Subject Code: EE151	Basic Electrical Science	Credits: 3 (3-0-0) Total hours: 45

Module 1 **DC circuit Analysis**

Review of circuit elements. Voltage sources. Current sources. Ohm's Law. KirchoffT's Laws. Mesh and Node analysis of DC circuits. Source transformation. Star-Delta Transformation. Network theorems. Time domain analysis of RC, RL, RLC with DC excitation.

1. **Electric Charge :** ↳ static charges → immobile
   ↳ Dynamic charge →
   - **Electric charge** is the physical property of matter that causes it to experience a force when placed in an electromagnetic field.
   - There are two types of electric charge: *positive* and *negative* (commonly carried by protons and electrons respectively).

unit of charge → Coloumb (C)

charge of an e^- ⇒ 1.602×10^{-19} C

1 Coloumb of charge flow → $\frac{1}{1.602 \times 10^{-19}}$

$= 6.24 \times 10^{+18}\ e^-$'s

$1e^- \rightarrow -1.602 \times 10^{-19}$ c

$1p^+ \rightarrow +1.602 \times 10^{-19}$ c

⇒ neutral.

Silk cloth
P
e

Glass rod
P
e

P > e
+ve
=

e > P
-ve charged
=

2. **Current:** charge

rate at which charge is moving

A i B $\quad 1A = \frac{1 \text{ coumb}}{1 \text{ sec}} = \frac{dq}{dt}$

$$i = \frac{dq}{dt}$$

$i_{AB} = 1A$

$i_{BA} = -1A$

$1\ C = \frac{6.24 \times 10^{18}\ e^-}{1 \text{ Sec}}$

Conductors :- Best current least resis

Gold, copper, Silver, Al, Steel,
↑ ↑ domestic ↑ 100 A

Insulators :- Rubber, plastic, wood, glass.

Semi-conductor : Si, Ge, Ar, In

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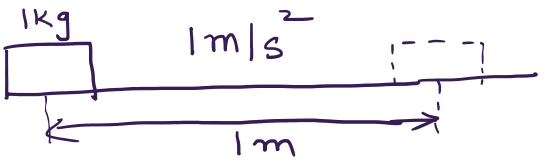
Force :-



1kg mass is made to accelerate at $1 m/s^2$, 1N of Force is to be applied

$$1N = 1 \frac{kg-m}{s^2}.$$

Energy :

Application of a const 1N Force thro 1m-distance requires an energy of 1Joule 1Joule = 1 N-m

Power : $\frac{dE}{dt}$: Power = 1 J/s = 1 Watt

Energy :- 1unit = 1 KWh V, f, I, P

P x T

60W x 5hr = 300Wh

LT 230V, 400V 3ϕ
LV 1ϕ

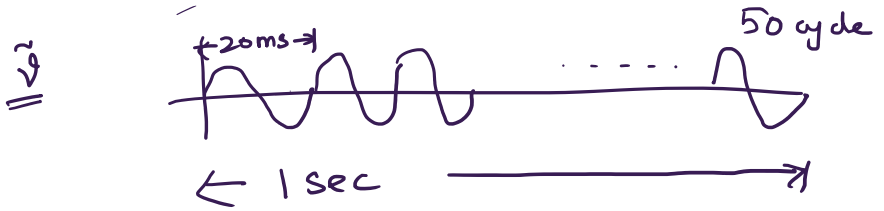
1 - 100 unit

1 - 100 unit 2Rs/unit
100 - 200 unit 3.5 Rs/unit

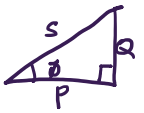
500 units = + Fc + =

Quantity	Symbol	Unit
Current	I, i(t)	Amp (A)

Current	I , i(t)	Amp (A)
Charge	Q	Coloumb (C)
Voltage	V	Volts (V)
Frequency	f	Hertz (Hz) ⇒ 50 cycles/sec



Power — P — 'P'



- R ⟵ ⟶ Real Power → Watts
- L, C ⟵ ⟶ Imaginary power (Reactive) → VAR → Q
- ⟶ Apparent Power → VA → $S = \sqrt{P^2 + Q^2}$

Electric Appliance

$V = 230\,V\ 1\phi$

$I = 5/10/15\,A$

$f = 50\,Hz$

$P = 500\,W$

$= \underline{500\,W}/\underline{750\,W}$

$= \underline{2\,KVA}$

Resistance	R	ohms (Ω)
Conductance	G	Mho (℧)
Inductive Reactance	$X_L = \omega L = (2\pi f)L$	ohms (Ω)
Capacitive Reactance	$X_C = \frac{1}{\omega C} = \frac{1}{2\pi f C}$	ohms (Ω)

