Quantum Information Computation And Cryptography An Introductory Survey Of Theory Technology And Experiments Lecture Notes In Physics

Recent work in quantum information science has produced a revolution in our understanding of quantum entanglement. Scientists now view entanglement as a physical resource with many important applications. These range from quantum computers, which would be able to compute exponentially faster than classical computers, to quantum cryptographic techniques, which could provide unbreakable codes for the transfer of secret information over public channels. These important advances in the study of quantum entanglement and information touch on deep foundational issues in both physics and philosophy. This interdisciplinary volume brings together fourteen of the world's leading physicists and philosophers of physics to address the most important developments and debates in this exciting area of research. It offers a broad spectrum of approaches to resolving deep foundational challenges - philosophical, mathematical, and physical - raised by quantum information, quantum processing, and entanglement. This book is ideal for historians, philosophers of science and physicists.

"This book is for security experts as well as for IoT developers to help them understand the concepts related to quantum cryptography and classical cryptography and providing a direction to security professionals and IoT solution developers toward using approaches of Quantum Cryptography as available computational power increases"--

Explore the potential of quantum information processing and understand the state of a quantum system with this practical guide Key Features: Get well-versed with quantum information processing using Python Understand the basics of quantum cryptography by implementing quantum key distribution protocols in Python Implement well-known games such as the CHSH and GHZ games using quantum strategies and techniques Book Description: Quantum computation is the study of a subclass of computers that exploits the laws of quantum mechanics to perform certain operations that are thought to be difficult to perform on a non-quantum computer. Hands-On Quantum Information Processing with Python begins by taking you through the essentials of quantum information processing to help you explore its potential. Next, you'll become well-versed with the fundamental property of quantum entanglement and find out how to illustrate this using the teleportation protocol. As you advance, you'll discover how quantum circuits and algorithms such as Simon's algorithm, Grover's algorithm, and Shor's algorithm work, and get to grips with quantum cryptography by implementing important quantum key distribution (QKD) protocols in Python. You will also learn how to implement non-local games such as the CHSH game and the GHZ game by using Python. Finally, you'll cover key quantum machine learning algorithms, and these implementations will give you full rein to really play with and fully understand more complicated ideas. By the end of this quantum computing book, you will have gained a deeper understanding and appreciation of quantum information. What You Will Learn: Discover how quantum circuits and quantum algorithms work Familiarize yourself with non-local games and learn how to implement them Get to grips with various quantum computing models Implement quantum cryptographic protocols such as BB84 and B92 in Python Explore entanglement and teleportation in quantum systems Find out how to measure and apply operations to qubits Delve into quantum computing with the continuous-variable quantum state Get acquainted with essential quantum machine learning algorithms Who this book is for: ?This book is for developers, programmers, or undergraduates in computer science who want to learn about the fundamentals of quantum information processing. A basic understanding of the Python programming language is required, and a good grasp of math and statistics will be useful to get the best out of this book.

This multi-authored textbook addresses graduate students with a background in physics, mathematics or computer science. No research experience is necessary. Consequently, rather than comprehensively reviewing the vast body of knowledge and literature gathered in the past twenty years, this book concentrates on a number of carefully selected aspects of quantum information theory and technology. Given the highly interdisciplinary nature of the subject, the multi-authored approach brings together different points of view from various renowned experts, providing a coherent picture of the subject matter. The book consists of ten chapters and includes examples, problems, and exercises. The first five present the mathematical tools required for a full comprehension of various aspects of quantum mechanics, classical information, and coding theory. Chapter 6 deals with the manipulation and transmission of information in the quantum realm. Chapters 7 and 8 discuss experimental implementations of quantum information ideas using photons and atoms. Finally, chapters 9 and 10 address ground-breaking applications in cryptography and computation.

