面向21世纪
高等学校信息工程类专业系列教材

信息科学类专业英语

Professional English for Information Science

袁立行 韩俊刚 编著

西安电子科技大学出版社
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2003

【内容简介】

本书选取信息科学前沿领域的相关内容，具有内容新，知识面广，难度大，趣味性强等特点。书中的主要内容涉及计算机、网络和通信、自动化和集成电路设计等信息技术领域的最新知识，具有广泛性和综合性。在每课末，结合课文内容给出相关的重点、难点句子的解释；同时为增强学生阅读兴趣，扩展知识面，提高阅读理解能力，本书采用了大学六级英语考试和研究生入学考试中的阅读理解题的形式，来考查学生对难句、长句和结构复杂句型的理解。

本书内容新颖，取材合理，叙述清楚，既可以用作高等理工科院校信息科学与技术本科生的专业英语教材，又可以作为相关领域技术人员的参考书。

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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，相应的教学计划、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，对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 年春季全部出齐。

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、好中选优、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

本书是在西安邮电学院计算机科学与技术系各专业已经使用了三年的内部教材的基础上修改补充而成的。

这本教材的特点是内容新，知识面广，难度大，趣味性强。本书所面向的对象包括计算机科学与技术、网络工程和电子信息科学与技术专业的学生，实际上可以是信息技术领域各个专业的学生，因此，所选择的文章超出了某一个专业的专业课的内容，具有广泛性和综合性，并尽量涉及计算机、网络和通信、自动化和集成电路设计等技术领域的最新知识，以引起学生阅读的兴趣。

本教材的另外一个特点是兼顾六级英语考试和研究生入学考试。六级考试大纲对阅读理解题的要求是：既能理解个别句子的意义，也能理解上下文的逻辑关系；既能理解字面的意思，也能理解隐含的意思；既能理解事实和细节，也能理解所读材料的主旨和大意；能就文章的内容进行判断、推理和信息转换。考研复习大纲要求考生在阅读理解方面，必须对难句和长句做充分的理解，在英译汉方面要对结构复杂的句型充分理解。为了适应这些要求，我们对于课文中结构复杂的句子给出了详细的注释和讲解。本书每课课文后面的问题就是仿照英语六级的方式编排的，课后的 Vocabulary 中还将课文中出现的六级词汇标注了星号(*)，要求同学掌握。

由于本书的上述特点，因而对授课教师的要求比较高，特别要求教师的知识面广泛，了解并关注信息技术领域的最新进展。建议在讲授本书时，按照英语六级阅读理解的要求，让学生在课堂上或在课前做 35 分钟的练习，在学生练习之后再把课文讲解透彻。有些课文比较长，可以只讲授一些段落，其余的留作课外练习，或者留给学有余力的学生课外阅读。另外，为训练写作能力，也可以让学生对课文进行缩写。

专业英语对于学生毕业后的工作非常重要，通过专业英语的学习，应当培养学生在工作中不断阅读英语资料和继续学习英语的能力。我们希望通过本书的出版，与国内教授专业英语的老师进行交流，把我国高校专业英语的教学提高到新的水平，特别希望广大教师和读者对本书提出宝贵意见。如果需要本书的电子版，可以和我们联系，我们将免费提供。联系方式：西安市长安南路 563 号西安邮电学院计算机系(710061)；电子邮件地址：lxyuan@xiyou.edu.cn 或 hjg@xiyou.edu.cn。

书中每课的英语选文都是从因特网上认真选择的，我们尽量保持作者的署名，并向作者致谢。

编者

2003 年 7 月

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Lesson 1

How does a logic gate in a microchip work?

by Manni Wood , Edmonton, Alberta, Canada

A gate seems like a device that must swing open and closed, yet microchips are etched onto silicon wafers that have no moving parts. So how can the gate open and close?

Larry Wissel, ASIC Applications Engineer at IBM Microelectronics, replies:

"Those of us who design logic gates for computers seldom reminisce on how the terms we use to describe technology came into use. The vision of a gate swinging back and forth clearly does not literally represent the structures on a silicon chip. But the reason for the usage of the term 'gate' for computer logic can be appreciated by examining the basic function of a gate: to control a flow."

