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# **Semiconductor Physics Devices Neamen 4th Edition**

***This junior-level electronics text provides a foundation for analyzing and designing analog and digital electronic circuits. Computer analysis and design are recognized as significant factors in electronics throughout the book. The use of computer tools is presented carefully, alongside the important hand analysis***

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***and calculations. The author, Don Neamen, has many years experience as an engineering educator and an engineer. His experience shines through each chapter of the book, rich with realistic examples and practical rules of thumb. The book is divided into three parts. Part 1 covers semiconductor devices and basic circuit applications. Part 2 covers more advanced topics in analog electronics, and Part 3 considers digital electronic circuits.***

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***The fourth edition of this book has been widely revised. It includes additional chapters and some sections are complemented with either new ones or an extension of their content. In this latest edition a complete treatment of the physics and properties of semiconductors is presented, covering transport phenomena in semiconductors, scattering mechanisms, radiation effects and displacement damages. Furthermore, this edition presents a***

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***comprehensive treatment of the Coulomb scattering on screened nuclear potentials resulting from electrons, protons, light- and heavy-ions – ranging from (very) low up to ultra-relativistic kinetic energies – and allowing one to derive the corresponding NIEL (non-ionizing energy-loss) doses deposited in any material. The contents are organized into two parts: Chapters 1 to 7 cover Particle Interactions and Displacement Damage while the remaining chapters***

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***focus on Radiation Environments and Particle Detection. This book can serve as reference for graduate students and final-year undergraduates and also as supplement for courses in particle, astroparticle, space physics and instrumentation. A section of the book is directed toward courses in medical physics. Researchers in experimental particle physics at low, medium, and high energy who are dealing with instrumentation will also find the book***

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***useful. Contents: Particle Interactions  
and Displacement  
Damage: Introduction  
Electromagnetic  
Interaction of Charged Particles in  
Matter  
Photon Interaction and  
Electromagnetic Cascades in  
Matter  
Nuclear Interactions in  
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Physics and Properties of Silicon  
Semiconductor  
Transport Phenomena in  
Semiconductors  
Radiation Effects and  
Displacement Damage in  
Semiconductors  
Radiation Environments***

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***and Particle Detection: Radiation  
Environments and Damage in  
Semiconductors Scintillating Media and  
Scintillator Detectors Solid State  
Detectors Displacement Damages and  
Interactions in Semiconductor  
Devices Gas Filled Chambers Principles of  
Particle Energy  
Determination Superheated Droplet  
(Bubble) Detectors and CDM  
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Applications Appendices: General***

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***Properties and Constants Mathematics and Statistics Readership: Researchers, academics, graduate students and professionals in accelerator, particle, astroparticle, space, applied and medical physics. Key Features: Exceptional large coverage of the different types of detectors used in particle and nuclear physics and their principles of detection Keywords: Radiation Interaction in Matter; Solid State Detectors; Scintillator Detectors; Gas***



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***Filled Chamber Detectors; Energy Determination; Dark Matter; Double Beta Decay; Processes of Energy Deposition; Radiation Damages; Medical Physics Applications "The fourth edition has been extensively revised and offers additional chapters. It presents a comprehensive treatment of the Coulomb scattering on screened nuclear potentials resulting from electrons, positrons, protons, light- and heavy-ions and allowing one to derive the***

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***corresponding NIEL doses deposited in any material and compound, because of atomic displacements caused by the interaction." Professor Karel Kudela  
Institute of Experimental Physics  
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***

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***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***

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***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***

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***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***

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***a broader knowledge of fundamental solid state physics.***

***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***

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***view of the increasing importance of wide-gap semiconductors, the electronic and optical properties of these materials are dealt with too.***

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Principles and Practices***

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**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**

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**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**

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**concepts, performance, and application Features**  
**discussions of topics of contemporary interest,**  
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**convert optical energy to electric energy Includes**  
**numerous problem sets, real-world examples,**  
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**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-**

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**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.

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**while being easily integrated with surrounding circuitry, are a crucial component in wireless microwave systems. The book is divided into three parts, the first of which introduces readers to mm-wave wireless systems and power amplifiers. In turn, the second focuses on design principles and EDA concepts, while the third discusses future trends in power amplifier research. The book provides essential information on mm-wave power amplifier theory, as well as the implementation options and technologies involved in their effective design, equipping researchers, circuit designers and**

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**practicing engineers to design, model, analyze, test and implement high-performance, spectrally clean and energy-efficient mm-wave systems. 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**

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**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**