Quantum information theory has revolutionised our view on the true nature of information and has led to such intriguing topics as teleportation and quantum computation. The field — by its very nature strongly interdisciplinary, with deep roots in the foundations both of quantum mechanics and of information theory and computer science — has become a major subject for scientists working in fields as diverse as quantum optics, superconductivity or information theory, all the way to computer engineers. The aim of this book is to provide guidance and introduce the broad literature in all the various aspects of quantum information theory. The topics covered range from the fundamental aspects of the theory, like quantum algorithms and quantum complexity, to the technological aspects of the design of quantum-information-processing devices. Each section of the book consists of a selection of key papers (with particular attention to their tutorial value), chosen and introduced by leading scientists in the specific area. An entirely new introduction to quantum complexity has been specially written for the book. Contents:Introductory ConceptsQuantum Entanglement ManipulationQuantum AlgorithmsQuantum ComplexityQuantum Error CorrectionQuantum ChannelsEntanglement Purification and Long-Distance Quantum CommunicationQuantum Key DistributionCavity Quantum

ElectrodynamicsQuantum Computation with Ion TrapsJosephson Junctions and Quantum ComputationQuantum Computing in Optical LatticesQuantum Computation and Quantum Communication with ElectronsNMR Quantum Computing Readership: Physicists. Keywords:Quantum Computation;Quantum Information Theory;Quantum Cryptography;Quantum Error Correction;Quantum Complexity;Quantum Algorithms;Quantum Gates;Foundation of Quantum Mechanics;Quantum Theory;Quantum Channels;Quantum Mechanics

Takes students and researchers on a tour through some of the deepest ideas of maths, computer science and physics.

Quantum information theory is a generalization of classical information theory to use quantum-mechanical particles and interference. It is used in the study of quantum computation and quantum cryptography.

The subject of this book is theory of quantum system presented from information science perspective. The central role is played by the concept of quantum channel and its entropic and information characteristics. Quantum information theory gives a key to understanding elusive phenomena of quantum world and provides a background for development of experimental techniques that enable measuring and manipulation of individual quantum systems. This is important for the new efficient applications such as quantum computing, communication and cryptography. Research in the field of quantum informatics, including quantum information theory, is in progress in leading scientific centers throughout the world. This book gives an accessible, albeit mathematically rigorous and self-contained introduction to quantum information theory, starting from primary structures and leading to fundamental results and to exiting open problems.

This is a self-contained, systematic and comprehensive introduction to all the subjects and techniques important in scientific computing. The style and presentation are readily accessible to undergraduates and graduates. A large number of examples, accompanied by complete C++ and Java code wherever possible, cover every topic.

This volume presents papers on the topics covered at the National Academy of Engineering's 2018 US Frontiers of Engineering Symposium. Every year the symposium brings together 100 outstanding young leaders in engineering to share their cutting-edge research and innovations in selected areas. The 2018 symposium was held September 5-7 and hosted by MIT Lincoln Laboratory in Lexington, Massachusetts. The intent of this book is to convey the excitement of this unique meeting and to highlight innovative developments in engineering research and technical work.

Quantum physics allows entirely new forms of computation and cryptography, which could perform tasks currently impossible on classical devices, leading to an explosion of new algorithms, communications protocols and suggestions for physical implementations of all these ideas. As a result, quantum information has made the transition from an exotic research topic to part of mainstream undergraduate courses in physics. Based on years of teaching experience, this textbook builds from simple fundamental concepts to cover the essentials of the field. Aimed at physics undergraduate students with a basic background in quantum mechanics, it guides readers through theory and experiment, introducing all the central concepts without getting caught up in details. Worked examples and exercises make this useful as a self-study text for those who want a brief introduction before starting on more advanced books. Solutions are available online at www.cambridge.org/9781107014466.

Quantum Computation and Quantum Information (QIP) deals with the identification and use of quantum resources for information processing. This includes three main branches of investigation: quantum algorithm design, quantum simulation and quantum communication, including quantum cryptography. Along the past few years, QIP has become one of the most active area of research in both, theoretical and experimental physics, attracting students and researchers fascinated, not only by the potential practical applications of quantum computers, but also by the possibility of studying fundamental physics at the deepest level of quantum phenomena. NMR Quantum Computation and Quantum Information Processing describes the fundamentals of NMR QIP, and the main developments which can lead to a large-scale quantum processor. The text starts with a general chapter on the interesting topic of the physics of computation. The very first ideas which sparkled the development of QIP came from basic considerations of the physical processes underlying computational actions. In Chapter 2 it is made an introduction to NMR, including the hardware and other experimental aspects of the technique. In Chapter 3 we revise the fundamentals of Quantum Computation and Quantum Information. The chapter is very much based on the extraordinary book of Michael A. Nielsen and Isaac L. Chuang, with an upgrade containing some of the latest developments, such as QIP in phase space, and telecloning. Chapter 4 describes how NMR generates quantum logic gates from radiofrequency pulses, upon which quantum protocols are built. It also describes the important technique of Quantum State Tomography for both, quadrupole and spin 1/2 nuclei. Chapter 5 describes some of the main experiments of quantum algorithm implementation by NMR, quantum simulation and QIP in phase space. The important issue of entanglement in NMR QIP experiments is discussed in Chapter 6. This has been a particularly exciting topic in the literature. The chapter contains a discussion on the theoretical aspects of NMR entanglement, as well as some of the main experiments where this phenomenon is reported. Finally, Chapter 7 is an attempt to address the future of NMR QIP, based in very recent developments in nanofabrication and single-spin detection experiments. Each chapter is followed by a number of problems and solutions. * Presents a large number of problems with solutions, ideal for students * Brings together topics in different areas: NMR, nanotechnology, quantum computation * Extensive references

