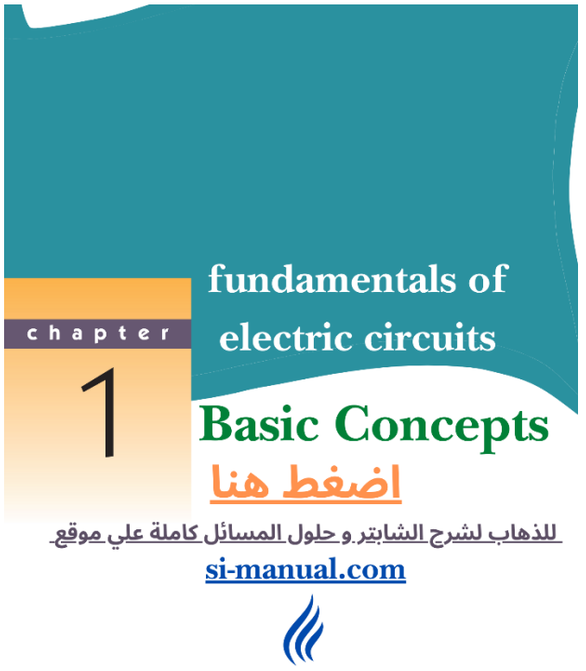
Chapter 1

Methods of Analysis



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Content

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1.1 Introduction

An electric circuit is an interconnection of electrical elements.

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1.2 Systems of Units

Quantity	Basic unit	Symbol
Length	meter	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Charge	coulomb	C

Prefix	Multiplier	Symbol
tera	10^{12}	T
giga	10^{9}	G
mega	10^{6}	M
kilo	10^{3}	K
milli	10^{-3}	m
micro	10^{-6}	μ
nano	10^{-9}	n
pico	10^{-12}	p

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1.3 Charge and Current

Charge is an electrical property of the atomic particles of which matter consists -> measured in coulombs (C).

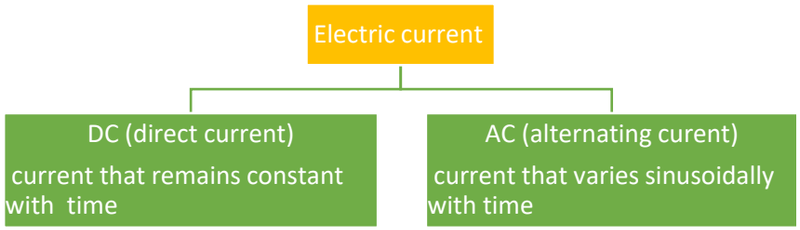
$$q = N_e \times e$$
$$e = -1.602 \times 10^{-19}$$

Electric current is the time rate of change of charge. → measured in amperes (A).

التيار الكهربي: معدل تغير الشحنة مع الزمن

$$i = \frac{dq}{dt}$$
$$q = \int_{t_o}^{t} idt + q(0)$$
$$q = it$$

1 ampere = 1 coulomb/second



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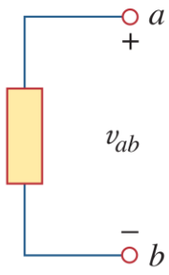
1.4 Voltage

Voltage (or potential difference) is the energy required to move a unit charge through an element, measured in volts (V).

$$v_{ab} = \frac{d\omega}{dq}$$

$$\boxed{v_{ab} = -v_{ba} = v_a - v_b}$$



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1.5 Power and Energy

Power is the time rate of expending or absorbing energy, measured in watts (W).

$$p = \frac{d\omega}{dt}$$

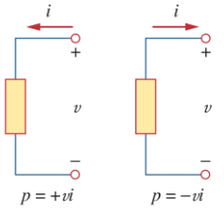
$$p = \frac{\omega}{t}$$

$p \rightarrow power$

$\omega \rightarrow energy$

$$p = vi$$

Passive sign convention is satisfied when the current enters through the positive terminal of an element and $p = +vi$. If the current enters through the negative terminal, $p = -vi$.



$$+p_{absorbed} = -p_{supplied}$$

Note:

- voltage and current → supply power
- Resistors → absorb power.

Energy is the capacity to do work, measured in joules (J).

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1.6 Circuit Elements

There are two types of elements found in electric circuits:

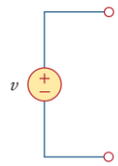
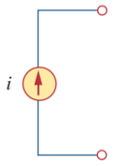
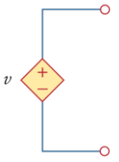
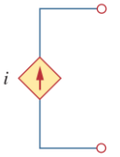
- passive elements
- active elements.

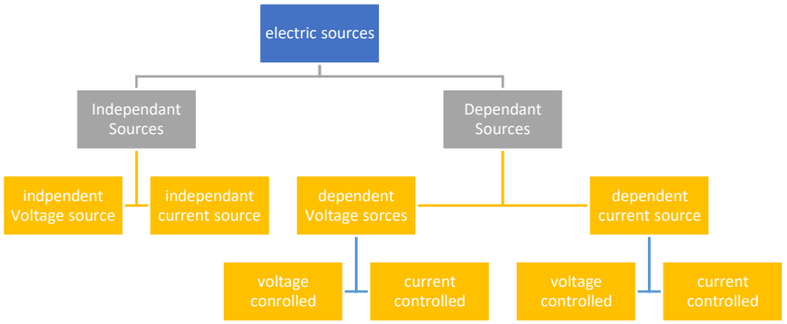
Passive elements عناصر غير فعالة	Active elements عناصر فعالة
An active element can NOT generate energy. *العناصر غير الفعالة: هي عناصر غير قادرة علي توليد الطاقة*	An active element can generate energy. *العناصر الفعالة: هي عناصر قادرة علي توليد الطاقة*
Examples of passive elements are: ▪ Resistors ▪ Capacitors ▪ inductors.	Examples of passive elements are: ▪ Generators ▪ Batteries ▪ operational amplifiers .

Type of electric sources:

An ideal independent source is an active element that provides a specified voltage or current that is completely independent of other circuit elements.

An ideal dependent (or controlled) source is an active element in which the source quantity is controlled by another voltage or current.

independent Voltage source	independent Current source	dependent Voltage source	dependent Current source
			



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- A voltage-controlled voltage source (VCVS).
- A current-controlled voltage source (CCVS).
- A voltage-controlled current source (VCCS).
- A current-controlled current source (CCCS).

Chapter summery

Chapter 1 Laws	
Charge (q)	$q = N_e \times e$ ▪ $e = -1.602 \times 10^{-19}$ ▪ $N_e \rightarrow$ number of electronics
current (i)	$i = \frac{dq}{dt}$ $q = it = \int_{t_o}^{t} idt + q(0)$
Voltage (V)	$v_{ab} = \frac{d\omega}{dq}$
Power (P)	$p = \frac{d\omega}{dt} = vi$ $+p_{absorbed} = -p_{supplied}$ Note: ▪ voltage and current → supply power ▪ Resistors → absorb power.

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