面向21世纪

高等学校信息工程类专业系列教材

电子信息类专业英语

Specialized English on Telecommunications

李白萍　主编

西安电子科技大学出版社
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2003

【内容简介】

本书共分 18 个单元，内容涉及到电子信息行业多数领域(如通信、电信、光电子、微电子、自动化、计算机等)的新技术。每个单元包括三篇文章，Passage A、Passage B 为精读部分，Passage C 为泛读部分，供读者自学。为了帮助读者深入领会文章内容，精读部分给出了文中较为难懂的单词、短语的中文释义，对文章中的长句和难句进行剖析，并在文章后面配有一定量的练习题，便于读者对文章内容的理解和掌握。通过对本书的学习，可以使读者掌握一定量的专业英语词汇及术语，了解科技文献的表达特点，提高阅读和理解原始专业英语文献的能力与速度，掌握英语翻译技巧，开阔视野。

本书可作为电子信息类部分专业大学本科生的专业英语教材，也有助于提高信息产业工程技术人员的专业英语水平。

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序

第三次全国教育工作会议以来，我国高等教育得到空前规模的发展。经过高校布局和结构的调整，各个学校的新专业均有所增加，招生规模也迅速扩大。为了适应社会对“大专业、宽口径”人才的需求，各学校对专业进行了调整和合并，拓宽专业面，相应地教学计划、大纲也都有了较大的变化。特别是进入21 世纪以来，信息产业发展迅速，技术更新加快。面对这样的发展形势，原有的计算机、信息工程两个专业的传统教材已很难适应高等教育的需要，作为教学改革的重要组成部分，教材的更新和建设迫在眉睫。为此，西安电子科技大学出版社聘请南京邮电学院、西安邮电学院、重庆邮电学院、吉林大学、杭州电子工业学院、桂林电子工业学院、北京信息工程学院、深圳大学、解放军电子工程学院等 10 余所国内电子信息类专业知名院校长期在教学科研第一线工作的专家教授，组成了高等学校计算机、信息工程类专业系列教材编审专家委员会，并且面向全国进行系列教材编写招标。该委员会依据教育部有关文件及规定对这两大类专业的教学计划和课程大纲，目前本科教育的发展变化和相应系列教材应具有的特色和定位以及如何适应各类院校的教学需求等进行了反复研究、充分讨论，并对投标教材进行了认真评审，筛选并确定了高等学校计算机、信息工程类专业系列教材的作者及审稿人，这套教材预计在 2004 年全部出齐。

审定并组织出版这套教材的基本指导思想是力求精品、力求创新、优中选优、以质取胜。教材内容要反映 21 世纪信息科学技术的发展，体现专业课内容更新快的要求；编写上要具有一定的弹性和可调性，以适合多数学校使用。体系上要有所创新，突出工程技术型人才培养的特点，面向国民经济对工程技术人才的需求，强调培养学生较系统地掌握本学科专业必需的基础知识和基本理论，有较强的本专业的基本技能、方法和相关知识，培养学生具有从事实际工程的研发能力。在作者的遴选上，强调作者应在教学、科研第一线长期工作，有较高的学术水平和丰富的教材编写经验；教材在体系和篇幅上符合各学校的教学计划要求。

相信这套精心策划、精心编审、精心出版的系列教材会成为精品教材，得到各院校的认可，对于新世纪高等学校教学改革和教材建设起到积极的推动作用。

系列教材编委会

2002 年 8 月

高等学校计算机、信息工程类专业

系列教材编审专家委员会

前　言

大多数技术方面的最新研究动态一般都是以英文的形式公布于众的。为了适应我国电子信息产业的飞速发展，了解电子信息产业的最新动态，提高从事电子信息类专业的教学、科研、工程技术人员的专业英语水平，使他们能熟练地阅读和翻译有关英文文献、资料和书籍，特编写了《电子信息类专业英语》这本教材。

全书共分 18 个单元，每个单元包括三篇文章。其中，Passage A、Passage B 为精读部分，Passage C 为泛读部分，供读者自学。为了帮助读者深入领会文章内容，精读部分给出了文中较为难懂的单词、短语的中文释义；对文章的长句和难句进行剖析，并在文章后面配有一定量的练习题，便于读者对文章内容的理解和掌握。

