ME 133 Lecture 17.

3/3

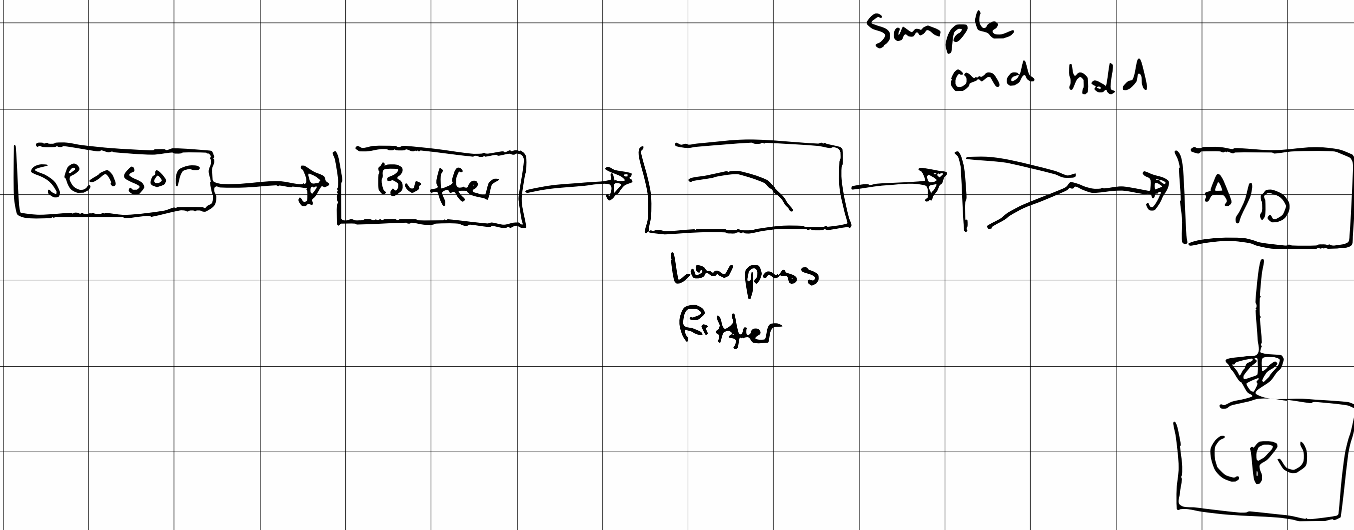
Final
March 16 8am - 11am
SKJ

lastime
→ sensors

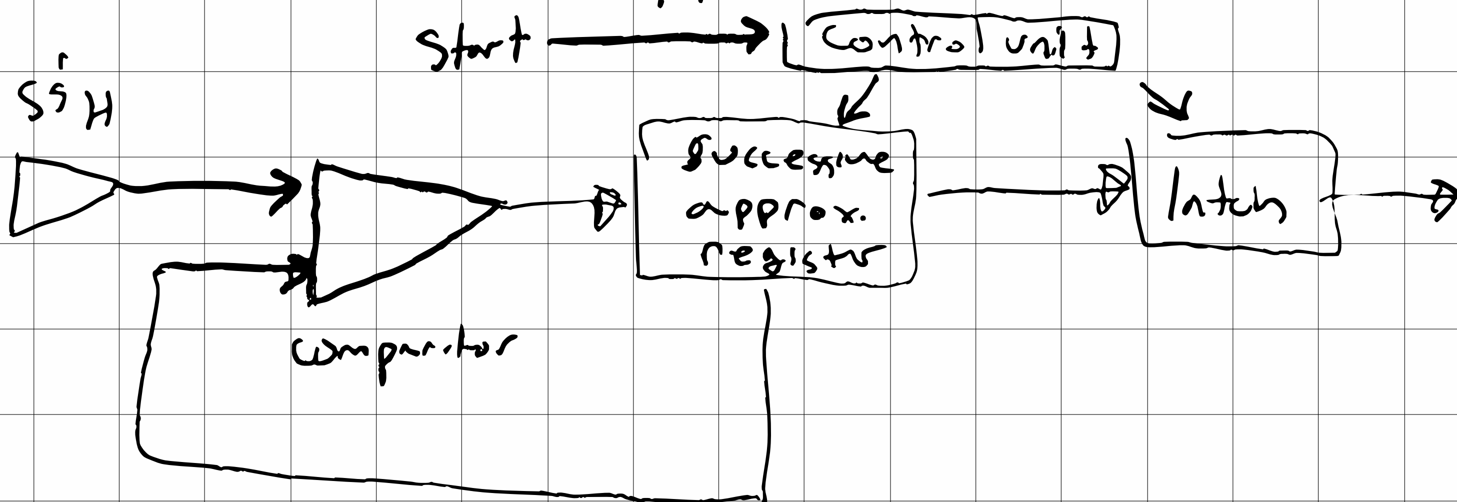
<u>ADC</u> Analog to digital Converter

→ most widely used
successive approximation

ADC overview:



Successive approximation



Exam structure

- 4 - 5 problems (1 hr 20 mins)
- no numerical calculations
- two sheets of notes
- mix of conceptual & symbolic derivations

Ch. 6 Digital Circuits

- digital vs analog signals
- Binary number
- Boolean logic

· Numerical Representation

$$d_{n-1} \cdots d_2 d_1 d_0 = d_{n-1} \cdot 10^{n-1} + \vdots + d_2 \cdot 10^2 + d_1 \cdot 10^1 + d_0 \cdot 10^0$$

base 10

$$d_{n-1} \cdots d_2 d_1 d_0 = d_{n-1} \cdot 2^{n-1} \vdots + d_2 \cdot 2^2 + d_1 \cdot 2^1 + d_0 \cdot 2^0$$

- Bits
- MSB vs LSB
- Byte
- Binary Arithmetic

$$\begin{array}{r} {}^{1}{}^{1} \\ 1001 \\ +\ 0011 \\ \hline 1100 \end{array} \rightarrow 12 \qquad \begin{array}{r} 9 \\ +\ 3 \\ \hline 12 \end{array}$$