Leading experts from "The Physics of Quantum Information" network, initiated by the European Commission, bring together the most recent results from this emerging area of quantum technology. Written in a consistent style as a research monograph, the book introduces quantum cryptography, quantum teleportation, and quantum computation,

considering both theory and newest experiments. Both scientists working in the field and advanced students will find a rich source of information on this exciting new area.
This book constitutes the thoroughly refereed post-conference proceedings of the 5th Conference on Theory of Quantum Computation, Communication, and Cryptography, TQC 2010, held in Leeds, UK, in April 2010. The 15 revised papers presented were carefully selected during two rounds of reviewing and improvement. Focussing on theoretical aspects of quantum computation, quantum communication, and quantum cryptography - part of a larger interdisciplinary field embedding information science in a quantum mechanical framework - the papers present current original research. Topics addressed include quantum algorithms, models of quantum computation, quantum complexity theory, simulation of quantum systems, quantum cryptography, quantum communication, quantum estimation and measurement, quantum noise, quantum coding theory, fault-tolerant quantum computing, and entanglement theory.
This open access book presents selected papers from International Symposium on Mathematics, Quantum Theory, and Cryptography (MQC), which was held on September 25-27, 2019 in Fukuoka, Japan. The international symposium MQC addresses the mathematics and quantum theory underlying secure modeling of the post quantum cryptography including e.g. mathematical study of the light-matter interaction models as well as quantum computing. The security of the most widely used RSA cryptosystem is based on the difficulty of factoring large integers. However, in 1994 Shor proposed a quantum polynomial time algorithm for factoring integers, and the RSA cryptosystem is no longer secure in the quantum computing model. This vulnerability has prompted research into post-quantum cryptography using alternative mathematical problems that are secure in the era of quantum computers. In this regard, the National Institute of Standards and Technology (NIST) began to standardize post-quantum cryptography in 2016. This book is suitable for postgraduate students in mathematics and computer science, as well as for experts in industry working on post-quantum cryptography.
First-ever comprehensive introduction to the major new subject of quantum computing and quantum information.
Quantum cryptography (or quantum key distribution) is a state-of-the-art technique that exploits properties of quantum mechanics to guarantee the secure exchange of secret keys. This 2006 text introduces the principles and techniques of quantum cryptography, setting it in the wider context of cryptography and security, with specific focus on secret-key distillation. The book starts with an overview chapter, progressing to classical cryptography, information theory (classical and quantum), and applications of quantum cryptography. The discussion moves to secret-key distillation, privacy amplification and reconciliation techniques, concluding with the security principles of quantum cryptography. The author explains the physical implementation and security of these systems, enabling engineers to gauge the suitability of quantum cryptography for securing transmission in their particular application. With its blend of fundamental theory, implementation techniques, and details of recent protocols, this book will be of interest to graduate students, researchers, and practitioners in electrical engineering, physics, and computer science.
Lecture Notes for Physics 229:Quantum Information and ComputationBy John Preskill
This undergraduate book, first published in 2006, introduces quantum information and computation for physicists, mathematicians and computer scientists.
In the quantum world, a particle can behave like a wave and accordingly seems to be in two places at the same time. This of course is contradictory to our daily experiences with classical particles. How then should this be understood? What happens in the transitional area between the classical world and quantum mechanics? The present book answers exciting questions like these in a way that is easy to follow and to understand and is shows that the link between these two worlds will have concrete and applied effects on our daily life in the near future. It will, for example, improve and change the conventional methods of information processing. With the help of quantum cryptography, it will be possible to communicate tap-proof. Using quantum computers we will be able to solve highly complicated problems in a very short time.
This book constitutes the thoroughly refereed post-conference proceedings of the 6th Conference on Theory of Quantum Computation, Communication, and Cryptography, TQC 2011, held in Madrid, Spain, in May 2011. The 14 revised papers presented were carefully selected from numerous submissions. The papers present new and original research and cover a large range of topics in quantum computation, communication and cryptography, a new and interdisciplinary field at the intersection of computer science, information theory and quantum mechanics.
Quantum mechanics, the subfield of physics that describes the behavior of very small (quantum) particles, provides the basis for a new paradigm of computing. First proposed in the 1980s as a way to improve computational modeling of quantum systems, the field of quantum computing has recently garnered significant attention due to progress in building small-scale devices. However, significant technical advances will be required before a large-scale, practical quantum computer can be achieved. Quantum Computing: Progress and Prospects provides an introduction to the field, including the unique characteristics and constraints of the technology, and assesses the feasibility and implications of creating a functional quantum computer capable of addressing real-world problems. This report considers hardware and software requirements, quantum algorithms, drivers of advances in quantum computing and quantum devices, benchmarks associated with relevant use cases, the time and resources required, and how to assess the probability of success.
A self-contained treatment of the fundamentals of quantum computing This clear, practical book takes quantum computing out of the realm of theoretical physics and teaches the fundamentals of the field to students and professionals who have not had training in quantum computing or quantum information theory, including computer scientists, programmers, electrical engineers, mathematicians, physics students, and chemists. The author cuts through the conventions of typical jargon-laden physics books and instead

