Unit 1

Text A

Electronic Engineering


扫码听课文

Electronic engineering is a form of engineering associated with electronic circuits, devices and the equipment and systems that use them.

1 Electronic Engineering Fields

When asking the question “What is electronic engineering?”, it is necessary to understand that there are many different fields and disciplines involved in the overall topic.

Some of the fields within electronic engineering include:

(1) Analog electronic engineering: analog electronics is still a major sector within the overall electronic engineering scene. With many analog elements still being needed, analog circuits are still widely used. While analog electronic engineering is not as large as it used to be many years ago before digital electronics took off in a big way, the growth in the overall electronics market has compensated for this. Analog electronic engineering can provide a stimulating environment in which to work and a good career.

(2) Radio frequency electronic engineering: radio frequency electronic engineering has grown in its size in recent years. With many more systems using wireless links, everything from mobile phones to WiFi, IoT, short range links and much more, wireless technology is needed.

(3) Digital development engineering: many functions are now undertaken using digital techniques. Accordingly many digital circuits are needed and this means that some digital / logic electronic engineering is needed.

(4) Programmable logic engineering: with the complexity of many logic / digitally based circuits, an approach that is being used increasingly is one where programmable logic chips are used. FPGAs and other programmable logic chips are widely used, enabling large amounts of logic circuits to be incorporated into programmable chips. Using high level design languages like VHDL, the design is brought to within manageable limits. Also if the design needs optimizing or changing, this can be achieved by changing the logic programme. This sector of the electronic engineering arena is growing, and the tools becoming more sophisticated and very interesting to use.

(5) Software engineering: there is an increasing amount of software contained within electronic products these days. As a result, software engineering is becoming increasingly

important. In many projects, at least two thirds of the development budgets are allocated to developing the software.

(6) Systems engineering: systems engineering is a particularly important element of the design of any item. In terms of this sector of electronic engineering, a system is any complete object. It may be a radio receiver, it may be a mobile phone, or it could be an item consisting of several individual items.

The term "systems engineering" refers to the fact that this form of engineering looks at the complete object or system, including smaller items, everything from boards to complete units. It focuses on the operation of the overall system and ensures that the initial requirements are correct. It finally tests the item to ensure that it operates to its specification, and also to the initial requirements that were placed upon it.

There are also many other niche areas of electronic engineering: component engineering, reliability engineering, risk management, quality assurance and many more. All are very important and need basic electronic engineering skills.

While most electronic engineers will tend to specialize in one area for their career, it is important to have a knowledge of other areas. This helps the engineer to interact effectively with others from slightly different disciplines as always happens on large projects.

Take one every day example: a mobile phone base station has many elements, each requiring electronic engineers with different specialities. There are the radio frequency parts used for the transmitter and receiver as well as the antennas. However large amounts of software are required as the system is complicated and it requires a lot of elements to be controlled. Signals have complex functions along with acknowledgements of messages sent and received. Software engineering is required for this. Also programmable logic is used for many of the logic requirements and this links into both software and also the logic hardware design as well as many analog functions.

Other engineering skills including system design, installation planning, cellular coverage planners and many others will be needed as well.

It can be seen that something as common as a mobile phone base station requires many engineers with a variety of skills.

2 Opportunities in Electronic Engineering

Electronic engineering is normally focused on creating electronic items, from small electronic gadgets right up to huge systems like aircraft, monitoring systems, and many more items.

In many areas electronic engineers can be creating items that benefit others: medical equipment has a huge amount of electronic elements; safety systems also have electronics; there are many ecological projects that have electronics at their core.

There are in fact many industry sectors in which electronic engineering is used and where electronic engineers are needed, including general electronics design and development;

telecommunications; automation and IoT; medical electronics; defence electronic engineering; manufacturing engineering; broadcast; aeronautical electronics; consumer products electronic engineering; and research and development.

3 Activities within Electronic Engineering Projects

There are many stages in an electronic engineering project, from the initial design concept right through its design, testing, production and then in services. There are many activities which can be interesting, captivating and can provide an interesting career.

