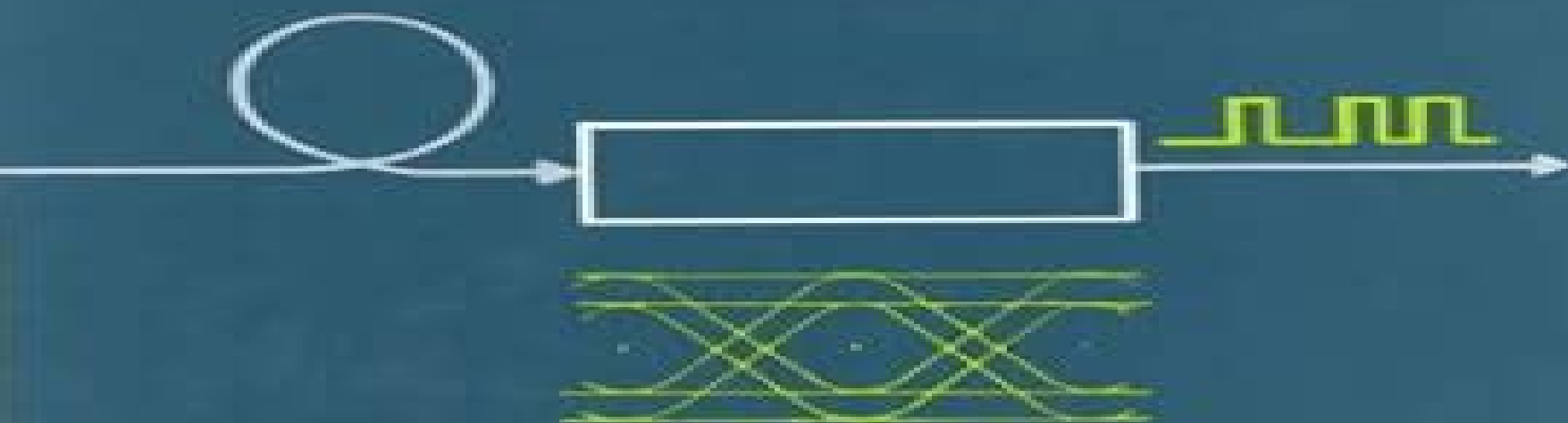


# OPTICAL • FIBER TELECOMMUNICATIONS II

*Edited by*

**STEWART E. MILLER  
IVAN P. KAMINOW**



# Optical Fiber Telecommunications II

**Richard C. Dorf**



## **Optical Fiber Telecommunications II:**

**Optical Fiber Telecommunications II** Stewart E. Miller, Ivan P. Kaminow, 1988 Optical Fiber Telecommunications II provides a comprehensive discussion of the new understanding and attractive new fiber optic technology that has appeared in the past decade. It is an invaluable resource for the lightwave telecommunications field and will be of interest to operating company engineers, component design and manufacturing engineers, researchers interested in the interrelation between their specialty and others in the system, and students seeking background for additional contributions they will be making. The Classic Fiber Optics Book INCLUDED IN FIBER OPTIC INSERT OCTOBER 90 **Optical Fiber Telecommunications**

**Volume VIB** Ivan Kaminow, Tingye Li, Alan E. Willner, 2013-05-11 Optical Fiber Telecommunications VI A B is the sixth in a series that has chronicled the progress in the R D of lightwave communications since the early 1970s. Written by active authorities from academia and industry, this edition brings a fresh look to many essential topics including devices, subsystems, systems, and networks. A central theme is the enabling of high bandwidth communications in a cost-effective manner for the development of customer applications. These volumes are an ideal reference for R D engineers and managers, optical systems implementers, university researchers, and students, network operators, and investors. Volume A is devoted to components and subsystems including photonic integrated circuits, multicore and few-mode fibers, photonic crystals, silicon photonics, signal processing, and optical interconnections. Volume B is devoted to systems and networks including advanced modulation formats, coherent detection, Tb/s channels, space division multiplexing, reconfigurable networks, broadband access, undersea cable, satellite communications, and microwave photonics. All the latest technologies and techniques for developing future components and systems. Edited by two winners of the highly prestigious OSA IEEE John Tyndal award and a President of IEEE's Lasers/Electro Optics Society (7,000 members). Written by leading experts in the field, it is the most authoritative and comprehensive reference on optical engineering on the market. **The Electrical Engineering Handbook, Second**