通过对本书的学习，可以使读者掌握和扩大电子信息类专业的英语词汇量及术语，了解科技文献的表达特点，提高阅读和理解原始专业英语文献的能力，掌握英语翻译技巧。

考虑到电子信息类专业目前与计算机的紧密联系，因此，本书的选材力求丰富、多样，涉及到电子信息类的通信、电信、光电子、微电子、自动化、计算机等各专业，有助于提高读者的阅读能力和开阔读者的视野。

本书由李白萍、王守华、倪云峰编写，李白萍担任主编。在编写和出版过程中，我们得到了学校领导和部分专业教师的关心和支持，在此，向他们表示衷心的感谢。同时，我们也对引用的国内外高等院校的教科书和一些高级别的专业技术刊物的文章的作者表示感谢。

本书在专业内容的涵盖范围和语言的难易程度上也许会有不尽如人意的地方，书中也会有一些错误和不足之处，希望读者指正并提出宝贵的意见，以便今后改进。

本书的出版得到了西安科技大学本科教材建设基金的立项支持。

编　者

2003 年 3 月 7 日

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Unit One

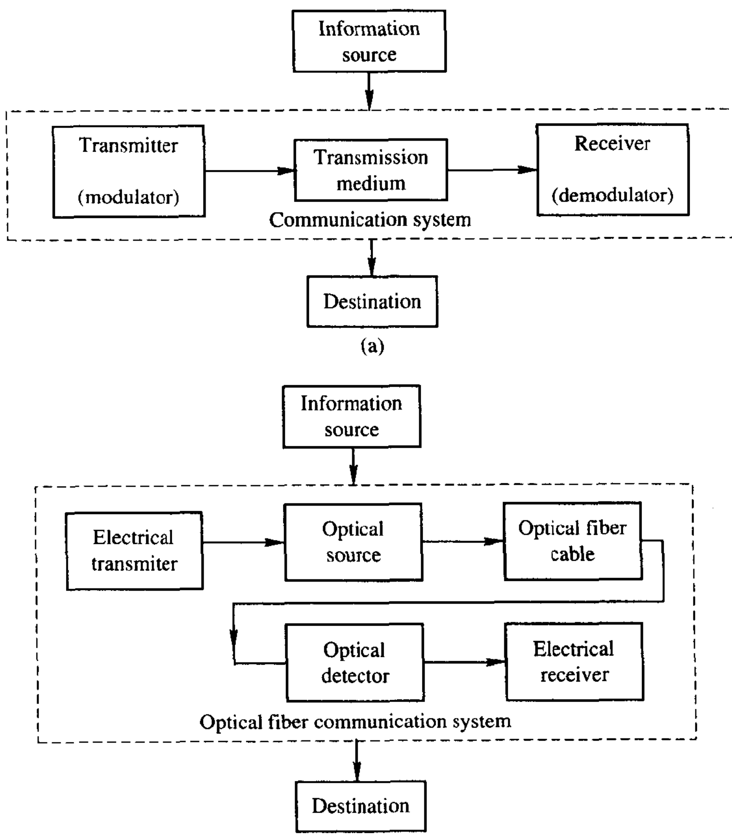
Optical Fiber Communication

Passage A The General System

Communication may be broadly defined as the transfer of information from one point to another. When the information is to be conveyed over any distance, a communication system is usually required. Within a communication system the information transfer is frequently achieved by superimposing or modulating the information on to an electromagnetic wave which acts as a carrier for the information signal. This modulated carrier is then transmitted to the required destination where it is received and the original information signal is obtained by demodulation . Sophisticated techniques have been developed for this process by using electromagnetic carrier waves operating at radio frequencies as well as microwave and millimeter wave frequencies. However, "communication" may also be achieved by using an electromagnetic carrier which is selected from the optical range of frequencies.