Some of the activities may include development of initial design concept; field trials of initial concept; initial design; development; design testing; introduction into production; post design services; customer liaison; and sales and marketing support.

These are some of the many activities that are undertaken by electronic engineers during projects. While much of the electronic engineering is undertaken at the base laboratory, it is sometimes necessary to travel to support customers, undertake liaison with suppliers or even with other contractor companies supplying an overall system. This can be challenging and rewarding and it can provide an additional insight into how the overall engineering environment operates.

New Words

electronic	[ɪˌlekˈtrɒnɪk]	*adj.*电子的；电子设备的
engineering	[ˌendʒɪˈnɪərɪŋ]	*n.*工程（学）
circuit	[ˈsɜːkɪt]	*n.*电路
device	[dɪˈvaɪs]	*n.*设备，装置，器具
field	[fiːld]	*n.*领域
discipline	[ˈdɪsəplɪn]	*n.*学科；训练
analog	[ˈænəlɒg]	*adj.*模拟的
compensate	[ˈkɒmpenseɪt]	*v.*补偿，弥补
provide	[prəˈvaɪd]	*v.*提供；规定
stimulate	[ˈstɪmjuleɪt]	*vt.*刺激，激励
radio	[ˈreɪdiəʊ]	*n.*无线电；收音机 *v.*用无线电发送讯息
frequency	[ˈfriːkwənsi]	*n.*频率
wireless	[ˈwaɪələs]	*adj.*无线的
link	[lɪŋk]	*n.*链接 *v.*使联系在一起；连接
logic	[ˈlɒdʒɪk]	*n.*逻辑（学）
programmable	[ˈprəʊgræməbl]	*adj.*可编程的

manageable	[ˈmænɪdʒəbl]	*adj.*易控制的，易处理的，可管理的
optimize	[ˈɒptɪmaɪz]	*vt.*使最优化
programme	[ˈprəʊgræm]	*n.*程序
		*v.*为（机器或系统）设定程序
budget	[ˈbʌdʒɪt]	*n.*预算
		*v.*把……编入预算
operate	[ˈɒpəreɪt]	*v.*运转；操作
specification	[ˌspesɪfɪˈkeɪʃn]	*n.*规格；详述；说明书
engineer	[ˌendʒɪˈnɪə]	*n.*工程师
project	[ˈprɒdʒekt]	*n.*项目，工程；方案，计划
		*v.*规划，计划
transmitter	[trænsˈmɪtə]	*n.*发射机
antenna	[ænˈtenə]	*n.*天线
complicate	[ˈkɒmplɪkeɪt]	*v.*使复杂化
control	[kənˈtrəʊl]	*n.&v.*控制
signal	[ˈsɪgnəl]	*n.*信号
		*v.*发信号
acknowledgement	[əkˈnɒlɪdʒmənt]	*n.*确认
opportunity	[ˌɒpəˈtjuːnətɪ]	*n.*机会，时机
huge	[hjuːdʒ]	*adj.*巨大的
ecological	[ˌiːkəˈlɒdʒɪkl]	*adj.*生态（学）的
telecommunication	[ˌtelɪkəˌmjuːnɪˈkeɪʃn]	*n.*电信
fix	[fɪks]	*v.*固定；确定
manufacturing	[ˌmænjuˈfæktʃərɪŋ]	*n.*制造业，工业
aeronautical	[ˌeərəˈnɔːtɪkl]	*adj.*航空（学）的
liaison	[liˈeɪzn]	*n.*联络，联络人
laboratory	[ləˈbɒrətrɪ]	*n.*实验室；研究室
insight	[ˈɪnsaɪt]	*n.*洞察力；领悟

Phrases

electronic engineering	电子工程
a form of ...	一种
be associated with	和……联系在一起；与……有关
electronic circuit	电子电路
analog electronic	模拟电子
analog circuit	模拟电路
radio frequency	无线电频率

high level design language	高级设计语言
software engineering	软件工程
electronic product	电子产品
systems engineering	系统工程
focus on	聚焦，集中，关注
risk management	风险管理
quality assurance	质量保证
interact with ...	与……相互作用，与……相互影响；与……相互配合
base station	基地；基站
a variety of	各种各样的
monitoring system	监视系统
consumer product	消费品
field trial	现场试验
liaison with	联络

