Voltage Gain: $A_v = \frac{v_o}{v_i}$ Current Gain: $A_i = \frac{i_o}{i_i}$ Power Gain: $G = A_v A_i$

Decibel: $A_{v\text{dB}} = 20\log(|A_v|)$ $A_{i\text{dB}} = 20\log(|A_i|)$ $G_{\text{dB}} = 10\log(|G|)$

$$\boxed{\text{Energy Conservation: } P_i + P_s = P_o + P_d \longrightarrow \begin{cases} P_i & = \text{Power from Source} \\ P_s & = \text{Power from DC Supplies} \\ P_o & = \text{Output Power at Load} \\ P_d & = \text{Power Dissipated in the Op-Amp} \end{cases}}$$

Frequency Dependence:

Capacitor: $Z_c = \frac{1}{j\omega C}$ Inductor: $Z_L = j\omega L$

Summing Point Constraint:

- Only applies when the op-amp is in negative feedback
- Assuming ideal op-amp, $V_+ - V_- = 0$ (no current at terminals)
- For non-ideal op-amps: $V_o = A(s)(V_+ - V_-)$

$f_{3\text{dB}} = \frac{\omega_{3\text{dB}}}{2\pi}$ $\text{GBW} = |A_v||f_{3\text{dB}}$

Diodes:

- In Forward Bias (FB): Permit current flow, have a positive voltage drop
- In Reverse Bias (RB): No current flow (open circuit)
  - Constant Voltage Drop (CVD): Diodes have same forward-bias drop ($\approx .7$[V])
- Assume bias mode for each diode in diagram, calculate values to verify assumptions
- CVD + resistance model: $r_d = \frac{nV_T}{I_{DQ}}$ (approximated around quiescent point, Q)

$I_D = I_s e^{\frac{V_D}{nV_T}} + 1$ Room Temp: $V_T \approx 26$[mV] $1 < n < 2$ $10^{-6} < I_s 10^{-18}$[A]

$\boxed{\underline{\text{Temp Dependence:}}\ \text{constant } I \rightarrow V \text{ drop decreases} \approx 2[\text{mV}] \text{ per } 1[^\circ\text{C}] \text{ temperature increase}}$

Zener Diodes: $V_D = -V_{zo} - I_z r_z$ in breakdown, with $I_z = -I_D > 0$

Transformers: step voltages according to turns ratio $(N_p : N_s)$ or $(n : 1)$, with $V_s = V_p/n$