An optical fiber communication system is similar in basic concept to any type of communication system. A block schematic of a general communication system is shown in Figure 1.1(a), the function of which is to convey the signal from the information source over the transmission medium to the destination. The communication system therefore consists of a transmitter or modulator linked to the information source, the transmission medium, and a receiver or demodulator at the destination point. In electrical communications the information source provides an electrical signal, usually derived from a message signal which is not electrical (e.g. sound), to a transmitter comprising electrical and electronic components which converts the signal into a suitable form for propagation over the transmission medium. This is often achieved by modulating a carrier, which, as mentioned previously, may be an electromagnetic wave. The transmission medium can consist of a pair of wires, a coaxial cable or a radio link through free space down which the signal is transmitted to the receiver, where it is transformed into the original electrical information signal (demodulated) before being passed to the destination. However, it must be noted that in any transmission medium the signal is attenuated, or suffers loss, and is subject to degradations due to communication by random signals and noise, as well as possible distortions imposed by mechanisms within the medium itself. Therefore, in any communication system there is a maximum permitted distance between the transmitter and the receiver beyond which the system effectively ceases to give intelligible communication. For long-haul applications these factors necessitate the installation of repeaters or line amplifiers at intervals, both to remove signal distortion and to increase signal level before transmission is continued down the link.

For optical fiber communications system shown in Figure1.1(a) may be considered in slightly greater detail, as given in Figure1.1(b). In this case the information source provides an electrical signal to a transmitter comprising an electrical stage which drives an optical source to give modulation of the lightwave carrier. The optical source which provides the electrical-optical conversion may be either a semiconductor laser or light emitting diode (LED). The transmission medium consists of an optical fiber cable and the receiver consists of an optical detector which drives a further electrical stage and hence provides demodulation of the optical carrier. Photodiodes (p-n, p-i-n or avalanche) and, in some instances, phototransistors and photoconductors are utilized for the detection of the optical signal and the optical-electrical conversion. Thus there is a requirement for electrical interfacing at either end of the optical link and at present the signal processing is usually performed electrically.



(b)

Figure 1.1

(a) The general communication system; (b) The optical fiber communication system

The optical carrier may be modulated using either an analog or digital information signal. In the system shown in Figure1.1(b) analog modulation involves the variation of the light emitted from the optical source in a continuous manner. With digital modulation, however, discrete changes in the light intensity are obtained (i.e. on-off pulses). Although often simpler to implement, analog modulation with an optical fiber communication system is less efficient, requiring a far higher signal to noise ratio at the receiver than digital modulation.[1] Also, the linearity needed for analog modulation is not always provided by semiconductor optical sources, especially at high modulation frequencies. For these reasons, analog optical fiber communication links are generally limited to shorter distances and lower bandwidths than digital links.

Figure 1.2 shows a block schematic of a typical digital optical fiber link. Initially, the input digital signal from the information source is suitably encoded for optical transmission. The laser drive circuit directly modulates the intensity of the semiconductor laser with the encoded digital signal. Hence a digital optical signal is launched into the optical fiber cable. The avalanche photodiode (APD) detector is followed by a front-end amplifier and equalizer or filter to provide gain as well as linear signal processing and noise bandwidth reduction.[2] Finally, the signal obtained is decoded to give the original digital information. However, at this stage it is instructive to consider the advantages provided by lightwave communication via optical fibers in comparison with other forms of line and radio communication which have brought about the introduction of such systems in many areas throughout the world.

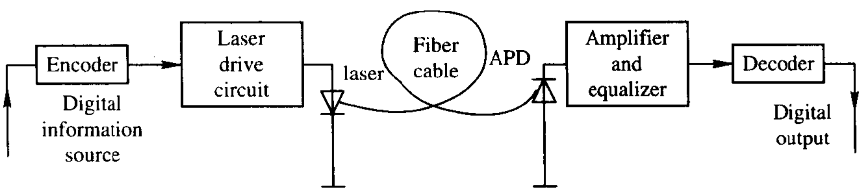


Figure 1.2

KEY WORDS

superimposing 叠加，重叠

sophisticated 复杂的，高级的，现代化的

coaxial 同轴的

degradation 恶化，降级

distortion 失真，畸变

LED (light-emitting-diode) 发光二极管

photoconductor 光敏电阻

discrete 离散，不连续

linearity 线性度

intensity 强度

avalanche 雪崩

front-end 前置，前级

NOTES

[1] Although often simpler to implement, analog modulation with an optical fiber communication system is less efficient , requiring a far higher signal to noise ratio at the receiver than digital modulation .

