

Fundamentals of carrier transport

Second Edition

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Fundamentals Of Carrier Transport

Kevin F. Brennan



Fundamentals Of Carrier Transport:

Fundamentals of Carrier Transport Mark Lundstrom, 2000-10-26 Fundamentals of Carrier Transport is an accessible introduction to the behaviour of charged carriers in semiconductors and semiconductor devices It is written specifically for engineers and students without an extensive background in quantum mechanics and solid state physics This second edition contains many new and updated sections including a completely new chapter on transport in ultrasmall devices The author begins by covering a range of essential physical principles He then goes on to cover both low and high field transport scattering transport in devices and transport in mesoscopic systems The use of Monte Carlo simulation methods is explained in detail Many homework exercises are provided and there are a variety of worked examples The book will be of great interest to graduate students of electrical engineering and applied physics It will also be invaluable to practising engineers working on semiconductor device research and development

Fundamentals of Carrier Transport, Second Edition Mark Lundstrom, 2000 *Modular Series on Solid State Devices: Fundamentals of carrier transport* Robert F. Pierret, 1983

Nanoelectronics Joachim Knoch, 2024-03-18 In recent years nanoelectronics has become very interdisciplinary requiring students to master aspects of physics electrical engineering chemistry etc The 2nd edition of this textbook is a comprehensive overview of nanoelectronics covering the necessary quantum mechanical and solid state physics foundation an overview of semiconductor fabrication as well as a brief introduction into device simulation using the non equilibrium Greens function formalism Equipped with this the work discusses nanoscale field effect transistors and alternative device concepts such as Schottky barrier MOSFETs as well as steep slope transistors based on different materials In addition cryogenic operation of MOSFETs for the realization of e g classical control electronics of semiconducting spin qubits is studied The work contains a number of tasks examples and exercises with step by step video solutions as well as tutorial videos that deepen the understanding of the material With additional access to simulation tools that allow students to do computational experiments the emphasis is on thorough explanation of the material enabling students to carry out their own research

Hierarchical Device Simulation Christoph Jungemann, Bernd Meinerzhagen, 2012-12-06 This book summarizes the research of more than a decade Its early motivation dates back to the eighties and to the memorable talks Dr C Moglestue FHG Freiburg gave on his Monte Carlo solutions of the Boltzmann transport equation at the NASECODE conferences in Ireland At that time numerical semiconductor device modeling basically implied the application of the drift diffusion model On the one hand those talks clearly showed the potential of the Monte Carlo model for an accurate description of many important transport issues that cannot adequately be addressed by the drift diffusion approximation On the other hand they also clearly demonstrated that at that time only very few experts were able to extract useful results from a Monte Carlo simulator With this background Monte Carlo research activities were started in 1986 at the University of Aachen RWTH Aachen Germany Different to many other Monte Carlo research groups the Monte Carlo research in Aachen