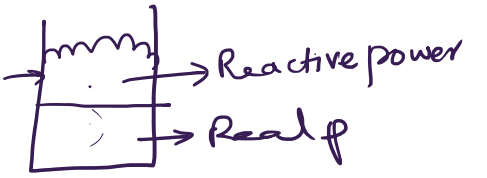
$$= \frac{1}{2\pi f C}$$

Impedance $Z = R + jX$

X_L

X_C

$(X_L \pm X_C)$

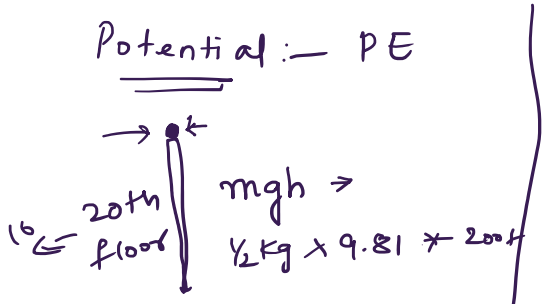


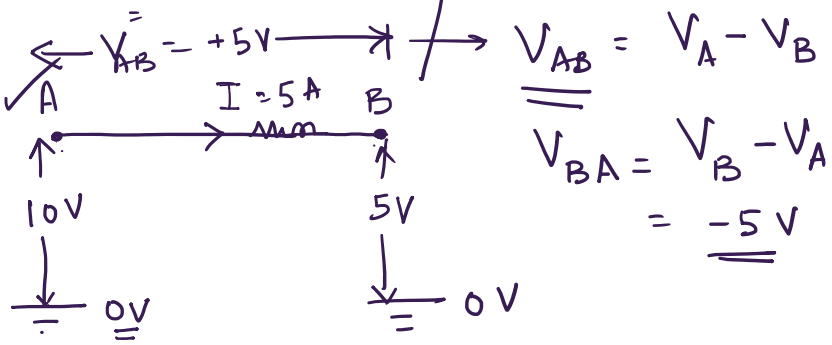
Voltage

Potential :— PE

KE

$KE = \frac{1}{2} m v^2$

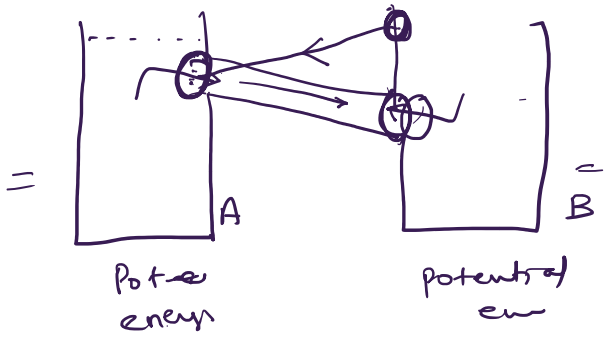




$V_{AB} = V_A - V_B$

$V_{BA} = V_B - V_A$

$= -5\,V$

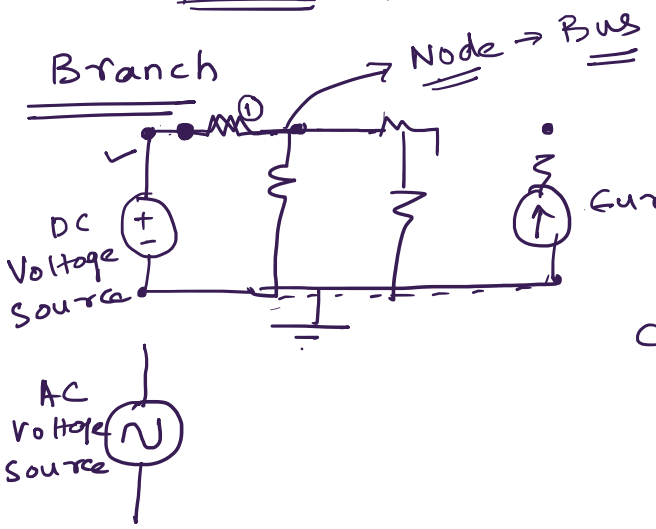


Electrical Circuit

Imp terms:

Node → Bus

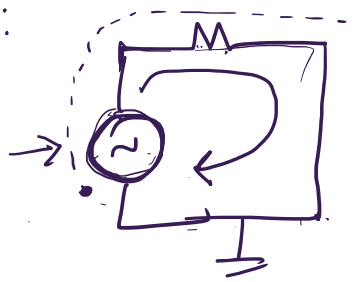
Imp terms:



Any two termal element can be represented as a branch

Node: A point of connection b/w 2 or more branches

Mesh / Loop: Any closed path in a ckt.



Mesh / Loop.

