

# 16 Electrical

**A** Electrical engineering deals with the practical application of the theory of electricity to the construction and manufacture of **systems, devices** and **assemblies** that use electric **power** and **signals**.

Electrical engineering can be divided into four main branches:

electric power and machinery	communications and control	electronics (→ 17&18)	computers (→ 5&6)
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Electrical applications are used in many industrial areas including:

electric power and machinery	superconductors	lasers
electronic circuits	solid-state electronics	radar
control systems	medical imaging systems	consumer electronics
computer design	robotics	fibre optics

In recent years, the electronic computer has emerged as the largest application of electrical engineering. However, another very large field is concerned with electric **light** and power and their applications. Specialities within the field include the design, manufacture, and use of **turbines, generators, transmission lines, transformers, motors, lighting systems, and appliances**.

**B** *Electrical problems* can be avoided by always using the right *devices* and taking appropriate measures for *electrical protection*.

## Electrical problems

ground fault • overcurrent • overload • short circuit

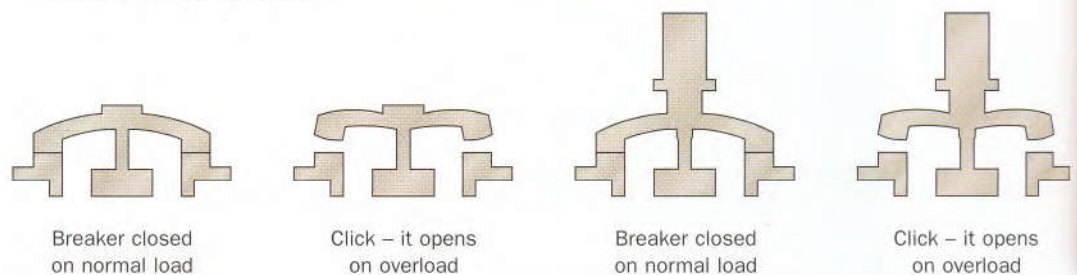
## Electrical protection

dustproof • explosionproof • rainproof • raintight • watertight • weatherproof

## Electrical devices

branch circuit • (circuit) breaker • cable • circuit • feeder  
fixture • fuse • ground • junction (electrical) box • panelboard  
service panel • switch • switchboard

## Circuit breaker operation



**C** Compounds are short ways of giving information. They are used to express complex ideas economically:

- noun + noun, e.g. panel board (or panelboard) = a board consisting of a number of panels
- noun + adjective, e.g. explosionproof = material which cannot be damaged by explosions
- adverb + noun, e.g. overload = current which is greater than the load for which the system or mechanism was intended

## TASKS

1

Express each of these ideas as a compound.

- 1 a board consisting of a number of panels
- 2 material that does not allow water to get into it
- 3 material that doesn't allow rain to get into it
- 4 a board consisting of a number of electrical switches
- 5 conductors which are perfect, conducting a current without a battery
- 6 material that will not be damaged in an explosion
- 7 current which is greater than the load for which the system or mechanism was intended
- 8 material that does not allow dust to get into it

2

What is being described? Find a word or phrase from the page opposite.

- 1 It produces a narrow beam of light and can be used to read barcodes in a supermarket, play compact discs, etc.
- 2 A word to describe any piece of equipment made for a specific purpose.
- 3 A pulse of light, current or sound that is used to convey information.
- 4 A device that uses electromagnetic waves to calculate the distance of an object.
- 5 Glass fibres that are used for data transmission.
- 6 The study of how robots are made and used.
- 7 A circuit where the current has a choice of paths.
- 8 A situation where the electrical current takes an easier path than the one intended.
- 9 A piece of equipment that stops an electrical current if it becomes dangerous.
- 10 A connection point where several cables are connected.

3

Complete the text below with words from the page opposite. The first letter of the missing words has been given.

In power stations, high pressure steam, gas, water or wind is used to drive (a) t\_\_\_\_\_ which turn huge (b) g\_\_\_\_\_. Large power stations generate electricity at 25,000 volts. This is then stepped up to 275,000 or 400,000 volts using (c) t\_\_\_\_\_ before being fed into a network of (d) c\_\_\_\_\_ known as the Grid. Electrical (e) p\_\_\_\_\_ is then carried across the country by overhead (f) t\_\_\_\_\_. The Grid voltage is reduced by stepping down (g) t\_\_\_\_\_ at substations before it is used in homes and factories. Some industrial plants take electrical energy from the Grid system at 33,000 or 11,000 volts, but for use in homes and offices it is stepped down to a lower level.

