CHAPTER 1

READ: 1.1 TO 1.5  HW 1.1, 1.2, 1.11, 1.13, 1.17, 1.18, 1.19

**Sources**

\[ N_i(t) = N_i \text{ rem.} \]

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\[ I_i(t) = I_i \text{ rem.} \]

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\[ V_i(t) = V_i \text{ rem.} \]

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\[ N_0 = N_i \left[ \frac{R_2}{R_1 + R_2} \right] \]
**Impedance**

\[ Z_x = \frac{N_x}{L_x} \]

**Example:**

\[ Z_x = \frac{R_1 \parallel R_2}{R_1 + R_2} \]
THEVENIN EQ CIRCUIT

\[ V_T = V_{op} \]

\[ Z_T = Z_x = \frac{V_x}{I_x} \]

\( V_{op} = \text{OPEN CIRCUIT VOLTAGE} \)

NORTON EQ CIRCUIT

\[ I_{SH} \]

\[ Z_T \]
\[ \mathbf{E}_v : \]

\[ \mathbf{V}_i : \]

\[ \mathbf{N}_i : \frac{R_2}{R_1 + R_1} \]

THEVENIN

\[ \mathbf{N}_i : \frac{1}{R_1} \]

NORTON
**SUPERPOSITION** (Will be used to separate the effects of AC & DC sources on a circuit)

**Ex. 1**

\[
\text{AC CIRCUIT} \quad N_0(\text{AC})
\]

\[
\text{DC CIRCUIT} \quad V_0(\text{DC})
\]

Total response is found by adding \( N_0(\text{AC}) + V_0(\text{DC}) \)

\[
N_0(\text{AC}) + N_0(\text{DC})
\]

**Ex. 2**

\[
I_0 \quad \text{V}_{\text{DC}} \quad V_0
\]
AC CIRCUIT

\[ N_0(AC) = I_{AC} \times R \]

\[ V_0(AC) \]

DC CIRCUIT

\[ V_0(DC) = V_{DC} - R I_{DC} \]

\[ N_0 = V_0(DC) + N_0(AC) \]

\[ t \]
Superposition with Capacitors (EE241)

For AC sources, capacitors are shorted.
For DC sources, "" "" open.

Ex:

\[ V_{DC} \]

\[ \begin{align*}
R_3 & \mid \quad R_1 & \mid \quad R_2 & \mid \\
N_1 & \mid & \quad C \rightarrow \infty & \mid & \quad N_0 & \mid \\
\end{align*} \]

AC Circuit

\[ N_1; \quad R_1 \mid \quad R_2 \mid \quad N_0 (AC) = N_1 \left[ \frac{R_1 || R_2}{R_2 + R_1 || R_2} \right] \]

DC Circuit

\[ \begin{align*}
V_{DC} & \mid \quad R_1 & \mid \quad R_2 & \mid \\
R_2 & \mid \quad V_0 (DC) = V_{DC} & \left[ \frac{R_2}{R_1 + R_2} \right] \\
\end{align*} \]
AMPLIFIER (IDEAL)

\[ N_o = A_V N_i \]

TRANSFER FUNCTION (IDEAL)

\[ A_V = \frac{N_o}{N_i} \]
INVERTING TRANSFER FUNCTION (IDEAL)

\[ N_0 = -A_v N_i \]

AMPLIFIER (REAL)

Ex 1
TRANSFER FUNCTION (REAL)

CLIPPING OR LIMITING

\[ N_0 \]

\[ N_1 \]

\[ -V_{POWER} \]
Ex 1b

\[ N_i' \]

\[ V_{dc} \]

\[ R \]

\[ N_i' \]

\[ N_i \]

\[ V_p \]

Ex 2

\[ V_{dc} \text{ is formed by } R_1, R_2 \text{ and } V_p \]

Ex 1b and 2 have the same input, \( N_i \)

\[ V_{dc} = V_p \left( \frac{R_2}{R_1 + R_2} \right) \]
CIRCUIT MODELS FOR AMPLIFIERS

VOLTAGE AMPS:

\[ R_i = \text{input impedance} \]
\[ R_o = \text{output impedance} \]
\[ A_V = \text{voltage gain (volt/volt)} \]
\[ G_m = \text{transconductance (current/voltage)} \]
Ex: Cascading of Amplifiers

\[
N_0 = A_2 N_2 \left[ \frac{R_L}{R_{o2} + R_L} \right]
\]

\[
N_2 = A_1 N_1 \left[ \frac{R_{i2}}{R_{o1} + R_{i2}} \right]
\]

\[
N_1 = N_i \left[ \frac{R_{i1}}{R_s + R_{i1}} \right]
\]

\[
\text{Gain} = \frac{N_0}{N_i} = A_1 A_2 \left[ \frac{R_L}{R_{o2} + R_L} \right] \left[ \frac{R_{i2}}{R_{o1} + R_{i2}} \right] \left[ \frac{R_{i1}}{R_s + R_{i1}} \right]
\]