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Semiconductor Physics.
Theoretical Approaches and
Device Physics Fundamentals
of Semiconductor Physics and
Devices Introduction to
Semiconductor Physics and
Devices The Physics of
Semiconductors
Semiconductor Physics Physics
of Semiconductor Devices
Semiconductor Device Physics
and Design Semiconductor
Physics and Devices Physics of
Semiconductor Devices
Semiconductor Physical
Electronics Fundamentals of

Semiconductor Physics and
Devices Fundamentals of
Semiconductor Modern
Semiconductor Physics and
Device Applications
Semiconductor Physics and
Devices-4e Basic
Semiconductor Physics
Fundamentals of
Semiconductors Survey of
Semiconductor Physics
Fundamentals of
Semiconductors Physics and
Technology of Semiconductor
Devices Modern
Semiconductor Physics and
Device Applications
Semiconductor Devices
Semiconductor Physics
Semiconductor Devices
Introduction to Semiconductor
Physics Physics of
Semiconductor Devices Physics

of Semiconductor Devices
SEMICONDUCTOR DEVICES:
PHYSICS AND TECHNOLOGY,
2ND ED Semiconductor
Devices Best of Soviet
Semiconductor Physics and
Technology, 1989-1990
Essentials of Semiconductor
Physics High Pressure in
Semiconductor Physics II
Semiconductor Physics And
Devices The Properties,
Physics, and Design of
Semiconductor Devices Basic
Semiconductor Physics Modern
Semiconductor Quantum
Physics

Modern Semiconductor
Quantum Physics has the
following constituents: (1)
energy band theory:
pseudopotential method
(empirical and ab initio);
density functional theory;
quasi-particles; LCAO method;
k.p method; spin-orbit splitting;
effective mass and Luttinger
parameters; strain effects and
deformation potentials;
temperature effects. (2) Optical
properties: absorption and
exciton effect; modulation
spectroscopy; photo

luminescence and photo
luminescence excitation;
Raman scattering and
polaritons; photoionization. (3)
Defects and Impurities:
effective mass theory and
shallow impurity states; deep
state cluster method, super cell
method, Green's function
method; carrier recombination
kinetics; trapping transient
measurements; electron spin
resonance; electron lattice
interaction and lattice
relaxation effects; multi-
phonon nonradiative
recombination; negative U
center, DX center and EL2
Defects. (4) Semiconductor
surfaces: two dimensional
periodicity and surface
reconstruction; surface
electronic states; photo-
electron spectroscopy; LEED,
STM and other experimental
methods. (5) Low-dimensional
structures: Heterojunctions,
quantum wells; superlattices,
quantum-confined Stark effect
and Wannier-Stark ladder
effects; resonant tunneling,
quantum Hall effect, quantum
wires and quantum dots. This
book can be used as an

advanced textbook on semiconductor physics for graduate students in physics and electrical engineering departments. It is also useful as a research reference for solid state scientists and semiconductor device engineers. This textbook covers the basic physics of semiconductors and their applications to practical devices, with emphasis on the basic physical principles upon which these devices operate. Extensive use of figures is made to enhance the clarity of the presentation and to establish contact with the experimental side of the topic. Graduate students and lecturers in semiconductor physics, condensed matter physics, electromagnetic theory, and quantum mechanics will find this a useful textbook and reference work. This book will be useful to solid-state scientists, device engineers, and students involved in semiconductor design and technology. It provides a lucid account of band structure, density of

states, charge transport, energy transport, and optical processes, along with a detailed description of many devices. It includes sections on superlattices and quantum well structures, the effects of deep-level impurities on transport, and the quantum Hall effect. This 8th edition has been revised and updated, including several new sections. Since its inception in 1966, the series of numbered volumes known as Semiconductors and Semimetals has distinguished itself through the careful selection of well-known authors, editors, and contributors. The "Willardson and Beer" Series, as it is widely known, has succeeded in publishing numerous landmark volumes and chapters. Not only did many of these volumes make an impact at the time of their publication, but they continue to be well-cited years after their original release. Recently, Professor Eicke R. Weber of the University of California at Berkeley joined as a co-editor of the series. Professor Weber, a well-known

