SNS COLLEGE OF ENGINEERING

Coimbatore-35
An Autonomous Institution
Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A+' Grade Approved by AICTE,
New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

II ECE / II SEMESTER

Unit 1 –BASIC CIRCUITS ANALYSIS

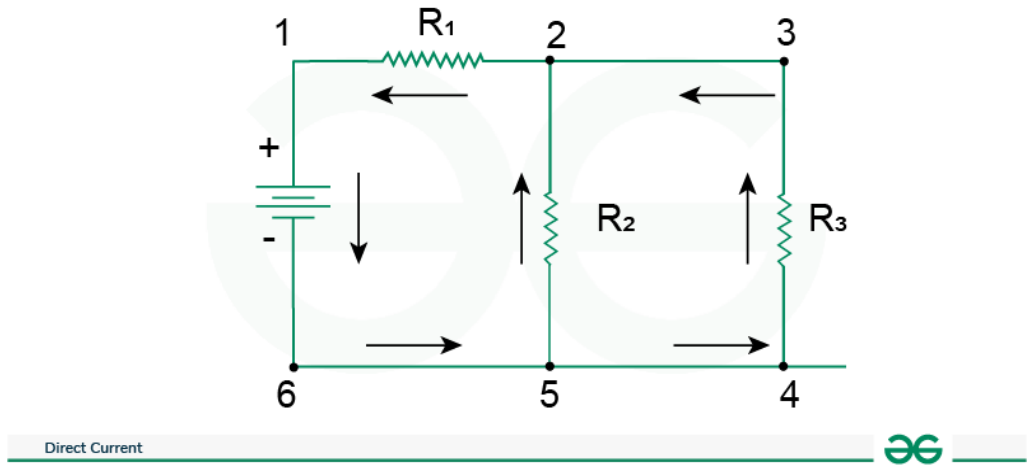
Topic 1 –DC circuits: Resistive elements

DC circuits & Resistive elements

DC circuits

The flow of direct current does not change periodically. The current electricity flows in a single direction in a steady voltage. The major use of DC is to supply power to electrical devices and also to charge batteries. Example: mobile phone batteries, flashlights, flat-screen television and electric vehicles. DC has the combination of a plus and a minus sign, a dotted line or a straight line.

Everything that runs on a battery and uses an AC adapter while plugging into a wall or uses a USB cable for power relies on DC. Examples would be cellphones, electric vehicles, flashlights, flat-screen TVs (AC goes into the TV and is converted into DC).



The major differences between Alternating Current and Direct Current are given in the table below

Alternating Current	Direct Current
AC is easy to be transferred over longer distances – even between two cities – without much energy loss.	DC cannot be transferred over a very long distance. It loses electric power.
The rotating magnets cause the change in direction of electric flow.	The steady magnetism makes DC flow in a single direction.
The frequency of AC is dependent upon the country. But, generally, the frequency is 50 Hz or 60 Hz.	DC has no frequency or zero frequency.
In AC the flow of current changes its direction forward and backward periodically.	It flows in a single direction steadily.
Electrons in AC keep changing their directions – backward and forward.	Electrons only move in one direction – forward.

Examples of circuits that use alternating current (AC) and direct current (DC)