In the home, supply from the mains (h) c\_\_\_\_\_ passes through a main (i) f\_\_\_\_\_ and then to a fuse box. The fuse box is a distribution point for the electricity supply to the house. Most houses have two or three ring main (j) c\_\_\_\_\_ connecting electric sockets. There are also two or three (k) l\_\_\_\_\_ circuits and separate circuits for (l) a\_\_\_\_\_ such as cookers and hot water heaters.



# 17 Electronics 1

**A** Electronics is a branch of engineering and physics. It deals with the **emission**, behaviour, and effects of **electrons** for the **generation**, **transmission**, **reception**, and **storage** of information. This information can be **audio signals** in a radio, **images** (**video signals**) on a television screen, or numbers and other data in a computer. **Electronic systems** are important in communication, **entertainment**, and **control** systems.

Electronic circuits consist of interconnections of electronic components, at the heart of which are **semiconductors**. **Transistors**, which are made of **silicon** or **germanium**, are made from semiconductors. Commercial products range from **cellular radiotelephone systems** and video cassette recorders to high-performance **supercomputers** and sophisticated **weapons systems**. In industry, electronic devices have led to dramatic improvements in productivity and quality. For example, **computer-aided design** tools facilitate the design of complex parts, such as aircraft wings, or intricate structures, such as **integrated circuits**.

**B** The development of microelectronics has had a major *impact* on the electronics industry. *Electronic components* are expected to deliver ever higher performance, while electronic circuits continue to benefit from miniaturization.

## Function of electronic circuits

amplification • demodulation • electronic processing • generation  
information extraction • modulation • radio wave • recovery (of audio signal)

## Electronic components

absorb • active • battery • capacitor • diode • energy • generator • inductor  
passive • resistor • transducer • transistor • vacuum tube (AmE) • valve (BrE)

## Impacts

device size • digitization • fidelity • high speed • increased reliability  
manufacturing cost • storage capacity • storage system • ultrahigh image definition

**C** One way of increasing your vocabulary is to learn the associated words from a key word. Look at the word table below, which shows words related to the key words presented above:

Noun	Verb	Adjective
activation	activate	active
amplification	amplify	amplified
emission	emit	emitted
entertainment	entertain	entertaining
extraction	extract	extracted
generation	generate	generative
integration	integrate	integrated/integrative
reception	receive	receptive
recovery	recover	recovered
reliability	rely	reliable
storage	store	stored
transmission	transmit	transmittable/transmissible

## TASKS

**1** Choose the correct word in the following sentences.

- 1 Transistors/inductors are the key component in electronics.
- 2 They consist of three layers of silicon semiconductor/superconductor.
- 3 All electronic/electrical systems consist of input, a processor and output, and usually memory.
- 4 The input receives/resists and converts information while the output converts and supplies electronically processed information.
- 5 The memory may not be present in simple systems, but its function is the storage/transmission of information for the processor.
- 6 Continual developments in electronics give us increased reliability/recovery in electronic devices.
- 7 Electronic equipment controls microprocessors/microwaves in, for example, weapons systems, cellular radiotelephone systems and domestic appliances.
- 8 Electronic devices have improved our lives by providing high quality communication/combination and entertainment.

**2** Use the word in brackets to form a word which fits in the sentence.

- 1 The weak audio signal entering a radio is \_\_\_\_\_ by the \_\_\_\_\_ thus making it audible. (amplify)
- 2 Computer games are just one example of electronic systems being used for \_\_\_\_\_. (entertain)
- 3 Due to developments in mobile telecommunications systems, a new \_\_\_\_\_ of mobile phone is now available. (generate)
- 4 IC stands for \_\_\_\_\_ circuit. (integrate)
- 5 Computer software is \_\_\_\_\_ if it does what the manual says it should. (rely)
- 6 One area of electronics is concerned with the \_\_\_\_\_ of information. (store)
- 7 The \_\_\_\_\_ of signals to satellites is made by microwaves. (transmit)
- 8 A computer chip is capable of holding vast amounts of \_\_\_\_\_ information. (store)
- 9 \_\_\_\_\_ of speech was first carried out through \_\_\_\_\_ of the amplitude of a radio signal. (transmit, modulate)
- 10 In a laser, energy is released in the form of \_\_\_\_\_ light. (emit)

**3** Complete the text about electronics by choosing a word from the box.

diodes • semiconductor • electrons • devices • germanium • transistors  
integrated circuits • capacitors • silicon • integrated • resistors

Electronic circuits are built from basic components.

(a) \_\_\_\_\_ are the most important components. They can be used to amplify the strength of a signal by converting a weak signal into a stronger one or to switch other circuits on or off. (b) \_\_\_\_\_ reduce the flow of (c) \_\_\_\_\_ through the circuit, adding resistance to that circuit. (d) \_\_\_\_\_ function as electronic valves allowing current to flow in only one direction. (e) \_\_\_\_\_ store electricity in order to smooth the flow. They

can be charged and discharged. The two most common capacitors are ceramic and electrolytic.

