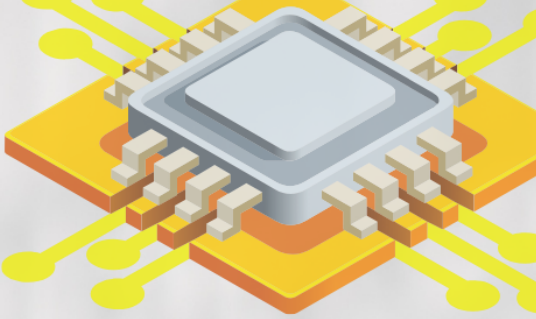
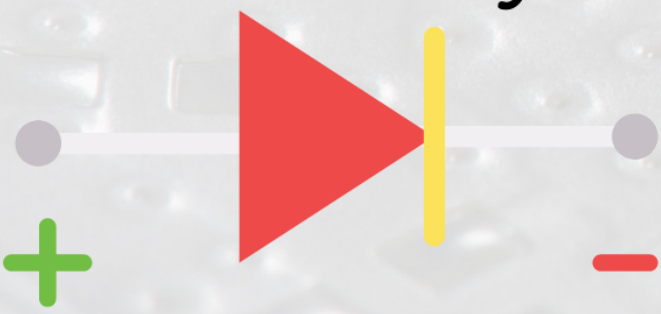
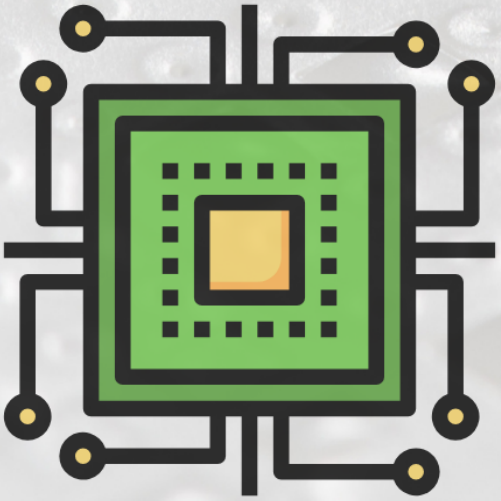


Circuits Analysis

By Rawan Alfares





Introduction

1. Voltage : is the energy per unit charge created by the separation , expressed as

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

v is voltage , Volt.
w is energy , Joul
q is charge , Colomb

2. Electric Current : is the Rate of charge flow. defined as :-

$$i = \frac{dq}{dt}$$; i is current , Ampere.

3. power : is the rate of doing work (energy) per time defined as : equals the terminal voltage with current
P : power (watt).

$$P = I\,V = \frac{dq}{dt} \cdot \frac{dw}{dq} = \frac{dw}{dt}$$

⇒ **what's the difference between power and energy :-**

power : is the rate at which energy is used or transfered over time
← معدل استهلاك أو نقل الطاقة خلال فترة زمنية , تبين مدى سرعة استخدام الطاقة أو إنتاجها. (watt)

Energy :- is the capacity to do work or produce heat.
← القدرة على إنجاز عمل أو إنتاج حرارة وتمثل كمية العمل الذي يتم تنفيذه خلال فترة زمنية (Joul)

⇒ **what's the difference between Network and Circuits :-**

Network : the inter Connection of two or more Simple Circuits element is called electrical network.

Circuit : if the network Contains at least one closed path , it is Called electrical Circuits

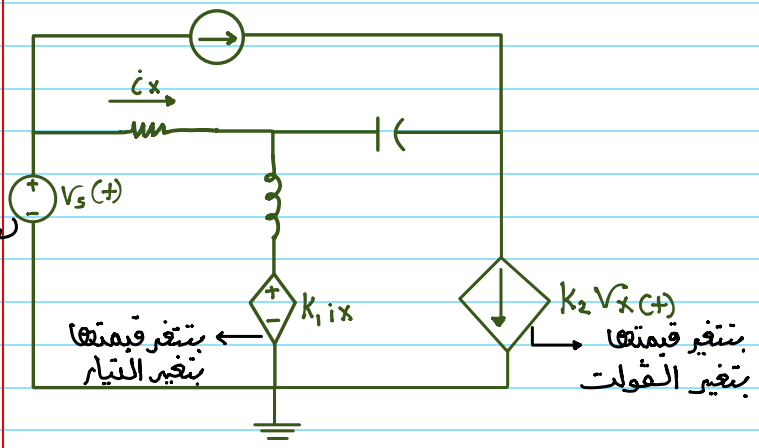
⇒ **Circuit analysis :** given a Circuit in which all the Components are specified, analysis involves finding such things as the voltage across some elemnts or the Current through another.

* the Solution is unique.

⇒ **Circuit design** envolus determining the Circuit Configuration that will meet Certain Specifications .

* the Solution is not unique.