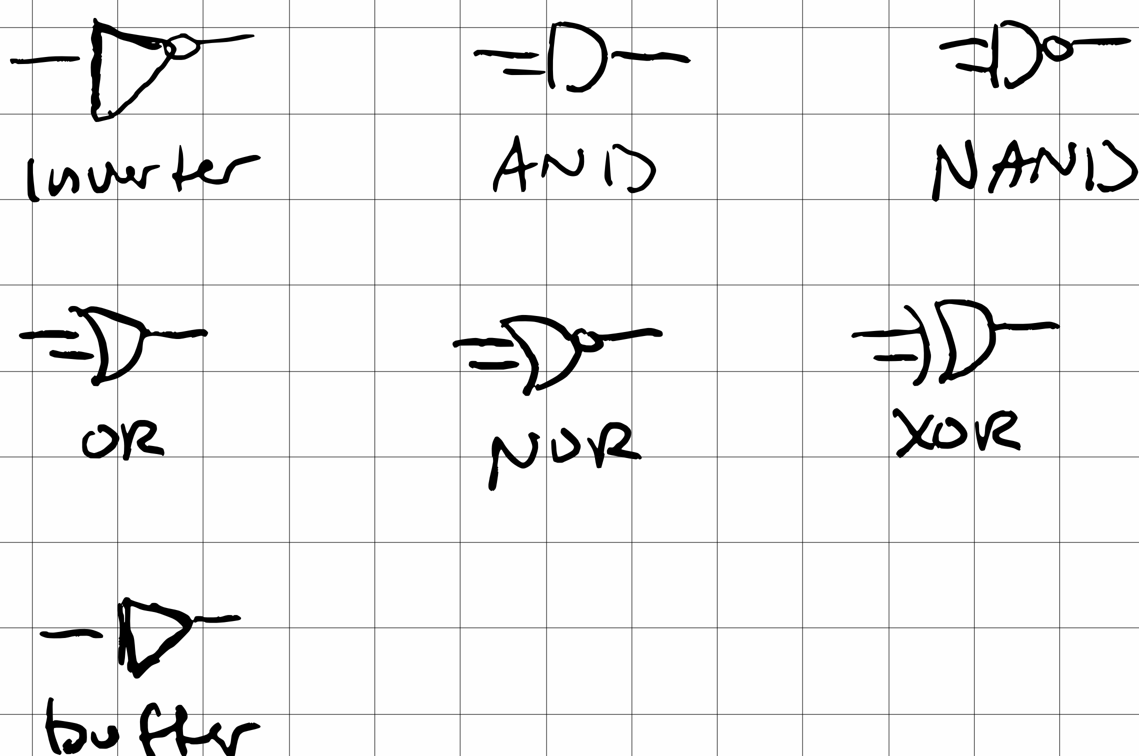
-

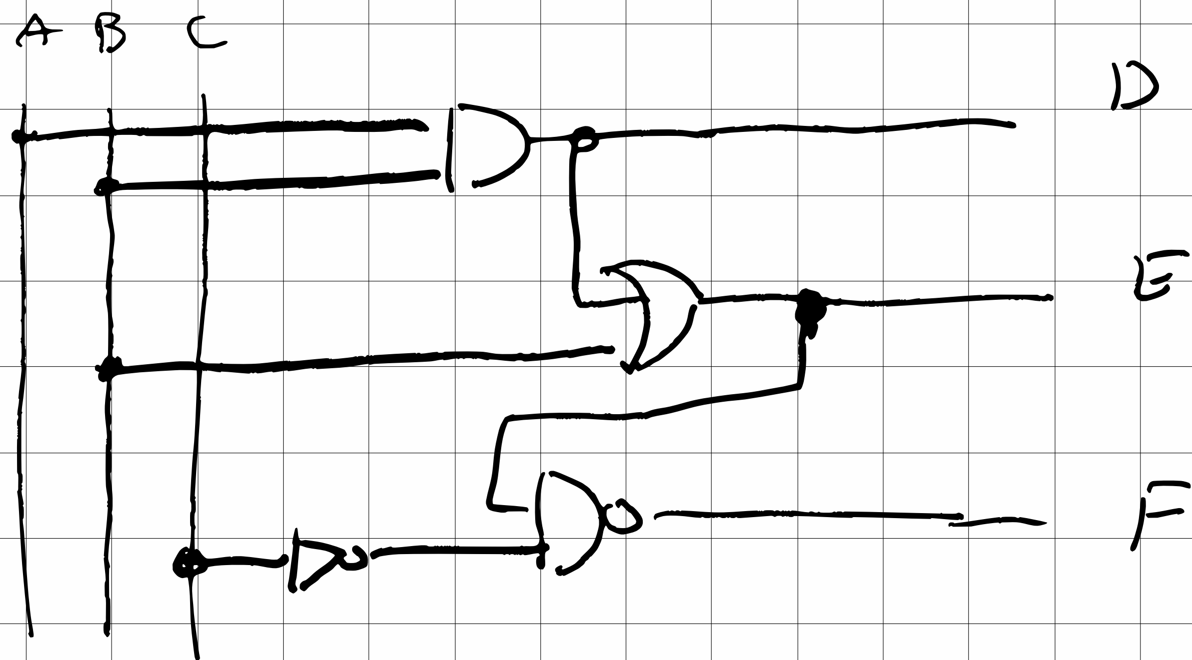
Combinational Logic

"logic gates"

