UNIT 2: CIRCUIT ELEMENTS

Current moves from a point of high potential energy to one of low potential. It can only do so if there is a path for it to follow. This path is called an electrical circuit. All circuits contain four elements: a source, a load, a transmission system, and a control.

The source provides electromotive force. This establishes the difference in potential which makes the current flow possible. The source can be any device which supplies electrical energy. For example, it may be a generator or a battery.

The load converts the electrical energy from the source into some other form of energy. For instance, a lamp changes electrical energy into light and heat. The load can be any electrical device. The transmission system conducts the current round the circuit. Any conductor can be part of a transmitting system. Most systems consist of wires. It is often possible, however, for the metal frame of a unit to be one section of its transmission system. For example, the metal chassis of many electric devices are used to conduct current. Similarly, the body of a car is part of its electrical transmission system. The control regulates the current flow in the circuit. It may control the current by limiting it, as does a rheostat, or by interrupting it, as does a switch.

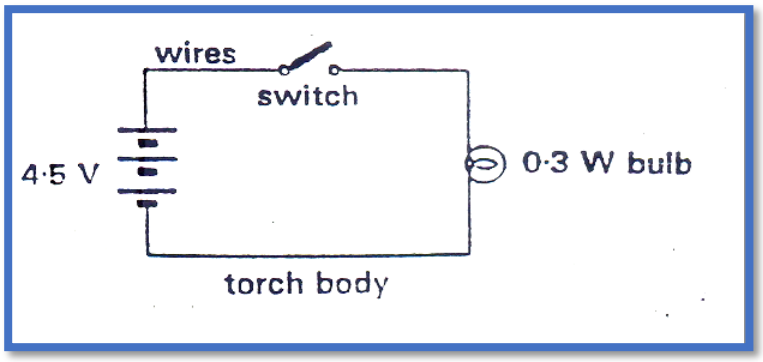


Figure 2.1

Study figure 2.1. In this simple flashlight circuit, the source comprises three 1.5V cells in series. The load is a 0.3 W bulb. Part of transmission system is the metal body of the flashlight, and the control is a sliding switch Compare figure 2.2. The function of this circuit is to operate a television

camera aboard a space satellite. Here the source is a battery of solar cells. A solar cell is an electric cell which converts sunlight into energy. The load is the television camera. The transmission system is the connecting wires. The control is a relay actuated by transmissions from ground control. Although the function of this circuit is much more complex than that of the flashlight, it too consists of the four basic elements.

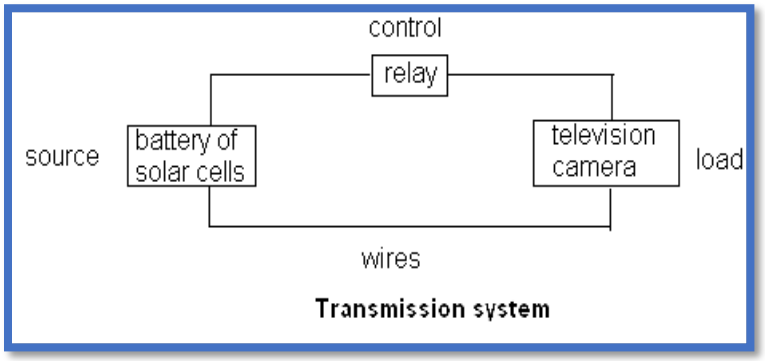


Figure 2.2 Transmission system

I. VOCABULARIES

- ***Circuit :*** a closed system esp. of wires through which electricity can flow
- ***Generator*** a machine that produces electrical power
- ***Regulate:*** to control something, especially by making it work in particular way
- ***Rheostat :*** An electrical instrument used to control a current by varying the resistance
- ***Flashlight :*** a small electric light you can carry in your hand
- ***Potential :*** the amount of electricity passing through an electric circuit, measured in volts
- ***Electromotive force :*** the force of an electric current produced by any device that supplies electrical energy
- ***Interrupt :*** to stop something from happening for a short period
- ***Aboard :*** on or onto a ship, aircraft, bus, or train
- ***Satellite :*** a device sent up into space to travel around the earth, used for collecting information or communicating by radio, television, etc
- ***Convert*** : Change the form, character, or function of something

- ***Provide*** : supply, give, produce something useful that can be used as part of a process or activity

II. READING COMPREHENSSION

Exercise 1: *Rephrasing*

Rewrite the following sentences, replacing the words in *italics* with expressions from the passage which has a similar meaning.

1. A lamp *converts electrical* energy into light.
2. The generator *provides* the circuit with electromotive force.
3. The metal *frame* of the oscilloscope is part of its transmission system.
4. The rheostat *controls* the current flow in the circuit.
5. A battery of a solar cells *supplies power* to the circuit.

Exercise 2: *Contextual reference*

What do the pronouns in *italics* in these sentences refer to?

