as semiconductor lasers photodiodes flat panel displays and MOSFETs The book contains many homework exercises and is suitable as a textbook for electrical engineering materials science or physics students taking courses in solid state device physics It will also be a valuable reference for practising engineers in optoelectronics and related areas

*Electrical and Electronic Measurement and Instrumentation, 4th Edition* Rajput R.K., 2015 This textbook has been written especially for the courses of B E B Tech for all Technical Universities of India It contains twenty two chapters in all Besides this an exhaustive set of Short Answer Question

and a section on GATE and UPSC Examinations Questions with Answers Solutions have been added at the end to make this treatise comprehensive and complete book on this subject *Solid State Electronics Devices (For MAKAUT), 3rd Edition* Bandyopadhyay, Jyoti Prasad, Devices has been written for the undergraduate students of Electronics and Electrical Engineering The book caters to introductory and advance courses on Solid State Devices It is student friendly and written for those who like to understand the subject from a physical perspective Even teachers and researchers will benefit immensely from this book This thoughtfully organized book provides intense knowledge of the subject with the help of lucid descriptions of theories and solved examples and covers the syllabus of most of the colleges under WBUT **Physics of**

**Semiconductors and Nanostructures** Jyoti Prasad Banerjee, Suranjana Banerjee, 2019-06-11 This book is a comprehensive text on the physics of semiconductors and nanostructures for a large spectrum of students at the final undergraduate level studying physics material science and electronics engineering It offers introductory and advanced courses on solid state and semiconductor physics on one hand and the physics of low dimensional semiconductor structures on the other in a single text book Key Features Presents basic concepts of quantum theory solid state physics semiconductors and quantum nanostructures such as quantum well quantum wire quantum dot and superlattice In depth description of semiconductor heterojunctions lattice strain and modulation doping technique Covers transport in nanostructures under an electric and magnetic field with the topics quantized conductance Coulomb blockade and integer and fractional quantum Hall effect Presents the optical processes in nanostructures under a magnetic field Includes illustrative problems with hints for solutions in each chapter Physics of Semiconductors and Nanostructures will be helpful to students initiating PhD work in the field of semiconductor nanostructures and devices It follows a unique tutorial approach meeting the requirements of students who find learning the concepts difficult and want to study from a physical perspective GaAs Devices and Circuits Michael S. Shur, 2013-11-21 GaAs devices and integrated circuits have emerged as leading contenders for ultra high speed applications This book is intended to be a reference for a rapidly growing GaAs community of researchers and graduate students It was written over several years and parts of it were used for courses on GaAs devices and integrated circuits and on heterojunction GaAs devices developed and taught at the University of Minnesota Many people helped me in writing this book I would like to express my deep gratitude to Professor Lester Eastman of Cornell University whose ideas and thoughts inspired me and helped to determine the direction of my research work for many years I also benefited from numerous discussions with his students and associates and from the very atmosphere of the pursuit of excellence which exists in his group I would like to thank my former and present co workers and colleagues Drs Levinstein and Gelmont of the A F Ioffe Institute of Physics and Technology Professor Melvin Shaw of Wayne State University Dr Kastalsky of Bell Communications Professor Gary Robinson of Colorado State University Professor Tony Valois and Dr Tim Drummond of Sandia Labs for their contributions to our joint research and for valuable discussions My special thanks to Professor Morko for his help his ideas

and the example set by his pioneering work Since 1978 I have been working with engineers from Honeywell Inc Drs

Semiconductor Device Physics and Simulation J.S. Yuan, Juin-Jei Liou, 2013-11-22 The advent of the microelectronics technology has made ever increasing numbers of small devices on a same chip The rapid emergence of ultra large scaled integrated ULSI technology has moved device dimension into the sub quarter micron regime and put more than 10 million transistors on a single chip While traditional closed form analytical models furnish useful intuition into how semiconductor devices behave they no longer provide consistently accurate results for all modes of operation of these very small devices The reason is that in such devices various physical mechanisms affect the device performance in a complex manner and the conventional assumptions i e one dimensional treatment low level injection quasi static approximation etc employed in developing analytical models become questionable Thus the use of numerical device simulation becomes important in device modeling Researchers and engineers will rely even more on device simulation for device design and analysis in the future This book provides comprehensive coverage of device simulation and analysis for various modern semiconductor devices It will serve as a reference for researchers engineers and students who require in depth up to date information and understanding of semiconductor device physics and characteristics The materials of the book are limited to conventional and mainstream semiconductor devices photonic devices such as light emitting and laser diodes are not included nor does the book cover device modeling device fabrication and circuit applications