**Edition** Richard C. Dorf, 1997-09-26 In 1993 the first edition of The Electrical Engineering Handbook set a new standard for breadth and depth of coverage in an engineering reference work. Now this classic has been substantially revised and updated to include the latest information on all the important topics in electrical engineering today. Every electrical engineer should have an opportunity to expand his expertise with this definitive guide. In a single volume, this handbook provides a complete reference to answer the questions encountered by practicing engineers in industry, government, or academia. This well-organized book is divided into 12 major sections that encompass the entire field of electrical engineering, including circuits, signal processing, electronics, electromagnetics, electrical effects and devices, and energy, and the emerging trends in the fields of communications, digital devices, computer engineering, systems, and biomedical engineering. A compendium of physical, chemical, material, and mathematical data completes this comprehensive resource. Every major topic is thoroughly covered, and every important concept is defined, described, and illustrated. Conceptually challenging but carefully explained articles

are equally valuable to the practicing engineer researchers and students A distinguished advisory board and contributors including many of the leading authors professors and researchers in the field today assist noted author and professor Richard Dorf in offering complete coverage of this rapidly expanding field No other single volume available today offers this combination of broad coverage and depth of exploration of the topics The Electrical Engineering Handbook will be an invaluable resource for electrical engineers for years to come

### **Optical Fiber Telecommunications VIA**

Stephen Frisken, Ian Clarke, Simon Poole, 2013-05-03 Liquid crystal is now the dominant technology for flat screen displays and has been used in telecom systems since the late 1990s More recently the adoption of liquid crystals in Wavelength Selective Switches with the control of light on a pixel by pixel basis has been enabled by developments in Liquid Crystal on Silicon LCoS backplane technologies derived from projection displays This chapter outlines the operating principles of LCoS in existing wavelength switching applications and describes the broad scope of new opportunities that are arising from the intrinsic performance and flexibility of LCoS as a switching medium

### *Optical Fiber Telecommunications VA*

Ivan Kaminow, Tingye Li, Alan E. Willner, 2010-07-28 Optical Fiber Telecommunications V A B is the fifth in a series that has chronicled the progress in the research and development of lightwave communications since the early 1970s Written by active authorities from academia and industry this edition not only brings a fresh look to many essential topics but also focuses on network management and services Using high bandwidth in a cost effective manner for the development of customer applications is a central theme This book is ideal for R D engineers and managers optical systems implementers university researchers and students network operators and the investment community Volume A is devoted to components and subsystems including semiconductor lasers modulators photodetectors integrated photonic circuits photonic crystals specialty fibers polarization mode dispersion electronic signal processing MEMS nonlinear optical signal processing and quantum information technologies Volume B is devoted to systems and networks including advanced modulation formats coherent systems time multiplexed systems performance monitoring reconfigurable add drop multiplexers Ethernet technologies broadband access and services metro networks long haul transmission optical switching microwave photonics computer interconnections and simulation tools Biographical Sketches Ivan Kaminow retired from Bell Labs in 1996 after a 42 year career He conducted seminal studies on electrooptic modulators and materials Raman scattering in ferroelectrics integrated optics semiconductor lasers DBR ridge waveguide InGaAsP and multi frequency birefringent optical fibers and WDM networks Later he led research on WDM components EDFAs AWGs and fiber Fabry Perot Filters and on WDM local and wide area networks He is a member of the National Academy of Engineering and a recipient of the IEEE OSA John Tyndall OSA Charles Townes and IEEE LEOS Quantum Electronics Awards Since 2004 he has been Adjunct Professor of Electrical Engineering at the University of California Berkeley Tingye Li retired from AT T in 1998 after a 41 year career at Bell Labs and AT T Labs His seminal work on laser resonator modes is considered a classic Since the late 1960s He and his

