

**Fundamentals
of
Semiconductor
Theory
and
Device
Physics**

BY

SHYH WANG

Fundamentals Of Semiconductor Theory And Device Physics

Donald Neamen



Fundamentals Of Semiconductor Theory And Device Physics:

Fundamentals of Semiconductor Physics and Devices Rolf Enderlein, Norman J. M. Horing, 1997 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 $k \cdot p$ 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

Fundamentals of Semiconductor Theory and Device Physics Shyh Wang, 1989 **Fundamentals of**

Semiconductor Theory and Device Physics Wang ` , 2009-07-07 *Physics of Semiconductor Devices* J.-P. Colinge, C.A. Colinge, 2005-10-03 *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 Reference Data for Engineers Mac E. Van Valkenburg, 2001-09-26 This standard handbook for engineers covers the fundamentals theory and applications of radio electronics computers and communications equipment It provides information on essential need to know topics without heavy emphasis on complicated mathematics It is a must have for every engineer who requires electrical electronics and communications data Featured in this updated version is coverage on intellectual property and patents probability and design antennas power electronics rectifiers power supplies and properties of materials Useful information on units constants and conversion factors active filter design antennas integrated circuits surface acoustic wave design and digital signal processing is also included This work also offers new knowledge in the fields of satellite technology space communication microwave science telecommunication global positioning systems frequency data and radar **Fundamentals of the Physics of Solids** Jenő Sólyom, 2008-11-18 The reader is holding the second volume of a three volume textbook on solid state physics This book is the outgrowth of the courses I have taught for many years at Eötvös University Budapest for undergraduate and graduate students under the titles Solid State Physics and Modern Solid State Physics The main motivation for the publication of my lecture notes as a book was that none of the truly numerous textbooks covered all those areas that I felt should be included in a multi semester course Especially if the course strives to present solid state physics in a unified structure and aims at discussing not only classic chapters of the subject matter but also in more or less detail problems that are of great interest for today's researcher as well Besides the book presents a much larger material than what can be covered in a two or three semester course In the first part of the first volume the analysis of crystal symmetries and structure goes into details that certainly cannot be included in a usual course on solid state physics The same applies among others to the discussion of the methods used in the determination of band structure the properties of Fermi liquids and non Fermi liquids and the theory of unconventional superconductors in the present and third volumes These parts can be assigned as supplementary reading for interested students or can be discussed in advanced courses **Semiconductor Devices** Jasprit Singh, 2000-08-03 This introductory text designed for the first course in semiconductor physics presents a well balanced coverage of semiconductor physics and device operation and shows how devices are optimized for applications The text begins with an exploration of the basic physical processes upon which all semiconductor devices diodes transistor light emitters and detectors are based Topics such as bandstructure effective masses holes doping carrier transport and lifetimes are discussed Next the author focuses on the operation of the important semiconductor devices along with issues relating to the optimization of device performance Issues such as how doping device dimensions and parasitic effects influence device operation are also included

The book is appropriate for the following courses Device Physics Semiconductor Devices Device Electronics Physics of Semiconductor Devices Integrated Circuit Devices Device Electronics Solid State Devices *Modern Semiconductor Physics and Device Applications* Vitalii K Dugaev, Vladimir I Litvinov, 2021-11-22 This textbook provides a theoretical background for contemporary trends in solid state theory and semiconductor device physics It discusses advanced methods of quantum mechanics and field theory and is therefore primarily intended for graduate students in theoretical and experimental physics who have already studied electrodynamics statistical physics and quantum mechanics It also relates solid state physics fundamentals to semiconductor device applications and includes auxiliary results from mathematics and quantum mechanics making the book useful also for graduate students in electrical engineering and material science Key Features Explores concepts common in textbooks on semiconductors in addition to topics not included in similar books currently available on the market such as the topology of Hilbert space in crystals Contains the latest research and developments in the field Written in an accessible yet rigorous manner *Introductory Semiconductor Device Physics* Greg Parker, 2004-09-30 Introduction to Semiconductor Device Physics is a popular and established text that offers a thorough introduction to the underlying physics of semiconductor devices It begins with a review of basic solid state physics then goes on to describe the properties of semiconductors including energy bands the concept of effective mass carrier concentr *Physics of Photonic Devices* Shun Lien Chuang, 2012-11-07 The most up to date book available on the physics of photonic devices This new edition of Physics of Photonic Devices incorporates significant advancements in the field of photonics that have occurred since publication of the first edition Physics of Optoelectronic Devices New topics covered include a brief history of the invention of semiconductor lasers the Lorentz dipole method and metal plasmas matrix optics surface plasma waveguides optical ring resonators integrated electroabsorption modulator lasers and solar cells It also introduces exciting new fields of research such as surface plasmonics and micro ring resonators the theory of optical gain and absorption in quantum dots and quantum wires and their applications in semiconductor lasers and novel microcavity and photonic crystal lasers quantum cascade lasers and GaN blue green lasers within the context of advanced semiconductor lasers Physics of Photonic Devices Second Edition presents novel information that is not yet available in book form elsewhere Many problem sets have been updated the answers to which are available in an all new Solutions Manual for instructors Comprehensive timely and practical Physics of Photonic Devices is an invaluable textbook for advanced undergraduate and graduate courses in photonics and an indispensable tool for researchers working in this rapidly growing field **Semiconductor Laser Theory** Prasanta Kumar Basu, Bratati Mukhopadhyay, Rikmantra Basu, 2015-06-17 Developed from the authors classroom tested material Semiconductor Laser Theory takes a semiclassical approach to teaching the principles structure and applications of semiconductor lasers Designed for graduate students in physics electrical engineering and materials science the text covers many recent developments including diode lasers u **Semiconductor Materials** B.G. Yacobi, 2006-04-18 The