took place in an environment of active drift diffusion and hydrodynamic model development **Solid State and Quantum Theory for Optoelectronics** Michael A. Parker, 2009-12-16 While applications rapidly change one to the next in our commercialized world fundamental principles behind those applications remain constant So if one understands those principles well enough and has ample experience in applying them he or she will be able to develop a capacity for reaching results via conceptual thinking rather than having to Fundamentals of Solar Cells and Photovoltaic Systems Engineering Marta Victoria, 2024-06-08 2025 Textbook and Academic Authors Association TAA Most Promising New Textbook Award Winner Fundamentals of Solar Cells and Photovoltaic Systems Engineering presents all the major topics relevant to understanding photovoltaic technology including the working principles of solar cells modeling and measuring solar radiation manufacturing processes for solar cells and photovoltaic modules the design and operation of rooftop installations and large scale power plants the economics of such systems and the role of photovoltaic solar energy in the ongoing energy transition This book is intended for use as a textbook on photovoltaic solar energy for upper level undergraduate graduate engineering students Consists of 15 chapters including basic theory along with problems to solve and a solutions manual Provides a basic understanding of topics such as semiconductor fundamentals the pn junction and the working principle of solar cells for students without previous experience Covers the design and operation principles of rooftop installations and large scale solar power plants Presents the IV curve and efficiency attained by solar cells photovoltaic modules and systems how they are impacted by solar radiation and temperature and how they can be measured **High-Speed Heterostructure Devices** Patrick Roblin, Hans Rohdin, 2002-03-07 Fuelled by rapid growth in communications technology silicon heterostructures and related high speed semiconductors are spearheading the drive toward smaller faster and lower power devices High Speed Heterostructure Devices is a textbook on modern high speed semiconductor devices intended for both graduate students and practising engineers This book is concerned with the underlying physics of heterostructures as well as some of the most recent techniques for modeling and simulating these devices Emphasis is placed on heterostructure devices of the immediate future such as the MODFET HBT and RTD The principles of operation of other devices such as the Bloch Oscillator RITD Gunn diode quantum cascade laser and SOI and LD MOSFETs are also introduced Initially developed for a graduate course taught at Ohio State University the book comes with a complete set of homework problems and a web link to MATLAB programs supporting the lecture material **Springer Handbook of Electronic and Photonic Materials** Safa Kasap, Peter Capper, 2017-10-04 The second updated edition of this essential reference book provides a wealth of detail on a wide range of electronic and photonic materials starting from fundamentals and building up to advanced topics and applications Its extensive coverage with clear illustrations and applications carefully selected chapter sequencing and logical flow makes it very different from other electronic materials handbooks It has been written by professionals in the field and instructors who teach the subject at a university or in corporate laboratories The Springer Handbook of Electronic and

Photonic Materials second edition includes practical applications used as examples details of experimental techniques useful tables that summarize equations and most importantly properties of various materials as well as an extensive glossary Along with significant updates to the content and the references the second edition includes a number of new chapters such as those covering novel materials and selected applications This handbook is a valuable resource for graduate students researchers and practicing professionals working in the area of electronic optoelectronic and photonic materials

Transistors! Mark S Lundstrom, 2022-12-19 Current leading edge CMOS transistors are about as small as they will get We now have a simple clear very physical understanding of how these devices function but it has not yet entered our textbooks Besides CMOS logic transistors power transistors are increasingly important as are III V heterostructure transistors for high frequency communication Transistor reliability is also important but rarely treated in introductory textbooks As we begin a new era in which making transistors smaller will no longer be a major driving force for progress it is time to look back at what we have learned in transistor research Today we see a need to convey as simply and clearly as possible the essential physics of the device that makes modern electronics possible That is the goal of these lectures This volume rearranges the familiar topics and distills the most essential among them while adding most recent approaches which have become crucial to the discussion To follow the lectures readers need only a basic understanding of semiconductor physics Familiarity with transistors and electronic circuits is helpful but not assumed Related Link s [Flash Memories](#) Paulo Cappelletti, Carla Golla, Piero Olivo, Enrico Zanoni, 2013-11-27 A Flash memory is a Non Volatile Memory NVM whose unit cells are fabricated in CMOS technology and programmed and erased electrically In 1971 Frohman Bentchkowsky developed a floating polysilicon gate transistor in which hot electrons were injected in the floating gate and removed by either Ultra Violet UV internal photoemission or by Fowler Nordheim tunneling This is the unit cell of EPROM Electrically Programmable Read Only Memory which consisting of a single transistor can be very densely integrated EPROM memories are electrically programmed and erased by UV exposure for 20 30 mins In the late 1970s there have been many efforts to develop an electrically erasable EPROM which resulted in EEPROMs Electrically Erasable Programmable ROMs EEPROMs use hot electron tunneling for program and Fowler Nordheim tunneling for erase The EEPROM cell consists of two transistors and a tunnel oxide thus it is two or three times the size of an EPROM Successively the combination of hot carrier programming and tunnel erase was rediscovered to achieve a single transistor EEPROM called Flash EEPROM The first cell based on this concept has been presented in 1979 3 the first commercial product a 256K memory chip has been presented by Toshiba in 1984 4 The market did not take off until this technology was proven to be reliable and manufacturable 5

