

## Physics For Computer Science Students

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This text is the product of several years' effort to develop a course to fill a specific educational gap. It is our belief that computer science students should know how a computer works, particularly in light of rapidly changing tech nologies. The text was designed for computer science students who have a calculus background but have not necessarily taken prior physics courses. However, it is clearly not limited to these students. Anyone who has had first-year physics can start with Chapter 17. This includes all science and engineering students who would like a survey course of the ideas, theories, and experiments that made our modern electronics age possible. This textbook is meant to be used in a two-semester sequence. Chapters 1 through 16 can be covered during the first semester, and Chapters 17 through 28 in the second semester. At Queens College, where preliminary drafts have been used, the material is presented in three lecture periods (50 minutes each) and one recitation period per week, 15 weeks per semester. The lecture and recitation are complemented by a two-hour laboratory period per week for the first semester and a two-hour laboratory period biweekly for the second semester.

Not only computer scientists, but also electrical engineers, and others interested in electronics are targeted here, and thus the presentation is directed toward understanding how a computer works, while still providing a broad and effective one-year introduction to classical and modern physics. The first half of the book covers many of the topics found in a standard introductory physics course, but with the selection tailored for use in the second half. This second part then covers the fundamentals of quantum mechanics, multi-electron systems, crystal structure, semiconductor devices, and logic circuits. All the mathematical complexities treated are alleviated by intuitive physical arguments, and students are encouraged to use their own programming to solve problems. The only prerequisite is some knowledge of calculus, and the second part can serve by itself as an introduction to the physics of electronics for students who have had a standard two-semester introductory physics course. In this second edition, much of the material on electronic devices has been brought up to date, and there is a new chapter on integrated circuits and heterostructures.

The multidisciplinary field of quantum computing strives to exploit some of the uncanny aspects of quantum mechanics to expand our computational horizons. Quantum Computing for Computer Scientists takes readers on a tour of this fascinating area of cutting-edge research. Written in an accessible yet rigorous fashion, this book employs ideas and techniques familiar to every student of computer science. The reader is not expected to have any advanced mathematics or physics background. After presenting the necessary prerequisites, the material is organized to look at different aspects of quantum computing from the specific standpoint of computer science. There are chapters on computer architecture, algorithms, programming languages, theoretical computer science, cryptography, information theory, and hardware. The text has step-by-step examples, more than two hundred exercises with solutions, and programming drills that bring the ideas of quantum computing alive for today's computer science students and researchers.

The Physics of Computing gives a foundational view of the physical principles underlying computers. Performance, power, thermal behavior, and reliability are all harder and harder to achieve as transistors shrink to nanometer scales. This book describes the physics of computing at all levels of abstraction from single gates to complete computer systems. It can be used as a course for juniors or seniors in computer engineering and electrical engineering, and can also be used to teach students in other scientific disciplines important concepts in computing. For electrical engineering, the book provides the fundamentals of computing that link core concepts to computing. For computer science, it provides foundations of key challenges such as power consumption, performance, and thermal. The book can also be used as a technical reference by professionals. Links fundamental physics to the key challenges in computer design, including memory wall, power wall, reliability Provides all of the background necessary to understand the physical underpinnings of key computing concepts Covers all the major physical phenomena in computing from transistors to systems, including logic, interconnect, memory, clocking, I/O

Quantum Physics for Scientists and Technologists is a self-contained, comprehensive review of this complex branch of science. The book demystifies difficult concepts and views the subject through non-physics fields such as computer science, biology, chemistry, and nanotechnology. It explains key concepts and phenomena in the language of non-physics majors and with simple math, assuming no prior knowledge of the topic. This cohesive book begins with the wavefunction to develop the basic principles of quantum mechanics such as the uncertainty principle and wave-particle duality. Comprehensive coverage of quantum theory is presented, supported by experimental results and explained through applications and examples without the use of abstract and complex mathematical tools or formalisms. From there, the book: Takes the mystery out of the Schrodinger equation, the fundamental equation of quantum physics, by applying it to atoms Shows how quantum mechanics explains the periodic table of elements Introduces the quantum mechanical concept of spin and spin quantum number, along with Pauli's Exclusion Principle regarding the occupation of quantum states Addresses quantum states of molecules in terms of rotation and vibration of diatomic molecules Explores the interface between classical statistical mechanics and quantum statistical mechanics Discusses quantum mechanics as a common thread through different fields of nanoscience and nanotechnology Each chapter features real-world applications of one or more quantum mechanics principles. "Study Checkpoints" and problems with solutions are presented throughout to make difficult concepts easy to understand. In addition, pictures, tables, and diagrams with full explanations are used to present data and further explain difficult concepts. This book is designed as a complete course in quantum mechanics for senior undergraduates and first-year graduate students in non-physics majors. It also applies to courses such as modern physics, physical chemistry and nanotechnology. The material is also accessible to scientists, engineers, and technologists working in the fields of computer science, biology, chemistry, engineering, and nanotechnology.

