What Is Electrical Engineering?

Text A

1 Electrical engineering is one of the newer branches of engineering, and dates back to the late 19th century. It is the branch of engineering that deals with the technology of electricity. Electrical engineers work on a wide range of components, devices and systems, from tiny microchips to huge power station generators.

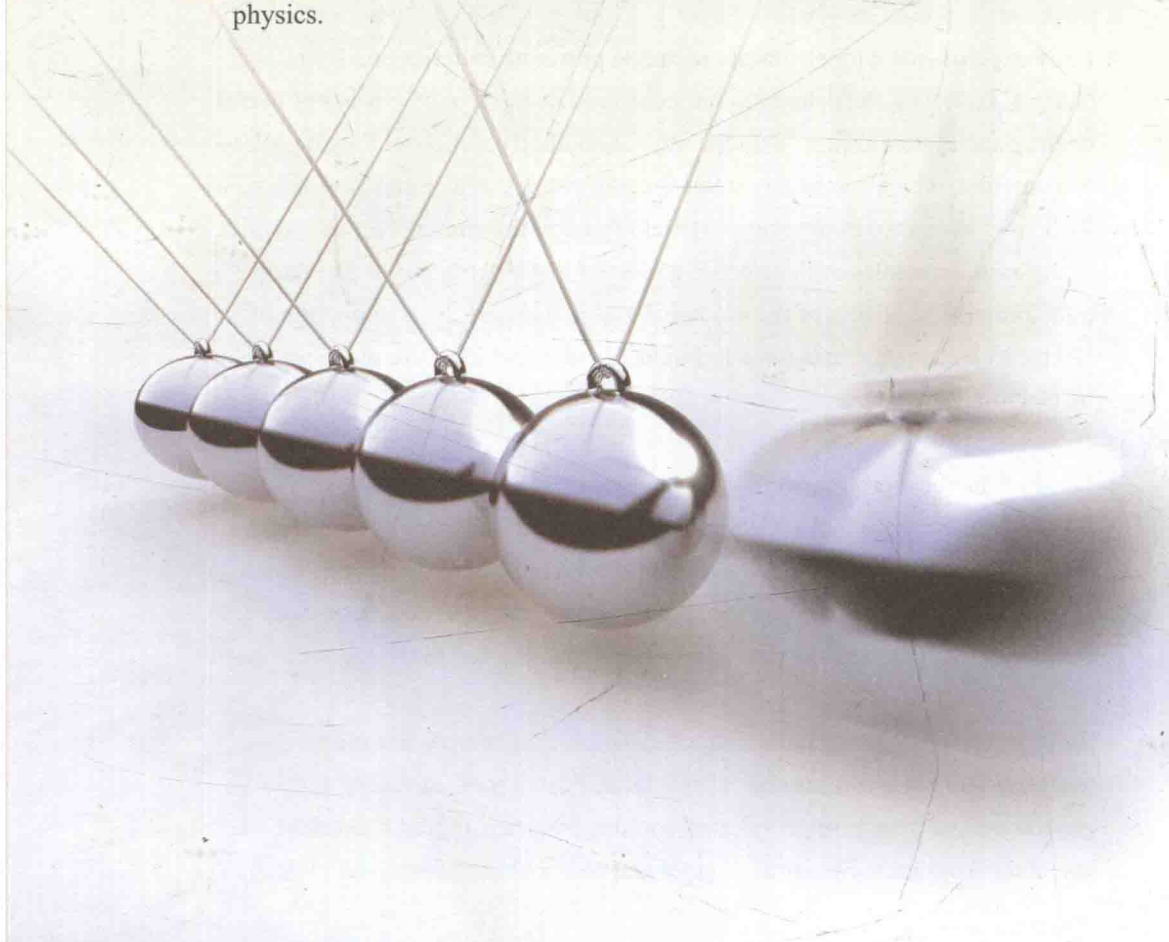
2 Early experiments with electricity included primitive batteries and static charges. However, the actual design, construction and manufacturing of useful devices and systems began with the implementation of Michael Faraday's Law of Induction, which essentially states that the voltage in a circuit is proportional to the rate of change in the magnetic field through the circuit. This law applies to the basic principles of the electric generator, the electric motor and the transformer. The advent of the modern age is marked by the introduction of electricity to homes, businesses and industry, all of which were made possible by electrical engineers.

3 Some of the most prominent pioneers in electrical engineering include Thomas Edison (electric light bulb), George Westinghouse (alternating current, AC), Nikola Tesla (induction motor), Guglielmo Marconi (radio) and Philo T. Farnsworth (television). These innovators turned ideas and concepts about electricity into practical devices and systems that ushered in the modern age.

4 Since its early beginnings, the field of electrical engineering has grown and branched out into a number of specialized categories, including power generation and transmission systems, motors, batteries, digital computers and control systems. Electrical engineering also includes electronics, which

has itself branched into an even greater number of subcategories, such as radio frequency (RF) systems, telecommunications, remote sensing, signal processing, digital circuits, microelectronics, instrumentation, audio, video and optoelectronics.