presents the material through his unique "how-to" approach and friendly, conversational style. Readers will learn how to carry out calculations with explicit details and will gain a fundamental grasp of: * Quantum mechanics * Quantum computation * Teleportation * Quantum cryptography * Entanglement * Quantum algorithms * Error correction A number of worked examples are included so readers can see how quantum computing is done with their own eyes, while answers to similar end-of-chapter problems are provided for readers to check their own work as they learn to master the information. Ideal for professionals and graduate-level students alike, Quantum Computing Explained delivers the fundamentals of quantum computing readers need to be able to understand current research papers and go on to study more advanced quantum texts.

An accessible introduction to an exciting new area in computation, explaining such topics as qubits, entanglement, and quantum teleportation for the general reader. Quantum computing is a beautiful fusion of quantum physics and computer science, incorporating some of the most stunning ideas from twentieth-century physics into an entirely new way of thinking about computation. In this book, Chris Bernhardt offers an introduction to quantum computing that is accessible to anyone who is comfortable with high school mathematics. He explains qubits, entanglement, quantum teleportation, quantum algorithms, and other quantum-related topics as clearly as possible for the general reader. Bernhardt, a mathematician himself, simplifies the mathematics as much as he can and provides elementary examples that illustrate both how the math works and what it means. Bernhardt introduces the basic unit of quantum computing, the qubit, and explains how the qubit can be measured; discusses entanglement—which, he says, is easier to describe mathematically than verbally—and what it means when two qubits are entangled (citing Einstein's characterization of what happens when the measurement of one entangled qubit affects the second as “spooky action at a distance”); and introduces quantum cryptography. He recaps standard topics in classical computing—bits, gates, and logic—and describes Edward Fredkin's ingenious billiard ball computer. He defines quantum gates, considers the speed of quantum algorithms, and describes the building of quantum computers. By the end of the book, readers understand that quantum computing and classical computing are not two distinct disciplines, and that quantum computing is the fundamental form of computing. The basic unit of computation is the qubit, not the bit.

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.

A thorough exposition of quantum computing and the underlying concepts of quantum physics, with explanations of the relevant mathematics and numerous examples. The combination of two of the twentieth century's most influential and revolutionary scientific theories, information theory and quantum mechanics, gave rise to a radically new view of computing and information. Quantum information processing explores the implications of using quantum mechanics instead of classical mechanics to model information and its processing. Quantum computing is not about changing the physical substrate on which computation is done from classical to quantum but about changing the notion of computation itself, at the most basic level. The fundamental unit of computation is no longer the bit but the quantum bit or qubit. This comprehensive introduction to the field offers a thorough exposition of quantum computing and the underlying concepts of quantum physics, explaining all the relevant mathematics and offering numerous examples. With its careful development of concepts and thorough explanations, the book makes quantum computing accessible to students and professionals in mathematics, computer science, and engineering. A reader with no prior knowledge of quantum physics (but with sufficient knowledge of linear algebra) will be able to gain a fluent understanding by working through the book.