虽然具有光纤系统的模拟调制易于实现，但其效率较低，且要求在接收端有比数字调制高得多的信噪比。

· signal to noise ratio 为信噪比。

[2] The avalanche photodiode (APD) detector is followed by a front-end amplifier and equalizer or filter to provide gain as well as linear signal processing and noise bandwidth reduction.

前置放大器与均衡器或滤波器跟在雪崩二极管检测器的后面以获得增益、线性信号处理及噪声带宽的抑制。

EXERCISES

1. Fill in the blanks.

(1) Within a communication system the information transfer is frequently achieved by_____or _______the information on to an electromagnetic wave.

(2) The general communication system consists of a ______ or modulator,the transmission medium, and a receiver or _______ at the destination point.

(3) The optical source which provides the __________ conversion may be either a semiconductor ______ or LED.

(4) The laser drive circuit directly modulates the ______ of the semiconductor laser with the encoded digital signal.

(5) The APD detector is followed by a _______ amplifier to provide gain.

(6) A much enhanced bandwidth utilization for an optical fiber can be achieved by transmitting several optical signals, each at different ______, in parallel on the same fiber.

(7) Optical fibers have very small diameters which are often ______ than the diameter of a human hair.

(8) The light from optical fibers does not radiate significantly and therefore they provide a _______ degree of signal security.

2. True/False.

(1) When the information is to be conveyed over any distance, a communication system is usually required. (　　)

(2) In any communication system there is a maximum permitted distance between the transmitter and the receiver beyond which the system effectively ceases to give intelligible communication. (　　)

(3) Digital modulation with an optical fiber communication system is less efficient, requiring a far higher signal to noise radio at the receiver than analog modulation. (   )

(4) Digital optical fiber communication links are generally limited to shorter distances and lower bandwidths than analog links. (   )

(5) The information-carrying capacity of optical fiber systems has proved far superior to the best copper cable systems. (   )

(6) The WDM (wavelength division multiplexed) operation offers the potential for a fiber information carrying capacity which is may orders of magnitude in excess of that obtained using copper cables or a radio system. (   )

(7) Like the situation with copper cables, a transmitted optical signal can be obtained from a fiber in a noninvasive manner. (   )

(8) Taking the size and weight advantage into account, these optical fiber cables are generally superior in terms of storage, transportation, handling and installation to corresponding copper cables, whilst exhibiting at least comparable strength and durability. (   )

(9) Hence with fewer repeaters, system reliability is generally enhanced in comparison with conventional electrical conductor system. (   )

(10) Although the use of the laser for free space optical communication proved somewhat limited, the invention for the laser instigated a tremendous research effort into the study of optical component to achieve reliable information transfer using a lightwave carrier. (   )

(11) In theory, the greater the carrier frequency, the smaller the available transmission bandwidth and thus the information-carrying capacity of the communication system. (   )

3. Fill in the blanks with the best choice.

(1) Sophisticated techniques have been developed for the process of modulation, demodulation and transmission using electromagnetic carrier waves operating at radio frequencies as well as _______.

a. microwave frequency   b. millimeter wave frequency

c. a and b   d. a or b

(2) The electrical transmission medium can consist of _______.

a. a pair of wires   b. a coaxial cable

c. a radio link through free space down   d. all of above

(3) _______ are not utilized for the detection of the signal and the optical-electrical conversion.

a. Light emitting diodes   b. Phototransistors

c. Photoconductors   d. Photodiodes

(4) The property of electrical isolation makes optical fiber transmission ideally suited for communication in electrically hazardous environments as the fibers create no_______.

a. arcing b. spark hazard at abrasions

c. short circuits d. any of above

(5) Optical fibers form a dielectric wave guide but not free from ________.

a. electromagnetic interference b. radio frequency interference

c. mechanical damage d. electromagnetic pulse

(6) Fibers have been fabricated with losses as low as _______ and this feature has become a major advantage of optical fiber communication.

a. 5 dB/km b. 0.2 dB/km

c. 1 dB/km d. 0.5 dB/km

(7) To obtain both the low loss and low dispersion at the same operating wavelength, which kind of new advanced single-mode structure has been realized: ______.

a. namely b. dispersion shifted

c. dispersion flattened d. all of above

Passage B Advantages of Optical Fiber Communication

Communication using an optical carrier wave guided along a glass fiber has a number of extremely attractive features, several of which were apparent when the technique was originally conceived. Furthermore, the advances in the technology to date have surpassed even the most optimistic predictions, creating additional advantages. Hence it is useful to consider the merits and special features offered by optical fiber communications over more conventional electrical communications. In this context we commence with the originally foreseen advantages and then consider additional features which have become apparent as the technology has been developed.