expert in the field of semiconductor materials, will further contribute to continuing the series' tradition of publishing timely, highly relevant, and long-impacting volumes. Some of the recent volumes, such as Hydrogen in Semiconductors, Imperfections in III/V Materials, Epitaxial Microstructures, High-Speed Heterostructure Devices, Oxygen in Silicon, and others promise indeed that this tradition will be maintained and even expanded. Reflecting the truly interdisciplinary nature of the field that the series covers, the volumes in Semiconductors and Semimetals have been and will continue to be of great interest to physicists, chemists, materials scientists, and device engineers in modern industry. Volumes 54 and 55 present contributions by leading researchers in the field of high pressure semiconductors. Edited by T. Suski and W. Paul, these volumes continue the tradition of well-known but outdated publications such as Brigman's The Physics of High

Pressure (1931 and 1949) and High Pressure Physics and Chemistry edited by Bradley. Volumes 54 and 55 reflect the industrially important recent developments in research and applications of semiconductor properties and behavior under desirable risk-free conditions at high pressures. These developments include the advent of the diamond anvil cell technique and the availability of commercial piston cylinder apparatus operating at high hydrostatic pressures. These much-needed books will be useful to both researchers and practitioners in applied physics, materials science, and engineering. The updated edition of this book provides comprehensive coverage of fundamental semiconductor physics. This subject is essential to an understanding of the physical and operational principles of a wide variety of semiconductor electronic and optoelectronic devices. It has been revised to reflect advances in semiconductor technologies over the past decade, including

many new semiconductor devices that have emerged and entered into the marketplace. Each year a large number of first rate articles on the physics and technology of semiconductor devices, written by Soviet experts in the field, are published. However, due to the lack of exchange and personal contact, most of these, unfortunately, are neglected by many scientists from the United States, Japan as well as Western Europe. Consequently, many important developments in semiconductor physics are missed by the Western world. This book is a serious attempt to bridge the gap between the Soviet and Western scientific communities. Most of all, it is an effort towards facilitating the communication and sharing of knowledge amongst people from different parts of the world. Ultimately, the aim is to contribute towards the building of a better world for all ? one where the knowledge of advanced technology and scientific discoveries is used to improve the quality of life and

not the pursuit of selfish mutually destructive behavior. For those in the field who wish to partake in this exchange of knowledge and as a gesture of support for their Soviet counterparts, the reading of this book provides the first step. 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. This handbook gives a complete and detailed survey of the field of semiconductor physics. It addresses every fundamental principle, the most important research topics and results, as well as conventional and emerging new areas of application. Additionally it provides all essential reference material on crystalline bulk, low-dimensional, and amorphous semiconductors, including valuable data on their optical, transport, and dynamic properties. This updated and extended second edition includes essential coverage of rapidly advancing areas in semiconductor physics, such as topological insulators, quantum optics, magnetic nanostructures and spintronic systems. Richly illustrated and authored by a

duo of internationally acclaimed experts in solar energy and semiconductor physics, this handbook delivers in-depth treatment of the field, reflecting a combined experience spanning several decades as both researchers and educators. Offering a unique perspective on many issues, Semiconductor Physics is an invaluable reference for physicists, materials scientists and engineers throughout academia and industry. Solid state physics is a fascinating sub-genre of condensed matter physics - though some graduate students consider it a very boring and tedious subject area in Physics and others even call it a "squalid state". Topics covered in this book are built on standard solid state physics references available in most online libraries or in other books on solid state physics. The complexity of high speed semiconductor physics and related devices arose from condensed solid state matter. The content covered in this book gives a deep coverage on some topics or sections that