groups have conducted pioneering studies on lightwave technologies and systems He led the work on amplified WDM transmission systems and championed their deployment for upgrading network capacity He is a member of the National Academy of Engineering and a foreign member of the Chinese Academy of Engineering He is a recipient of the IEEE David Sarnoff Award IEEE OSA John Tyndall Award OSA Ives Medal Quinn Endowment AT T Science and Technology Medal and IEEE Photonics Award Alan Willner has worked at AT T Bell Labs and Bellcore and he is Professor of Electrical Engineering at the University of Southern California He received the NSF Presidential Faculty Fellows Award from the White House Packard Foundation Fellowship NSF National Young Investigator Award Fulbright Foundation Senior Scholar IEEE LEOS Distinguished Lecturer and USC University Wide Award for Excellence in Teaching He is a Fellow of IEEE and OSA and he has been President of the IEEE LEOS Editor in Chief of the IEEE OSA J of Lightwave Technology Editor in Chief of Optics Letters Co Chair of the OSA Science Engineering Council and General Co Chair of the Conference on Lasers and Electro Optics For nearly three decades the OFT series has served as the comprehensive primary resource covering progress in the science and technology of optical fiber telecom It has been essential for the bookshelves of scientists and engineers active in the field OFT V provides updates on considerable progress in established disciplines as well as introductions to new topics OFT V generates a value that is even higher than that of the sum of its chapters      *Optical Fiber Telecommunications Volume VIA* Ivan Kaminow, Tingye Li, Alan E Willner, 2013-05-03 Optical Fiber Telecommunications VI A B is the sixth in a series that has chronicled the progress in the R D of lightwave communications since the early 1970s Written by active authorities from academia and industry this edition brings a fresh look to many essential topics including devices subsystems systems and networks A central theme is the enabling of high bandwidth communications in a cost effective manner for the development of customer applications These volumes are an ideal reference for R D engineers and managers optical systems implementers university researchers and students network operators and investors Volume A is devoted to components and subsystems including photonic integrated circuits multicore and few mode fibers photonic crystals silicon photonics signal processing and optical interconnections      Optical Fiber Telecommunications VB Ivan Kaminow, Tingye Li, Alan E. Willner, 2010-07-28 Optical Fiber Telecommunications V A B is the fifth in a series that has chronicled the progress in the research and development of lightwave communications since the early 1970s Written by active authorities from academia and industry this edition not only brings a fresh look to many essential topics but also focuses on network management and services Using high bandwidth in a cost effective manner for the development of customer applications is a central theme This book is ideal for R D engineers and managers optical systems implementers university researchers and students network operators and the investment community Volume A is devoted to components and subsystems including semiconductor lasers modulators photodetectors integrated photonic circuits photonic crystals specialty fibers polarization mode dispersion electronic signal processing MEMS nonlinear optical signal processing and quantum information technologies Volume B is

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*Optical Fiber Telecommunications IV* Ivan P. Kaminow, Tingye Li, 2002 Volume IVA is devoted to progress in optical component research and development Topics include design of optical fiber for a variety of applications plus new materials for fiber amplifiers modulators optical switches light wave devices lasers and high bit rate electronics This volume is an excellent companion to *Optical Fiber Telecommunications IVB Systems and Impairments* March 2002 ISBN 0 12 3951739 Fourth in a respected and comprehensive series Authoritative authors from a range of organizations Suitable for active lightwave R D designers developers purchasers operators students and analysts Lightwave

components reviewed in Volume A Lightwave systems and impairments reviewed in Volume B Up to the minute coverage