"On a farm, gates may be used to control the 'flow' of sheep or goats between pens. In this case, the gate consists of a physical barrier whose position is controlled by a farmer. The farmer makes a decision about the flow of animals and then moves the physical barrier to permit the desired flow."

"In a computer, a gate controls the flow of electric current through a circuit. The gate consists of transistors; the transistors are selected by the chip designer from two basic types (PMOS and NMOS transistors) that are found in the ubiquitous CMOS (complementary metal-oxide semiconductor) technology.[1] The current that flows through a gate establishes a voltage at a particular point in the circuit. This voltage represents a single 'bit' of information. The voltage may either be high (representing the value '1') or low (representing the value '0')."

"To establish a 1 on a circuit, the current flow is steered to the circuit (controlled) by 'turning on' a PMOS transistor connected between the circuit and the positive supply voltage. The supply voltage is usually an industry-standard value such as 3.3 or 5.0 volts. For the very brief interval that is required for a logic gate to switch (on the order of a nanosecond, or a billionth of a second), current will flow through a PMOS transistor from the positive power supply to the circuit."

"The current flow that charges the circuit node to a 0 is steered away from the circuit through a different kind of transistor (NMOS) connected between the circuit and the negative supply voltage, or electrical ground. Again, current will flow through the NMOS transistor for a very brief interval, but for the NMOS the current is between the circuit and the negative supply. In either case, the current flow results in a change in the circuit voltage, and the circuit voltage represents a bit of information. So, when a gate is controlling current flow, it is actually controlling the flow of information."

"Returning to the analogy between the farm and the computer chip, it is obvious that the flow is different (farm animals compared to information) and that the gate itself is different (a physical barrier compared to a transistor in the CMOS technology). But the most important difference is the means of controlling the flow. On the farm, the farmer resets the gate location by making a decision and then moving a physical barrier. A flow of animals through a complex maze of gates would require a farm hand at each gate."

"But in a computer chip, the control mechanism is the voltage on the control terminal of a transistor. This voltage turns on a transistor by changing its characteristics from that of an open circuit (the 'off' position) to one that can conduct a small current. This control voltage, in turn, is already available within the chip as a voltage at a point on another circuit. And, being a voltage on a circuit, this control mechanism represents a different bit of information."

"The overwhelming computing power of logic gates stems from the fact that the output of any particular gate is a voltage, which can in turn be used to control another gate.[(2)] A computer chip therefore can be designed to make complex decisions about the information flow within itself. This ability enables sophisticated systems to be created by interconnecting as many as a million gates within a single chip. All of this with no farm hands and no moving parts."

Tak Ning of the IBM T.J. Watson Research Center adds some complementary details:

"A logic gate in a microchip is made up of a specific arrangement of transistors. For modern microchips, the transistors are of the kind called metal-oxide-semiconductor field-effect transistor (MOSFET), and the semiconductor used is silicon. A MOSFET has three components, or regions: a source region, a drain region and a channel region having a gate over it. The three regions are arranged horizontally adjacent to one another, with the channel region in the middle."

"In a logic gate arrangement, each of the MOSFETs works like a switch. The switch is closed, or the MOSFET is turned on, if electric current can flow readily from the source to the drain. The switch is open, or the MOSFET is turned off, if electric current cannot flow from the source to the drain." [(3)]

"The source and drain regions of a MOSFET are fabricated to be full of electrons which are ready to carry current. The channel region, on the other hand, is designed to be empty of electrons under normal condition, blocking the movement of current. Hence, under normal condition, the MOSFET is 'off'(or 'open') and no current can flow from the source to the drain."

"If a positive voltage is applied to the gate (which sits on top of the channel region), then electrons, which are negative charges, will be attracted toward the gate. These electrons are collected in the channel region of the MOSFET. The larger the gate voltage, the larger is the concentration of electrons in the channel region. The substantial concentration of electrons in the channel provides a path by which the electrons can move easily from the source to the drain. When that happens, the MOSFET is 'on' (or 'closed') and current can flow from the source to the drain freely".