Ch.2: Circuit Elements



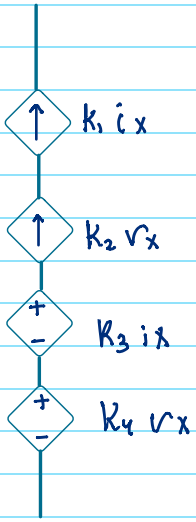
قيمتها ثابتة لا بتعتمد على أي إشي ثاني.

بتتغير قيمتها بتغير التيار

بتتغير قيمتها بتغير الفولت

⇒ dependent Source :-

* بتعتمد على element في الدارة
* أي تغير في قيمة أحدهم يحمل تغير على قيمته.



⇒ Independent Sources :-

like Current , voltage.

قيمهم ثابتة حتى في حال تغير قيمة أحد قيم الـ elements في الدارة.

Circuit element :-

1) Active element : Capable of delivering power to Some external elements (Sources), ex. voltage source, Current source.

2) Passive elements :- Capable only of recieving power.
(R, L, C).

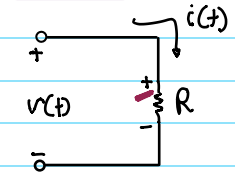
L: Storage element of Current magnatice field.

C: Storage element of voltage (electric field).

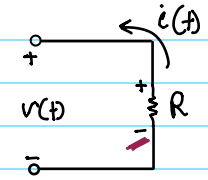
Circuit elements Can be classified according to the relationship of the Current through the element to the voltage across the element.

Circuit elements:

1. Resistors:



* $v(t) = +i(t)\,R$
* $i(t) = \frac{1}{R}\,v(t) = G\,v(t)$

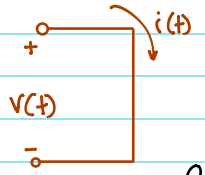


* $v(t) = -R\,i(t)$

* R is called the resistance of the component and is measured in units of ohm (Ω)

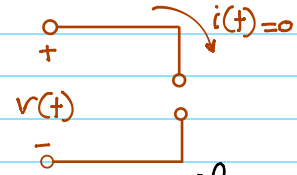
* G is called Conductance of the component and is measured in units of Siemens $\frac{1}{\Omega} = \Omega^{-1} = \mho$

Two speacial resistor value s-



short Circuit

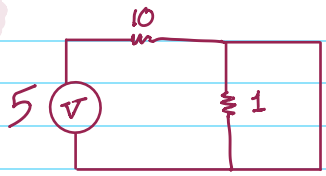
* $v(t) = 0$
* $i(t) \rightarrow$ depend on Circuit
* $R = 0\ \Omega$
* $G = \infty\ \mho$



open Circuit

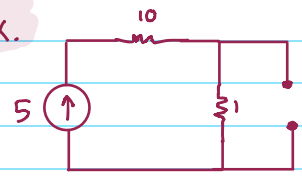
* $i(t) = 0$
* $v(t)$ = depend on Circuit.
* $R = \infty\ \Omega$
* $G = 0\ \mho$

ex.

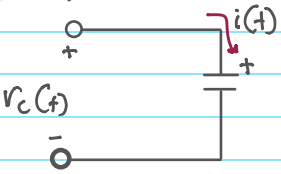


$I = \frac{5}{10} = 0.5A$

ex.

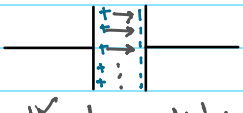


2. Capacitors :



معادلة

$$v_c(t) = \frac{1}{C}\int_{-\infty}^{t} i_c(t)\,dt$$



* يعتمد الجهد على electric field.

* $v_c(t) = v_c(0^-) + \frac{1}{C}\int_{0}^{t} i_c(t)\,dt \quad , t \geq 0.$

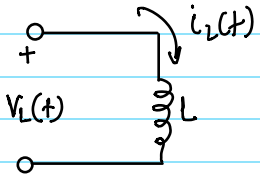
$v_c(0^-)$ the value for the intial value.

* measured by Fared (F)

$$v_c(0^-) = v_c(0^+) + \frac{1}{C}\int_{0^-}^{0^+} i_c(t)\,dt$$

$v_c(0^-) = v_c(0^+)$ ← * means that the initial value will be the same magnitude after very tiny time.

3. Inductors :



$$V_L(t) = L\frac{di_L(t)}{dt}$$

* $i_L(t) = i_L(0^-) + \frac{1}{L}\int_0^t V_L(t)\,dt$
* $i_L(0^-) = i_L(0^+)$
* measured by Henry (H)

