



CHAPTER 5

ELECTRICAL ENGINEERING: A BROAD SCIENCE OF BOARDS!

When hearing electrical engineering, the only ideas that come to many people's minds are electric light bulb and wiring they see inside their homes. In spite of these misconceptions, electrical engineering is a very broad field encompassing from tiny ICs (Integrated Circuits) used in motherboards, microcontrollers, and microchips to huge power station generators, signal processing systems, face recognition devices and photovoltaic panels.

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.

PRE-READING

Improve Your Reading Skills

One of the common skills in reading comprehension is to find the **reference** of certain words (for example, this, that, it, he, their, one, who, which, this problem, the question, etc). In English, the reference could be to something which has already mentioned or to something which appear after the pronoun or the specified word or phrase.

Example 1:

The Greek geometers took many ideas from their Oriental predecessors.

Example 2:

Taking many ideas from their Oriental predecessors, the Greek geometers learned a lot about architecture.

In both cases, “their” refers to the Greek geometers, but with the difference that in Example 1 “their” refers backward while in Example 2 it refers forward.

Now read the following texts and find the references of the underlined words.

Scientists have done experiments on bilingual surgical patients with electrical stimulation and found that their first and second languages share some cortical area but also have some separate zone. The second language occupies more cortex than the first. They speculate that as the new language becomes familiar, the cortical area devoted to it becomes less.

Eight basic practices have been found to be characteristic of successfully managed companies. One of these is management’s bias toward action. This is manifest in a willingness to experiment and take risks. In such a company, all new ideas which are proposed by staff get tested and then stored rather than discarded if they do not work right away.

READING

Electrical Engineering

Introduction

Electrical engineering is one of the branches of engineering which dates back to the late 19th century and deals with the technology of electricity. Some of the most prominent pioneers in electrical engineering include Edison (electric light bulb), Westinghouse (alternating current), Tesla (induction motor), Marconi (radio) and Farnsworth (television). These innovators turned ideas and concepts about electricity into practical devices and systems.

The field of electrical engineering has branched into a number of specialized categories including electronics (analogue and digital), communications (waves and fields, broadcast

and communications systems, and satellites), power generation and transmission (power plant systems, motors, and batteries, generators), control systems, and mechatronics (mechanical electronics, robotics). Electronics has itself branched into an even greater number of subcategories such as radio frequency (RF) systems, telecommunications, remote sensing, signal processing (image, audio, video), digital circuits, instrumentation, and optoelectronics. Today, nearly all electronic devices, from the generators at an electric power plant to the microprocessors in your phone, are moving toward becoming smart. They are dependent on a few basic electronic equipment from portable music players to global positioning systems (GPS), wireless protocols, conductors, coils, magnets, batteries, switches, resistors, capacitors, inductors, diodes and transistors.

Smart homes

The idea of controlling your home in an automated way has now come true via smart home or home automation systems. A smart home is a convenient home setup where appliances and devices are automatically controlled remotely from anywhere in the world using an accessible central point – an application installed on a smartphone or other networked devices such as tablets, laptops, or even game console.

This residence has its devices interconnected through the Internet, which controls functions such as security access to the home (door locks, home monitors, fire sensors, surveillance systems and cameras), temperature (thermostats), lighting (light bulbs), home theaters and T.V sets, and even refrigerators and cookers. As part of the internet of things (IoT), smart home systems and devices often operate together, sharing consumer usage data among themselves and automating actions based on the residents' preferences.

Smart grids

The issue of electric current consumption and loss in electric grids has led many countries to switch to new ideas. Grid refers to the electric grid, a network of transmission lines, substations and transformers that deliver electricity from the power plants to your home or business. It is what you plug into when you flip on your light switch or power up your computer. Although the electric grid is considered an engineering marvel, its disorganized and top-down expansion has moved far beyond its capacity. To move forward, we need a new kind of electric grid, one that is built from the bottom up to move in line with digital and computerized technologies and one that can automate and manage the increasing complexity and needs of electricity in the 21st century. A smart grid is an electricity supply network that uses digital communications technology to detect and react to local changes in usage to respond digitally to our quickly changing electric demand.

