P3360 / AEP 3630

Lecture 1

I. Bazarov, Newman 210 / Wilson 373

web site: blackboard.cornell.edu (self enroll)
↳ TA info, office hours, etc.

Texts: E. Kirkland and R. Littauer, Lab Manual
I. Bazarov, Supplement

Labs: 401 MW 7:30PM - 10:30PM starts today!
402 TR 1:25PM - 4:25PM

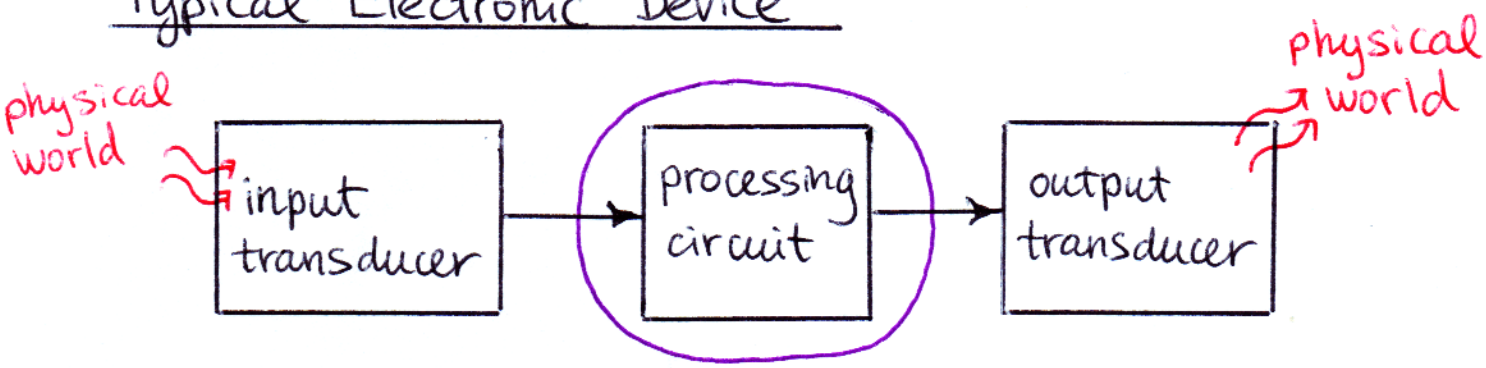
HW: 1 each week, due next week (Friday)
Soln. handed out → no late HW accepted

Grade: 40% lab
40% exam (prelim + final)
15% HW
5% participation (e.g. mailing list)

More info: Blackboard, printouts, 1st lab (!)

Goals:
- design & build simple circuits
- trouble shoot equipment
- analyze complicated circuit diagrams

Typical Electronic Device



transducer : converts physical quantity into electric signal (and vice versa)

input transducer (sensor) : e.g. thermistor (T → R)
microphone (sound → electric signal)

output transducer : e.g. LED (electr. → light)
speaker (electr. → sound)
robotic arm (aka actuator)

Two types of circuits

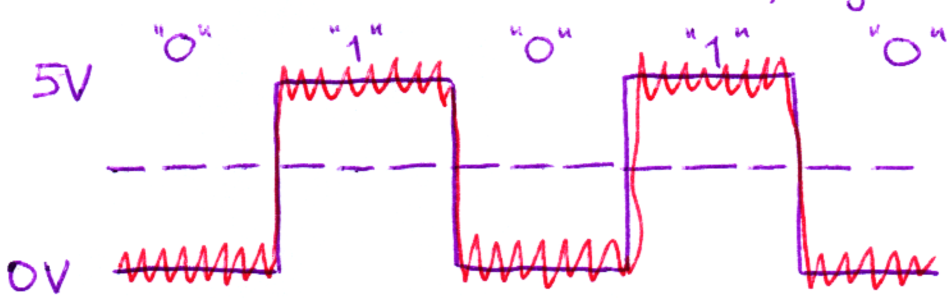
Analog   info is represented by continuously varying signal

typical functions : amplification
filters (bass, treble)
mixing

Q: possible problems?

- sensitive to noise
- p.s. drift

Digital   input / output signals have discrete values, e.g. 0 and 5 V



typical fcn : memory storage
logic, etc.