Temp ↓ −273°C or 0°k

Super conductor

	Super Conductor / 0 Resi
Tungsten	−202°C
Copper	−235°C
Al	−237°C
Silver	−243°C

SOURCE

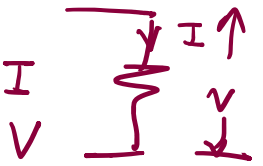
✓ → Battery → DC Source

✓ → Charged capacitor

✓ → Generator

Sources

- Independent
  - Current
    - Ac
    - DC
  - Voltage
    - Ac
    - DC
- Dependent
  - current
    - Ac
    - DC
  - voltage
    - Ac
    - DC



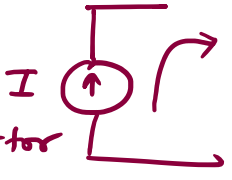
Independent current Source :

which is completely independent of Voltage

Independent Voltage Source:-

which is completely independent of current drawn by the system

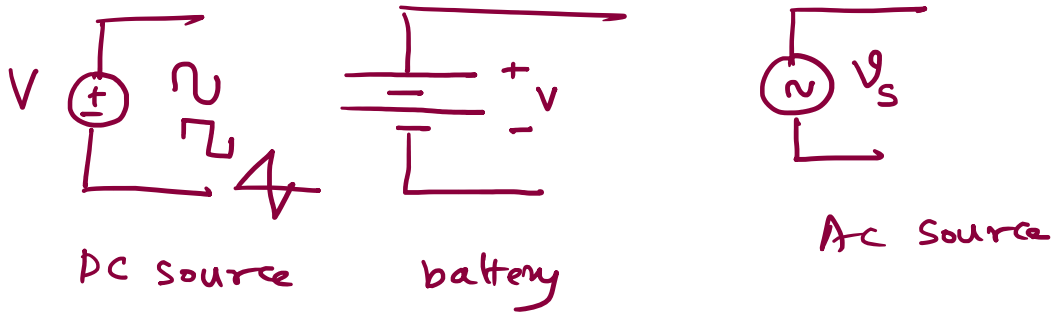
Independent Current Source



Ex:- Van de Graff Generator

Independent Voltage Source

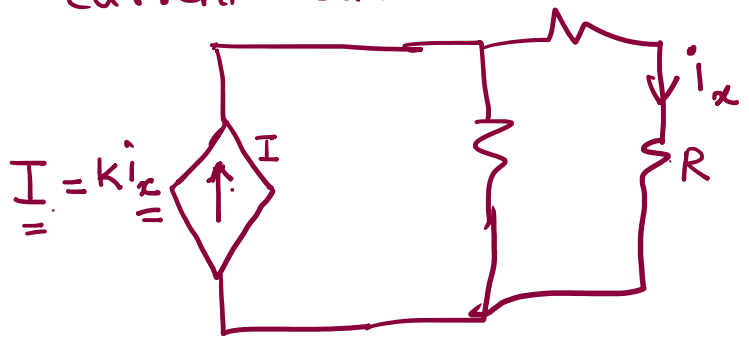
Independent Voltage Source



DC source battery Ac source

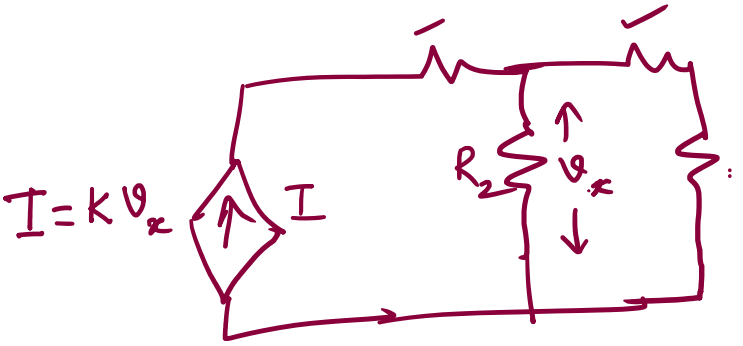
Dependent Sources

current source



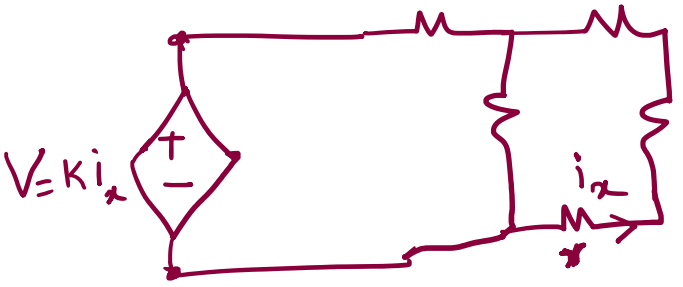
i_x { Current controlled

I { Current Source



⇒ I { Voltage controlled; Current Source

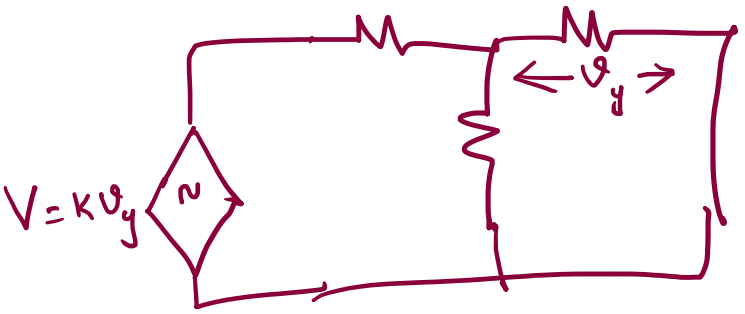
Dependent Voltage Source



i_x { Current controlled

$V = ki_x$ { Voltage source

{ Voltage controlled



Voltage controlled voltage source