**The Handbook of Photonics** Mool C. Gupta, John Ballato, 2018-10-03 Reflecting changes in the field in the ten years since the publication of the first edition The Handbook of Photonics Second Edition explores recent advances that have affected this technology In this new updated second edition editor Mool Gupta is joined by John Ballato strengthening the handbook with their combined knowledge and the continued contributions of world class researchers New in the Second Edition Information on optical fiber technology and the economic impact of photonics Coverage of emerging technologies in nanotechnology Sections on optical amplifiers and polymeric optical materials The book covers photonics materials devices and systems respectively An introductory chapter new to this edition provides an overview of photonics technology innovation and economic development Resting firmly on the foundation set by the first edition this new edition continues to serve as a source for introductory material and a collection of published data for research and training in this field making it the reference of first resort

*Optical Fiber Telecommunications VII* Alan Willner, 2019-10-16 With optical fiber telecommunications firmly entrenched in the global information infrastructure a key question for the future is how deeply will optical communications penetrate and complement other forms of communication e g wireless access on premises networks interconnects and satellites Optical Fiber Telecommunications the seventh edition of the classic series that has chronicled the progress in the research and development of lightwave communications since 1979 examines present and future opportunities by presenting the latest advances on key topics such as Fiber and 5G wireless access networks Inter and intra data center communications Free space and quantum communication links Another key issue is the use of advanced photonics manufacturing and electronic signal processing to lower the cost of services and increase the system performance To address this the book covers Foundry and software capabilities for widespread user access to photonic integrated circuits Nano and microphotonic components Advanced and nonconventional data modulation formats The traditional emphasis of achieving higher data rates and longer transmission distances are also addressed through chapters on space division multiplexing undersea cable systems and efficient reconfigurable networking This book is intended as an ideal reference suitable for university and industry researchers graduate students optical systems implementers network operators managers and investors Quotes This book series which owes much of its distinguished history to the late Drs Kaminow and Li describes hot and growing applied topics which include long distance and wideband systems data centers 5G wireless networks foundry production of photonic integrated circuits quantum communications and AI deep learning These subjects will be highly beneficial for industrial R D engineers university teachers and students and funding agents in the business sector Prof Kenichi Iga President Retired Tokyo Institute of Technology With the passing of two luminaries Ivan Kaminow and Tingye Li I feared the loss of one of the premier reference books in the field Happily this new version comes to chronicle the current state of the art and is written by the next generation of leaders This is a must have reference book for anyone

working in or trying to understand the field of optical fiber communications technology Dr Donald B Keck Vice President Corning Inc Retired This book is the seventh edition in the definitive series that was previously marshaled by the extraordinary Ivan Kaminow and Tingye Li both sadly no longer with us The series has charted the remarkable progress made in the field and over a billion kilometers of optical fiber currently snake across the globe carrying ever increasing Internet traffic Anyone wondering about how we will cope with this incredible growth must read this book Prof Sir David Payne Director Optoelectronics Research Centre University of Southampton Updated edition presents the latest advances in optical fiber components systems subsystems and networks Written by leading authorities from academia and industry Gives a self contained overview of specific technologies covering both the state of the art and future research challenges

*Photonic Signal Processing, Second Edition* Le Nguyen Binh, 2019-01-15 This Second Edition of Photonic Signal Processing updates most recent R D on processing techniques of signals in photonic domain from the fundamentals given in its first edition Several modern techniques in Photonic Signal Processing PSP are described Graphical signal flow technique to simplify the analysis of the photonic transfer functions plus its insights into the physical phenomena of such processors The resonance and interference of optical fields are presented by the poles and zeros of the optical circuits respectively Detailed design procedures for fixed and tunable optical filters These filters brick wall like now play a highly important role in ultra broadband 100GBaud to spectral shaping of sinc temporal response so as to generate truly Nyquist sampler of the received eye diagrams 3 D PSP allows multi dimensional processing for highly complex optical signals Photonic differentiators and integrators for dark soliton generations Optical dispersion compensating processors for ultra long haul optical transmission systems Some optical devices essentials for PSP Many detailed PSP techniques are given in the chapters of this Second Edition Optical Fiber Telecommunications VA Tingye Li, Alan E. Willner, Ivan Kaminow, 2010-07-28 Optical Fiber Telecommunications V A B is the fifth in a series that has chronicled the progress in the research and development of lightwave communications since the early 1970s Written by active authorities from academia and industry this edition not only brings a fresh look to many essential topics but also focuses on network management and services Using high bandwidth in a cost effective manner for the development of customer applications is a central theme This book is ideal for R D engineers and managers optical systems implementers university researchers and students network operators and the investment community Volume A is devoted to components and subsystems including semiconductor lasers modulators photodetectors integrated photonic circuits photonic crystals specialty fibers polarization mode dispersion electronic signal processing MEMS nonlinear optical signal processing and quantum information technologies Volume B is devoted to systems and networks including advanced modulation formats coherent systems time multiplexed systems performance monitoring reconfigurable add drop multiplexers Ethernet technologies broadband access and services metro networks long haul transmission optical switching microwave photonics computer interconnections and simulation tools Biographical Sketches