may be covered only superficially in other literature. Therefore, these topics are likely to differ a great deal from what is deemed important elsewhere in other books or available literature. There are many extremely good books on solid-state physics and condensed matter physics but very few of these books are restricted to high speed semiconductor physics though. Chapter one covers the general semiconductor qualities that make high speed semiconductor devices effective and includes the theory of crystals, diffusion and its mechanisms, while chapter two covers solid state materials, material processing for high speed semiconductor devices and an introduction to quantum theory for materials in relation to density of states of the radiation for a black body and its radiation properties. Chapter three discusses high speed semiconductor energy band theory, energy bands in general solid semiconductor materials, the Debye model, the Einstein model the Debye

model and semiconductor transport carriers in 3D semiconductors while chapter four discusses effect of external force on current flow based on the concept of holes valence band, and lattice scattering in high speed devices. Chapter five briefly describes solid state thermoelectric fundamentals, thermoelectric material and thermoelectric theory of solids in lattice and phonons while chapter six scattering in high field effect in semiconductors in inter-valley electron scattering and the associated Fermi Dirac statistics and Maxwell-Boltzmann approximation on their carrier concentration variation with energy in extrinsic doping chapter seven covers p-n junction diodes, varactor diode, pin diode Schottky diode and their transient response of diode in multi-valley semiconductors. Chapter eight discusses high speed metal semiconductor field effect transistors. Excellent bridge between general solid-state physics textbook and research articles packed with providing

detailed explanations of the electronic, vibrational, transport, and optical properties of semiconductors "The most striking feature of the book is its modern outlook ... provides a wonderful foundation. The most wonderful feature is its efficient style of exposition ... an excellent book." Physics Today "Presents the theoretical derivations carefully and in detail and gives thorough discussions of the experimental results it presents. This makes it an excellent textbook both for learners and for more experienced researchers wishing to check facts. I have enjoyed reading it and strongly recommend it as a text for anyone working with semiconductors ... I know of no better text ... I am sure most semiconductor physicists will find this book useful and I recommend it to them." Contemporary Physics Offers much new material: an extensive appendix about the important and by now well-established, deep center known as the DX center, additional

problems and the solutions to over fifty of the problems at the end of the various chapters. The new edition of the most detailed and comprehensive single-volume reference on major semiconductor devices The Fourth Edition of Physics of Semiconductor Devices remains the standard reference work on the fundamental physics and operational characteristics of all major bipolar, unipolar, special microwave, and optoelectronic devices. This fully updated and expanded edition includes approximately 1,000 references to original research papers and review articles, more than 650 high-quality technical illustrations, and over two dozen tables of material parameters. Divided into five parts, the text first provides a summary of semiconductor properties, covering energy band, carrier concentration, and transport properties. The second part surveys the basic building blocks of semiconductor devices, including p-n junctions, metal-semiconductor contacts, and

metal-insulator-semiconductor (MIS) capacitors. Part III examines bipolar transistors, MOSFETs (MOS field-effect transistors), and other field-effect transistors such as JFETs (junction field-effect-transistors) and MESFETs (metal-semiconductor field-effect transistors). Part IV focuses on negative-resistance and power devices. The book concludes with coverage of photonic devices and sensors, including light-emitting diodes (LEDs), solar cells, and various photodetectors and semiconductor sensors. This classic volume, the standard textbook and reference in the field of semiconductor devices: Provides the practical foundation necessary for understanding the devices currently in use and evaluating the performance and limitations of future devices Offers completely updated and revised information that reflects advances in device concepts, performance, and application Features discussions of topics of contemporary interest, such as

applications of photonic devices that convert optical energy to electric energy Includes numerous problem sets, real-world examples, tables, figures, and illustrations; several useful appendices; and a detailed solutions manual for Instructor's only Explores new work on leading-edge technologies such as MODFETs, resonant-tunneling diodes, quantum-cascade lasers, single-electron transistors, real-space-transfer devices, and MOS-controlled thyristors Physics of Semiconductor Devices, Fourth Edition is an indispensable resource for design engineers, research scientists, industrial and electronics engineering managers, and graduate students in the field. This classroom-tested textbook provides a self-contained one-semester course in semiconductor physics and devices that is ideal preparation for students to enter burgeoning quantum industries. Unlike other textbooks on semiconductor