This textbook presents a basic course in physics to teach mechanics, mechanical properties of matter, thermal properties of matter, elementary thermodynamics, electrodynamics, electricity, magnetism, light and optics and sound. It includes simple mathematical approaches to each physical principle, and all examples and exercises are selected carefully to reinforce each chapter. In addition, answers to all exercises are included that should ultimately help solidify the concepts in the minds of the students and increase their confidence in the subject. Many boxed features are used to separate the examples from the text and to highlight some important physical outcomes and rules. The appendices are chosen in such a way that all basic simple conversion factors, basic rules and formulas, basic rules of differentiation and integration can be viewed quickly, helping student to understand the elementary mathematical steps used for solving the examples and exercises. Instructors teaching form this textbook will be able to gain online access to the solutions manual which provides step-by-step solutions to all exercises contained in the book. The solutions manual also contains many tips, coloured illustrations, and explanations on how the solutions were derived.

Physics-Based Deformable Models presents a systematic physics-based framework for modeling rigid, articulated, and deformable objects, their interactions with the physical world, and the estimate of their shape and motion from visual data. This book presents a large variety of methods and associated experiments in computer vision, graphics and medical imaging that help the reader better to understand the presented material. In addition, special emphasis has been given to the development of techniques with interactive or close to real-time performance. Physics-Based Deformable Models is suitable as a secondary text for graduate level courses in Computer Graphics, Computational Physics, Computer Vision, Medical Imaging, and Biomedical Engineering. In addition, this book is appropriate as a reference for researchers and practitioners in the above-mentioned fields.

In the 1990's it was realized that quantum physics has some spectacular applications in computer science. This book is a concise introduction to quantum computation, developing the basic elements of this new branch of computational theory without assuming any background in physics. It begins with an introduction to the quantum theory from a computer-science perspective. It illustrates the quantum-computational approach with several elementary examples of quantum speed-up, before moving to the major applications: Shor's factoring algorithm, Grover's search algorithm, and quantum error correction. The book is intended primarily for computer scientists who know nothing about quantum theory, but will also be of interest to physicists who want to learn the theory of quantum computation, and philosophers of science interested in quantum foundational issues. It evolved during six years of teaching the subject to undergraduates and graduate students in computer science, mathematics, engineering, and physics, at Cornell University.

Imagine, if you can, the world in the year 2100. In Physics of the Future, Michio Kaku—the New York Times bestselling author of Physics of the Impossible—gives us a stunning, provocative, and exhilarating vision of the coming century based on interviews with over three hundred of the world ' s top scientists who are already inventing the future in their labs. The result is the most authoritative and scientifically accurate description of the revolutionary developments taking place in medicine, computers, artificial intelligence, nanotechnology, energy production, and astronautics. In all likelihood, by 2100 we will control computers via tiny brain sensors and, like magicians, move objects around with the power of our minds. Artificial intelligence will be dispersed throughout the environment, and Internet-enabled contact lenses will allow us to access the world's information base or conjure up any image we desire in the blink of an eye. Meanwhile, cars will drive themselves using GPS, and if room-temperature superconductors are discovered, vehicles will effortlessly fly on a cushion of air, coasting on powerful magnetic fields and ushering in the age of magnetism. Using molecular medicine, scientists will be able to grow almost every organ of the body and cure genetic diseases. Millions of tiny DNA sensors and nanoparticles patrolling our blood cells will silently scan our bodies for the first sign of illness, while rapid advances in genetic research will enable us to slow down or maybe even reverse the aging process, allowing human life spans to increase dramatically. In space, radically new ships—needle-sized vessels using laser propulsion—could replace the expensive chemical rockets of today and perhaps visit nearby stars. Advances in nanotechnology may lead to the fabled space elevator, which would propel humans hundreds of miles above the earth ' s atmosphere at the push of a button. But these astonishing revelations are only the tip of the iceberg. Kaku also discusses emotional robots, antimatter rockets, X-ray vision, and the ability to create new life-forms, and he considers the development of the world economy. He addresses the key questions: Who are the winner and losers of the future? Who will have jobs, and which nations will prosper? All the while, Kaku illuminates the rigorous scientific principles, examining the rate at which certain technologies are likely to mature, how far they can advance, and what their ultimate limitations and hazards are. Synthesizing a vast amount of information to construct an exciting look at the years leading up to 2100, Physics of the Future is a thrilling, wondrous ride through the next 100 years of breathtaking scientific revolution.

Until recently, almost all of the interactions between objects in virtual 3D worlds have been based on calculations performed using linear algebra. Linear algebra relies heavily on coordinates, however, which can make many geometric programming tasks very specific and complex-often a lot of effort is required to bring about even modest performance enhancements. Although linear algebra is an efficient way to specify low-level computations, it is not a suitable high-level language for geometric programming. Geometric Algebra for Computer Science presents a compelling alternative to the limitations of linear algebra. Geometric algebra, or GA, is a compact, time-effective, and performance-enhancing way to represent the geometry of 3D objects in computer programs. In this book you will find an introduction to GA that will give you a strong grasp of its relationship to linear algebra and its significance for your work. You will learn how to use GA to represent objects and perform geometric operations on them. And you will begin mastering proven techniques for making GA an integral part of your applications in a way that simplifies your code without slowing it down. \* The first book on Geometric Algebra for programmers in computer graphics and entertainment computing \* Written by leaders in the field providing essential information on this new technique for 3D graphics \* This full colour book includes a website with GAViewer, a program to experiment with GA