Ivan Kaminow retired from Bell Labs in 1996 after a 42 year career. He conducted seminal studies on electrooptic modulators and materials Raman scattering in ferroelectrics integrated optics semiconductor lasers DBR ridge waveguide InGaAsP and multi frequency birefringent optical fibers and WDM networks. Later he led research on WDM components EDFAs AWGs and fiber Fabry Perot Filters and on WDM local and wide area networks. He is a member of the National Academy of Engineering and a recipient of the IEEE OSA John Tyndall OSA Charles Townes and IEEE LEOS Quantum Electronics Awards. Since 2004 he has been Adjunct Professor of Electrical Engineering at the University of California Berkeley. Tingye Li retired from AT T in 1998 after a 41 year career at Bell Labs and AT T Labs. His seminal work on laser resonator modes is considered a classic. Since the late 1960s He and his groups have conducted pioneering studies on lightwave technologies and systems. He led the work on amplified WDM transmission systems and championed their deployment for upgrading network capacity. He is a member of the National Academy of Engineering and a foreign member of the Chinese Academy of Engineering. He is a recipient of the IEEE David Sarnoff Award IEEE OSA John Tyndall Award OSA Ives Medal Quinn Endowment AT T Science and Technology Medal and IEEE Photonics Award. Alan Willner has worked at AT T Bell Labs and Bellcore and he is Professor of Electrical Engineering at the University of Southern California. He received the NSF Presidential Faculty Fellows Award from the White House Packard Foundation Fellowship NSF National Young Investigator Award Fulbright Foundation Senior Scholar IEEE LEOS Distinguished Lecturer and USC University Wide Award for Excellence in Teaching. He is a Fellow of IEEE and OSA and he has been President of the IEEE LEOS Editor in Chief of the IEEE OSA J of Lightwave Technology Editor in Chief of Optics Letters Co Chair of the OSA Science Engineering Council and General Co Chair of the Conference on Lasers and Electro Optics.

**Optical Fiber Telecommunications IV-B** Ivan Kaminow, Tingye Li, 2002-05-22 Volume B is devoted to light wave systems and system impairments and compensation. Some of the topics include growth of the Internet network architecture undersea systems high speed TDM transmission cable TV systems access networks simulation tools nonlinear effects polarization mode dispersion bandwidth formats and more. This book is an excellent companion to Optical Fiber Telecommunications IVA Components March 2002 ISBN 0 12 395172 0. Fourth in a respected and comprehensive series. Authoritative authors from a range of organizations. Suitable for active lightwave R D designers, developers, purchasers, operators, students and analysts. Lightwave components reviewed in Volume A, Lightwave systems and impairments reviewed in Volume B. Up to the minute coverage.

