Chapter Description

Aims
This chapter is aimed to:
1. Introduce the basic component related to electric circuit analysis
2. Introduce the SI unit to the students
3. Explain the circuit elements in electric circuit

Expected Outcomes
Student should be able to
1. Recognize the electric circuit component
2. Use the SI unit correctly
3. Explain and recognize the basic circuit element in electric circuit

References
BASIC CONCEPT

1.1 Introduction of circuit analysis
1.2 Electrical quantities: Systems of units, charge, current, voltage, power and energy
1.3 Circuit elements: Passive and active elements, independent and dependent sources
1.1 Introduction of circuit analysis

DC characteristics

![Diagram showing DC characteristics](image-url)
AC characteristics
A source of electrical potential difference or voltage. (a battery or electrical outlet)

A conductive path (typically made of wire)

Any object that uses electricity to do work (exp. a light bulb, electric motor, heating element, speaker, etc.)

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**ELECTRICAL QUANTITIES: SYSTEMS OF UNITS**

International System of Units (SI): International measurement language which enables engineers to communicate their results.

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<th>Prefix</th>
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<td>Mass</td>
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<tr>
<td>Time</td>
<td>Second</td>
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<tr>
<td>Electric current</td>
<td>Ampere</td>
<td>A</td>
</tr>
<tr>
<td>Thermodynamic temperature</td>
<td>Kelvin</td>
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<tr>
<td>Luminous intensity</td>
<td>Candela</td>
<td>cd</td>
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Like charge repel

Opposite charge attract
FORCE FIELDS ASSOCIATED WITH CHARGED PARTICLES

• Lines of force between charges

(a) Unlike charges
(b) Like charges
THE UNIT OF CHARGE

Coulomb

1 Coulomb = 6.25 x 10^{18} electrons
CURRENT FLOW

• Analogy for the concept of current flow
Can you explain?
CURRENT DEFINITION

Rate of charge flow

Electric Current

\[ i = \frac{dq}{dt} \]

- \( i \) = current flow (amperes)
- \( q \) = charge (coulombs)
- \( t \) = time (seconds)
CURRENT FLOW

1 amp

1 coulomb past a point in a circuit in 1s

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CURRENT

2 Informations

Arrow
Direction of current flow

Value
Variable or a known value

Unit: Ampere

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**ACTIVE ELEMENT: CURRENT SOURCE**

### Independent

- **Current Source (I_s)**
- **0.5 A**
- **100 Ω**

The I_s through the source is completely independent of the voltage across the source.

### Dependent

- **DCS “2i_x”** depends on the current “i_x” which is at another location in the circuit.
- **The value of the current “3v_x”** depends on the value of the voltage “v_x”.

**Diagram Description:**

1. **Independent Current Source:**
   - Symbol for I_s
   - 0.5 A
   - 100 Ω

2. **Dependent Current Source:**
   - Symbol for k_i_x (or k_v_x)
   - 2i_x
   - 3v_x
   - Additional components: R_1, R_2, R_3, V_s, i_s, v_x
When a current flows through a circuit element, it develops a voltage drop across the terminals of that element.

The voltage across an element is the work (energy $W$) required to move a unit positive charge from the –ve terminal to the +ve terminal.

$$v = \frac{dw}{dq}$$

When work is linear in the formula reduces to:

$$v = \frac{w}{Q}$$

volt = joule/coulomb or $V = \frac{J}{C}$
VOLTAGE

2 Informations

1. + / - sign
   Voltage reference direction

2. Value
   variable or a known value

Unit: Volts

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How to identify the voltage value?

\[ V_x = 10\, \text{V} \]

\[ V_x = -10\, \text{V} \]
Ideal Basic Circuit Element

Active
- Capable of generating electrical energy
- Voltage Source
  - Independent
  - Dependent
- Current Source
  - Independent
  - Dependent
- Resistor
- Capacitor
- Inductor

Passive
- Receiving electrical energy
- Capacitor
- Inductor
ACTIVE ELEMENT: VOLTAGE SOURCE

The 5V across the source is completely independent of the current through the source.

DVS “100V₁” depends on the voltage “V₁” which is at another location in the circuit.

The value of the voltage “3iₓ” depends on the value of the current “iₓ.”
Resistors

(a) Carbon-composition
(b) Metal film

(a) Metal film chip resistor
(b) Chip resistor array
(c) Resistor network (SMD)
(d) Resistor network (surface mount)

Source
http://slideplayer.com

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Capacitors
Inductors
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