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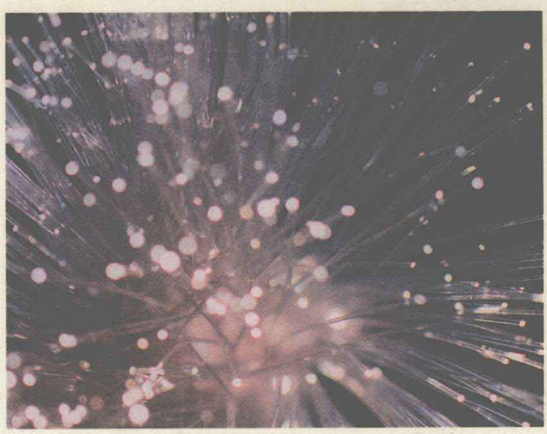
国外高校电子信息类优秀教材

光纤通信技术

Fiber-Optic Communications Technology

(英文影印版)



Djafar K. Mynbaev Lowell L. Scheiner 著

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内 容 简 介

本书为国外高校电子信息类优秀教材(英文影印版)之一。

本书通过大量的例子、图表以及实际问题,不但全面介绍了光纤通信系统中的基本技术,而且结合实际应用,介绍了光纤、系统以及网络中的最新技术和设备。本书主要内容有单模光纤基础、光缆的连接与测试、光源及光传输基础、接受器、光器件及光网络、光网络中的无源部件、开关及功能部件等。

本书适用于通信、电子、计算机及相关专业本科生,也可供一般工程技术人员参考。

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To Bronia

Preface

TO THE READER

Fiber-optic communications has been growing at a phenomenal pace over the past twenty years, so rapidly, in fact, that its impact is increasingly felt in nearly all aspects of communications technology. Fiber optics has, in just a couple of decades, metamorphosed from a somewhat exotic research curiosity into a strong commercial reality—to the point where even the general public has some idea of its ever expanding role in communications. But this doesn't mean that this technology, now that it has found its logical (and for many highly profitable) place in telecommunications, will cease developing. On the contrary. As far as we can see, the demand for transmission over the global telecommunications network will continue to grow at an exponential rate and only fiber optics will be able to meet this challenge. (Wireless communications take us in another direction and is a story in itself. For more on this, see Section 1.3 and Chapter 15.)

There are hundreds of books on fiber-optic communications ranging from primers to highly theoretical monographs. There are a number of textbooks aimed at different readership levels as well. And so, you rightly ask, why this book?

Purpose

This text addresses a broad audience. It is, first and foremost, a textbook for technology and engineering students taking a beginning course in fiber-optic communications. It is also written for those already in the field who may need to pass an exam, for end-users who need to gain an understanding of fiber-optic technology to work with contractors at the professional level, and for students taking advanced courses in fiber-optic technology who need to bone up on some of the basic principles. These readers, too, will find this a helpful guide.

In addition, engineers and technicians who work with fiber optics can use this text as a source of useful everyday information. Finally, people technically trained in other disciplines who simply want to know what this technology is all about—and this number is surprisingly high—will find this book a useful source of comprehensive up-to-date information.

Primarily written for today's students, this textbook, we believe, will provide a marked benefit to you. Traditionally, technical colleges are divided into engineering and technical schools, with the former providing a greater emphasis on the theoretical and the latter stressing the more practical, job-related aspects of the field. Accepting this reality, we have included two levels of discussion in this text. As a result, the technology schools may restrict themselves to the chapters marked "Basics," while engineering colleges may concentrate on the chapters marked "A Deeper Look." We appreciate, of course, that every class—whether in an engineering or a technology school—comprises individuals and so the instructor will certainly base his or her syllabus on the specific needs of the students.

This text is unique in that it responds to the needs and interests of most students seeking to enter the profession and enables them to gain important knowledge whether it be in the theoretical or practical realm.

So how can this textbook help you acquire the essentials you need to succeed in such a vibrant field? First, it provides you with a strong foundation through clear, logical explication of the basic concepts, augmented by lots of examples, graphical presentations, and solutions to problems similar to ones you'll encounter in the workplace. Secondly, it also includes the newest technological innovations in components, systems, and networks. By concentrating our efforts on the truly new and most promising technological achievements, ones we believe you'll be encountering in your career, we've succeeded on both counts.