---

logic gates

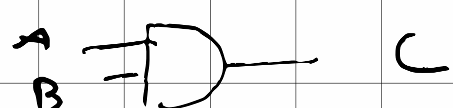


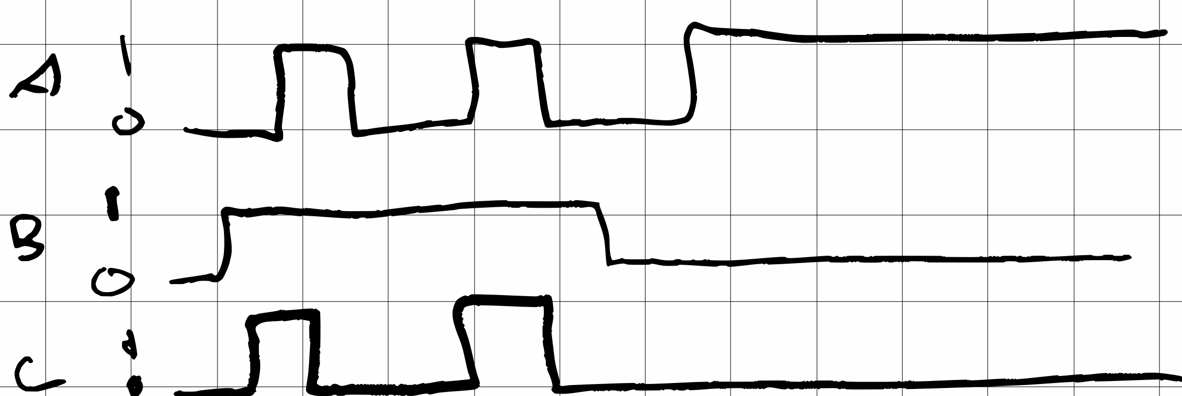


D = ? E = ? F = ?

- Truth tables

- Timing Diagram





Boolean Algebra

- Fundamental Laws
- commutative law
- Associative
- Distributive
- De Morgan's laws