"In summary, a MOSFET in a microchip is turned on by applying a voltage to the gate to attract electrons to the channel region, and turned off by applying a voltage to the gate to repel electrons away from the channel region. There is movement of charges in the silicon, but there are no mechanical moving parts involved." (4)

What's a MOSFET?

MOSFET stands for metal-oxide-semiconductor field-effect transistor. It's a kind of transistor that clips gradually when overdriven, as most tubes do.

Both tubes and transistors amplify signals by passing current from one side of the device to the other, sculpting it along the way to the same shape as a much weaker input signal. It's like a movie or slide projector — a source of energy (the bulb) is shaped by the film, and projected on the screen, where we see a much bigger version of the image on the film (even though the actual light we see comes from the bulb, not the film).

There are basically three kinds of transistor that are used to amplify audio: the most common is a bipolar transistor. It is a sandwich of three layers of silicon, with the outer ones negatively charged and the middle one positively charged (NPN). Or, the other way around (PNP). A small signal on the middle layer controls a much bigger current passing between the two outer layers.(5)

A later development was the field-effect transistor (FET). Here the current doesn't have to pass through the middle layer of the sandwich, it passes near it, and is controlled by the field effect exerted on it. This was more efficient in a number of ways. It also happens to clip more softly than a bi-polar transistor.

The third type is an FET where the element doing the controlling doesn't even contact the channel carrying the large current. It's insulated from it by a thin layer of silicon dioxide—a kind of glass. This is the MOSFET, and it clips very softly.

The clipping characteristics of individual vacuum tube or solid-state semiconductors are by no means the whole story in the behavior of a circuit. You've probably noticed by now that a circuit with a tube in it can produce a sound that's buzzier and harsher than another that's made up of bi-polar transistors. And the sound that formed the original criterion for what' s desirable in overdrive, the sound of a cranked non-master-volume tube amp, has got to do with a lot things besides the tubes. There's transformers, speakers and the interaction of these with the tubes, to say nothing of the acoustic and psycho-acoustic biproducts of playing loud. Anyone interested in getting a repeatable sound that isn't dependant on playing at a certain sound pressure level would better off discarding the dogma surrounding tubes and transistors, and employing the only devices that can be trusted—the ears.

1. Basic Structure and Principle of Operation

The n-type metal-oxide-semiconductor field-effect transistor (MOSFET) consists of a source and a drain, two highly conducting n-type semiconductor regions which are isolated from the p-type substrate by reversed-biased p-n diodes. A metal (or poly-crystalline) gate covers the region between source and drain, but is separated from the semiconductor by the gate oxide. The basic structure of an n-type MOSFET and the corresponding circuit symbol are shown in fig. 1.

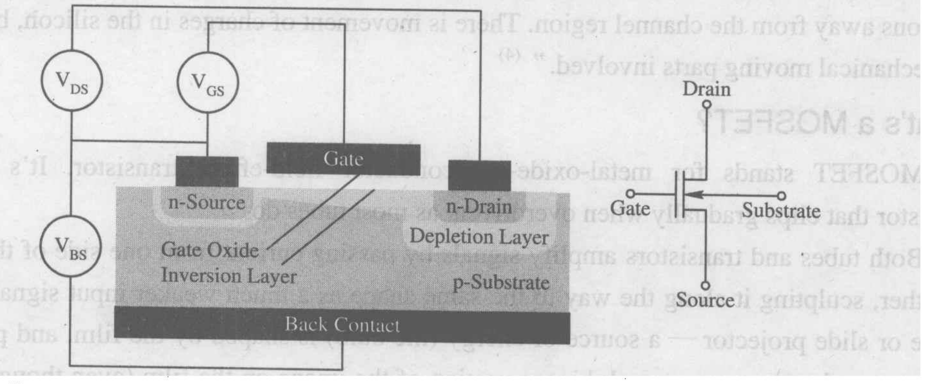

Fig.1 Crosssection and circuit symbol of an n-type metal-oxide-semiconductor field-effect transistor

As can be seen on the figure the source and drain regions are identical. It is the applied voltages which determine which n-type region provides the electrons and becomes the source, while the other n-type region collects the electrons and becomes the drain. The voltages applied to the drain and gate electrode as well as to the substrate by means of a back contact are referred to the source potential, as also indicated on the figure.