(a) Enormous potential bandwidth. The optical carrier frequency in the range 10^{13} to 10^{16} Hz (generally in the near infrared around 10^{14} Hz or 10^{5} GHz) yields a far greater potential transmission bandwidth than metallic cable systems (i.e. coaxial cable bandwidth up to around 500 MHz) or even millimeter wave radio systems (i.e. systems currently operating with modulation bandwidths of 700 MHz). At present, the bandwidth available to fiber systems is not fully utilized but modulation at several gigahertz over a hundred kilometers and hundreds of megahertz over three hundred kilometers without intervening electronics (repeaters)is possible. [1] Therefore, the information-carrying capacity of optical fiber systems has proved far superior to the best copper cable systems. By comparison the losses in wideband coaxial cable systems restrict the transmission distance to only a few kilometers at bandwidths over one hundred megahertz.

Although the usable fiber bandwidth will be extended further towards the optical carrier frequency, it is clear that this parameter is limited by the use of a single optical carrier signal. Hence much enhanced bandwidth utilization for an optical fiber can be achieved by transmitting several optical signals, each at different center wavelengths, in parallel on the same fiber. This wavelength division multiplexed operation, particularly with dense packing of the optical wavelengths (or, essentially, fine frequency spacing), offers the potential for a fiber information-carrying capacity which is many orders of magnitude in excess of that obtained using copper cables or a wideband radio system. [2]

(b) Small size and weight. Optical fibers have very small diameters which are often no greater than the diameter of a human hair. Hence, even when such fibers are covered with protective coatings they are far smaller and much lighter than corresponding copper cables. This is tremendous boon towards the alleviation of duct congestion in cities, as well as allowing for an expansion of signal transmission within mobiles such as aircraft, satellites and even ships.

(c) Electrical isolation. Optical fibers which are fabricated from glass, or sometimes a plastic polymer, are electrical insulators and therefore, unlike their metallic counterparts, they do not exhibit earth loop and interface problems. Furthermore, this property makes optical fiber transmission ideally suited for communication in electrically hazardous environments as the fibers create no arcing or spark hazard at abrasions or short circuits.

(d) Immunity to interference and cross-talk. Optical fibers form a dielectric wave-guide and are therefore free from electromagnetic interference (EMI), radio frequency interference (RFI), or switching transients giving electromagnetic pulse(EMP).Hence the operation of an optical fiber communication system is unaffected by transmission through an electrically noisy environment and the fiber cable requires no shielding from EMI. The fiber cable is also not susceptible to lightning strikes if used overhead rather than underground. Moreover, it is fairly easy to ensure that there is no optical interference between fibers and hence, unlike communication using electrical conductors, cross-talk is negligible, even when many fibers are cabled together.

(e) Signal security. The light from optical fibers does not radiate significantly and therefore they provide a high degree of signal security. Unlike the situation with copper cables, a transmitted optical signal cannot be obtained from a fiber in a noninvasive manner (i. e. without drawing optical power from the fiber). Therefore, in theory, any attempt to acquire a message signal transmitted optically may be detected. This feature is obviously attractive for military, banking and general data transmission (i.e. computer network) applications.

(f) Low transmission loss. The development of optical fibers over the last twenty years has resulted in the production of optical fiber cables which exhibit very low attenuation or transmission loss in comparison with the best copper conductors. Fibers have been fabricated with losses as low as 0.2 dB/km and this feature has become a major advantage of optical fiber communications. It facilitates the implementation of communication links with extremely wide repeater spacing (long transmission distances without intermediate electronics), thus reducing both system cost and complexity. Together with the already proven modulation bandwidth capability of fiber cable this property provides a totally compelling case for the adoption of optical fiber communication in the majority of long-haul telecommunication applications.