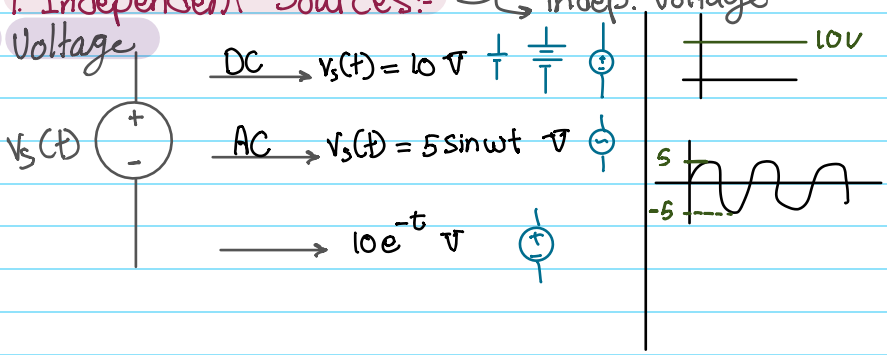
Active elements :

- Independent Sources
- Dependent Sources

1. Independent Sources :-

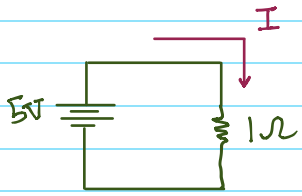
indep. Current
indep. Voltage

1. Voltage

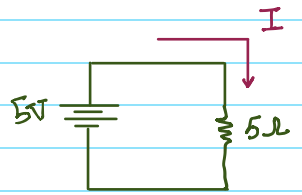


* قيمته ثابتة بغض النظر عن تغير قيم المكونات الاخرى في الدارة مثل البطارية

example:



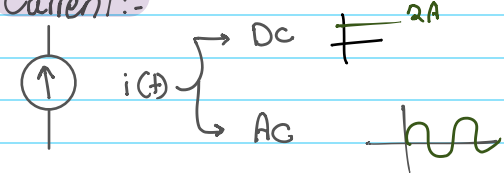
$$I = \frac{5}{1} = 5\ A$$



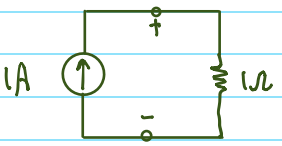
$$I = \frac{5}{5} = 1A$$

---

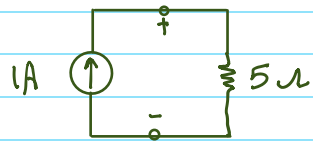
2. Current :-



* قيمته ثابتة بغض النظر عن تغير قيمة الفولت



$V = IR(1) = 1$ V



$V = IR$
$= 1.5 = 5\Omega$

2. dependent Sources: are Sources in which the Source Voltage or Current depend on upon a Current or Voltage else where in the Circuit.

$K_1 i_x$

dep. Current Source

Control parameter is Current

$K_3 i_x$

dep. Voltage Source

Control parameter is Current

$K_2 v_x$

dep. Current Source

Control parameter is Voltage

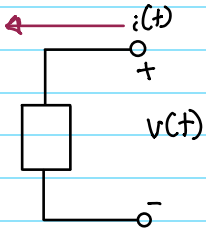
$K_4 v_x$

dep. Voltage Source

Control parameter is Voltage

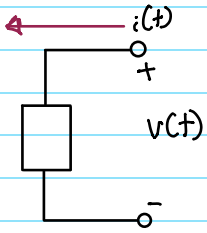
Power and Energy

$* p(t) = \frac{dw(t)}{dt} \rightarrow p(t) = i(t)\,v(t)$



$p(t) = +v(t)\,i(t)$

absorbing



$p(t) = -v(t)\,i(t)$

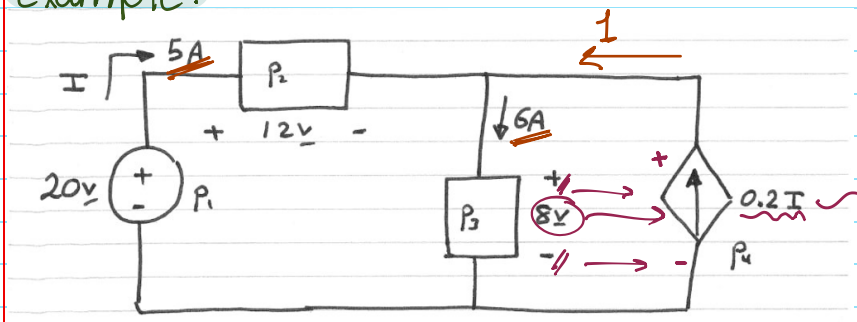
Supplying

$* \Sigma P = 0$

$\Sigma P_{supplying} = \Sigma P_{absorbing}$

↳ the law of Conservation of energy must be obeyed in any electric Circuit.

example:



$0.2 \times 5 = 1$

1. $P_1 = -IV = (-20)(5) = -100$ watt — Supplied power
2. $P_2 = IV = (5)(12) = 60$ watt. — absorbing Power
3. $P_3 = (8)(6) = 48$ watt — absorbing Power
4. $P_4 = (-1)(8) = -8$ watt — Supplied power

$\Sigma P = 0$

$= -8 + 48 - 100 + 60 = 0$ ✓

ربنا تقبَّل منَّا إنَّك أنتَ السميعُ العليم