technological progress is closely related to the developments of various materials and tools made of those materials. Even the different ages have been defined in relation to the materials used. Some of the major attributes of the present day age i.e. the electronic materials age are such common tools as computers and fiber optic telecommunication systems in which semiconductor materials provide vital components for various mic electronic and optoelectronic devices in applications such as computing memory storage and communication. The field of semiconductors encompasses a variety of disciplines. This book is not intended to provide a comprehensive description of a wide range of semiconductor properties or of a continually increasing number of the semiconductor device applications. Rather the main purpose of this book is to provide an introductory perspective on the basic principles of semiconductor materials and their applications that are described in a relatively concise format in a single volume. Thus this book should especially be suitable as an introductory text for a single course on semiconductor materials that may be taken by both undergraduate and graduate engineering students. This book should also be useful as a concise reference on semiconductor materials for researchers working in a wide variety of fields in physical and engineering sciences.

The Electrical Engineering Handbook - Six Volume Set Richard C. Dorf, 2018-12-14. In two editions spanning more than a decade, The Electrical Engineering Handbook stands as the definitive reference to the multidisciplinary field of electrical engineering. Our knowledge continues to grow and so does the Handbook. For the third edition, it has grown into a set of six books carefully focused on specialized areas or fields of study. Each one represents a concise yet definitive collection of key concepts, models, and equations in its respective domain, thoughtfully gathered for convenient access. Combined, they constitute the most comprehensive authoritative resource available. Circuits, Signals, and Speech and Image Processing presents all of the basic information related to electric circuits and components, analysis of circuits, the use of the Laplace transform, as well as signal, speech, and image processing using filters and algorithms. It also examines emerging areas such as text-to-speech synthesis, real-time processing, and embedded signal processing. Electronics, Power Electronics, Optoelectronics, Microwaves, Electromagnetics, and Radar delves into the fields of electronics, integrated circuits, power electronics, optoelectronics, electromagnetics, light waves, and radar, supplying all of the basic information required for a deep understanding of each area. It also devotes a section to electrical effects and devices and explores the emerging fields of microlithography and power electronics. Sensors, Nanoscience, Biomedical Engineering, and Instruments provides thorough coverage of sensors, materials, and nanoscience instruments and measurements and biomedical systems and devices, including all of the basic information required to thoroughly understand each area. It explores the emerging fields of sensors, nanotechnologies, and biological effects. Broadcasting and Optical Communication Technology explores communications information theory and devices, covering all of the basic information needed for a thorough understanding of these areas. It also examines the emerging areas of adaptive estimation and optical communication. Computers, Software Engineering, and Digital Devices examines digital and logical devices, displays, testing,

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Semiconductor Nanophotonics Prasanta Kumar Basu, Bratati Mukhopadhyay, Rikmantra Basu, 2022 One of the first comprehensive textbooks dealing with the modern field of Nanophotonics Though emphasis is given on semiconductors optical processes in metals and insulators are discussed as well Provides basic theoretical models in simple terms and discusses the application areas

Fundamentals of Semiconductor Physics Mijoe Joseph, 2015-05-11 Semiconductors have made an enormous impact on 20th century science and technology This is because components made from semiconductors have very favorable properties such as low energy consumption compactness and high reliability and so they now dominate electronics and radio engineering Semiconductors are indispensable for space exploration and where the requirements of small size low weight and low energy consumption are especially stringent The book uses quantum mechanical concepts and band theory to present the theory of semiconductors in a comprehensible for It also describes how basic semiconductor devices e g diodes transistors and lasers operate The book was written for senior high school students interested in physics