Today, an electricity disruption such as a blackout can have a domino effect—a series of failures that can affect banking, communications, traffic, heat, and security. A smarter grid

makes our electric power system better prepared to address emergencies such as severe storms, earthquakes, fires, and terrorist attacks.

While the potential benefits of the smart grid are usually discussed in terms of economics, national security, and renewable energy goals, it has the potential to help people save money by helping them to manage their electricity use, generate their homely-made electricity (via photovoltaic panels) when it is not available from utilities or it is too expensive and store it and choose the best times to purchase and sell electricity using "smart meters". It is a way to address energy efficiency, make consumers aware of the connection between electricity use and environment, and bring increased national security to energy systems.

If you manage activities such as personal banking from your home computers now, imagine managing your electricity in a similar way. Once mature, the smart grid will bring the same kind of transformation that the Internet has already brought to the way we live, work, play, and learn.

POST-READING

Recalling Information. Decide if the following sentences are True (T), False (F), or Not Given (NG).

- 1. In a smart grid, people produce electricity using photovoltaic panels or cells.
- 2. Most people have a misunderstanding about what electrical engineering is.
- 3. Electricity disruptions have no effect on national security.
- 4. Devices in a smart home are able to learn the owners' modes and preferences.
- 5. Smart grids cannot work without the use of Internet.
- 6. Electric devices are dependent on a wide variety of electronic equipment.

Text Comprehension. Provide the following questions with appropriate answers from the text.

1. According to the text,
 - a. Electrical engineering started in twentieth century.
 - b. Internet of things is an example of smart homes.
 - c. Power plants can be a possible place for electrical engineers to work.
 - d. Designing robots and their movements has no relationship with electrical engineering.
2. Which of the following is **NOT** mentioned about a smart home?
 - a. It is a way to use less energy.
 - b. You can turn your lights on and off when you are away.
 - c. You have access to the cameras of the surveillance system.
 - d. Everything is controlled from your cell phone

3. It can **NOT** be inferred about the smart grids that
- They are the best solution to provide an environmentally-friendly form of energy.
 - People can raise money if they are able to produce and sell their own electricity.
 - They collect the electricity from the small consumers and bring it to the whole network.
 - The normal electric grids provide electricity from power plants to the consumers.
4. In the second paragraph line 10, what does **they** refer to?
- Microprocessors
 - generators
 - electric devices
 - power plant
5. According to the text, smart grids are particularly important in
- emergency cases
 - blackouts
 - energy loss in high-voltage cables
 - banking and communication

Under the heading "Smart grids", there are 5 paragraphs. Match the paragraphs with the main ideas below.

Paragraphs	Answers	Main ideas
1	a. Features of a smart grid
2	b. Future of smart grids
3	c. The benefits of using a smart rather than an ordinary electric grid
4	d. The most important reasons for developing smart grids
5	e. Definition of an electric grid

Vocabulary

Match the words in the left column with the definitions in the right.

- | | | |
|--------------------|-------|---|
| 1. instrumentation | ..... | a. people who inhabit a particular place; inhabitants |
| 2. mature | ..... | b. a piece of electrical equipment, such as a cooker or washing machine, used in people's homes |
| 3. surveillance | ..... | c. power cut; a period of darkness caused by a failure of the electricity supply |
| 4. photovoltaic | ..... | d. a service such as gas or electricity provided for people to use |
| 5. renewable | ..... | e. the set of instruments used to help in controlling a machine |
| 6. utility | ..... | f. to connect one piece of electrical equipment to another, or to be connected |
| 7. blackout | ..... | g. can be replaced very easily |
| 8. residents | ..... | h. developed enough |
| 9. plug into | ..... | i. watching and controlling |
| 10. appliance | ..... | j. able to produce electricity from light |

Go through the text and find a word or phrase which is synonymous to the underlined words.

1. This lecture is useful(.....) for everybody who is interested in home automation.
2. Because of communication(.....) difficulties, we have not received today's stock prices.
3. The wonders(.....) of modern technologies and sciences are now emerging in very short intervals.
4. In recent years, the movie industry has undergone a dramatic change (.....).
5. Mandela played an important(.....) role in the fight against discrimination.
6. Because the workers were fixing the road, there was some interruption(.....) in the traffic.