device physics, it provides a brief but comprehensive introduction to quantum physics and statistical physics, with derivations and explanations of the key facts that are suitable for second-year undergraduates, rather than simply postulating the main results. The book is structured into three parts, each of which can be covered in around ten lectures. The first part covers fundamental background material such as quantum and statistical physics, and elements of crystallography and band theory of solids. Since this provides a vital foundation for the rest of the text, concepts are explained and derived in more detail than in comparable texts. For example, the concepts of measurement and collapse of the wave function, which are typically omitted, are presented in this text in language accessible to second-year students. The second part covers semiconductors in and out of equilibrium, and gives details which are not commonly presented, such as a derivation

of the density of states using dimensional analysis, and calculation of the concentration of ionized impurities from the grand canonical distribution. Special attention is paid to the solution of Poisson's equation, a topic that is feared by many undergraduates but is brought back down to earth by techniques and analogies from first-year physics. Finally, in the third part, the material in parts 2 and 3 is applied to describe simple semiconductor devices, including the MOSFET, the Schottky and PN-junction diodes, and optoelectronic devices. With a wide range of exercises, this textbook is readily adoptable for an undergraduate course on semiconductor physics devices, and with its emphasis on consolidating and applying knowledge of fundamental physics, it will leave students in engineering and the physical sciences well prepared for a future where quantum industries proliferate. Excellent bridge between general solid-state physics textbook and research articles packed with

providing detailed explanations of the electronic, vibrational, transport, and optical properties of semiconductors "The most striking feature of the book is its modern outlook ... provides a wonderful foundation. The most wonderful feature is its efficient style of exposition ... an excellent book." Physics Today "Presents the theoretical derivations carefully and in detail and gives thorough discussions of the experimental results it presents. This makes it an excellent textbook both for learners and for more experienced researchers wishing to check facts. I have enjoyed reading it and strongly recommend it as a text for anyone working with semiconductors ... I know of no better text ... I am sure most semiconductor physicists will find this book useful and I recommend it to them." Contemporary Physics Offers much new material: an extensive appendix about the important and by now well-established, deep center known as the DX center, additional

problems and the solutions to over fifty of the problems at the end of the various chapters. 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. A detailed description of the basic physics of semiconductors. All the important equations describing the properties of these materials are derived without the help of other textbooks. The reader is assumed to have only a basic command of mathematics and some elementary semiconductor physics. The text covers a wide range of important semiconductor phenomena, from the simple to the advanced. This textbook describes the basic physics of semiconductors, including the

hierarchy of transport models, and connects the theory with the functioning of actual semiconductor devices. Details are worked out carefully and derived from the basic physical concepts, while keeping the internal coherence of the analysis and explaining the different levels of approximation. Coverage includes the main steps used in the fabrication process of integrated circuits: diffusion, thermal oxidation, epitaxy, and ion implantation. Examples are based on silicon due to its industrial importance. Several chapters are included that provide the reader with the quantum-mechanical concepts necessary for understanding the transport properties of crystals. The behavior of crystals incorporating a position-dependent impurity distribution is described, and the different hierarchical transport models for semiconductor devices are derived (from the Boltzmann transport equation to the hydrodynamic and drift-diffusion models). The

transport models are then applied to a detailed description of the main semiconductor-device architectures (bipolar, MOS, CMOS), including a number of solid-state sensors. The final chapters are devoted to the measuring methods for semiconductor-device parameters, and to a brief illustration of the scaling rules and numerical methods applied to the design of semiconductor devices. The new edition of this textbook presents a detailed description of basic semiconductor physics. The text covers a wide range of important phenomena in semiconductors, from the simple to the advanced. Four different methods of energy band calculations in the full band region are explained: local empirical pseudopotential, non-local pseudopotential, KP perturbation and tight-binding methods. The effective mass approximation and electron motion in a periodic potential, Boltzmann transport equation and deformation potentials