Fundamentals of Solid State Engineering Manijeh Razeghi, 2009-03-03 Fundamentals of Solid State Engineering 3rd Edition provides a multi disciplinary introduction to solid state engineering combining concepts from physics chemistry electrical engineering materials science and mechanical engineering Revised throughout this third edition includes new topics such as electron electron and electron phonon interactions in addition to the Kane effective mass method A chapter devoted to quantum mechanics has been expanded to cover topics such as the harmonic oscillator the hydrogen atom the quantum mechanical description of angular momentum and the origin of spin This textbook also features an improved transport theory description which now goes beyond Drude theory discussing the Boltzmann approach Introducing students to the rigorous quantum mechanical way of thinking about and formulating transport processes this textbook presents the basic physics concepts and thorough treatment of semiconductor characterization technology designed for solid state

engineers Theory of Optical Processes in Semiconductors Prasanta Kumar Basu, P. K. Basu, 2003 Semiconductor optoelectronic devices are at the heart of all information generation and processing systems and are likely to be essential components of future optical computers. With more emphasis on optoelectronics and photonics in graduate programmes in physics and engineering, there is a need for a text providing a basic understanding of the important physical phenomena involved. Such a training is necessary for the design, optimization and search for new materials, devices and application areas. This book provides a simple quantum mechanical theory of important optical processes, i.e. band to band, intersubband and excitonic absorption and recombination in bulk, quantum wells, wires, dots, superlattices and strained layers, including electro-optic effects. The classical theory of absorption, quantization of radiation and band picture based on k - p perturbation has been included to provide the necessary background. Prerequisites for the book are a knowledge of quantum mechanics and solid state theory. Problems have been set at the end of each chapter, some of which may guide the reader to study processes not covered in the book. The application areas of the phenomena are also indicated. **Handbook of Nitride**

Semiconductors and Devices, Electronic and Optical Processes in Nitrides Hadis Morkoç, 2009-07-30 The three volumes of this handbook treat the fundamentals, technology and nanotechnology of nitride semiconductors with an extraordinary clarity and depth. They present all the necessary basics of semiconductor and device physics and engineering together with an extensive reference section. Volume 2 addresses the electrical and optical properties of nitride materials. It includes semiconductor metal contacts, impurity and carrier concentrations and carrier transport in semiconductors. *III-V Compound Semiconductors and Devices* Keh Yung Cheng, 2020-11-08 This textbook gives a complete and fundamental introduction to the properties of III-V compound semiconductor devices, highlighting the theoretical and practical aspects of their device physics. Beginning with an introduction to the basics of semiconductor physics, it presents an overview of the physics and preparation of compound semiconductor materials as well as a detailed look at the electrical and optical properties of compound semiconductor heterostructures. The book concludes with chapters dedicated to a number of heterostructure electronic and photonic devices, including the high electron mobility transistor, the heterojunction bipolar transistor, lasers, unipolar photonic devices and integrated optoelectronic devices. Featuring chapter end problems, suggested references for further reading as well as clear didactic schematics accompanied by six information-rich appendices, this textbook is ideal for graduate students in the areas of semiconductor physics or electrical engineering. In addition, up-to-date results from published research make this textbook especially well suited as a self-study and reference guide for engineers and researchers in related industries. **Semiconductor Physics And Devices** Donald Neamen, 2003 Neamen's *Semiconductor Physics and Devices* Third Edition deals with the electrical properties and characteristics of semiconductor materials and devices. The goal of this book is to bring together quantum mechanics, the quantum theory of solids, semiconductor material physics and semiconductor device physics in a clear and understandable way.

The Top Books of the Year Fundamentals Of Semiconductor Theory And Device Physics The year 2023 has witnessed a noteworthy surge in literary brilliance, with numerous engrossing novels enthralling the hearts of readers worldwide. Lets delve into the realm of popular books, exploring the captivating narratives that have captivated audiences this year.

Fundamentals Of Semiconductor Theory And Device Physics : Colleen Hoover's "It Ends with Us" This touching tale of love, loss, and resilience has gripped readers with its raw and emotional exploration of domestic abuse. Hoover expertly weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can succeed. Uncover the Best : Taylor Jenkins Reid's "The Seven Husbands of Evelyn Hugo" This intriguing historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reid's captivating storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery. Discover the Magic : Delia Owens' "Where the Crawdads Sing" This captivating coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens weaves a tale of resilience, survival, and the transformative power of nature, entrancing readers with its evocative prose and mesmerizing setting. These top-selling novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of engaging stories waiting to be discovered. The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a masterful and suspenseful novel that will keep you speculating until the very end. The novel is a cautionary tale about the dangers of obsession and the power of evil.

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