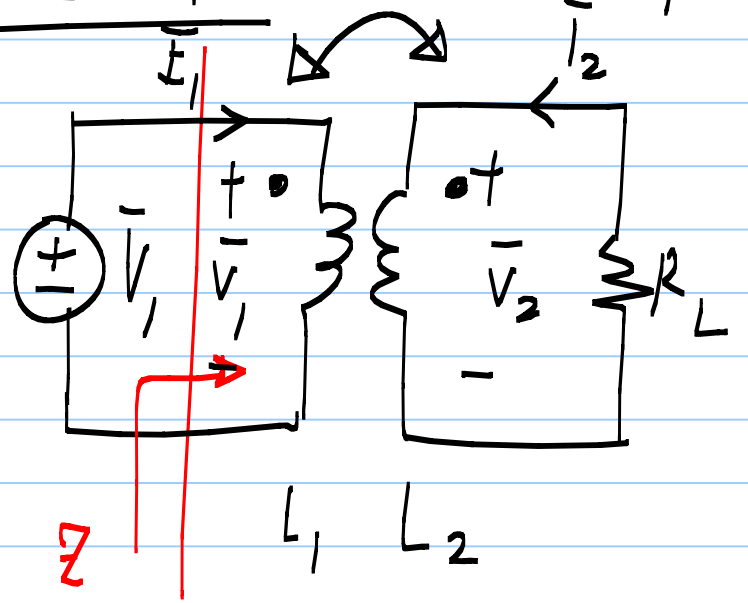
Lecture 34

$M = k\sqrt{L_1 L_2}$



$$\begin{cases} \bar{V}_1 = j\omega L_1 \bar{I}_1 + j\omega M \bar{I}_2 \\ \bar{V}_2 = j\omega M \bar{I}_1 + j\omega L_2 \bar{I}_2 \\ \bar{V}_2 = -\bar{I}_2 \cdot R_L \end{cases}$$

$\bar{I}_2$ in terms of $\bar{I}_1$

$$\bar{I}_2 = -\frac{j\omega M \bar{I}_1}{j\omega L_2 + R_L}$$

$$Z = \frac{\bar{V}_1}{\bar{I}_1} = j\omega L_1 + \frac{k^2 L_1 L_2 \omega^2}{R_L + j\omega L_2} = \frac{j\omega L_1 R_L + \omega^2 L_1 L_2 (k^2 - 1)}{R_L + j\omega L_2}$$

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$$= j\omega L_1 \cdot \frac{\left[1 + j\frac{\omega L_2}{R_L}(1 - k^2)\right]}{1 + j\frac{\omega L_2}{R_L}}$$

$k = 1$,

$L_1, L_2 \to \infty$

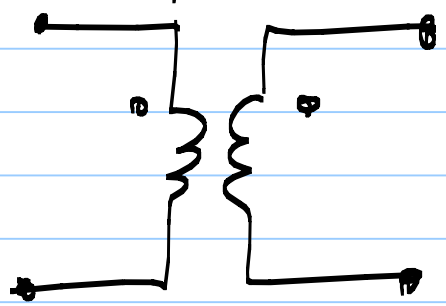
$L_1 / L_2 = n^2$

$$\frac{\bar{V}_2}{\bar{V}_1} = \frac{M/L_1}{1 + j\frac{\omega L_2}{R_L}(1 - k^2)} = \frac{1}{n}$$

$$j\omega L_1 \cdot \left[\frac{1}{\quad + \frac{j\omega L_2}{R_L}} \right] = R_L \cdot \frac{L_1}{L_2} = R_L \cdot \eta^2$$