used for analysis of transport properties are discussed. Further, the book examines experiments and theoretical analyses of cyclotron resonance in detail. Optical and transport properties, magneto-transport, two-dimensional electron gas transport (HEMT and MOSFET) and quantum transport are reviewed, while optical transition, electron-phonon interaction and electron mobility are also addressed. Energy and electronic structure of a quantum dot (artificial atom) are explained with the help of Slater determinants. The physics of semiconductor lasers is also described, including Einstein coefficients, stimulated emission, spontaneous emission, laser gain, double heterostructures, blue lasers, optical confinement, laser modes, and strained quantum well lasers, offering insights into the physics of various kinds of semiconductor lasers. In this third edition, energy band calculations in full band zone with spin-orbit interaction are

presented, showing all the matrix elements and equipping the reader to prepare computer programs of energy band calculations. The Luttinger Hamiltonian is discussed and used to analyze the valence band structure. Numerical calculations of scattering rate, relaxation time, and mobility are presented for typical semiconductors, which are very helpful for understanding of transport. Energy band structures and effective masses of nitrides such as GaN, InN, AlN and their ternary alloys are discussed because they are very important materials for the blue light emission, and high power devices with high frequency. Learning and teaching with this textbook is supported by problems and solutions in the end of the chapters. The book is written for bachelor and upper undergraduate students of physics and engineering. Brings the reader to an overview of the subject as a whole and to the point where they can specialize and enter supervised laboratory research

Provides a balance between aspects of solid state and semiconductor physics and the concepts of various semiconductor devices and their applications in electric and photonic devices. Proffers explicit formulas (with the help of Mathematica) for as many as possible results, going beyond current textbook equations, thus makes easier to understand for undergrads. From physical process to practical applications - Singh makes the complexities of modern semiconductor devices clear! The semiconductor devices that are driving today's information, technologies may seem remarkably complex, but they don't have to be impossible to understand. Filled with figures, flowcharts, and solved examples, Jasprit Singh's Semiconductor Devices provides an accessible, well-balanced introduction to semiconductor physics and its application to modern devices. Beginning with the physical process behind semiconductor devices, Singh clearly explains difficult topics, including

bandstructure, effective masses, holes, doping, carrier transport, and lifetimes. Following these physical fundamentals, you'll explore the operation of important semiconductor devices, such as diodes, transistors, light emitters, and detectors, along with issues relating to the optimization of device performance. Features Over 150 solved examples, integrated throughout the text, clarify difficult concepts. End-of-chapter summary tables and hundreds of figures reinforce the intricacies of modern semiconductor devices. Discussion of device optimization issues explains why you have to trade one performance against another in devices. Shows the relationship of physical parameters to SPICE parameters and its impact on circuit issues. Technology Roadmaps outline what's currently happening in the field and present a look at where device technology is headed in the future. A Bit of History sections, included in each chapter, explore the

history of the concepts developed and provide a snapshot of the personalities involved and the challenges of the time. 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. Market_Desc: · Electrical Engineers· Scientists Special Features: · Provides

strong coverage of all key semiconductor devices. Includes basic physics and material properties of key semiconductors· Covers all important processing technologies About The Book: This book is an introduction to the physical principles of modern semiconductor devices and their advanced fabrication technology. It begins with a brief historical review of major devices and key technologies and is then divided into three sections: semiconductor material properties, physics of semiconductor devices and processing technology to fabricate these semiconductor devices. This book covers the physics of semiconductors on an introductory level, assuming that the reader already has some knowledge of condensed matter physics. Crystal structure, band structure, carrier transport, phonons, scattering processes and optical properties are presented for typical semiconductors such as silicon, but III-V and II-VI compounds are also included. In view of

the increasing importance of wide-gap semiconductors, the electronic and optical properties of these materials are dealt with too. Provides a basis for understanding the characteristics, operation, and limitations of semiconductor devices. This title deals with the electrical properties and characteristics of semiconductor materials and devices. It intends to bring together quantum mechanics, the quantum theory of solids, and semiconductor material physics. 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 Provides a modern introduction to semiconductor physics, presenting the basic information necessary to understand semiconductors, along with some of the latest theories and developments. Based on the author's undergraduate course, this book bridges the gap between basic subjects such as quantum mechanics and Maxwell's equations and the fundamental processes determining the behaviour of semiconductors. Following a quantum mechanics approach