With so much commercial activity underway and a wealth of exciting research developments in the works, we concluded that the best way to serve your needs in a single volume would be to include only innovations and applications that are commercially available or that, in our judgment, will be within the next few years. Progress in this field has been fast and furious so it is not surprising to see yesterday's R&D project become today's commercial product. For this reason, the book includes discussions of trends in technology and networks to make you aware of today's R&D projects that will likely be commercial realities when you start your career.

Student Research

A key feature of this text is that it introduces engineering and technology students to the principles of research. Increasingly, undergraduate institutions—both senior and junior colleges—are encouraging students to use research as a powerful teaching tool to help them master a technical subject. The National Science Foundation furthers this practice by spending hundreds of dollars a year to support student research starting at the junior (community) college level.

How can this book help you develop your research skills?

First, it provides a list of topics that are ripe for research activity. For example, consider dispersion in optical fibers. A research project on this topic would require you to determine the real model of dispersion in a singlemode fiber, how nonlinear effects impact dispersion in a singlemode fiber, and what the theoretical limit is to dispersion in singlemode and multimode fibers. These and many other ideas for research will emerge as you read this book.

Secondly, as the scope of this text ranges from the introductory to the intermediate level, a broad area of inquiry is open for students to pursue. As questions and problems arise, the more ambitious students will wish to pursue answers and solutions on their own or perhaps as part of a research team. And since both theoretical and experimental approaches are discussed here, the text can serve as the fulcrum for student research, even to the point of allowing students to adapt the research topic and level to their particular backgrounds, interests, and even future work.

How Much to Learn

If you hope to become a professional in the components field and concentrate in the area of optical fiber, transmitters, receivers, amplifiers, and active and passive components, you will need a strong understanding of the technology. This knowledge can be acquired only if you have first established a solid background in physics, mathematics, and electronics. There are no shortcuts to this knowledge base.

On the other hand, if you are intent on becoming a fiber-optic communications systems specialist, a knowledge of electronic communications and telecommunications is needed. Those of you planning to work at the fiber-optic-network level must master the intricacies of two disciplines: fiber-optic technology and telecommunications networks. Finally, students interested in becoming telecommunications managers must combine technical knowledge with insight into complex legal regulations and a keen understanding of how a business operates.

Fiber-optic communications technology is a special field, one that integrates knowledge from diverse areas to devise new concepts. As a result, the broader the background and experience you bring to your job, the more valuable you are as a professional.

Career Opportunities

You have chosen to enter a truly exciting profession, a profession where companies are aggressively pioneering in their efforts to stay in the forefront of leading-edge technology, where yesterday's latest innovation becomes passé today, where professionals with far-reaching ideas still have unlimited opportunities to grow along with a young, fast-paced, rapidly expanding industry and, yes, where talent and success are rewarded with big money. No doubt about that.

Whether you intend to enter the field as a technologist, engineer, technician, or product manager, the future holds unlimited potential for a dynamic technology that was barely a gleam in a far-thinking scientist's eye just twenty-five years ago, let alone the explosive technological business it has become today. The field, in fact, has developed so quickly that in the span of just a few short years it has become the linchpin of the giant telecommunications industry, an industry that itself accounts for one-sixth of the U.S. economy and is still growing—with few seeing an end in sight.

Indeed, your decision to become a professional in some area of telecommunications—which means to become a professional in fiber-optic communications technology—bodes well for your career. Our experience shows that even for recent college graduates, the problem is not finding a job, but choosing the best job from among a plethora of excellent offers. Today corporations serving this industry are competing for engineers, technologists, and product managers even far more aggressively than the job seekers are hunting for positions. As a result, fiber-optic technology professionals are among the highest paid in American industry.

TO THE INSTRUCTOR

It would be inappropriate to tell you how to use this or any textbook. Thus, we would like to simply share with you the plan of this book to help you prepare your course syllabus.

General Structure

Most topics are presented on two levels: "Basics" and "A Deeper Look." At the basic level, we introduce the main ideas and the principles behind the devices covered. The basic sections are necessary to give students with little background in fiber-optic communications technology a fundamental understanding of the topic. These sections are presented in a simple manner for the beginning student to grasp the subject matter easily and quickly.