5 The field of electronics was born with the invention of the thermionic valve diode vacuum tube in 1904 by John Ambrose Fleming. The vacuum tube basically acts as a current amplifier by outputting a multiple of its input current. It was the foundation of all electronics, including radios, television and radar, until the mid-20th century. It was largely supplanted by the transistor, which was developed in 1947 at AT&T's Bell Laboratories by William Shockley, John Bardeen and Walter Brattain, for which they received the 1956 Nobel Prize in physics.



What does an electrical engineer do?

6 "Electrical engineers design, develop, test and supervise the manufacturing of electrical equipment, such as electric motors, radar and navigation systems, communications systems and power generation equipment," states the U.S. Bureau of Labor Statistics (BLS). "Electronics engineers design and develop electronic equipment, such as broadcast and communications systems – from portable music players to global positioning systems (GPS)."

7 If it's a practical, real-world device that produces, conducts or uses electricity, in all likelihood, it was designed by an electrical engineer. Additionally, engineers may conduct or write the specifications for destructive or nondestructive testing of the performance, reliability and long-term durability of devices and components.

8 Today's electrical engineers design electrical devices and systems using basic components such as conductors, coils, magnets, batteries, switches, resistors, capacitors, inductors, diodes and transistors. Nearly all electrical and electronic devices, from the generators at an electric power plant to the microprocessors in your phone, use these few basic components.

9 Critical skills needed in electrical engineering include an in-depth understanding of electrical and electronic theory, mathematics and materials. This knowledge allows engineers to design circuits to perform specific functions and meet requirements for safety, reliability and energy efficiency, and to predict how they will behave, before a hardware design is implemented. Sometimes, though, circuits are constructed on "breadboards", or prototype circuit boards made on computer numeric controlled (CNC) machines for testing before they are put into production.

10 Electrical engineers are increasingly relying on computer-aided design (CAD) systems to create schematics and lay out circuits. They also use computers to simulate how electrical devices and systems will function. Computer

simulations can be used to model a national power grid or a microprocessor; therefore, proficiency with computers is essential for electrical engineers. In addition to speeding up the process of drafting schematics, printed circuit board (PCB) layouts and blueprints for electrical and electronic devices, CAD systems allow for quick and easy modifications of designs and rapid prototyping using CNC machines. A comprehensive list of necessary skills and abilities for electrical and electronics engineers can be found at MyMajors.com.

Electrical engineering jobs and salaries

11 Electrical and electronics engineers work primarily in research and development industries, engineering services firms, manufacturing and the federal government, according to the BLS. They generally work indoors, in offices, but they may have to visit sites to observe a problem or a piece of complex equipment, the BLS says.

12 Manufacturing industries that employ electrical engineers include automotive, marine, railroad, aerospace, defense, consumer electronics, commercial construction, lighting, computers and components, telecommunications and traffic control. Government institutions that employ electrical engineers include transportation departments, national laboratories and the military.

13 Most electrical engineering jobs require at least a bachelor's degree in engineering. Many employers, particularly those that offer engineering consulting services, also require state certification as a professional engineer. Additionally, many employers require certification from the Institute of Electrical and Electronics Engineers (IEEE) or the Institution of Engineering and Technology (IET). A master's degree is often required for promotion to management, and ongoing education and training are needed to keep up with advances in technology, testing equipment, computer hardware and software, and government regulations.

14 As of July 2014, the salary range for a newly graduated electrical engineer with a bachelor's degree is $55,570 to $73,908, according to Salary.com. The range for a mid-level engineer with a master's degree and five to 10 years of experience is $74,007 to $108,640, and the range for a senior engineer with a master's or doctorate and more than 15 years of experience is $97,434 to $138,296. Many experienced engineers with advanced degrees are promoted to management positions or start their own businesses where they can earn even more.

The future of electrical engineering

15 Employment of electrical and electronics engineers is projected to grow by 4% between now and 2022, because of these professionals' "versatility in developing and applying emerging technologies" as the BLS says.

16 The applications for these emerging technologies include studying red electrical flashes, called sprites, which hover above some thunderstorms. Victor Pasko, an electrical engineer at Penn State, and his colleagues have developed a model for how the strange lightning evolves and disappears.

17 Another electrical engineer, Andrea Alù, of the University of Texas at Austin, is studying sound waves and has developed a one-way sound machine. "I can listen to you, but you cannot detect me back; you cannot hear my presence." Alù told LiveScience in a 2014 article.

18 And Michel Maharbiz, an electrical engineer at the University of California, Berkeley, is exploring ways to communicate with the brain wirelessly.

19 The BLS states, "The rapid pace of technological innovation and development will likely drive demand for electrical and electronics engineers in research and development, an area in which engineering expertise will be needed to develop distribution systems related to new technologies."