this text is predominantly aimed at scientists rather than engineers, and forms the basis for the understanding of modern mesoscopic physics in semiconductors and quantum devices like resonant tunneling diodes. Rather than attempting to comprehensively cover all aspects of semiconductor physics, this text aims to cover the most important and interesting aspects of this subject to scientists. Starting with the development of semiconductor physics from basic quantum mechanics, the text moves on to cover band structure and effective mass theory, before covering electron-phonon coupling and charge transport. It concludes with a chapter on optical transitions. Students will need some knowledge of quantum mechanics and solid state although this is covered to some extent in the book.

FEATURES * Concise introduction to the basics of semiconductor physics * Bridges the gap between fundamental subjects such as

quantum mechanics and Maxwell's equations and the processes determining the behaviour of semiconductors * Describes semiconductor theory from a full quantum mechanical approach. An accessible introduction, avoiding reliance on group theory

CONTENTS:
Preface; Notation Conventions; Introduction; Electrons, nuclei and Hamiltonians; Band Structure; The k - p Approximation; Effective Mass Theory; The Crystal Lattice; Electron-phonon Coupling; Charge Transport, Optical Transitions; Band Electrons in an Optical Field; Appendix A: The Hydrogen Atom; Appendix B: The Harmonic Oscillator; Appendix C: Perturbation Theory; Appendix D: Tensors in Cubic Crystals; Appendix E: The Classical Limit; Appendix F: Some Fourier Transforms; Appendix G: Exercises; Bibliography.

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. *Semiconductor Physics and Devices: Basic Principles, Second Edition*, provides the fundamentals necessary to understand semiconductor device characteristics, operations, and limitations. Neamen's book reveals the fundamentals by establishing for the student a sound understanding of quantum mechanics and an introduction to the quantum theory of solids. This background permits the student to develop a deeper understanding of how essential physics,

semiconductor material physics, and semiconductor device physics interrelate. Espousing neither the intuitive approach of many textbooks, nor the highly technical characteristics of handbooks, *Semiconductor Physics and Devices: Basic Principles* provides students with a resource that is engaging and understandable and instructors with a textbook that offers teachability without sacrificing technical exactitude. 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. "This book is an introduction to the physical principles of modern semiconductor devices and their advanced fabrication technology. It begins with a brief historical review of major devices and key technologies and is then divided into three

sections: semiconductor material properties, physics of semiconductor devices and processing technology to fabricate these semiconductor devices."--Publisher's description. Bridging the gap between a general solid-state physics textbook and research articles, the renowned authors provide detailed explanations of the electronic, vibrational, transport, and optical properties of semiconductors. Their approach is a physical and intuitive one, rather than formal and pedantic. This textbook has been written with both students and researchers in mind, and the authors therefore present theories to explain experimental results. Throughout, the emphasis is on understanding the physical properties of Si, and similar tetrahedrally coordinated semiconductors, with explanations based on physical insights. Each chapter is enriched by an extensive collection of tables of material parameters, figures and problems -- many of the latter 'lead students by the hand' to

arrive at the results. Provides a comprehensive treatment of semiconductor device physics and technology, with emphasis on modern planar silicon devices. Physical principles are explained by the use of simple physical models and illustrated by experimental measurements. 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.

Contents: Characterization of Semiconductors
Electronic Structure of Ideal Crystals
Electronic Structure of Semiconductor Crystals with Perturbations
Electron System in Thermodynamic Equilibrium
Non-Equilibrium Processes in Semiconductors
Semiconductor Junctions in Thermodynamic Equilibrium
Semiconductor Junctions Under Non-Equilibrium Conditions
Readership: Undergraduates, graduates and researchers in the fields of physics and engineering.

keywords: Semiconductors; Transistor; Devices; Heterojunctions; Microstructures; Band-Structure; Luttinger-Kohn-Model; Kane-Model; Deep-Levels; Transport; Semiconductor Physics; Fundamental Physical Phenomena; General

Background; Characterization of Semiconductor; Electronic Structure of

Semiconductors; Semiconductor Junctions the Thermodynamic Equilibrium; Semiconductor Junctions Under Non-Equilibrium Conductions; "...