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*were taking an introductory device core course using this book. This Solution Manual also contains an extensive appendix which illustrates the application of the fundamentals to solutions of state-of-the-art transistor reliability problems which have been taught to advanced undergraduate and graduate students. This book is also available as a set with Fundamentals of Solid-State Electronics and Fundamentals of Solid-State Electronics — Study Guide.*

*This book provides an overview of compound semiconductor materials and their technology. After presenting a theoretical background, it describes the*

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*relevant material preparation technologies for bulk and thin-layer epitaxial growth. It then briefly discusses the electrical, optical, and structural properties of semiconductors, complemented by a description of the most popular characterization tools, before more complex hetero- and low-dimensional structures are discussed. A special chapter is devoted to GaN and related materials, owing to their huge importance in modern optoelectronic and electronic devices, on the one hand, and their particular properties compared to other compound semiconductors, on the other. In the last part of the book, the physics and functionality of optoelectronic and*

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*electronic device structures (LEDs, laser diodes, solar cells, field-effect and heterojunction bipolar transistors) are discussed on the basis of the specific properties of compound semiconductors presented in the preceding chapters of the book. Compound semiconductors form the back-bone of all opto-electronic and electronic devices besides the classical Si electronics. Currently the most important field is solid state lighting with highly efficient LEDs emitting visible light. Also laser diodes of all wavelength ranges between mid-infrared and near ultraviolet have been the enabler for a huge number of unprecedented applications like CDs and DVDs for*

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*entertainment and data storage, not to speak about the internet, which would be impossible without optical data communications with infrared laser diodes as key elements. This book provides a concise overview over this class of materials, including the most important technological aspects for their fabrication and characterisation, also covering the most relevant devices based on compound semiconductors. It presents therefore an excellent introduction into this subject not only for students, but also for engineers and scientist who intend to put their focus on this field of science.*

*This book is an introduction to the principles of*

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*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.*

*Fundamentals of Semiconductor Physics and Devices*

*The Art of Electronics: The x Chapters*

*Nanophotonics, Nanoelectronics, and Nanoplasmonics*

*(Volume Six)*

*Semiconductor Physical Electronics*

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Designed for senior undergraduate/first year graduate

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students in electrical engineering departments, this text covers key subjects in optical electronics and their applications in modern optical communications where optical waves are used as carriers of information. Updating its bestselling predecessor, *Ferroelectric Devices, Second Edition* assesses the last decade of developments—and setbacks—in the commercialization of ferroelectricity. Field pioneer and esteemed author Uchino provides insight into why this relatively nascent and interdisciplinary process has failed so far without a systematic accumulation of fundamental knowledge regarding materials and device development. Filling the informational void, this collection of information reviews state-of-the-art research and development trends



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reflecting nano and optical technologies, environmental regulation, and alternative energy sources. Like the first edition, which became a standard in the field, this volume provides a general introduction to ferroelectrics with theoretical background. It then addresses practical design and device manufacturing, including recently developed processes and applications. Updating old data with a forecast of future developments, the text analyzes improvements to original ferroelectric devices to aid the design process of new ones. The second edition includes new sections on: Pb-free piezoelectrics Size effect on ferroelectricity Electrocaloric devices Micro mass sensor Piezoelectric energy harvesting Light valves and scanners Multi-ferroic devices, including magneto-

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electric sensors Uchino provides a general introduction to the theoretical background of ferroelectric devices, practical materials, device designs, drive/control techniques, and typical applications. He presents frequently asked questions from students, lab demonstrations for practical understanding, and "check point" quizzes and model solutions to monitor understanding. After a thorough exploration of ferroelectric devices and their past, this book looks to the industry's future, assessing market size and remaining reliability/lifetime issues. The author also unveils his strategy for developing "best-selling" ferroelectric devices.

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improvements across most all application spaces are now severely limited by the energy dissipation involved in processing, storing, and moving data. The exponential increase in the volume of data to be handled by our computational infrastructure is driven in large part by unstructured data from countless sources. This book explores revolutionary device concepts, associated circuits, and architectures that will greatly extend the practical engineering limits of energy-efficient computation from device to circuit to system level. With chapters written by international experts in their corresponding field, the text investigates new approaches to lower energy requirements in computing.

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technologies • Written by international experts in their corresponding field • Covers revolutionary concepts at the device, circuit, and system levels

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and computer assisted self-learning, this second edition of Electrical Energy Conversion and Transport is thoroughly updated to address the recent environmental effects of electric power generation and transmission, which have become more important together with the deregulation of the industry. New content explores different power generation methods, including renewable energy generation (solar, wind, fuel cell) and includes new sections that discuss the upcoming Smart Grid and the distributed

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power generation using renewable energy generation, making the text essential reading material for students and practicing engineers.