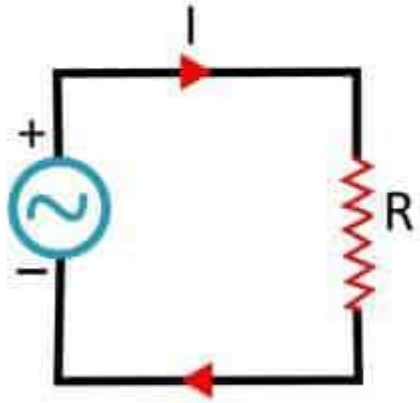
- **Power outlets**: Most power outlets in homes use AC.
- **Batteries**: Batteries use DC.
- **USB devices**: USB devices use DC.
- **Microprocessors**: Microprocessors use DC.
- **Solar panels**: Solar panels generate DC, but an inverter is needed to convert it to AC for use in the mains.
- **AC/DC power supplies**: These power supplies use a transformer to reduce the AC input voltage, then rectify it to create DC voltage.
- **AC-to-DC converter circuits**: These circuits use a transformer, diode bridge rectifier, and capacitor to convert AC power to DC voltage.
- **Cell phones**: Cell phones use DC.
- **Electric vehicles**: Electric vehicles use DC.
- **Flashlights**: Flashlights use DC.
- **Flat-screen TVs**: Flat-screen TVs use AC, which is converted to DC.

Example for AC & DC

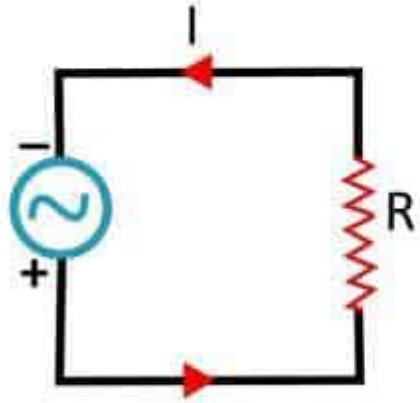
Alternating Current (AC) Vs Direct Current (DC)

Alternating Current (AC)

Current reverses direction in equal intervals of time



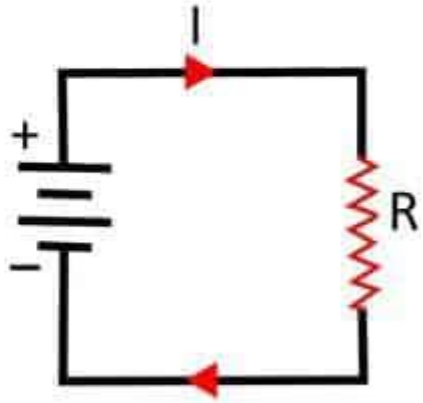
Positive Polarity



Negative Polarity

Direct Current (DC)

Current flows only in one direction



Polarity remains same

What is Resistive elements?

Resistive elements

A resistive element is a component that controls or provides electrical resistance to a circuit. It is the core component of a resistor, which is a common type of electronic component.

What are resistive elements used for?

Temperature sensors

Resistive elements can be made sensitive to temperature, and are used in resistance temperature detectors (RTDs).

Strain sensors

Resistive elements can be made sensitive to strain, which can be caused by pressure or flex.

Light sensors

Resistive elements can be made sensitive to light.

Heating elements

Resistive elements are used in heating elements like toasters, ovens, and space heaters.

Resistive elements

How are resistive elements made?

Resistive elements are typically made from materials with high resistivity, such as carbon, metal alloys, or semiconductors.

The resistive element is encased in an insulating material, like ceramic or plastic, to prevent electrical contact.

How do resistive elements work?

The resistance of a resistive element changes in a predictable way with temperature.

By measuring the resistance of the element, you can determine its temperature.

ACTIVE ELECTRONIC COMPONENTS

SEMICONDUCTORS	TRANSISTORS
▪ Diodes (All)	▪ Composit Transistors
▪ Light-Emitting Diode (LED)	▪ Compound Transistor
▪ Rectifier Diode	▪ Darlington Transistor
▪ Schottky Diode	▪ Field-Effect Transistor (FET)
▪ Solar PV Cell, PV Panel	▪ JFET (Junction Field-Effect Transistor)
▪ Unipolar / Bipolar Diode	▪ MOSFET (Metal Oxide Semiconductor FET)
▪ Varicap	▪ Photo Transistor
▪ Varactor	▪ Transistors (All)
▪ Zener Diode	▪ Thyristors