**Physics of Semiconductors** Aditya Saxena, 2025-02-20 Physics of Semiconductors Core Principles is a comprehensive guide that demystifies how semiconductors function from the fundamental physics to the devices we use daily We cater to a general audience with a focus on readers in the United States We begin with the basics of quantum mechanics and solid state physics before diving into how these principles apply to semiconductors like silicon and gallium arsenide We explain crucial concepts such as band theory the flow of electricity through semiconductors and their use in devices like transistors and solar cells Additionally we discuss the manufacturing processes of semiconductors and highlight the advancements scientists are making in developing new and improved semiconductors Physics of Semiconductors Core Principles is an excellent resource for anyone eager to understand the intricacies of this essential technology

**Electronic, Magnetic, and Optical Materials** Pradeep Fulay, Jung-Kun Lee, 2016-04-19 More than ever before technological developments are blurring the boundaries shared by various areas of engineering such as electrical chemical mechanical and biomedical materials science physics and chemistry In response to this increased interdisciplinarity and interdependency of different engineering and science fields Electronic Magnetic and Optical Materials takes a necessarily critical all encompassing approach to introducing the fundamentals of electronic magnetic and optical properties of materials to students of science and engineering Weaving together science and engineering aspects this book maintains a careful balance between fundamentals i e underlying physics related concepts and technological aspects e g manufacturing of devices materials processing etc to cover applications for a variety of fields

including Nanoscience Electromagnetics Semiconductors Optoelectronics Fiber optics Microelectronic circuit design Photovoltaics Dielectric ceramics Ferroelectrics piezoelectrics and pyroelectrics Magnetic materials Building upon his twenty years of experience as a professor Fulay integrates engineering concepts with technological aspects of materials used in the electronics magnetics and photonics industries This introductory book concentrates on fundamental topics and discusses applications to numerous real world technological examples from computers to credit cards to optic fibers that will appeal to readers at any level of understanding Gain the knowledge to understand how electronic optical and magnetic materials and devices work and how novel devices can be made that can compete with or enhance silicon based electronics Where most books on the subject are geared toward specialists e g those working in semiconductors this long overdue text is a more wide ranging overview that offers insight into the steadily fading distinction between devices and materials It is well suited to the needs of senior level undergraduate and first year graduate students or anyone working in industry regardless of their background or level of experience

**Principles of Semiconductor Devices** Sima Dimitrijevic, 2012 The dimensions of modern semiconductor devices are reduced to the point where classical semiconductor theory including the concepts of continuous particle concentration and continuous current becomes questionable Further questions relate to two dimensional transport in the most important field effect devices and one dimensional transport in nanowires and carbon nanotubes Designed for upper level undergraduate and graduate courses Principles of Semiconductor Devices Second Edition presents the semiconductor physics and device principles in a way that upgrades classical semiconductor theory and enables proper interpretations of numerous quantum effects in modern devices The semiconductor theory is directly linked to practical applications including the links to the SPICE models and parameters that are commonly used during circuit design The text is divided into three parts Part I explains semiconductor physics Part II presents the principles of operation and modeling of the fundamental junctions and transistors and Part III provides supplementary topics including a dedicated chapter on the physics of nanoscale devices description of the SPICE models and equivalent circuits that are needed for circuit design introductions to the most important specific devices photonic devices JFETs and MESFETs negative resistance diodes and power devices and an overview of integrated circuit technologies The chapters and the sections in each chapter are organized so as to enable instructors to select more rigorous and design related topics as they see fit

**Proceedings of the Symposium on Low Temperature Electronic Device Operation** Daniel Foty, 1991

**VLSI Electronics** Norman G. Einspruch, 2014-12-01

VLSI Electronics Microstructure Science Volume 3 evaluates trends for the future of very large scale integration VLSI electronics and the scientific base that supports its development This book discusses the impact of VLSI on computer architectures VLSI design and design aid requirements and design fabrication and performance of CCD imagers The approaches potential and progress of ultra high speed GaAs VLSI computer modeling of MOSFETs and numerical physics of micron length and submicron length semiconductor devices are also elaborated This text likewise covers the optical linewidth



measurements on photomasks and wafers and effects of materials technology and fabrication tolerances on guided wave optical communication and signal processing This volume is recommended for scientists and engineers who wish to become familiar with VLSI electronics device designers concerned with the fundamental character of and limitations to device performance systems architects who will be charged with tying VLSI circuits together and engineers conducting work on the utilization of VLSI circuits in specific areas of application

**Semiconductor Physical Electronics** Sheng S. Li, 2012-12-06

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

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