The reader who has only a first acquaintance with semiconductor physics will find that this book has fully detailed explanations of the fundamental physical phenomena, providing a good general background ... A brilliant discussion of artificial atomic superstructures of nanometer length scale establishes a link to the most active field of semiconductor physics ... In my opinion the book of R Enderlein and N J M Horing Fundamentals of Semiconductor Physics and Devices is a valuable contribution to the modern didactic literature on the physics of semiconductors. Moreover, it is of considerable value as a reference for specialists as well." J T Devreese Professor at the Physics Department University

of Antwerpen, Belgium “In Fundamentals of Semiconductor Physics and Devices, R Enderlein and N J M Horing have provided a very extensive and detailed text on the physics underlying semiconductor devices. More so than any other current text, this book provides a greatly expanded discussion of modern tight-binding methods, helping the students to understand these aspects of electronic structure in clear, simple terms. In connection with this the authors offer a very detailed discussion of deep levels in semiconductors, which are so important to semiconducting properties. Also, in the discussion of transport properties, the book goes into much greater depth about nonlinear and nonequilibrium processes than is usual. It is quite a unique contribution, containing the basic physics which tends to be missing from device-oriented books, but going much further into the essentials needed for device development than any solid-state-physics text.” Walter

A Harrison Professor of Applied Physics Stanford University, USA Taking up where the first volume left off, this work provides coverage of the inhomogeneous semiconductor. It deals mainly with Si and GaAs, but also investigates other materials of theoretical and practical interest, such as Ge, other III-V and II-VI compounds, and amorphous SiH. Equipped with this source, physicists, semiconductor engineers, device engineers and fabrication engineers will have access to a vast reservoir of practical information on the design, production and operations of semiconductor devices. The Third Edition of the standard textbook and reference in the field of semiconductor devices This classic book has set the standard for advanced study and reference in the semiconductor device field. Now completely updated and reorganized to reflect the tremendous advances in device concepts and performance, this Third Edition remains the most detailed and exhaustive single

source of information on the most important semiconductor devices. It gives readers immediate access to detailed descriptions of the underlying physics and performance characteristics of all major bipolar, field-effect, microwave, photonic, and sensor devices. Designed for graduate textbook adoptions and reference needs, this new edition includes: A complete update of the latest developments New devices such as three-dimensional MOSFETs, MODFETs, resonant-tunneling diodes, semiconductor sensors, quantum-cascade lasers, single-electron transistors, real-space transfer devices, and more Materials completely reorganized Problem sets at the end of each chapter All figures reproduced at the highest quality Physics of Semiconductor Devices, Third Edition offers engineers, research scientists, faculty, and students a practical basis for understanding the most important devices in use today and for evaluating future device performance and

limitations. A Solutions Manual is available from the editorial department. This book has been designed primarily as a text book for a three-semester, three-hour per week senior or graduate course in semiconductor physics for students In electrical engineering and physics, It may be supplemented by a solid state physics course. Prerequisites are courses in electrodynamics and -for some of the chapters -basic quantum mechanics. Emphasis has been laid on physical rather than technological aspects. Semiconductor physics is in fact an excellent and demanding training ground for a future physicist or electrical engineer giving him an opportunity to practice a large variety of physical laws he was introduced to in the more fundamental courses. A detailed treatment of the transport and optical properties of semiconductor is given. It was decided to omit the usual description of the material properties of certain semiconductors and instead to

include the "in-between" equations in mathematical derivations which I hope will make life simpler for a non-theoretical physicist. In view of the many thousands of papers which appear every year in the field of semiconductor physics and which are distributed among more than 30 journals, it would have been impossible for a single person to write a comprehensive book unless there had not been some excellent review articles on special topics published in the series "Solid State Physics", "Festschriften-Probleme! Advances in Solid State Physics", "Semiconductors and Semimetals", and "Progress in Semiconductors", and I have leaned heavily on such review articles

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