Abbreviations

WiFi (wireless fidelity)	无线保真
FPGA (field programmable gate array)	现场可编程门阵列
VHDL (VHSIC hardware description language)	高速集成电路硬件描述语言

参考译文

电 子 工 程

电子工程是一种与电子电路、器件以及使用它们的设备和系统相关的工程。

1 电子工程领域

当问到“什么是电子工程？”时，知道这个主题涉及许多不同的领域和学科是很有必要的。

电子工程包括以下领域：

（1）模拟电子工程：在整个电子工程领域，模拟电子仍然是一个主要领域。由于仍需要许多模拟元件，因此，模拟电路仍被广泛使用。虽然模拟电子工程的范围不如多年前数字电子产品还未蓬勃发展时那么庞大，但整个电子市场的增长弥补了这一点。模拟电子工程可以提供一个令人振奋的工作环境和良好的职业生涯。

（2）射频电子工程：近年来，射频电子工程的规模不断扩大。越来越多的系统使用无线链路（从手机到 WiFi、物联网、短程链路等），这些都需要无线技术。

（3）数字开发工程：现在许多功能都是使用数字技术实现的。因此，许多地方都需要数字电路，这意味着需要一些数字/逻辑电子工程。

（4）可编程逻辑工程：由于许多基于逻辑/数字的电路的复杂性，人们越来越多地使用可编程逻辑芯片。FPGA 和其他可编程逻辑芯片被广泛使用，使得大量的逻辑电路能够被集成到可编程芯片中。通过使用 VHDL 等高级设计语言，将设计控制在可管理的范围内。如果设计需要优化或更改，则可以通过更改逻辑程序来实现。电子工程的该领域正在增长，工具变得更加先进而且使用起来也非常有趣。

（5）软件工程：如今，电子产品中包含的软件越来越多。因此，软件工程变得越来越重要。在许多项目中，至少三分之二的开发预算用于开发软件。

（6）系统工程：系统工程在任何项目设计中都特别重要。就电子工程这一领域而言，系统是任何完整的对象。它可能是一个无线电接收器，可能是一部手机，也可能是由几个单独的项目组成的整体。

“系统工程”指这种工程着眼于完整的对象或系统，包括更小的项目，如从电路板到完整的单元。它关注整个系统的运行，并确保初始要求是正确的。最后，它会测试该项目，以确保它按照规范和初始要求运行。

电子工程还有许多其他领域，如组件工程、可靠性工程、风险管理、质量保证等。所有这些领域都非常重要，而且需要基本的电子工程技能。

虽然大多数电子工程师在职业生涯中倾向专注于一个领域，但了解其他领域的知识也很重要。这有助于工程师与来自不同学科的其他人进行高效地互动，就像大型项目中经常发生的那样。

例如，手机基站有许多元件，每个元件都需要具有不同专业知识的电子工程师。发射器、接收器和天线都使用射频部件。由于系统很复杂，并且需要控制很多元件，因此需要大量的软件。信号的功能复杂，还可用于对发送和接收的消息的确认。这就需要软件工程。此外，可编程逻辑用于许多逻辑需求，并与软件、逻辑硬件设计以及许多模拟功能相关联。

还需要其他工程技能，包括系统设计、安装规划、蜂窝覆盖规划等。

可以看出，像手机基站这样常见的东西需要许多具有各种技能的工程师。

2 电子工程的机会

电子工程通常专注于创建电子产品，从小型电子产品到大型系统，如飞机、监控系统等。

在许多领域，电子工程师都可以创造出有益于他人的产品：医疗设备有大量的电子元件；安全系统也有电子设备；许多生态项目的核心都是电子产品。

事实上，许多行业都使用电子工程，也需要电子工程师，包括通用电子设计与开发、电信、自动化和物联网、医用电子学、国防电子工程、制造工程、广播、航空电子、消费品电子工程以及研究与开发。