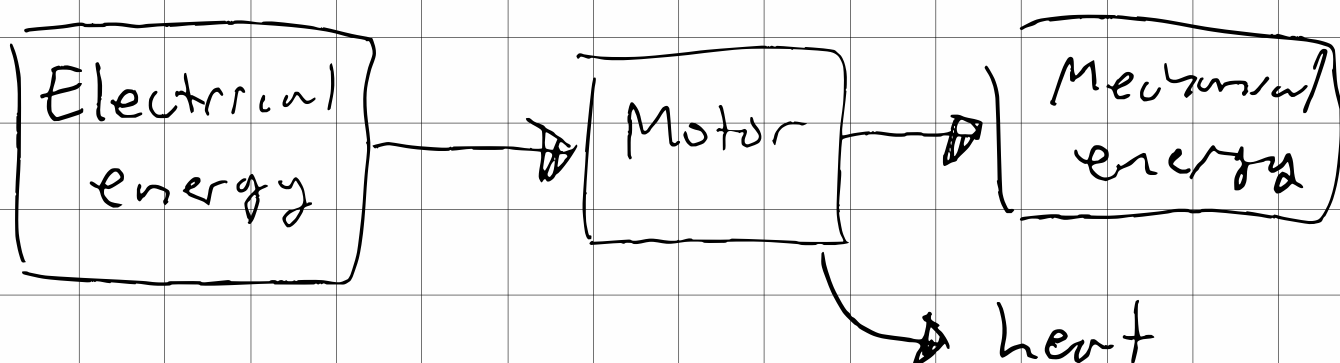
- Design logic Network

  → like the alarm example

Ch. 10 Actuators

- Identify different actuators
  - solenoids
  - electric motors

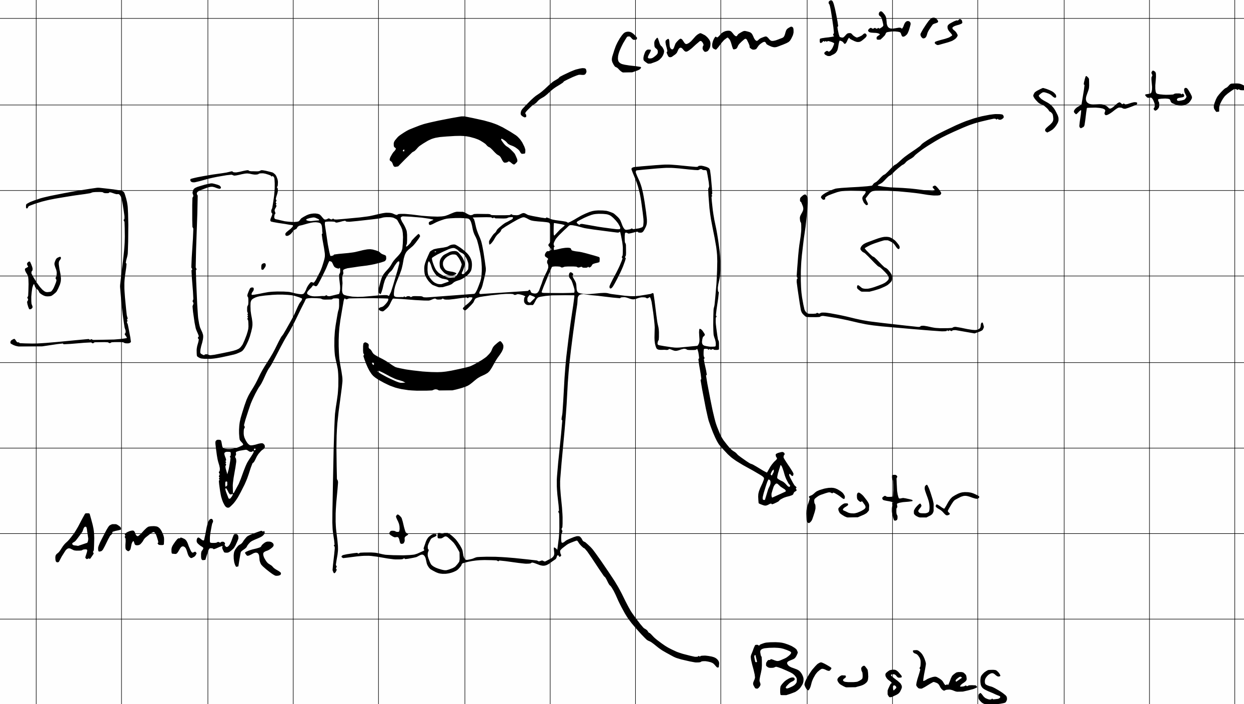
- Fundamental principle



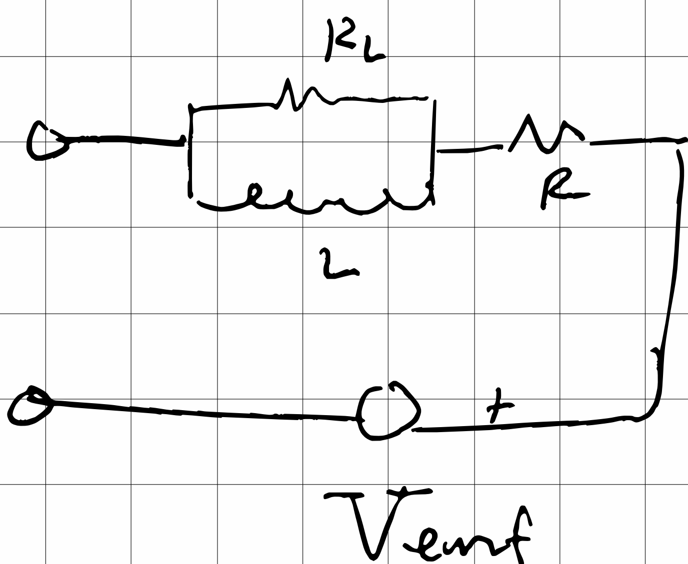
$$P_{in} = P_{out}$$

$$\eta \, V \cdot I = \tau \cdot \omega$$

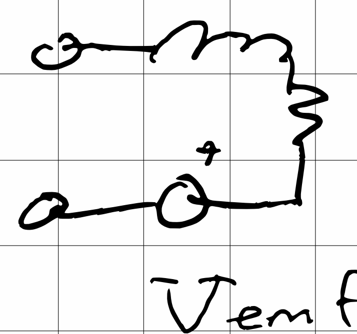