(g) Ruggedness and flexibility. Although protective coatings are essential, optical fibers may be manufactured with very high tensile strengths. Perhaps surprisingly for a glassy substance,

the fibers may also be bent to quite small radii or twisted without damage. Furthermore, cable structures have been developed, which have proved flexible, compact and extremely rugged. Taking the size and weight advantage into account, these optical fiber cables are generally superior in terms of storage, transportation, handling and installation to corresponding copper cables, whilst exhibiting at least comparable strength and durability.[3]

(h) System reliability and ease of maintenance. These features primarily stem from the low loss property of optical fiber cables which reduces the requirement for intermediate repeaters or line amplifiers to boost the transmitted signal strength. Hence with fewer repeaters, system reliability is generally enhanced in comparison with conventional electrical conductor systems. Furthermore, the reliability of the optical components is no longer a problem with predicted lifetimes of 20 to 30 years now quite common. Both these factors also tend to reduce maintenance time and costs.

(i) Potential low cost. The glass which generally provides the optical fiber transmission medium is made from sand—not a scarce resource. So, in comparison with copper conductors, optical fibers offer the potential for low cost line communication. Although over recent years this potential has largely been realized in the costs of the optical fiber transmission medium which for bulk purchases is now becoming competitive with copper wires (i.e. twisted pairs), it has not yet been achieved in all the other component areas associated with optical fiber communications. For example, the costs of high performance semiconductor lasers and detector photodiodes are still relatively high, as well as some of those concerned with the connection technology (demountable connectors, couplers, etc).

Overall system costs when utilizing optical fiber communication on long-haul links, however, are substantially less than those for equivalent electrical line systems because of the low loss and wideband properties of the optical transmission medium. As indicated in (*f*), the requirement for intermediate repeaters and the associated electronics is reduced, giving a substantial cost advantage. Although this cost benefit gives a net gain for long-haul links it is not always the case in short-haul applications where the additional cost incurred, due to the electrical-optical conversion (and vice versa), may be a deciding factor. Nevertheless, there are other possible cost advantages in relation to shipping, handing, installation and maintenance, as well as the features indicated in (*c*) and (*d*) which may prove significant in the system choice.

The reducing costs of optical fiber communications has not only provided strong competition with electrical line transmission systems, but also for microwave and millimeter wave radio transmission systems. Although these systems are reasonably wideband the relatively short span "line of sight" transmission necessitates expensive aerial towers at intervals no greater than a few tens of kilometers. Hence optical fiber is fast becoming the dominant transmission medium within the major industrialized societies.

Many advantages are therefore provided by the use of a light-wave carrier within a transmission medium consisting of an optical fiber. The fundamental principles giving rise to these enhanced performance characteristics, together with their practical realization, are described in the following chapters. However, a general understanding of the basic nature and properties of light is assumed.

KEY WORDS

metallic (像)金属的，含金属的，(声音)刺耳的
parameter 参数，参量
congestion 充满，拥挤，阻塞
hazardous 危险的
arc 电弧
abrasion 擦伤，磨损
immunity 抗扰，免除，免疫性
dielectric 电介质，绝缘材料；电解质的，绝缘的
wave-guide 波导
transient 瞬时的
susceptible (to) 敏感的，易受…的
noninvasive 非侵略的，非侵害的
attenuation 衰减
implementation 实施，实现，执行，敷设
ruggedness 结实
tensile 拉力的，张力的
demountable 可拆卸的
substantial 多的，大的，实际上的
aerial 空气的，空中的，无形的，虚幻的；天线
encompass 围绕，包围，造成，设法做到

※ ※ ※

wavelength division multiplexed 波分复用
in parallel on 并联到，合并到
in excess of 超过
no greater than 不大于
take…into account 考虑，重视…
stem from… 起源于；由…发生
in comparison with… 与…比较
give rise to 引起，使产生

NOTES

[1] At present, the bandwidth available to fiber systems is not fully utilized but modulation at several gigahertz over a hundred kilometers and hundreds of megahertz over three hundred kilometers without intervening electronics (repeaters) is possible.