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.

Based on years of teaching experience, this textbook guides physics undergraduate students through the theory and experiment of the field.

Introduction to the Theory of Quantum Information Processing provides the material for a one-semester graduate level course on quantum information theory and quantum computing for students who have had a one-year graduate course in quantum mechanics. Many standard subjects are treated, such as density matrices, entanglement, quantum maps, quantum cryptography, and quantum codes. Also included are discussions of quantum machines and quantum walks. In addition, the book provides detailed treatments of several underlying fundamental principles of quantum theory, such as quantum measurements, the no-cloning and no-signaling theorems, and their consequences. Problems of

various levels of difficulty supplement the text, with the most challenging problems bringing the reader to the forefront of active research. This book provides a compact introduction to the fascinating and rapidly evolving interdisciplinary field of quantum information theory, and it prepares the reader for doing active research in this area.

While there are many available textbooks on quantum information theory, most are either too technical for beginners or not complete enough. Filling this gap, Elements of Quantum Computation and Quantum Communication gives a clear, self-contained introduction to quantum computation and communication. Written primarily for undergraduate students in p

By the year 2020, the basic memory components of a computer will be the size of individual atoms. At such scales, the current theory of computation will become invalid. "Quantum computing" is reinventing the foundations of computer science and information theory in a way that is consistent with quantum physics - the most accurate model of reality currently known. Remarkably, this theory predicts that quantum computers can perform certain tasks breathtakingly faster than classical computers – and, better yet, can accomplish mind-boggling feats such as teleporting information, breaking supposedly "unbreakable" codes, generating true random numbers, and communicating with messages that betray the presence of eavesdropping. This widely anticipated second edition of Explorations in Quantum Computing explains these burgeoning developments in simple terms, and describes the key technological hurdles that must be overcome to make quantum computers a reality. This easy-to-read, time-tested, and comprehensive textbook provides a fresh perspective on the capabilities of quantum computers, and supplies readers with the tools necessary to make their own foray into this exciting field. Topics and features: concludes each chapter with exercises and a summary of the material covered; provides an introduction to the basic mathematical formalism of quantum computing, and the quantum effects that can be harnessed for non-classical computation; discusses the concepts of quantum gates, entangling power, quantum circuits, quantum Fourier, wavelet, and cosine transforms, and quantum universality, computability, and complexity; examines the potential applications of quantum computers in areas such as search, code-breaking, solving NP-Complete problems, quantum simulation, quantum chemistry, and mathematics; investigates the uses of quantum information, including quantum teleportation, superdense coding, quantum data compression, quantum cloning, quantum negation, and quantum cryptography; reviews the advancements made towards practical quantum computers, covering developments in quantum error correction and avoidance, and alternative models of quantum computation. This text/reference is ideal for anyone wishing to learn more about this incredible, perhaps "ultimate," computer revolution. Dr. Colin P. Williams is Program Manager for Advanced Computing Paradigms at the NASA Jet Propulsion Laboratory, California Institute of Technology, and CEO of Xtreme Energetics, Inc. an advanced solar energy company. Dr. Williams has taught quantum computing and quantum information theory as an acting Associate Professor of Computer Science at Stanford University. He has spent over a decade inspiring and leading high technology teams and building business relationships with and Silicon Valley companies. Today his interests include terrestrial and Space-based power generation, quantum computing, cognitive computing, computational material design, visualization, artificial intelligence, evolutionary computing, and remote olfaction. He was formerly a Research Scientist at Xerox PARC and a Research Assistant to Prof. Stephen W. Hawking, Cambridge University.