3 电子工程项目内的活动

电子工程项目有很多阶段：从最初的设计概念到设计、测试、生产，再到投入使用。许多活动是有趣的、吸引人的，可以提供一个有趣的职业生涯。

其中一些活动可能包括初步设计概念的开发、初始概念的现场试验、初步设计、开发、设计测试、投入生产、后期设计服务、客户联络以及销售和市场支持。

这些是电子工程师在项目期间进行的许多活动中的一部分。虽然大部分电子工程是在基地实验室进行的，但有时需要出差去支持客户，与供应商进行联络，甚至与提供整个系统的其他承包商公司进行联络。这可能具有挑战性和回报性，并且可以对整个工程环境如何运行提供额外的见解。

Text B

Types of Electronic Devices

扫码听课文

1 Resistors

The resistor is a passive electrical component, whose function is to introduce resistance to the flow of electric current in an electrical circuit to limit the current. The magnitude of the opposition to the flow of current is called the resistance of the resistor. A larger resistance value indicates a greater opposition to current flow. The resistance is measured in ohms (Ω), and its equation is as follows.

$$R = \frac{V}{I}$$

The voltage (V), current (I), and resistance (R) are related by Ohm's law. i.e. $V = IR$. The higher the resistance R, the lower is the current I for a given voltage V across it. It is a linear device.

Resistors dissipate electrical energy given by $P = I^2R$ Watts or Joules/sec.

Resistors are made using different materials such as carbon film, metal film, etc.

Different types of resistors by application: common resistor (which is used in current limiter, setting biases, voltage dividers, filtering, termination resistors, load resistors, etc.), precision resistor (for voltage feedback circuits, voltage references), current sense resistors, and power resistors.

Resistor selection parameters: while selecting any resistor in the circuit, the designer needs to consider the following parameters: resistance value (R), power (Wattages) dissipated across it, and tolerance (+/– %).

2 Capacitor

The capacitor is a passive electrical component, whose function is to store electrical energy and deliver it to the circuit when needed. The capacity of a capacitor to store electrical charge is known as the capacitance of that capacitor. It is denoted by C. The unit of capacitance is Farad (F).

Various uses of capacitors: Blocking the flow of DC voltage and permitting the flow of AC, hence used for coupling of the circuits; phase shifting and creating time delays; filtration, especially in removing ripples from the rectified waveform; getting the tuned frequency; and as a motor starter.

Capacitor selection parameters: While selecting a capacitor in any circuit users need to take care of the following parameters: capacitance value, maximum operating voltage of the capacitor, tolerance, breakdown voltage, frequency range, equivalent series resistance (ESR) and size.

3 Inductors

The inductors (also called as a coil or choke) is a passive two-terminal electrical component. It stores magnetic energy when an electric current is passed through it. It's an insulated wire wound into a coil around a core of some material (air, iron, powdered iron, or ferrite material) in a spiral form.

The inductor is denoted by inductance L and the measuring unit is Henry (H).

An ideal inductor has zero resistance and zero capacitance. However, real inductors have a small value resistance associated with the winding of the coil and whenever current flows through it, energy is lost in the form of heat.

Applications of inductors: in buck/boost power regulators, in filter circuits in DC power supplies, isolating signals, in transformer to step up/down the AC voltage level, in oscillator and tuning circuits, and generating voltage surges in fluorescent lamp sets.

Types of inductors: inductors are mainly classified depending on the core material used and operating frequency. The different types of inductors are iron cored inductors, air cored inductors, powdered iron cored inductors, ferrite cored inductors, variable inductors, audio frequency inductors and radio frequency inductors.

Inductor selection parameters: while selecting an inductor in any circuit user needs to take care of the following parameter apart from the application: inductance value, tolerance , maximum current rating, shielded and non-shielded, size, Q ratings, frequency range, the resistance of the inductor and type of core used.

4 Diodes

The diode is a two-terminal semiconductor device that allows an electric current to pass in one direction while blocking it in the reverse direction. The diode is made up of a semiconductor device with P-type material and N-type material. Typical material used in a diode is silicon and germanium. They conduct when a minimum forward voltage (around 0.7V for Silicon) is applied across it and remain off during reverse bias condition.