Components of DC Motor



DC motor model



$R_L >> R$



$$V_{in} = L\dot{I}_{in} + R I_{in} + \underline{k_e \omega}$$

Torque constant

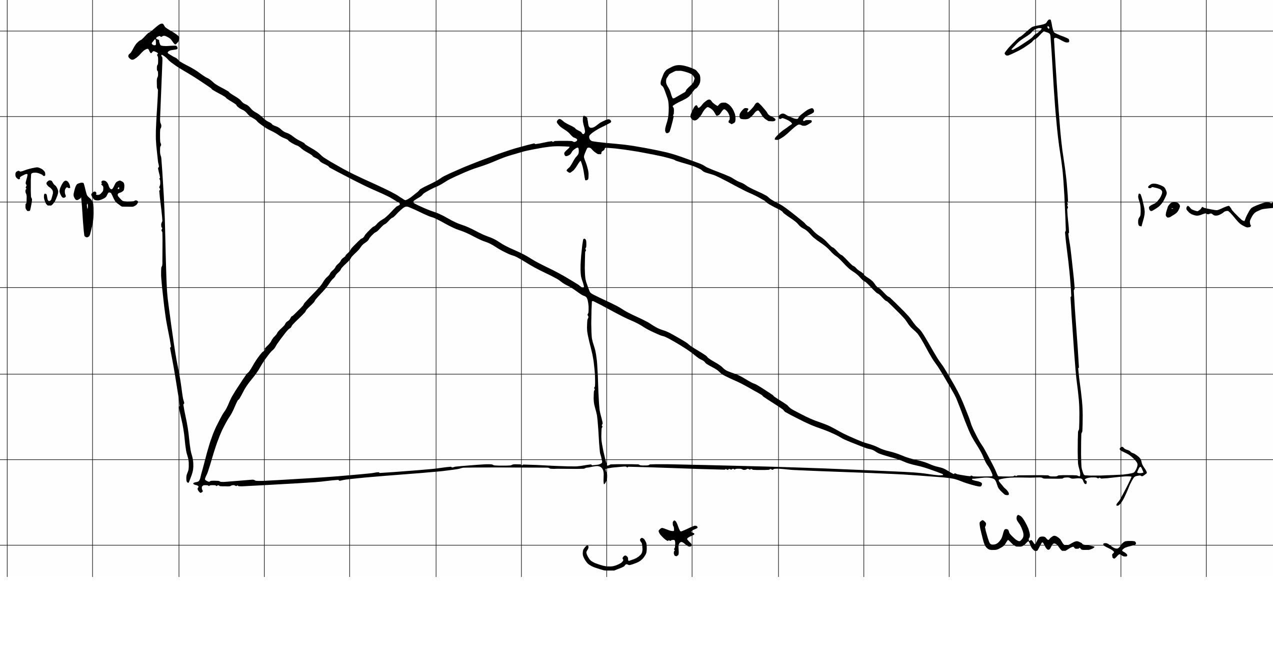
$$\tau = K_\tau I_{in}$$

Mechanical Model:

$$\tau = (\overbrace{J_a + J_L}^{\text{rotor + load inertia}}) \frac{d\omega}{dt} + \underbrace{\tau_f + \tau_L}_{\text{"losses"}}$$