21st Century Nanoscience - A Handbook: Nanophotonics, Nanoelectronics, and Nanoplasmonics (Volume 6) will be the most comprehensive, up-to-date large reference work for the field of nanoscience.

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applied aspects of nanophysics. This follow-up project has been conceived as a necessary expansion and full update that considers the significant advances made in the field since 2010. It goes well beyond the physics as warranted by recent developments in the field. This sixth volume in a ten-volume set covers nanophotonics, nanoelectronics, and nanoplasmonics. Key Features: Provides the most comprehensive, up-to-date large reference work for the field. Chapters written by international experts in the

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field. Emphasises presentation and real results and applications. This handbook distinguishes itself from other works by its breadth of coverage, readability and timely topics. The intended readership is very broad, from students and instructors to engineers, physicists, chemists, biologists, biomedical researchers, industry professionals, governmental scientists, and others whose work is impacted by nanotechnology. It will be an indispensable resource in academic, government, and industry libraries



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worldwide. The fields impacted by nanophysics extend from materials science and engineering to biotechnology, biomedical engineering, medicine, electrical engineering, pharmaceutical science, computer technology, aerospace engineering, mechanical engineering, food science, and beyond.

An Introduction to Semiconductor Devices by Donald Neamen provides an understanding of the characteristics, operations and limitations of semiconductor devices. In order to provide this understanding, the

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book brings together the fundamental physics of the semiconductor material and the semiconductor device physics. This new text provides an accessible and modern presentation of material. Quantum mechanic material is minimal, and the most advanced material is designated with an icon. Excellent pedagogy is present throughout the book in the form of interesting chapters openers, worked examples, a variety of exercises, key terms, and end of chapter problems. This junior level electronics text

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provides a foundation for analyzing and designing analog and digital electronics throughout the book. Extensive pedagogical features including numerous design examples, problem solving technique sections, Test Your Understanding questions, and chapter checkpoints lend to this classic text. The author, Don Neamen, has many years experience as an Engineering Educator. His experience shines through each chapter of the book, rich with realistic examples and practical rules of thumb. The Third Edition continues

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to offer the same hallmark features that made the previous editions such a success. Extensive Pedagogy: A short introduction at the beginning of each chapter links the new chapter to the material presented in previous chapters. The objectives of the chapter are then presented in the Preview section and then are listed in bullet form for easy reference. Test Your Understanding Exercise Problems with provided answers have all been updated. Design Applications are included at the end of chapters. A

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specific electronic design related to that chapter is presented. The various stages in the design of an electronic thermometer are explained throughout the text. Specific Design Problems and Examples are highlighted throughout as well.

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**sets with answers, and detailed suggestions on supplemental reading to reinforce students' learning and help them prepare for exams.**

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**Graduate text with comprehensive treatment of semiconductor device physics and engineering, and descriptions of real optoelectronic devices. "This is the fifth edition of the most widely used introductory book on semiconductor materials, physics, devices and technology. The book was written with two basic goals in mind: 1) develop the basic semiconductor physics concepts to understand current and future devices; 2) provide a sound understanding of current semiconductor devices and technology so that their applications to electronic and optoelectronic circuits and systems can be appreciated."--BOOK JACKET.Title Summary**

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**devices such as three-dimensional MOSFETs, MODFETs, resonant-tunneling diodes, semiconductor sensors, quantum-cascade lasers, single-electron transistors, real-space transfer devices, and more**

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**A textbook introducing the physical concepts required for a comprehensive understanding of p-n junction devices, light emitting diodes and solar cells.**

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**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. \_ e reader will gain a thorough**

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**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**

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**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.**

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Provides a basis for understanding the characteristics, operation, and limitations of

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About The Book: This introductory text presents a well-balanced coverage of semiconductor physics and device operation and shows how devices are optimized for applications. The text

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begins with an exploration of the basic physical processes upon which all semiconductor devices are based. Next, the author focuses on the operation of the important semiconductor devices along with issues relating to the optimization of device performance.

This book presents those terms, concepts, equations, and models that are routinely used in describing the operational behavior of solid state devices. The second edition provides many new problems and illustrative examples.

Electronic Circuit Analysis  
Microelectronics

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semiconductor devices. Neamen's Semiconductor Physics and Devices 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.

Semiconductor Physics and Devices provides an introduction to the physics of semiconductor materials and devices. The text is supported by a large number of examples and exercises to test the understanding of topics.

Semiconductor Physics And Devices  
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Semiconductor Physics and Devices

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**Energy Efficient Computing & Electronics**

**Optical Electronics in Modern Communications**

**Fundamentals of Photonics**

**Circuit Analysis and Design**