Basic quantities of interest

V = voltage = electric potential difference (measured w.r.t. some reference, e.g. "ground")

[V] = volts

$q \cdot \Delta V = \Delta PE$ (of charge q due to ΔV)

I = current = charge flow rate = charge / unit time

[I] = amps

direction : dir. of +ve charge flow

DC : I, V indep. of time
AC : —"— time varying

Convention I, V – pure dc
i, v – ac or dc + ac

I, V – represent physical quantities (sound, temp, color, etc.)

Electric circuit – interconnection of elect. devices which creates and / or manipulates I, V to perform some fcn.

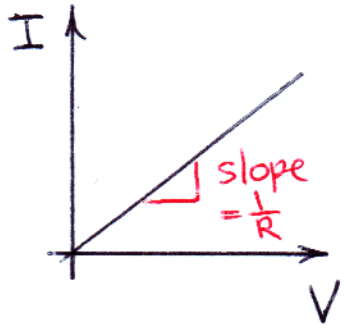
Linear circuit devices

① Resistor

obeys Ohm's law

$$I = \frac{V_2 - V_1}{R} = \frac{V}{R}$$

[R] = ohm, Ω



"I-V curve" $R \neq f(I,V)$

value		accuracy	
Black	0	n/a	- 20%
Brown	1	silver	- 10%
R	2	gold	- 5%
O	3		
Y	4		
G	5		
B	6		
V	7		
Gray	8		
White	9		

Richard of York gave battle in vain

example

O B R S

3 6 2 (10%)

$= 36 \times 10^2 \pm 10\%$

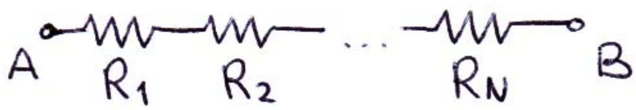
$= 3.6\,k\Omega$

Typical power rating $\frac{1}{4}$ to $\frac{1}{2}$ W

Conductance = inverse resistance $= G = \frac{1}{R} = \frac{I}{V}$

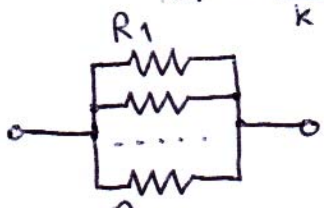
$[G]$ = siemens (mho)

Series resistors



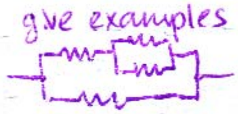
$R_T = \sum_k R_k$ add resistances

Parallel



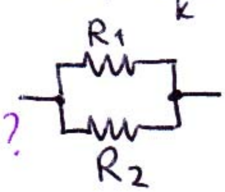
$G_T = \sum_k G_k$ add conductances, $R_T = G_T^{-1}$

give examples



easy,

hard?

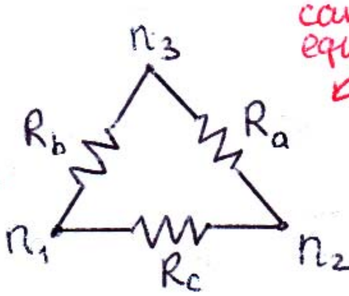


$R_T = \frac{R_1 R_2}{R_1 + R_2} = R_1 \| R_2$

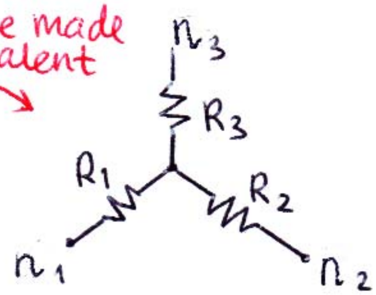
Y-Δ transformation

Δ→Y : $R \equiv R_a + R_b + R_c$

$R_1 = \frac{R_b R_c}{R}$, $R_2 = \frac{R_c R_a}{R}$, $R_3 = \frac{R_a R_b}{R}$



can be made equivalent



proof: HW

Y→Δ: $G = G_1 + G_2 + G_3$

$G_a = \frac{G_2 G_3}{G}$, $G_b = \frac{G_3 G_1}{G}$, $G_c = \frac{G_1 G_2}{G}$