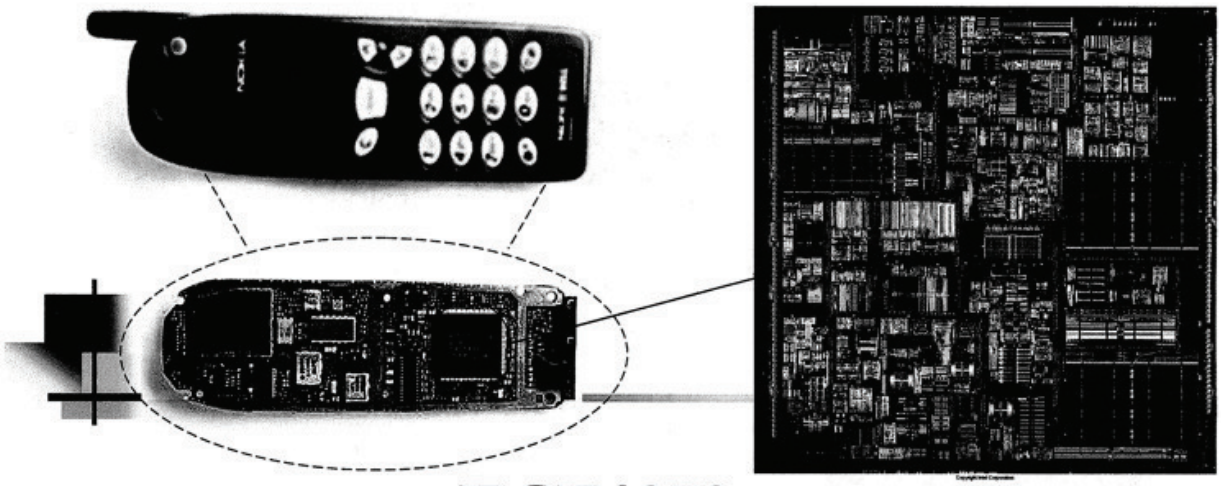


ECE1270

Introduction to Electrical and Computer Engineering

Professor Angela Rasmussen

Unit 1

memorize

UNITS

Current	Amps	A
Voltage	Volts	V
Resistance	Ohms	Ω
Capacitance	Farads	F
Inductance	Henrys	H
power	Watts	W

Values

G	Giga	10^9
M	mega	10^6
K	Kilo	10^3
m	milli	10^{-3}
μ	micro	10^{-6}
n	nano	10^{-9}
P	pico	10^{-12}
f	femto	10^{-15}

Conversions:

$1F = 1\ C/V$

$1A = Q/sec.$

$\Omega = V/A$

$1H = V \cdot s/A$

Independent Sources:

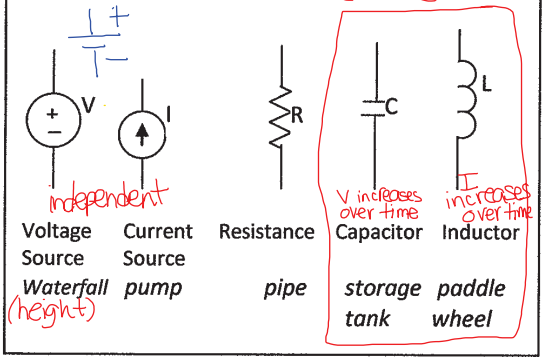
Voltage Source: (ex. Common battery) Able to supply or absorb any amount of current. Current value is set by EXTERNAL Circuit. Voltage is between + and – terminals.

Current Source: Supplies constant current in set "branch" of circuit. Voltage across current source is not zero for a nonideal current source.

Dependent Sources: "line"

Either current or voltage. Value is controlled by other variable (current or voltage). If value can be set, than it can be treated as independent source.

Circuit Elements: time

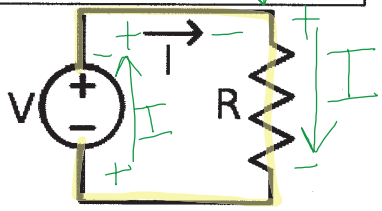


Voltage Source	Current Source	Resistance	Capacitor	Inductor
Waterfall (height)	*pump*	*pipe*	*storage tank*	*paddle wheel*

Passive Sign Convention:

Current arrow always pts from plus to negative (- at arrow)

same "line" even with bend



Ohms Law: memorize

V=IR or I=V/R

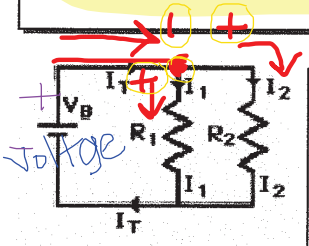
Linear device =>

2x current = 2xvoltage

Kirchoff's Current Law (KCL):

- If you have water flowing into and out of a junction of several pipes, water flowing into the junction must equal water flowing out.
- The same applies to electric circuits

The algebraic sum of currents into a node at any instant is zero



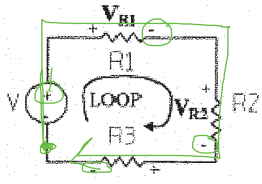
$I_T - I_1 - I_2 = 0$ or

$-I_T + I_1 + I_2 = 0$

$I_T = I_1 + I_2$

Kirchoff's Voltage Law (KVL):

The algebraic sum of voltages around any closed path (loop) is zero

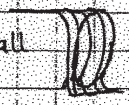


$-V + V_{R1} + V_{R2} + V_{R3} = 0$ or

$+V - V_{R1} - V_{R2} - V_{R3} = 0$ or

1

Voltage

waterfall  + v −

Voltage ↔ altitude
Volts 10V typ 1mV small
V

Lift charge Δq change energy Δw $\quad v = \lim_{\Delta q \to 0} \frac{\Delta w}{\Delta q} = \frac{dw}{dq}$

V-source
independent  v_s ± indicates polarity of measurement

dependent  $v_x = 3i_g$

Current

 i_s → i

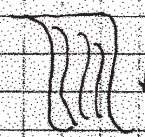
Current ↔ Flow rate
Amps 1A large 1mA typ
A

$v_x = 3i_s$

move charge Δq in time Δt $\quad i = \lim_{\Delta t \to 0} \frac{\Delta q}{\Delta t} = \frac{dq}{dt}$

i-source
Independent  i_s dependent  $i_x = 3v_c$

Power

 + i v

Power ↔ hydroelectric power
Watts 1/4 W typ 100W med
W

change energy by Δw in time Δt $\quad p = \lim_{\Delta t \to 0} \frac{\Delta w}{\Delta t} = \frac{dw}{dt}$

chain rule $\quad p = \frac{dw}{dq}\frac{dq}{dt}$ $\quad$ tot pwr in circuit = 0.