**Analysis and Design of Transimpedance Amplifiers for Optical Receivers** Eduard Säckinger, 2017-10-09 An up to date comprehensive guide for advanced electrical engineering students and electrical engineers working in the IC and optical industries. This book covers the major transimpedance amplifier TIA topologies and their circuit implementations for optical receivers. This includes the shunt feedback TIA common base TIA common gate TIA regulated cascode TIA distributed amplifier TIA nonresistive feedback TIA current mode TIA burst mode TIA and analog receiver TIA. The noise transimpedance and other performance parameters of these circuits are

analyzed and optimized Topics of interest include post amplifiers differential vs single ended TIAs DC input current control and adaptive transimpedance The book features real world examples of TIA circuits for a variety of receivers direct detection coherent burst mode etc implemented in a broad array of technologies HBT BiCMOS CMOS etc The book begins with an introduction to optical communication systems signals and standards It then moves on to discussions of optical fiber and photodetectors This discussion includes p i n photodetectors avalanche photodetectors APD optically preamplified detectors integrated detectors including detectors for silicon photonics and detectors for phase modulated signals including coherent detectors This is followed by coverage of the optical receiver at the system level the relationship between noise sensitivity optical signal to noise ratio OSNR and bit error rate BER is explained receiver impairments such as intersymbol interference ISI are covered In addition the author presents TIA specifications and illustrates them with example values from recent product data sheets The book also includes Many numerical examples throughout that help make the material more concrete for readers Real world product examples that show the performance of actual IC designs Chapter summaries that highlight the key points Problems and their solutions for readers who want to practice and deepen their understanding of the material Appendices that cover communication signals eye diagrams timing jitter nonlinearity adaptive equalizers decision point control forward error correction FEC and second order low pass transfer functions Analysis and Design of Transimpedance Amplifiers for Optical Receivers belongs on the reference shelves of every electrical engineer working in the IC and optical industries It also can serve as a textbook for upper level undergraduates and graduate students studying integrated circuit design and optical communication

*Fundamentals of Semiconductor Lasers* Takahiro Numai, 2006-05-10 Fundamentals of Semiconductor Lasers explains the physics and fundamental characteristics of semiconductor lasers with regard to systems applications The detailed and comprehensive presentation is unique in that it encourages the reader to consider different semiconductor lasers from different angles Emphasis is placed on recognizing common concepts such operating principles and structure and solving problems based on individual situations The treatment is enhanced by an historical account of advances in semiconductor lasers over the years discussing both those ideas that have persisted over the years and those that have faded out The first four chapters cover the basics of semiconductors including band structures optical transitions optical waveguides and optical resonators The remaining chapters discuss operating principles and basic characteristics of semiconductor lasers and advanced topics including dynamic single mode lasers quantum well lasers and control of spontaneous emission The reader need only be familiar with undergraduate level electromagnetism and quantum mechanics After reading this book the student will be able to think critically about semiconductor lasers and be able to read and understand journal papers in the field This book will be essential to any advanced undergraduate or graduate student of semiconductor lasers and any professional physicist or engineer looking for a good overview of the subject

**Erbium-Doped Fiber Amplifiers** Philippe M. Becker, Anders A. Olsson, Jay R. Simpson, 1999-03-15 Erbium Fiber

Amplifiers is a comprehensive introduction to the increasingly important topic of optical amplification. Written by three Bell Labs pioneers, the book stresses the importance of the interrelation of materials properties, optical properties, and systems aspects of optical fiber amplifiers. All disc-based content for this title is now available on the Web. Key Features: Explains the theory of noise in optically amplified systems in an intuitive way. The book contains a discussion of components used in amplifier fabrication and of the attendant technologies used in real systems. The book provides basic tools for amplifier design as well as systems engineering, including the latest developments in WDM and soliton systems. The book discusses the fundamentals of rare earth ions for the reader desiring more depth in the topic. The book is for either the novice or experienced reader. The chapters have links between them to allow the reader to understand the relationship between the amplifier characteristics, noise, and systems applications. The book contains extensive references.

