Principles of Electrical Engineering Cheat Sheet

Basics

- $V = IR$ | $P = IV$ | $P = \frac{V^2}{R}$
- $R_a \| R_b = \frac{R_a + R_b}{R_a * R_b}$
- Absorbed power = $\frac{V^2}{R}$

Circuit Analysis/Simplification

Superposition

- For **Independent** Sources only:
- Current sources –> OC | Voltage sources –> SC
- Deactivate all but **1** source and solve the circuit. Repeat with a different source. Add the values for each component

Thevenin/Norton with respect to a & b

- V_{Th} is open circuit voltage between a and b
- Find R_{Th} by removing sources like in superposition and find equivalent resistance between a and b
- Find I_{SC} by shorting across a and b. $V_{Th} = I_{sc}R_{Th}$
- Norton: Take Thevenin and source transform into current source parallel to R_{Th}

Source Transformation

- V_s in series with R <–> I_s in parallel with R

Delta-Wye ($\Delta - Y$)

Δ to Y

$$R_A = \frac{R_{AB}R_{AC}}{R_{AB} + R_{AC} + R_{BC}}$$

$$R_B = \frac{R_{AB}R_{BC}}{R_{AB} + R_{AC} + R_{BC}}$$

$$R_C = \frac{R_{AC}R_{BC}}{R_{AB} + R_{AC} + R_{BC}}$$

Y to Δ

$$R_{AB} = \frac{R_A R_B + R_A R_C + R_B R_C}{R_C}$$

$$R_{BC} = \frac{R_A R_B + R_A R_C + R_B R_C}{R_A}$$

$$R_{AC} = \frac{R_A R_B + R_A R_C + R_B R_C}{R_B}$$

Maximum Power Transfer

- $R_L = R_{Th}$ | $P = \frac{V_{Th}^2}{4R_L}$

Op Amps

- Linear Region: $-V_{cc} \leq V_o \leq V_{cc}$
- $I_n = I_p = 0$ | $V_n = V_p$
- Perform KCL @ inputs, Node voltage method

Time Varying Sources

- $v(t) = V_m cos(\omega t + \phi)$ | V_m is the amplitude, DC
- RMS for cos: $V_{rms} = \frac{V_m}{\sqrt{2}}$

Inductors and Capacitors

- Capacitor:
  - $I = C\frac{dv}{dt}$ | $C = \frac{q}{v}$
  - $v(t) = \frac{1}{C}\int_{t_0}^{t} idt + v(t_0)$
  - $P = vC\frac{dv}{dt}$ | $w = \frac{1}{2}Cv^2$
- Series
  - $\frac{1}{C_{eq}} = \sum \frac{1}{C_n}$
- Parallel
  - $C_{eq} = \sum C_n$
- Inductor:
  - $vdt = Ldi$
  - $i(t) = \frac{1}{L}\int_{t_0}^{t} vdt + i(t_0)$
  - $P = Li\frac{di}{dt}$ | $w = \frac{1}{2}Li^2$
  - Series
    - $L_{eq} = \sum L_n$
    - $v = \sum L_n \frac{di}{dt}$
  - Parallel
    - $\frac{1}{L_{eq}} = \sum \frac{1}{L_n}$
    - $i(t_0) = \sum i_n(t_0)$

Trig Relationshiips and Angles

- $\cos(\omega t) = \sin(\omega t + \frac{\pi}{2}) = -\sin(\omega t - \frac{\pi}{2})$
- $\sin(\omega t) = \cos(\omega t - \frac{\pi}{2}) = -\cos(\omega t + \frac{\pi}{2})$
- In an inductorthe current lags voltage 90 degrees
- In a capacitive circuit, current leads voltage by 90 degrres

Mutual Inductance

- Mutually induced voltage = $M\frac{di_2}{dt}$ where I_2 is the current in the other coil