Most electronic devices use (f) \_\_\_\_\_ (IC) or microchips. Inside an IC is a very small piece of (g) \_\_\_\_\_ with circuits built in. Today, semiconductors are usually made of (h) \_\_\_\_\_ which is cheaper and easier to manufacture than (i) \_\_\_\_\_.

Researchers are constantly trying to reduce the size of transistors in order to reduce the size of (j) \_\_\_\_\_.



# 18 Electronics 2

**A** The electronics industry creates, designs, produces, and sells **devices** such as **radios**, **televisions**, **stereos**, **video games**, and **computers**, and components such as semiconductors, transistors, and integrated circuits. In the second half of the 20th century, this industry had two major influences. Firstly it transformed our lives in factories, offices, and homes; secondly it emerged as a key economic sector. Specific advances include:

- the development of **space technology** and **satellite communications**
- the revolution in the computer industry that led to the personal computer
- the introduction of computer-guided **robots** in factories
- systems for **storing** and **transmitting** data electronically
- radio systems to automobiles, ships, and other vehicles
- **navigation** aids for aircraft, automatic pilots, altimeters, and **radar** for traffic control

**B** The *applications of electronic engineering* cover almost every aspect of modern life; the industry involves a wide range of *tasks*.

## Applications of electronic engineering

aerospace • automotive • consumer goods • chemical  
 defence • energy/power • environmental • imaging equipment  
 industrial automation • medical instrumentation • oil and gas • pharmaceutical  
 pulp and paper • semiconductor • telecommunications • transportation

## Tasks in electronic engineering

design • develop • diagnose • evaluate  
 manufacture • repair • test

**C** Electronic engineers are highly sought after, well rewarded and can be found in practically every branch of industry and commerce. Here is an extract from a job description for an electronic engineer:

## Scope and responsibilities

### Senior Electronics Design Engineer

The **Senior Electronics Design Engineer** will be responsible for enhancing and supporting the entire electronic design process, including, but not limited to:

- electronic product development from design to production release
- electronic design, analysis and testing of new products from product specification, producing electronic prototypes and preparation of all necessary design documentation
- firmware design for electronic devices
- electronic circuit design and board layout for very small devices and instruments
- accurate project and design documentation
- interfacing closely with marketing to create and develop products according to customer needs
- interacting with contract engineers that support product development
- developing and maintaining vendor selection and involvement to ensure the highest quality products
- obtaining necessary product approvals and communicating progress throughout the design process
- providing technical support for new and existing products in manufacturing and in the field
- producing design schedules
- staffing and operating an electronics lab

## TASKS

**1** Put these words and phrases into one of the three categories below.

develop solutions • transportation systems • robot • automotive industry  
transmit data • diagnose problems • radio • pharmaceutical industry  
evaluate results • television • provide support • chemical industry  
altimeter • defence • computer

devices

functions

applications

**2** Choose one word from A with one word from B to complete the sentences below.

A	B
space	computer
computer-guided	goods
satellite	robots
consumer	technology
navigation	communications
personal	aids

- \_\_\_\_\_ has enabled people to survive in space.
- Communications systems for aircraft and ships are dependent on \_\_\_\_\_.
- Many people today have their own \_\_\_\_\_ at home.
- Industrial processes have been made more efficient through the use of \_\_\_\_\_.
- Ships and aircraft require \_\_\_\_\_ to find their way.
- \_\_\_\_\_ such as washing machines and dishwashers contain electronic circuits.

**3** Here are two extracts from advertisements for jobs in electronics. Complete them with words from the box.

architecture • repair • examined • technicians • instrumentation • medical

### (a) **Electronics Technician**

The Biomedical Engineering Department provides electronic and mechanical engineering as well as ITU support to different specialities within the hospital. We are looking for (b) \_\_\_\_\_ to join our team of engineers. You will be involved in the management, (c) \_\_\_\_\_ and maintenance of the hospital's highly sophisticated medical electronic (d) \_\_\_\_\_. You will be required to work unsupervised in maintaining complex systems and equipment.

There have been great changes in crime and in its detection over the past ten years as a result of technological advances. Computers and mobile phones have become more common and, as a result, criminal activity involving them has also risen. Computers and SIM cards are (e) \_\_\_\_\_ in our department to recover data that is required in criminal investigations.

You will have knowledge of electronic (f) \_\_\_\_\_ of computers, PDAs or mobile phones and possibly an understanding of computer operating systems.