Applications of diodes: power conversion (AC to DC) / rectification , clamping the voltage, zener diode as a voltage regulator, over voltage protection, ESD protection, and demodulation of signals.

Type of diodes: rectifier diode, switching diode, light emitting diode, zener diode, Schottky diode, ESD diode, tunnel diode, varicap diode, photodiode, and laser diode in optical communication.

Diode selection parameters: while selecting a diode in any circuit users needs to take care of the following parameters: forward bias voltage, maximum forward current, average forward current , power dissipation , reverse breakdown voltage/peak inverse voltage, maximum reverse current, operating junction temperature, reverse recovery time, and size.

5 Quartz Crystals

The quartz crystal is made from a thin piece of quartz wafer. This wafer is made from silicon-material. The wafer is tightly fitted and controlled between two parallel metalized surfaces which make an electrical connection. When an external voltage is applied to the plates, the crystal vibrates with a certain fundamental frequency which creates alternating waveform which swings between high and low levels. This phenomenon is known as the piezoelectric effect. Due to this property, they are used in electronic circuits along with active components to create stable clock input to the processor.

Quartz crystal applications: used in oscillator circuit to provide a clock input to the processor device, and source of reference signals for RF.

Quartz crystal selection parameters: load capacitance, fundamental frequency, frequency tolerance, frequency stability, ESR, and operating voltage.

6 Relays

A relay is an electromagnetic switch that opens and closes potential-free contacts. An electro-mechanical relay consists of an armature, coil, spring and contacts. When the voltage is applied to a coil, it generates a magnetic field. This attracts the armature and causes a change in the open/closed state of the circuit. It is mainly used to control a high powered circuit using a low power signal.

There are mainly two types of relays based on constructions: electromechanical relays (EMR) and solid state relays (SSR).

A solid state relay has a photodiode at its input side and a switching device such as transistor/FET at its output side. When a specific voltage is applied at its input, photodiode conducts and triggers the base of the transistor to cause the switching. Due to its fast switching, miniaturized form factor, low voltage requirement, and eliminating the mechanical arching,

electrical noise and contact bounce, it's more widely used in applications compared with electromechanical relay.

Applications of relays: controlling the high powered circuit with isolated low power, such as controlling 230V AC circuits with a +5V signal; switching voltage ON/OFF; and connecting or disconnecting electrical MCB (Micro Circuit Breaker).

Selection parameters for relays: output load type (AC/DC), input coil voltage for a electromechanical relay, photodiode voltage for SSR, output switching voltage, output current, on-state resistance, number of switching, number of poles and contacts, and type of output contacts.

7 Transistor

The transistor is a non-linear three-terminal semiconductor device. The transistor is considered to be one of the most important devices in the field of electronics. The transistor has transformed many aspects of man's life. There are two main functions of transistors, to act as solid state switches and to amplify input signals. The transistor acts as a switch when operated either in saturation or cut-off region. It amplifies signals when used in the active region. It offers very high input resistance and very low output resistance.

Transistors are categorized into BJT (bipolar junction transistor) and FET (field effect transistor) based on their construction.

Types of transistors: BJT: NPN and PNP ; FET: JFET and MOSFET.

Applications of transistors (BJT/FET): amplification of analog signals; as switching devices in SMPS, microcontrollers, etc.; oscillators; over/under voltage protection; modulation circuits and demodulation of signals; and power control in invertors and chargers (high current power transistors).

New Words

resistor	[rɪˈzɪstə]	*n.*电阻器
passive	[ˈpæsɪv]	*adj.*被动的
resistance	[rɪˈzɪstəns]	*n.*电阻
magnitude	[ˈmægnɪtjuːd]	*n.*量级
indicate	[ˈɪndɪkeɪt]	*v.*表明，指示
voltage	[ˈvəʊltɪdʒ]	*n.*电压，伏特数
current	[ˈkʌrənt]	*n.*电流
linear	[ˈlɪnɪə]	*adj.*线性的
dissipate	[ˈdɪsɪpeɪt]	*vt.*消耗
bias	[ˈbaɪəs]	*n.*偏差