EE 207

Foundation of Electrical and Computer Engineering

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Chapter One
Basic Concepts

- This course basically deals with the analysis of electric circuits.
- The most basic quantity used in the analysis of electrical circuits is the electric charge (electron).

Basic Quantities

(1) Electron :electron is a mobile charge carrier.

- The electron is measured in coulumb [C]
- $e = 1.6*10^{-19}$ C
- Multiple of electrons constitute charge (q).

•The movement of charge (q) over time causes current.

(2) <u>Current :</u>

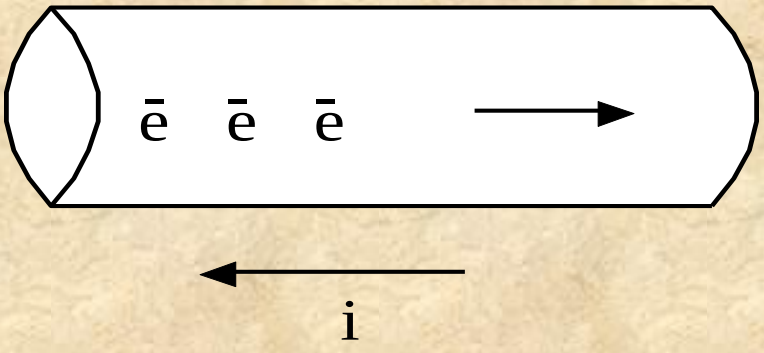
the time rate of change of charge produces an electrical current

$$i(t) = \frac{dq(t)}{dt} \quad \text{or} \quad q(t) = \int_{\tau=-\infty}^{t} i(\tau)\, d\tau$$

• the electric current is measured in Amper [A]

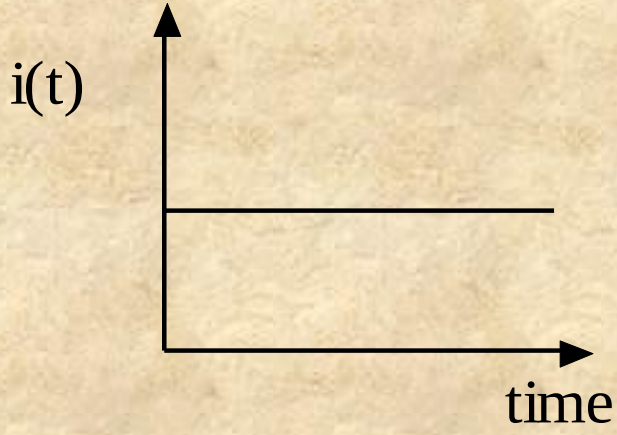
1 A = 1 C / 1 sec

•.current convention.