$$\begin{cases} k \to 1, \\ L_1, L_2 \to \infty \end{cases}$$

$$\frac{L_1}{L_2} = \eta^2$$



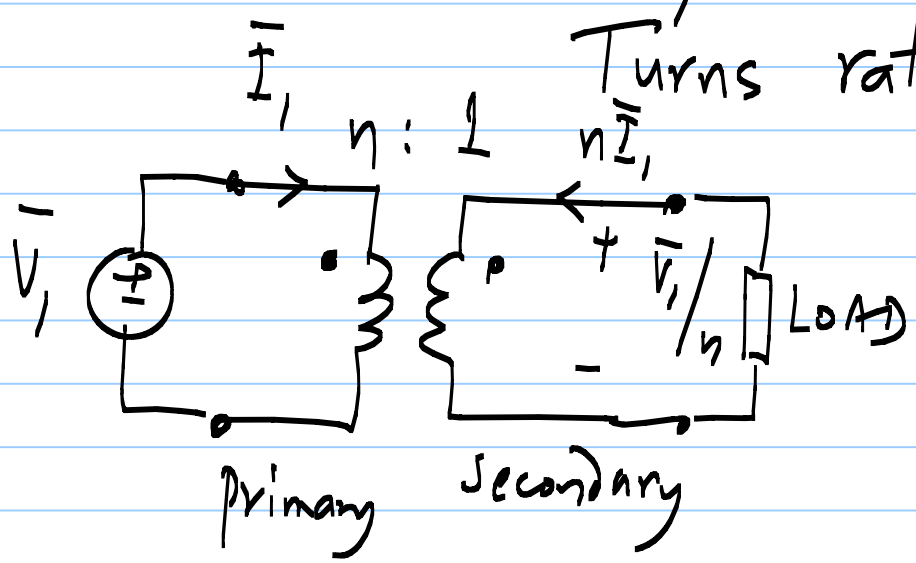
Ideal transformer

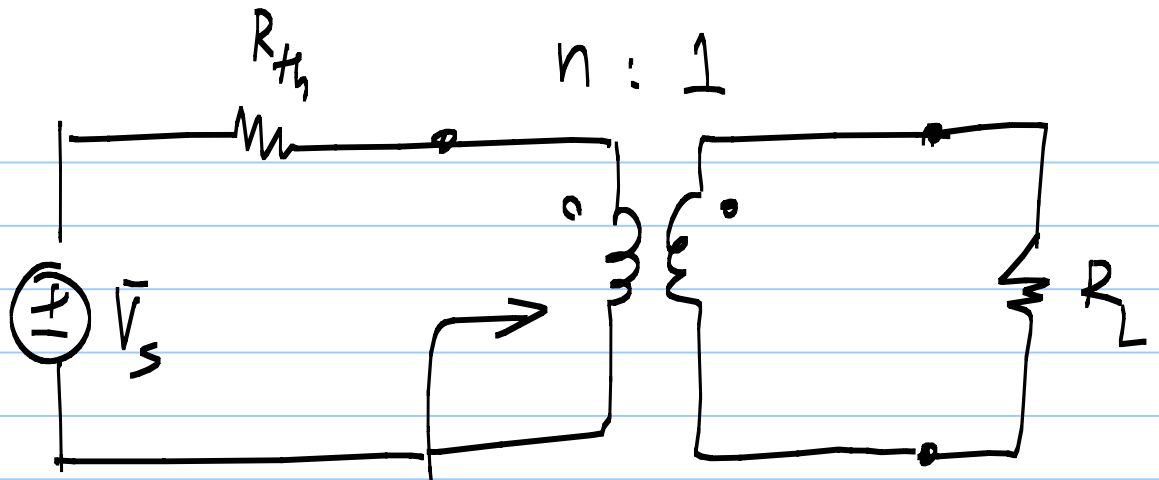
Ideal transformer:

Mutually coupled coils with $k \to 1$ & $L_1, L_2 \to \infty$

$$\frac{L_1}{L_2} = n^2 \quad \left\{ n:1 \text{ transformer} \right\}$$

Turns ratio





$$n = \sqrt{\frac{R_{th}}{R_L}}$$

$$n^2 R_L = R_{th}$$

Transformers for impedance matching