1. Current moves from a point of high potential energy to *one* of low potential.
   a. Current.
   b. Energy
   c. A point
2. For example, *it* may be a generator or a battery.
   a. The source
   b. A device
   c. Electromotive force
3. It is often possible, however, for the metal frame of a unit to be one section of *its* transmission system.
   a. The metal frame's
   b. The unit's
   c. The circuit's
4. Although the function of this circuit is much more complex than that of the flashlight, *it* too consists of the four elements.

a. This circuit
b. The function
c. The flashlight

Exercise 3: *Checking facts and ideas.*

Decide if these statements are true (T) or false (F). Quote from the passage to support your decisions.

1. A difference in potential is required before current can flow in a circuit.
2. A generator is a source of electromotive force.
3. Loads convert electrical energy into light.
4. Transmission systems must consist of wires.
5. A rheostat may be used as a control.
6. The load in the flashlight circuit is a solar cell.
7. Loads convert electrical energy into light and heat.
8. The source in the satellite circuit is a solar cell.
9. The current flow in the satellite circuit is regulated by a relay.
10. The flashlight circuit differs basically from the satellite circuit.

III. ENGLISH GRAMMAR IN USE

Exercice 1: Describing function.

When we answer the question *what does it do?* We describe the function of *It.*

Example:

- What does a fuse do? It protects the circuit.

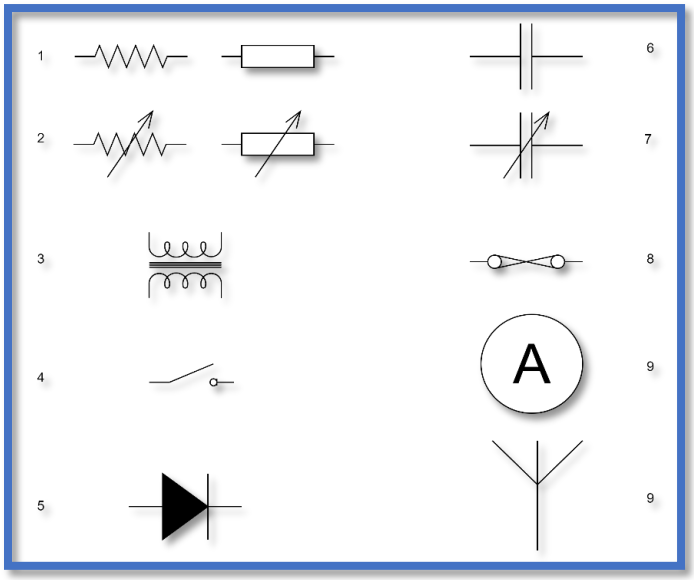
We can emphasize function by using this pattern:

- The function of a fuse is to protect a circuit.

Now identify and explain the function of each component with help of this list.

a. adds capacitance to a circuit.
b. rectifies alternating currents.
c. adds resistance to a circuit.
d. Measures currents.

e. Breaks a circuit.
f. Protect a circuit.
g. Varies the current in a circuit.
h. Transforms AC voltages.
i. Receives RF signal.
j. selects a frequency.



Exercice 2 *: Describing purpose*

When we answer the question *What is it for?* we describe the purpose of *It.*

Example:

What is an ammeter for? It is for measuring current.

Other ways we can describe the purpose of an ammeter are:

1. It is used for measuring current.
2. It is used to measure current.
3. We measure current with an ammeter.
4. We measure current using an ammeter.

Now describe the purpose of these instruments and tools using any of the structures presented above.

a. A voltmeter.
b. A soldering iron.
c. A milli-ammeter.
d. An oscilloscope.
e. An ohmmeter.
f. A signal generator.
g. A battery charger.

Exercice 3*: Relative clause: making definition.*

Study these two sentences:

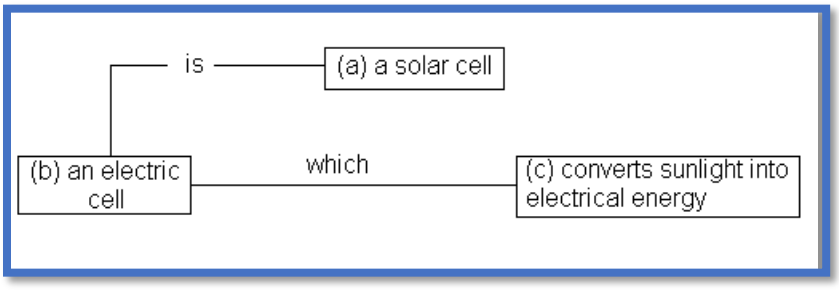
1. The cables were undamaged.
2. The cables were armoured.