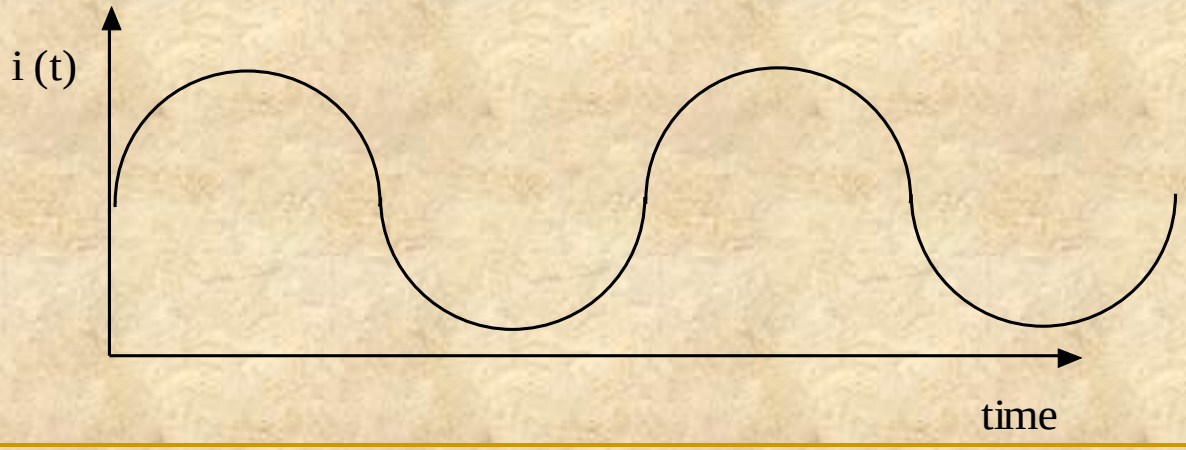


There are 2 types of currents

1. Direct current (DC)



2. Alternating current (AC)



(3) Voltage :

The voltage is defined as the work or energy (in Joules) required per unit charge to move a test charge though an element

$$V = \frac{W}{q} \qquad \text{And} \qquad 1V = \frac{1J}{1C}$$

- Since we are dealing with a changing charge and energy, we have

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

(4) Power :

Power is the time rate of change of energy.

$$P(t) = \frac{dw(t)}{dt}$$

$$P(t) = \frac{dw(t)}{dt} = \frac{dw(t)}{dq} \cdot \frac{dq}{dt}$$

$$P(t) = V(t)\, i(t)$$

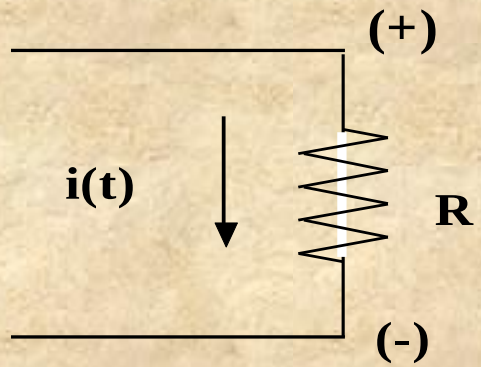
- The unit of power is Watt [W].
- **1 W = 1 V * 1A**

(5) <u>Energy:</u> energy can be expressed as

$$w(t) = \int_{t=t_1}^{t_2} p(t)\, dt = \int_{t=t_1}^{t_2} v(t)\, i(t)\, dt$$

Passive sign convention

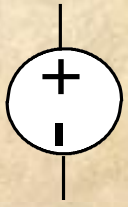
Current flow from the positive to the negative terminal.



- Power can be absorbed or supplied by an element.
- Power is absorbed (or dissipated) by an element if the sign of power is (+)
- Power is supplied (delivered or generated) by an element if the sign of power is (-)

Circuit Active Elements:

There are 4 types of active elements (sources):



1. Independent voltage source:

   It is a 2-terminal sources that maintains a specific voltage across its terminals regardless of the current through it

2. Independent current source:

   It is a 2-terminal sources that maintains a specific current through it regardless of the voltage across it terminals.