PASSIVE ELECTRONIC COMPONENTS

BASIC COMPONENTS	ELECTROMECHANICAL COMPONENTS
▪ Antennas	▪ Cables
▪ Assembly Modules	▪ Circuit Protection Devices
▪ Capacitors (All Types)	▪ Crystals
▪ Detectors	▪ Mechanical Devices such as a Fan, Lamp
▪ Inductors / Coil	▪ PCB
▪ Memristor / Network	▪ Piezoelectric devices
▪ Resistors (All Types)	▪ Resonators
▪ Sensors	▪ Switches
▪ Transducers	▪ Terminals and Connectors

WHAT'S THE DIFFERENCE?

Active Components	Passive Components
Active Device transforms and injects power or energy into a circuit.	Passive Device utilizes power or energy into a circuit.
Examples: Diode, Transistor, SCR, ICs, DC generator, Current & Voltage sources etc.	Examples: Resistors, Capacitors, Inductors, Transformer, Motors etc.
Active element produces energy in the form of voltage or current	Passive element stores energy in the form of voltage or current.
They have function and provide power gain (Amplifier).	They do not have function provide power gain.
It can control the flow of current.	It cannot control the flow of the current.
Active components require an external & conditional source to operate in the circuit.	Passive Components do not require any external source to operate in the circuit.
They have gain more than 1, so they can amplify the signal.	They have gain less than 1, so they can't amplify the signal.
They are energy donor.	They are energy acceptor
They lay in Linear category	They lay in Non-Linear category.

Basic concepts

- **Voltage**: The driving force in a circuit, voltage is the pressure that pushes electrons through a conductor.
- **Electrical current**: The flow of electrons through a conductor.
- **Resistance**: The degree to which a material resists the flow of electrons.
- **Capacitance**: A basic element of electronics.
- **Inductance**: The energy stored in a magnetic field when an electric current flows.

Electronic circuits

- **Digital circuits**: Work with discrete signals and are used for data processing and digital computing.
- **Mixed-signal circuits**: Combine analog and digital components to handle a wide range of signals.

Voltage: Voltage is the force that makes electrons flow. It's a difference in potential energy between two different points in a circuit. Current: Current is the rate of the flow of electrons. It's measured in amperes, which are also called amps. Power (Watts): The power used in a circuit is measured in watts

Multiple choice question

Question:

In a simple series circuit with a 12V battery and two resistors (R1 = 4Ω and R2 = 6Ω), what is the total resistance of the circuit?

A) 10Ω

B) 12Ω

C) 8Ω

D) 16Ω

Answer:

The total resistance R_{total} in a series circuit is the sum of the individual resistances.

So,

$$R_{\text{total}} = R_1 + R_2 = 4\Omega + 6\Omega = 10\Omega$$

Thus, the correct answer is **A) 10Ω**.

2. Question:

What is the total current in a circuit with a 10V battery and a total resistance of 5Ω?

A) 0.5A

B) 2A

C) 1A

D) 10A

Answer:

Using Ohm's Law:

$$I = \frac{V}{R} = \frac{10V}{5\Omega} = 2A$$

So, the correct answer is **B) 2A**.

3. Question:

If the power supplied by a 10V battery in a circuit with a current of 2A is calculated, what is the power?

A) 10W

B) 20W

C) 15W

D) 25W

Answer:

Using the formula for power:

$$P = V \times I = 10V \times 2A = 20W$$

So, the correct answer is **B) 20W**.

4. Question:

In a parallel circuit with resistors R1 = 10Ω and R2 = 10Ω, what is the total resistance?

A) 5Ω

B) 20Ω

C) 10Ω

D) 15Ω

Answer:

For resistors in parallel:

$$\frac{1}{R_{\text{total}}} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{10\Omega} + \frac{1}{10\Omega} = \frac{2}{10\Omega} \quad \Rightarrow \quad R_{\text{total}} = 5\Omega$$

So, the correct answer is **A) 5Ω**.

Thank you