We can link in two ways using a relative clause:

1. The cables WHICH WERE ARMOURED were undamaged.
2. The cables, WHICH WERE ARMOURED, were undamaged.

- Sentence 1 means that only armoured cables were undamaged. Other cables, for example PVC coated cables, were damaged. The relative clause is a defining one. It defines the type of cable which was undamaged. It carries essential information.
- Sentence 2 means that all the cables were undamaged, and all the cables were armoured. The relative clause is a non-defining one. It adds extra information to the sentence and still makes good sense. It is separated from the rest of the sentence by commas.

One use of defining relative clauses is to make definition. Study this diagram.



We can make a definition of a solar cell by joining (a), (b) and (c).

A solar cell is an electric cell which converts sunlight into electrical energy.

Now make eight definitions using the information in this table. You must decide the correct combinations of (A), (B) and (C).

(A)	(B)	(C)
A generator An insulator An alternating current A direct current A resistor A conductor A light meter An ammeter	a material an instrument a current a device	measures light readily releases electrons. flows first in one direction then in the other. does not readily release electrons. Impedes the flow of current in a circuit. Measures current Converts mechanical energy into electrical energy. Flows in one direction only

Exercise 04: making definitions.

Try to write your own definitions of these:

1. A voltmeter.
2. An electric motor.
3. A receiver.
4. A transmitter.
5. An electrical cell.

IV. FURTHER READING

Electrical Circuit Elements

Resistors, inductors, and capacitors are the three basic circuit parameters or circuit components of any electrical network. Resistors can be wire-wound type or carbon-molded type. When current flows in a resistance, heat is produced, which is dissipated. The heat is produced because friction between moving free electrons and atoms obstructs the free flow of electrons producing electric current. A resistor is an element that dissipates energy as heat when current flows through it.

Inductors are made of a coil that has a few turns. The core of the coil may be air or a magnetic material, which is placed inside the coil. When the coil is wound on an iron core, the inductor formed is called an iron-core inductor coil. Inductance of an inductor is directly proportional to the square of the number of turns of the coil used. Inductor stores energy because of current flowing through it.

A capacitor consists of two conductors or conducting plates between which a dielectric is placed. The capacitance of a capacitor is its ability to store electric charge. Different types of capacitors are available. They are named according to the dielectric placed between the conductors. Common types of capacitors are air, mica, paper, ceramic, etc.

1. Resistors

Wire-wound resistors are made of wires of constantan, manganin or nichrome wound on a ceramic tube. These resistances are available in ranges varying from a fraction of an ohm to thousands of ohms. The power rating also varies from a fraction of a Watt to few kiloWatts. While specifying a resistance, both resistance value and power dissipating value must be mentioned. Electronic circuits require resistors of accurate values. The value of resistors used in electronic circuits is quite high, of the order of kilo ohms. Since carbon has high resistivity, carbon resistors are made with copper leads. Their power rating varies from a fraction of a Watt to several Watts. Color code is used to indicate the value of such resistors.

2. Inductors

The ability of a coil to induce EMF in itself when the current through it changes is called its inductance. The unit of inductance is Henry. 1 Henry of inductance causes 1 Volt to be induced when current changes at the rate of 1 Ampere per second.

When steady direct current flows through an inductor, it will not affect the circuit as there is no change in current. Inductors are of two types: viz air-core type and iron-core type. Inductors are also called chokes.

Inductors are available in all current ranges. Air-core inductors are wound on Bakelite or cardboard rods and are extensively used in electronic circuits in millihenry and microhenry ranges. High-value inductors are made of iron core. They are mainly used in ac power supply of frequency of 50 Hz.

3. Capacitors

A capacitor, in its simplest form, consists of two thin parallel plates of conducting material separated by a dielectric material. A capacitor is capable of storing charge when a voltage is applied across the capacitor plates.

Charging and discharging are the two main effects of capacitors. When a voltage is applied, there is accumulation of charge in the capacitor and as a result voltage is built up across the terminals of the capacitor. This is called charging of the capacitor. The capacitor voltage becomes equal to the applied voltage when the capacitor is fully charged. The voltage across the capacitor remains even after the voltage source is disconnected. The capacitor discharges when a conducting path is provided across the plates without any applied voltage connected.

The more the charging voltage is, the more the accumulation of charge in the capacitor. The amount of charge, Q stored in a capacitor is, therefore, proportional to the charging voltage, V. A capacitor with a large area of the parallel plates can store more charge. Capacitance of a capacitor also depends on the distance between the plates and the type of dielectric used between the plates. A large capacitor, obviously, will store more charge.

Study the passage carefully and answer the questions bellow:

1. What are the three basic circuit parameters or components of any electrical network mentioned in the passage?

2. How is heat produced in resistors when current flows through them?
3. What is the inductance of an inductor directly proportional to?
4. What is the unit of inductance, and what does 1 Henry of inductance cause?
5. How are wire-wound resistors made, and what materials are used?
6. What is the main effect of capacitors, and how does it relate to charging and discharging?
7. What factors affect the capacitance of a capacitor?

Electronic Circuit Symbols