This open access book makes quantum computing more accessible than ever before. A fast-growing field at the intersection of physics and computer science, quantum computing promises to have revolutionary capabilities far surpassing "classical" computation. Getting a grip on the science behind the hype can be tough: at its heart lies quantum mechanics, whose enigmatic concepts can be imposing for the novice. This classroom-tested textbook uses simple language, minimal math, and plenty of examples to explain the three key principles behind quantum computers: superposition, quantum measurement, and entanglement. It then goes on to explain how this quantum world opens up a whole new paradigm of computing. The book bridges the gap between popular science articles and advanced textbooks by making key ideas accessible with just high school physics as a prerequisite. Each unit is broken down into sections labelled by difficulty level, allowing the course to be tailored to the student's experience of math and abstract reasoning. Problem sets and simulation-based labs of various levels reinforce the concepts described in the text and give the reader hands-on experience running quantum programs. This book can thus be used at the high school level after the AP or IB exams, in an extracurricular club, or as an independent project resource to give students a taste of what quantum computing is really about. At the college level, it can be used as a supplementary text to enhance a variety of courses in science and computing, or as a self-study guide for students who want to get ahead. Additionally, readers in business, finance, or industry will find it a quick and useful primer on the science behind computing's future.

In this first comprehensive introduction to the main ideas and techniques of quantum computation and information, Michael Nielsen and Isaac Chuang ask the question: What are the ultimate physical limits to computation and communication? They detail such remarkable effects as fast quantum algorithms, quantum teleportation, quantum cryptography and quantum error correction. A wealth of accompanying figures and exercises illustrate and develop the material in more depth. They describe what a quantum computer is, how it can be used to solve problems faster than familiar "classical" computers, and the real-world implementation of quantum computers. Their book concludes with an explanation of how quantum states can be used to perform remarkable feats of communication, and of how it is possible to protect quantum states against the effects of noise.

One of the most cited books in physics of all time, Quantum Computation and Quantum Information remains the best textbook in this exciting field of science. This 10th anniversary edition includes an introduction from the authors setting the work in context. This comprehensive textbook describes such remarkable effects as fast quantum algorithms, quantum teleportation, quantum cryptography and quantum error-correction. Quantum mechanics and computer science are introduced before moving on to describe

what a quantum computer is, how it can be used to solve problems faster than 'classical' computers and its real-world implementation. It concludes with an in-depth treatment of quantum information. Containing a wealth of figures and exercises, this well-known textbook is ideal for courses on the subject, and will interest beginning graduate students and researchers in physics, computer science, mathematics, and electrical engineering.

Quantum computation and information is a rapidly developing interdisciplinary field. It is not easy to understand its fundamental concepts and central results without facing numerous technical details. This book provides the reader with a useful guide. In particular, the initial chapters offer a simple and self-contained introduction; no previous knowledge of quantum mechanics or classical computation is required. Various important aspects of quantum computation and information are covered in depth, starting from the foundations (the basic concepts of computational complexity, energy, entropy, and information, quantum superposition and entanglement, elementary quantum gates, the main quantum algorithms, quantum teleportation, and quantum cryptography) up to advanced topics (like entanglement measures, quantum discord, quantum noise, quantum channels, quantum error correction, quantum simulators and tensor networks). It can be used as a broad range textbook for a course in quantum information and computation, both for upper-level undergraduate students and for graduate students. It contains a large number of solved exercises, which are an essential complement to the text, as they will help the student to become familiar with the subject. The book may also be useful as general education for readers who want to know the fundamental principles of quantum information and computation and who have the basic background acquired from their undergraduate course in physics, mathematics, or computer science, as well as for researchers interested in some of the latest spin-off of the field, including the use of quantum information in the theories of many-body systems.

Developing many of the major, exciting, pre- and post-millennium developments from the ground up, this book is an ideal entry point for graduate students into quantum information theory. Significant attention is given to quantum mechanics for quantum information theory, and careful studies of the important protocols of teleportation, superdense coding, and entanglement distribution are presented. In this new edition, readers can expect to find over 100 pages of new material, including detailed discussions of Bell's theorem, the CHSH game, Tsirelson's theorem, the axiomatic approach to quantum channels, the definition of the diamond norm and its interpretation, and a proof of the Choi–Kraus theorem. Discussion of the importance of the quantum dynamic capacity formula has been completely revised, and many new exercises and references have been added. This new edition will be welcomed by the upcoming generation of quantum information theorists and the already established community of classical information theorists.

This book gives an overview for practitioners and students of quantum physics and information science. It provides ready access to essential information on quantum information processing and communication, such as definitions, protocols and algorithms. Quantum information science is rarely found in clear and concise form. This book brings together this information from its various sources. It allows researchers and students in a range of areas including physics, photonics, solid-state electronics, nuclear magnetic resonance and information technology, in their applied and theoretical branches, to have this vital material directly at hand.