New words and expressions

component /kəm'pəʊnənt/ *n.*
one of several parts that together make up a whole machine 零件

generator /'dʒenəreɪtə(r)/ *n.*
an engine that converts mechanical energy into electrical energy by electromagnetic induction 发电机

charge /tʃɑːdʒ/ *n.*
the amount of electricity that is put into a battery or carried by a substance 电荷；电量

implementation /ˌɪmplɪmen'teɪʃən/ *n.*
the act of accomplishing some aim or executing some order 履行；执行；实施

voltage /'vəʊltɪdʒ/ *n.*
electrical force measured in volts 电压；伏特数

circuit /'sɜːkɪt/ *n.*
the complete path of wires and equipment along which an electric circuit flows 电路

transformer /træns'fɔːmə(r)/ *n.*
a piece of electrical equipment which changes a voltage to a higher or lower voltage 变压器

advent /'ædvənt/ *n.*
the coming of an important event, person, invention, etc. 出现；到来

prominent /'prɒmɪnənt/ *adj.*
conspicuous in position and importance 显著的；突出的；著名的

AC abbr. (alternating current) 直流电

usher /'ʌʃə(r)/ *vt.*
to cause sth. new to start, or to be at the start of sth. new 宣告；开创

transmission /trænz'mɪʃən/ *n.* 传输

instrumentation /ˌɪnstrʊmen'teɪʃən/ *n.*
the set of instruments used to help in controlling a machine 使用仪器；仪器仪表

optoelectronics /'ɒptəʊɪˌlek'trɒnɪks/ *n.*
光电子学

thermionic /ˌθɜːmɪ'ɒnɪk/ *adj.*
热电子的；热离子的

valve /vælv/ *n.*
a closed glass tube used to control the flow of electricity in old radios, television, etc. 电子管；真空管

diode /'daɪəʊd/ *n.*
an electric device in which the electric current passes in one direction only （电子）二极管

vacuum /'vækjuəm/ *n.*
a space that is completely empty of all gas, especially one from which all the air has been taken away 真空

current /'kʌrənt/ *n.*
a flow of electricity through a conductor 电流

supplant /sə'plɑːnt/ *vt.*
to take the place of, or move into the position of 代替；取代；把……排挤掉

transistor /træn'sɪstə(r)/ *n.*
a semiconductor device capable of controlling the flow of electricity 晶体管

capacitor /kə'pæsɪtə(r)/ *n.*
an electrical device characterized by its capacity to store an electric charge 电容器

inductor /ɪn'dʌktə(r)/ *n.*
an electrical device (typically a conducting coil) that introduces inductance into a circuit 感应器

prototype /'prəʊtəʊtaɪp/ *n.*
a standard or typical example 原型；蓝本

numeric /nju:'merɪk/ *adj.*
measured or expressed in numbers 数字的；数值的

schematic /skɪ'mætɪk/ *n.* 图表；电路图

simulate /'sɪmjʊleɪt/ *vt.*
to create a representation or model, or reproduce someone's behavior or looks 模拟；模仿

amplifier /'æmplɪfaɪə(r)/ *n.*
electronic equipment that increases the strength of signals passing through it 放大器

grid /grɪd/ *n.*
a system of high tension cables by which electrical power is distributed throughout a region 输电网

prototyping /ˌprəʊtəʊ'taɪpɪŋ/ *n.*
样机（原型机）制造；样机研究；原型机设计

versatility /ˌvɜ:sə'tɪlətɪ/ *n.*
having a wide variety of skills 多用途；多才多艺

emerging /ɪ'mɜ:dʒɪŋ/ *adj.*
coming into existence 新兴的

hover /'hɒvə(r)/ *vi.*
to hang in the air, or to move to and fro 盘旋；徘徊

expertise /ˌekspɜ:'ti:z/ *n.*
special skill or knowledge that is acquired by training, study or practice 专门知识或技能

distribution /ˌdɪstrɪ'bju:ʃən/ *n.*
the act of distributing or spreading or apportioning 分配；分布

branch out (into) 涉足；拓展

lay out 展示；设计；安排

Reading comprehension

Fill in the blanks based on the information from Text A with the help of the initial letters given and figure out the paragraphs.

1. Electrical engineering is about the technology of e_____ which dates back to the late 19th century. (Para. ___)
2. Law of Induction, written by Michael Faraday, states that the v_____ in a circuit is proportional to the rate of change in the magnetic field through the circuit. (Para. ___)
3. Electrical engineering has itself branched into an even greater number of subcategories, such as r_____ frequency (RF) systems, telecommunications, remote sensing, signal processing and digital circuits. (Para. ___)
4. It was the invention of the v_____ tube that made electronics widespread and practical in the first half of the 20th century. (Para. ___)
5. The t_____, an IEEE milestone, revolutionized the field of electronics and paved the way for smaller and cheaper radios, calculators and computers. (Para. ___)