Fundamentals of Semiconductor Materials and Devices Adrian Kitai, 2023-10-16 Gain an introduction to the concepts behind semiconductor materials and devices in this advanced textbook Semiconductors are the foundation of the electronics industry and are therefore embedded in virtually all modern technology No engineer or materials scientist can be without an

understanding of this essential field Since semiconductors are also the foundation of solar cells they play an increasingly critical role in the transition to sustainable technology and promise as a result to become even more central in global technological progress

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Detailed analysis of topics including flash memory the quantum dot two dimensional semiconductor materials and more

Fundamentals of Semiconductor Materials and Devices is a valuable guide for students and researchers in any area of engineering physics or materials science

Future Trends in Microelectronics Serge Luryi, Jimmy Xu, Alexander Zaslavsky, 2013-06-13

Leaders in the field predict the future of the microelectronics industry

This seventh volume of **Future Trends in Microelectronics** summarizes and synthesizes the latest high level scientific discussions to emerge from the **Future Trends in Microelectronics** international workshop which has occurred every three years since 1995

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Provides a unified cohesive exploration of various trends in microelectronics looking to future opportunities rather than past successes

Quantum Physics of Semiconductor Materials and Devices Debdeep Jena, 2022-05-16

Quantum Phenomena do not occur in a Hilbert space They occur in a laboratory

Asher Peres

Semiconductor physics is a laboratory to learn and discover the concepts of quantum mechanics and thermodynamics condensed matter physics and materials science and the payoffs are almost immediate in the form of useful semiconductor devices

Debdeep Jena has had the opportunity to work on both sides of the fence on the fundamental materials science and quantum physics of semiconductors and in their applications in semiconductor electronic and photonic devices

In **Quantum Physics of Semiconductors and Nanostructures** Jena uses this experience to make each topic as tangible and accessible as possible to students at all levels

Consider the simplest physical processes that occur in semiconductors electron or hole transport in bands and over barriers collision of electrons with the atoms in the crystal or when electrons and holes annihilate each other

to produce a photon The correct explanation of these processes require a quantum mechanical treatment Any shortcuts lead to misconceptions that can take years to dispel and sometimes become roadblocks towards a deeper understanding and appreciation of the richness of the subject A typical introductory course on semiconductor physics would then require prerequisites of quantum mechanics statistical physics and thermodynamics materials science and electromagnetism Rarely would a student have all this background when s he takes a course of this nature in most universities Jena s work fills in these gaps and gives students the background and deeper understanding of the quantum physics of semiconductors and nanostructures

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

Introduction to the Physics of Electron Emission Kevin L. Jensen,2024-08-19 A practical in depth description of the physics behind electron emission physics and its usage in science and technology Electron emission is both a fundamental phenomenon and an enabling component that lies at the very heart of modern science and technology Written by a recognized authority in the field with expertise in both electron emission physics and electron beam physics An Introduction to Electron Emission provides an in depth look at the physics behind thermal field photo and secondary electron emission mechanisms how that physics affects the beams that result through space charge and emittance growth and explores the physics behind their utilization in an array of applications The book addresses mathematical and numerical methods underlying electron emission describing where the equations originated how they are related and how they may be correctly used to model actual sources for devices using electron beams Writing for the beam physics and solid state communities the author explores applications of electron emission methodology to solid state statistical and quantum mechanical ideas and concepts related to simulations of electron beams to condensed matter solid state and fabrication communities Provides an extensive description of the physics behind four electron emission mechanisms field photo and secondary and how that physics relates to factors such as space charge and emittance that affect electron beams Introduces readers to mathematical and numerical methods their origins and how they may be correctly used to model

actual sources for devices using electron beams Demonstrates applications of electron methodology as well as quantum mechanical concepts related to simulations of electron beams to solid state design and manufacture Designed to function as both a graduate level text and a reference for research professionals Introduction to the Physics of Electron Emission is a valuable learning tool for postgraduates studying quantum mechanics statistical mechanics solid state physics electron transport and beam physics It is also an indispensable resource for academic researchers and professionals who use electron sources model electron emission develop cathode technologies or utilize electron beams