Steady state behavior

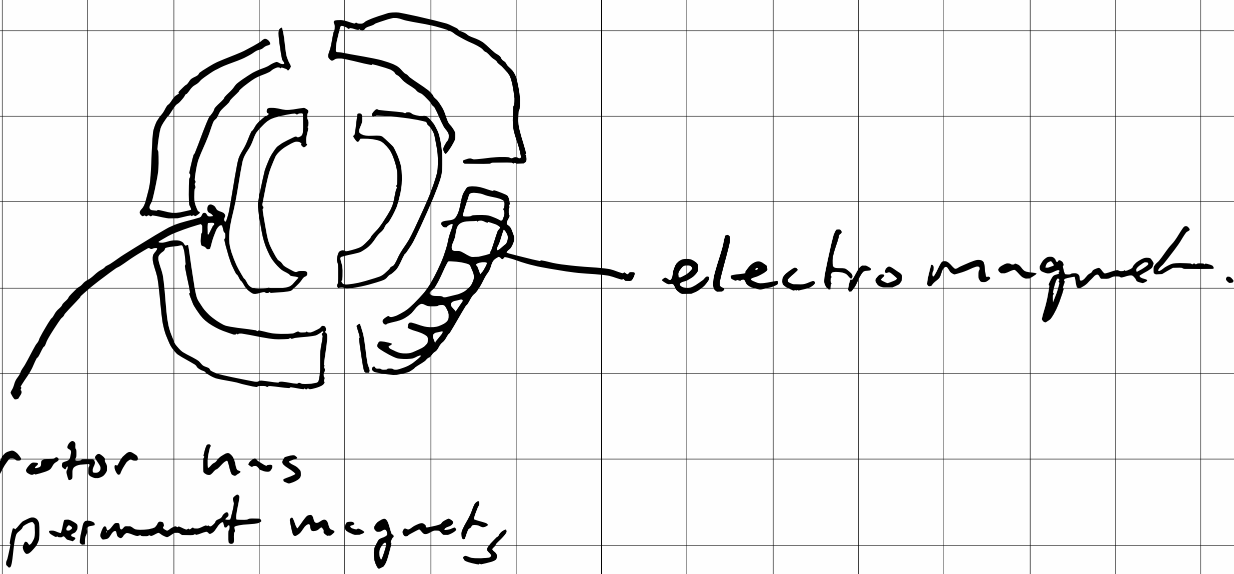
$$\tau = \left(\frac{k_\tau}{R}\right) V_{in} - \left(\frac{k_e k_\tau}{R}\right) \omega$$



$$\underbrace{\omega^* = \frac{1}{2}\omega_{max}}$$

know why!!

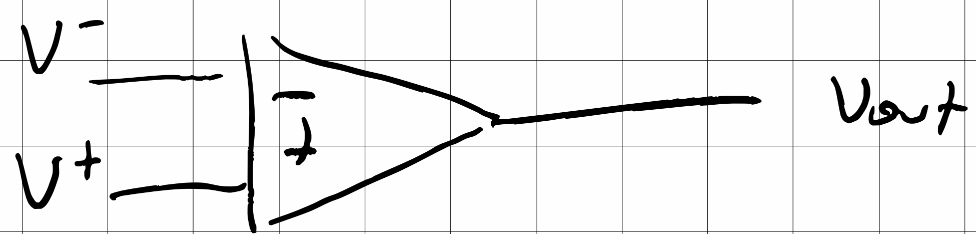
Stepper Motors



locked step mode vs slewing mode

Ch. 5 Analog Signal Processing

→ Why?



$$V_{out} = A_{OL}\,(V^+ - V^-)$$

Ideal op amp Assumptions

1. Infinite input impedance
   → $I^- = I^+ = 0$
2. Infinite gain
   → $V^+ = V^-$
3. Output impedance is zero
   V_{out} is independent of I_{out}

$$\boxed{\begin{aligned} V &= IR \\ R &= \frac{V}{I} \\ Z &= \frac{V}{I} \end{aligned}}$$

[Know how to analyze op amp circuits]

- Inverting Amp
- non-inverting Amp
- Buffer
- Summer
- Intergrator
- differentiator
- comparator
- Active filter
- Sample & hold

Sensors Ch. 9

- Position & Speed

conceptual
- photoemitter - detector
- switches
- potentiometer
- LVDT
- encoders

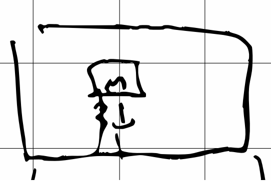
- Stress & strain

* Wheatstone Bridge !

- Temperature Sensors

→ basic

- Vibration & Accelerations



Ch. 8 Data Aquisition

- Shannon's sampling Theorem

- ADC successive approximation

---

op Amp