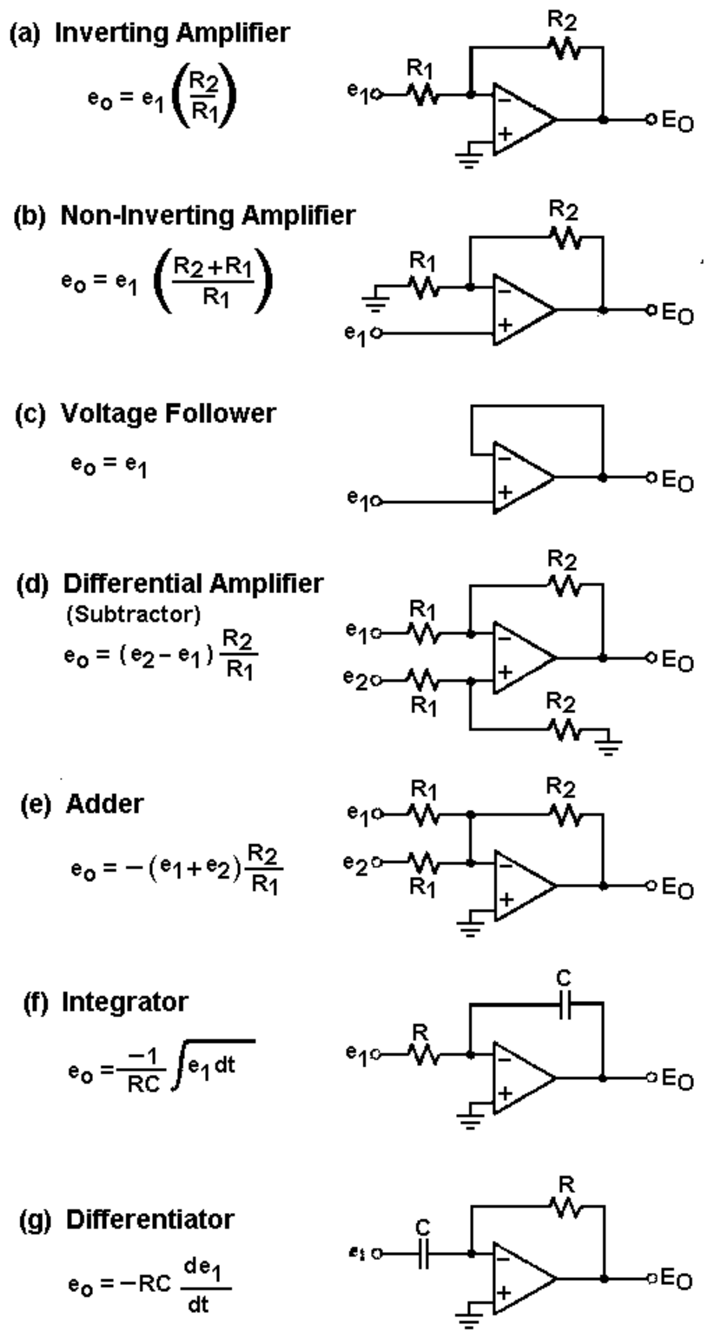

Figure 1: Types of Op Amps

- Dot convention:
  - When the reference direction for a current enters the dotted terminal of a coil, the reference polarity of the voltage that it induces in the other col is positive at its dotted terminal

Impedance (Z)

Ohm's Law: V=I**Z**

- Resistor: $Z_R = R$
- Inductor: $Z_L = j\omega L$
- Capacitor: $Z_C = \frac{1}{j\omega C}$

Admittance is the reciprocal of impedance

Phasors

$C = M\angle\theta = M\cos(t\omega + \theta) = Me^{j\theta}$

Forms

- Phasor: $C = M\angle\theta$
- Rectangular: $C = A + jB$

Conversion

- $M = \sqrt{A^2 + B^2}$, $\theta = arctan(\frac{B}{A})$
- $A = M\cos\theta$, $B = M\sin\theta$

Phasor Math

Let $C_1 = M_1\angle\theta_1$ and $C_2 = M_2\angle\theta_2$

- $C_1 \times C_2 = M_1 \times M_2\angle(\theta_1 + \theta_2)$
- $C_1 \div C_2 = \frac{M_1}{M_2}\angle(\theta_1 - \theta_2)$