MOSFET Modeling for Circuit Analysis and Design Carlos Galup-Montoro, Mrcio Cherem Schneider, 2007 This is the first book dedicated to the next generation of MOSFET models Addressed to circuit designers with an in depth treatment that appeals to device specialists the book presents a fresh view of compact modeling having completely abandoned the regional modeling approach Both an overview of the basic physics theory required to build compact MOSFET models and a unified treatment of inversion charge and surface potential models are provided The needs of digital analog and RF designers as regards the availability of simple equations for circuit designs are taken into account Compact expressions for hand analysis or for automatic synthesis valid in all operating regions are presented throughout the book All the main expressions for computer simulation used in the new generation compact models are derived Since designers in advanced technologies are increasingly concerned with fluctuations the modeling of fluctuations is strongly emphasized A unified approach for both space matching and time noise fluctuations is introduced

Proceedings of International Conference on VLSI, Communication, Advanced Devices, Signals & Systems and Networking (VCASAN-2013) Veena S. Chakravarthi, Yasha Jyothi M. Shirur, Rekha P., 2013-07-10 This book is a collection of papers presented by renowned researchers keynote speakers and academicians in the International Conference on VLSI Communication Analog Designs Signals Systems and Networking VCASAN 2013 organized by B N M Institute of Technology Bangalore India during July 17 19 2013 The book provides global trends in cutting edge technologies in electronics and communication engineering The content of the book is useful to engineers researchers and academicians as well as industry professionals

Handbook of Optoelectronic Device Modeling and Simulation Joachim Piprek, 2017-10-12 Optoelectronic devices are now ubiquitous in our daily lives from light emitting diodes LEDs in many household appliances to solar cells for energy This handbook shows how we can probe the underlying and highly complex physical processes using modern mathematical models and numerical simulation for optoelectronic device design analysis and performance optimization It reflects the wide availability of powerful computers and advanced commercial software which have opened the door for non specialists to perform sophisticated modeling and simulation tasks The chapters comprise the know how of more than a hundred experts from all over the world The handbook is an ideal starting point for beginners but also gives experienced researchers the opportunity to renew and broaden their knowledge in this expanding field

Springer Handbook of Semiconductor Devices Massimo Rudan, Rossella Brunetti, Susanna Reggiani, 2022-11-10 This Springer

Handbook comprehensively covers the topic of semiconductor devices embracing all aspects from theoretical background to fabrication modeling and applications. Nearly 100 leading scientists from industry and academia were selected to write the handbook's chapters, which were conceived for professionals and practitioners: material scientists, physicists, and electrical engineers working at universities, industrial R D, and manufacturers. Starting from the description of the relevant technological aspects and fabrication steps, the handbook proceeds with a section fully devoted to the main conventional semiconductor devices like e.g. bipolar transistors and MOS capacitors and transistors used in the production of the standard integrated circuits and the corresponding physical models. In the subsequent chapters, the scaling issues of the semiconductor device technology are addressed, followed by the description of novel concept-based semiconductor devices. The last section illustrates the numerical simulation methods ranging from the fabrication processes to the device performances. Each chapter is self-contained and refers to related topics treated in other chapters when necessary, so that the reader interested in a specific subject can easily identify a personal reading path through the vast contents of the handbook.

Reviewing **Fundamentals Of Carrier Transport**: Unlocking the Spellbinding Force of Linguistics

In a fast-paced world fueled by information and interconnectivity, the spellbinding force of linguistics has acquired newfound prominence. Its capacity to evoke emotions, stimulate contemplation, and stimulate metamorphosis is really astonishing. Within the pages of "**Fundamentals Of Carrier Transport**," an enthralling opus penned by a very acclaimed wordsmith, readers set about an immersive expedition to unravel the intricate significance of language and its indelible imprint on our lives. Throughout this assessment, we shall delve in to the book is central motifs, appraise its distinctive narrative style, and gauge its overarching influence on the minds of its readers.

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