3. Dependent voltage source:

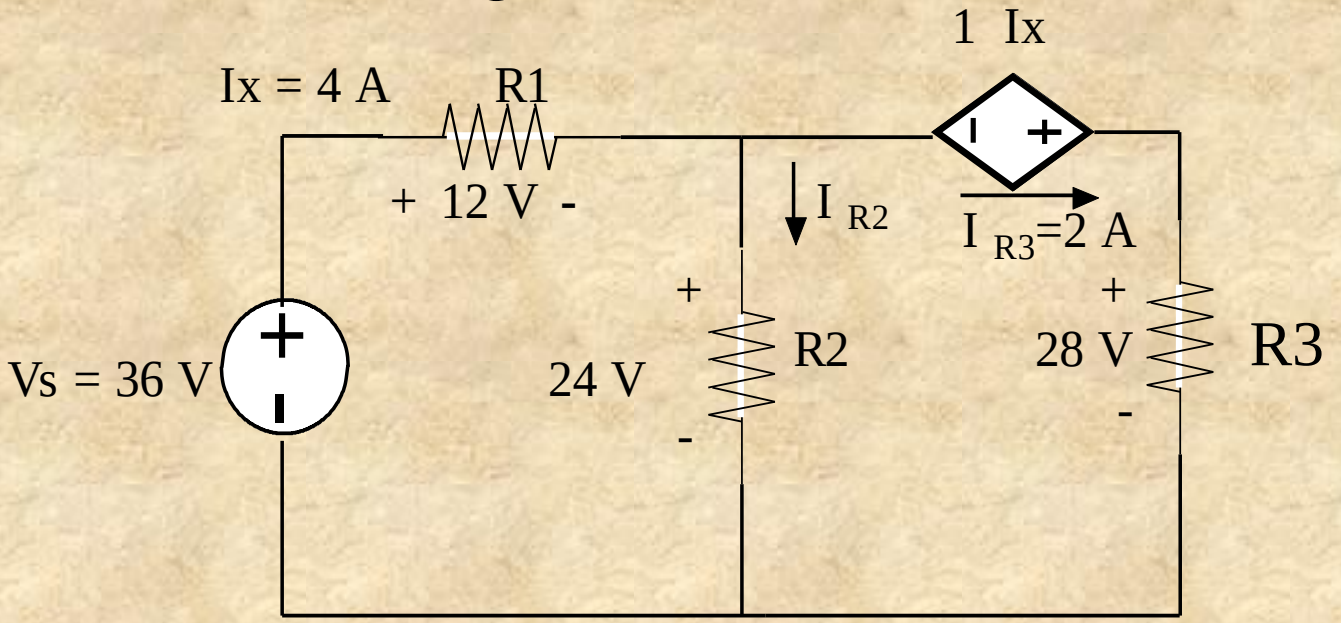
   It is a 2-terminal sources that generates a voltage that is determined by a voltage or current at a specified location in the circuit.

4. Dependent current source:

It is a 2-terminal sources that generates a current that is determined by voltage or current at a specified location in the circuit.

Example :

Compute the power that is absorbed or supplied by each of the elements in the following circuit



$$P_{vs} = V_s\, I_x = (36)(-4) = -144\text{W} \quad \text{(supplies)}$$

$$P_{R1} = V_{R1}\, I_x = (12)(4) = 48\text{W} \quad \text{(absorbs)}$$

$$P_{R2} = V_{R2}\, I_{R2} = V_{R2}\,(I_x - I_{R3}) =$$

$$(24)(4-2) = 48\text{W} \quad \text{(absorbs)}$$

$$P_{Ds} = V_{Ds}\, I_{R3} = (1I_x)(I_{R3}) = (4)(-2) = -8\text{W} \quad \text{(supplies)}$$

$$P_{R3} = V_{R3}\, I_{R3} = (28)(2) = 56\,\text{W} \quad \text{(absorbs)}$$

Important Units

QUANTITY	SYMBOL	UNIT	ABBREV.
Length	ℓ	meter	m
Current	I, i	ampere	A
Temperature	T	kelvin	K
Mass	m	kilogram	kg
Time	t	second	s

Important Units

Voltage	*V, v,*	volt	V
Charge	*Q, q*	coulomb	C
Resistance	*R*	ohm	Ω
Power	*P, p*	watt	W
Capacitance	*C*	farad	F
Inductance	*L*	henry	H
Frequency	*f*	hertz	Hz
Magnetic Flux	Φ	weber	Wb
Mag. Flux Density	*B*	tesla	T

Unit Conversions

UNIT	MULTIPLY BY	TO GET
in	0.0254	m
ft	0.3048	m
mi	1.609	km
lb	4.448	N
hp	746	W
kWh	3.6×10^6	J
ft-lb	1.356	J

Prefixes For Engineering Notation

POWER OF 10	PREFIX	SYMBOL
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{-3}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p