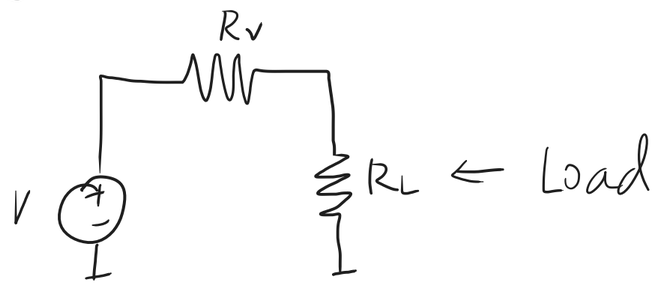
① Maximum Power Transfer Theorem

1) DC



$$P_L = I^2 R_L = \frac{V^2}{(R_V + R_L)^2} R_L$$

if $P_L = \text{Max}(P_L)$, $\frac{dP_L}{dR_L} = 0$

$$\frac{dP_L}{dR_L} = \frac{V^2}{(R_V+R_L)^2} + V^2 R_L \cdot -2\frac{1}{(R_V+R_L)^3}$$

$$= \frac{V^2(R_V + R_L - 2R_L)}{(R_V+R_L)^3}$$

$$= \frac{V^2(R_V - R_L)}{(R_V+R_L)^3} = 0$$

$$\Longrightarrow R_V = R_L, \quad P_L = \text{Max}(P_L)$$

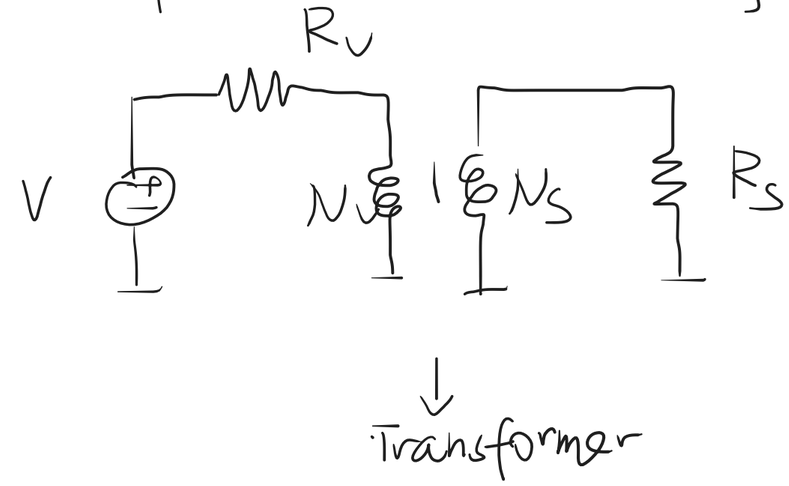
2) AC

$$R_V + jX_V = R_L - jX_L$$

cancel out

$$\Rightarrow \quad Z_V = \overline{Z_L}$$

② Impedance Matching



$$\frac{V_{NV}}{V_{NS}} = \frac{N_V}{N_S}$$

$$\therefore V_{NV} I_{NV} = V_{NS} I_{NS}$$

$$\therefore \frac{I_{NV}}{I_{NS}} = \frac{N_S}{N_V}$$

$$\therefore \frac{R_{NV}}{R_{NS}} = \frac{V_{NV}/I_{NV}}{V_{NS}/I_{NS}} = \frac{N_S^2}{N_V^2}$$

∵ Maximal Power Transfer

$$\therefore R_V = R_{NV}, \; R_{NS} = R_L$$

$$R_V = \frac{N_S^2}{N_V^2} R_L$$