A top view of the same MOSFET is shown in Fig.2, where the gate length, L, and gate width, W, are identified. Note that the gate length does not equal the physical dimension of the gate, but rather the distance between the source and drain regions underneath the gate. The overlap between the gate and the source and drain region is required to ensure that the inversion layer forms a continuous conducting path between the source and drain region. Typically this overlap is made as small as possible in order to minimize its parasitic capacitance.

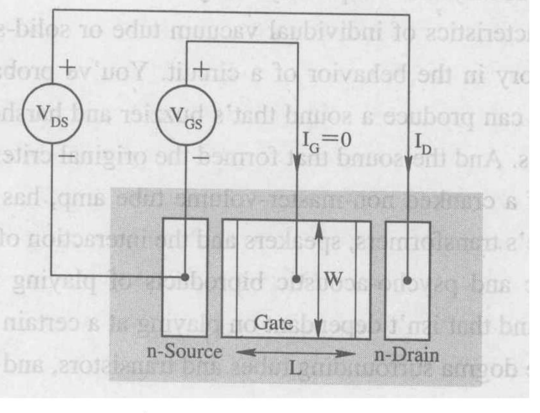

Fig.2 Top view of an n-type metal-oxide-semiconductor field-effect transistor (MOSFET)

The flow of electrons from the source to the drain is controlled by the voltage applied to the gate. A positive voltage applied to the gate, attracts electrons to the interface between the gate dielectric and the semiconductor. These electrons form a conducting channel between the source and the drain, called the inversion layer. No gate current is required to maintain the inversion layer at the interface since the gate oxide blocks any carrier flow. The net result is that the current between drain and source is controlled by the voltage which is applied to the gate.

The typical current versus voltage (I–V) characteristics of a MOSFET are shown in the figure below(Fig.3). Implemented is the quadratic model for the MOSFET.

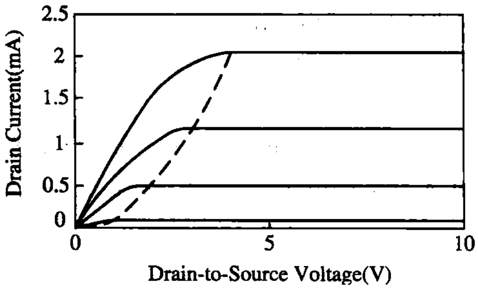

Fig.3 I–V characteristics of an n-type MOSFET with V_G = 5 V (top curve), 4 V, 3 V and 2 V (bottom curve)

NOTE: We will primarily discuss the n-type or n-channel MOSFET. This type of MOSFET is fabricated on a p-type semiconductor substrate. The complementary MOSFET is the p-type or p-channel MOSFET. It contains p-type source and drain regions in an n-type substrate. The inversion layer is formed when holes are attracted to the interface by a negative gate voltage. While the holes still flow from source to drain, they result in a negative drain current. CMOS circuits require both n-type and p-type devices.

2. A Short History

A conceptually similar structure was first proposed and patented by Lilienfeld and Heil in 1930, but was not successfully demonstrated until 1960. The main technological problem was the control and reduction of the surface states at the interface between the oxide and the semiconductor.

Initially it was only possible to deplete an existing n-type channel by applying a negative voltage to the gate. Such devices have a conducting channel between source and drain even when no gate voltage is applied and are called "depletion-mode" devices.

A reduction of the surface states enabled the fabrication of devices which do not have a conducting channel unless a positive voltage is applied. Such devices are refered to as "enhancement-mode" devices. The electrons at the oxide-semiconductor interface are concentrated in a thin (~10 nm thick) "inversion" layer. By now, most MOSFETs are "enhancement-mode" devices.