At the deeper-look level, we include a more theoretical, highly detailed discussion of the same material and add new topics. This gives you considerable flexibility based on the technical level of your class and the length of the course. The deeper-look sections have two goals: First, they cover the material in greater depth, thereby involving more theory, assuming, of course, a stronger background in physics and mathematics. Second, they prepare students for further course work that will involve complex theory and the kinds of professional responsibilities they will encounter in the workplace. These sections bring the students to the next level and provides more insight into fiber-optic communications technology. They also provide many topics for student research should this be an integral part of your course.

It should be emphasized that the basic and deeper-look sections are closely related and, if the advanced students should feel the need for a "refresher course," we strongly recommend that they reread the introductory section before proceeding to the more complex material.

About the Examples

We use examples not only to illustrate how to apply formulas for computing numbers but also to move the discussion in a logical, comprehensive way and to provide additional helpful information.

Reading the Data Sheets

For practicing engineers, the ability to read data sheets is critical. This ability enables them to assimilate the knowledge they have acquired. In a sense, it is an excellent measure of the level of one's professionalism. For this reason, every topic concludes with a discussion of specific data sheets. In addition, specifications sheets are used as sources of data for making various calculations in the examples given, as an aid in explaining the material, and for solving the problems strewn throughout the text and at the end of each chapter.

Your Course Syllabus

We cannot imagine a single all-purpose syllabus that could meet the needs of every class using this textbook. Obviously, the volume of material well exceeds the needs of even a two-semester course, let alone a one-semester class. This book gives you wide latitude in building your syllabus.

At New York City Technical College, we always leave time during the term to take up topics suggested or requested by our students. Many part-time students, for example, bring their job experiences and needs to the classroom, where these topics are discussed in an open forum. The design of an installation for local area networks has been one of the most frequently requested topics in recent years, reflecting a significant trend in the communications world. Another important topic raised by students has been fiber-optic networks and their components, particularly erbium-doped fiber-optic amplifiers. Allowing some freedom to revise course content during the semester, without feeling constrained by a rigid course syllabus, brings considerable creativity to the classroom.

A critical aspect of the learning experience is the class format. At New York City Technical College, classes meet once a week for five hours, with each session combining theory and lab experiments. Other schools run classes that meet two or three times a week, separating the lab work from the lectures. As you can see, it is virtually impossible to provide every instructor with a ready-to-use syllabus. Our syllabus for a one-semester course in an engineering-technology program is found in the *Instructor's Manual* accompanying this text. The *Instructor's Manual* also provides you with additional possibilities for preparing course outlines that will meet your course objectives.

About the Laboratory Exercises

The descriptions of the test and measurement procedures can be used as a guide for building a laboratory course. This has already been done at New York City Technical College. Also the experiments presented are simple to perform yet have a lot of information to convey, they can be carried out as a series of small, independent projects rather than as step-by-step exercises. For example, one of these projects requires the student to measure certain characteristics, such as a multimode fiber's attenuation, but it does not delineate a specific sequence by which to achieve that goal. This approach is recommended because it gives students a feel for the real working environment. The *Instructor's Manual* accompanying this book contains more detailed suggestions on how to set up a program of laboratory exercises.

To sum up, we believe this textbook provides you with all the material you need to devise a course that will be suitable for the technical level of your students.

Acknowledgments

I am deeply obliged to the many people who helped in the preparation of this book.

I wish to express my thanks, first of all, to my coauthor, Professor Lowell Scheiner, who shared this long, difficult, but ultimately rewarding experience with me every step of the way.

The administration of New York City Technical College cooperated with me fully by allotting me sufficient time to undertake this endeavor, and I am especially indebted to Dr. Emilie Cozzi, the president of the college at the time this project was undertaken.

My colleagues in the Department of Electrical Engineering and Telecommunications Technologies supported and encouraged me throughout this venture.

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Dr. Karim Mynbaev reviewed Chapters 9, 10, and 11. His contribution helped significantly to improve the material covered there.

Andrei Basov did yeoman work turning rough graphics into polished artwork.

My students at New York City Technical College stimulated me in developing this course. Their constructive feedback introduced new topics and led, I trust, to the overall improvement of the course and the book.

I appreciate the valuable feedback from the following reviewers: Eugene Bartlett, ITT Tech–Florida; John Nawn, Ocean County College; Thomas Shay, New Mexico State University; and Chris Wernicki, New York Institute of Technology.

Finally, Professor Scheiner and I are greatly appreciative of the assistance provided by the various companies that sent us documentation, particularly graphic material, to help illustrate the concepts discussed.

D. K. M.

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