**Fiber Optics** Fedor Mitschke, 2010-01-14. Telephone, telefax, email, and internet: the key ingredient of the inner workings is the conduit, the line which is designed to carry massive amounts of data at breakneck speed. In their data-carrying capacity, optical fiber lines beat other technologies: copper cable, microwave beacons, satellite links, hands down, at least in the long haul. This book is a comprehensive source about optical fibers: their structure, their light-guiding mechanism, their material and manufacture, their use. Several effects tend to degrade the signal as it travels down the fiber; they are spelled out in detail. Nonlinear processes are given due consideration for a twofold reason. On one hand, they are fundamentally different from the more familiar processes in electrical cable. On the other hand, they form the basis of particularly interesting and innovative applications, provided they are understood well enough. A case in point is the use of so-called solitons, i.e., special pulses of light which have the wonderful property of being able to heal after perturbation. The book starts with the physical basics of ray and beam optics, explains fiber structure and the functions of optical elements, and continues to the forefront of applications. The state of the art of high-speed data transmission will be described, and the use of fiber optic sensors in metrology is treated. The book is written in a pedagogical style so that students of both physics and electrical engineering as well as technicians and engineers involved in optical technologies will benefit.

**Topics in Lightwave Transmission Systems** Tingye Li, 2013-09-03. Topics in Lightwave Transmission Systems is a second volume of a treatise on optical fiber communications that is devoted to the science, engineering, and application of information transmission via optical fibers. The first volume, published in 1985, dealt exclusively with fiber fabrication. The present volume contains topics that pertain to subsystems and systems. The book contains five chapters and begins with discussions of transmitters and receivers, which are basic to systems now operating in the field. Subsequent chapters cover topics relating to coherent systems, frequency and phase modulation of the optical carrier, and systems considerations and experiments. The last chapter reviews the fundamentals of nonlinear effects in optical fibers and considers how systems are affected by various nonlinear phenomena.

**Structural Monitoring with Fiber Optic Technology** Raymond M. Measures, 2001-04-10. This book is the first to

address the field of structurally integrated fiber optic sensors Fiber optic sensors embedded within materials and systems are able to measure a variety of parameters i e temperature vibration deformation strain etc that allows for real time non destructive evaluation Examples include the following monitoring structural fatigue in aging aircraft or loads in bridge structures In more advanced applications fiber optic sensors control actuators that allow materials to adapt to their environment This gives rise to the names smart intelligent and or adaptive materials or structures Structural Monitoring with Fiber Optic Technology is the first single author book on the new field of fiber optic structural sensing As such it provides coverage of the fundamentals of the technology a coherent and systematic discussion on the most important aspects of the subject a broad view of the subject while retaining a degree of focus on those advances most significant in terms of their future potential particularly in regard to broad implementation of the technology The book provides an introduction to the relevant value to structural monitoring It also highlights the advantages of fiber optic based sensors over conventional electrical measurement technology The book richly illustrates the subject matter with 615 figures and provides many examples of fiber optic structural sensing including a detailed overview of a number of major field site applications Most of these large scale applications are drawn from the civil engineering community as they have been the first to strongly embrace fiber optic structural monitoring This is especially true for bridges where innovative new designs and the use of fiber reinforced polymer composite materials to replace steel represents a major advance that is expected to revolutionize the construction industry Examples include new bridges which are serving as testbeds for these new materials and are instrumented with arrays of fiber optic structural sensors In one case this state of the art monitoring system permits engineers at a distant site to track the response of the bridge to traffic loads and keep an eye on the long term performance of the new materials Fiber optic structural sensing technology is equally applicable to other industrial sectors such as the aerospace and marine industries Indeed several examples of ships being instrumented with arrays of fiber optic sensors are also included The author directed one of the leading laboratories in the development of this technology and its application to civil engineering Provides a strong concise foundation in the basics of the technology Includes many examples of the application of the technology including many major field site case studies Richly illustrated with 615 figures many redrawn to make them easier to understand also includes over 600 references Written in a style designed to help the reader unfamiliar with fiber optic technology appreciate what can be accomplished with this new form of structural monitoring

Optical Networks Rajiv Ramaswami, Kumar Sivarajan, 2002 Introduction to optical networks Propagation of signals in optical fiber Components Modulation and demodulation Transmission system engineering Client layers of the optical layer WDM network elements WDM network design Control and management Network survivability Access networks Photonic packet switching Deployment considerations

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### **Optical Fiber Telecommunications II Introduction**

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