3. How does a MOSFET amplify electrical signals?

While a minimum requirement for amplification of electrical signals is power gain, one finds that a device with both voltage and current gain is a highly desirable circuit element. The MOSFET provides current and voltage gain yielding an output current into an external load which exceeds the input current and an output voltage across that external load which exceeds the input voltage.

The current gain capability of a field-effect-transistor (FET) is easily explained by the fact that no gate current is required to maintain the inversion layer and the resulting current between drain and source. The device has therefore an infinite current gain in DC. The current gain is inversely proportional to the signal frequency, reaching unity current gain at the transit frequency.[6]

The voltage gain of the MOSFET is caused by the fact that the current saturates at higher drain-source voltages, so that a small drain current variation can cause a large drain voltage variation.

Vocabulary

1. silicon*　n. [化]硅，硅元素
2. wafers*　n. [无]晶片，圆片，薄饼，干胶片
   vt. 用干胶片封
3. reminisce　vi. 缅怀往事，回忆过去的经历或事件，话旧
4. appreciate　vt.
   (1) 重视，赏识，认识到…的质量、显著性或重要性
   (2) 意识到，察觉，对…的充分意识或领会
   (3) 感谢，感激，对…表示感激
   (4) 欣赏；重视
5. barrier　n.
   (1) 栅栏，挡板，壁垒，关卡；一种建造物，例如篱笆，用来禁止通行
   (2) 非物质的妨碍或阻碍物
   (3) 界线或限制
   (4) 分开物，隔离物，用于分开或隔离的事物
6. ubiquitous　adj. 无处不在的，在同一时间是或看起来是到处存在的
7. CMOS　abbr. complementary metal-oxide semiconductor n. [计]互补金属氧化物半导体
8. steer　vt.
   (1) 掌舵，用舵、桨或轮等装置指引
   (2) 指引…的路线

(3) 操纵，控制使(某人)进入一地区或行动路线

vi. 驾驶，驾驶船或车

9. overwhelming* adj. 在影响力量上势不可挡的，不可抗拒的

10. sophisticated adj.

(1) 老于世故的，具备世故的知识或精细的；缺乏自然的单纯或天真幼稚的

(2) 非常复杂、精密或尖端的

(3) 深奥的，微妙的；适于或吸引精于此道者胃口的

11. MOSFET abbr. metal-oxide-semiconductor field-effect transistor [电子]金属氧化物半导体场效应(晶体管)

12. fabricate* vt.

(1) 制作；创造

(2) 装配；把不同的，通常是标准化的零件组装或装配成一个整体

(3) 编造，以欺骗为目的进行捏造

13. concentration n.

(1) 专心，全神贯注的动作或过程，尤指专注的、不分散的注意力的集中

(2) 全神贯注的状态

14. repel* vt.

(1) 击退或赶回；驱除

(2) 抵制，抵御；反抗

(3) 拒绝接受；拒绝

15. involved adj.

(1) 繁杂的，复杂的；错综的

(2) 内卷的，向内卷的；盘绕的或内卷的

(3) 纠缠的，纠缠不清的；绞在一起的

(4) 受牵扯的；因参与或合作而有关联的

Important Sentences

1. The gate consists of transistors; the transistors are selected by the chip designer from two basic types (PMOS and NMOS transistors) that are found in the ubiquitous CMOS (complementary metal-oxide semiconductor) technology.

门电路由晶体管组成，而这些晶体管是由芯片的设计者从广泛使用的 CMOS(互补金属氧化物半导体)技术中出现的两种基本类型的晶体管(PMOS 晶体管和 NMOS 晶体管)选择确定的。

2. The overwhelming computing power of logic gates stems from the fact that the output of any particular gate is a voltage, which can in turn be used to control another gate.

逻辑门电路的强大计算能力源于这样一个事实：任何特殊门电路的输出都是一个电压信号，这个电压又可以用来控制另外的门电路。

3. In a logic-gate arrangement, each of the MOSFETs works like a switch. The switch is