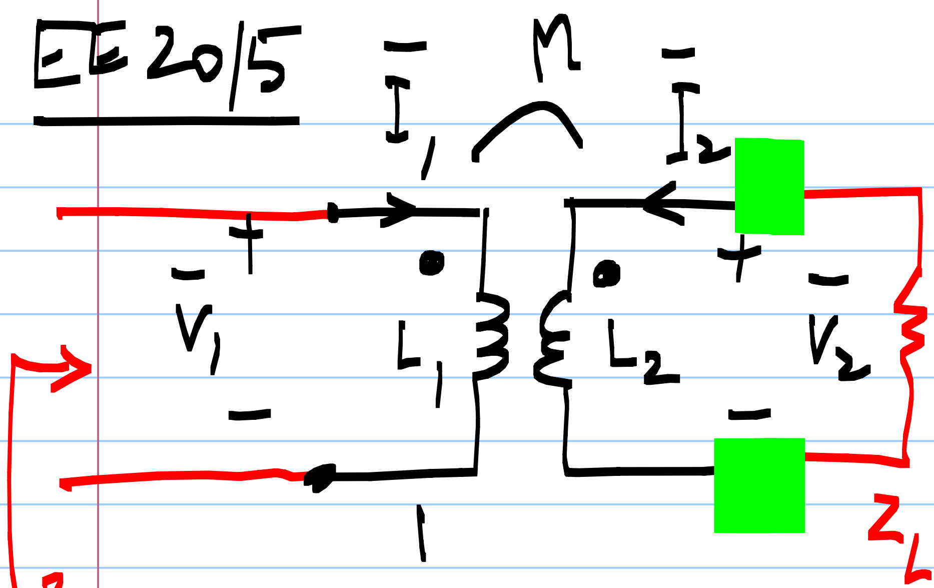
EE 2015 — 25/10/2017



$$\begin{bmatrix} \bar{V}_1 \\ \bar{V}_2 \end{bmatrix} = \begin{bmatrix} j\omega L_1 & j\omega M \\ j\omega M & j\omega L_2 \end{bmatrix} \begin{bmatrix} \bar{I}_1 \\ \bar{I}_2 \end{bmatrix}$$

$$M = k\sqrt{L_1 L_2}$$

$$Z_{eq} = \frac{j\omega L_1 Z + \text{[illegible]}}{Z + j\omega L_2}$$

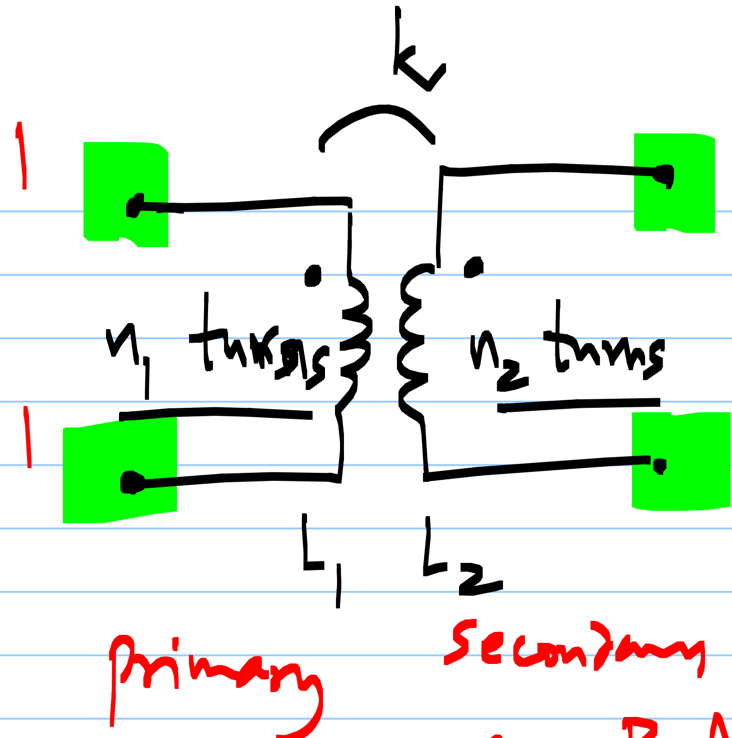
$\omega L_2 \gg |Z|$

[illegible] : $Z_{eq} = \frac{L_1}{L_2} \cdot Z$

Ideal transformer:

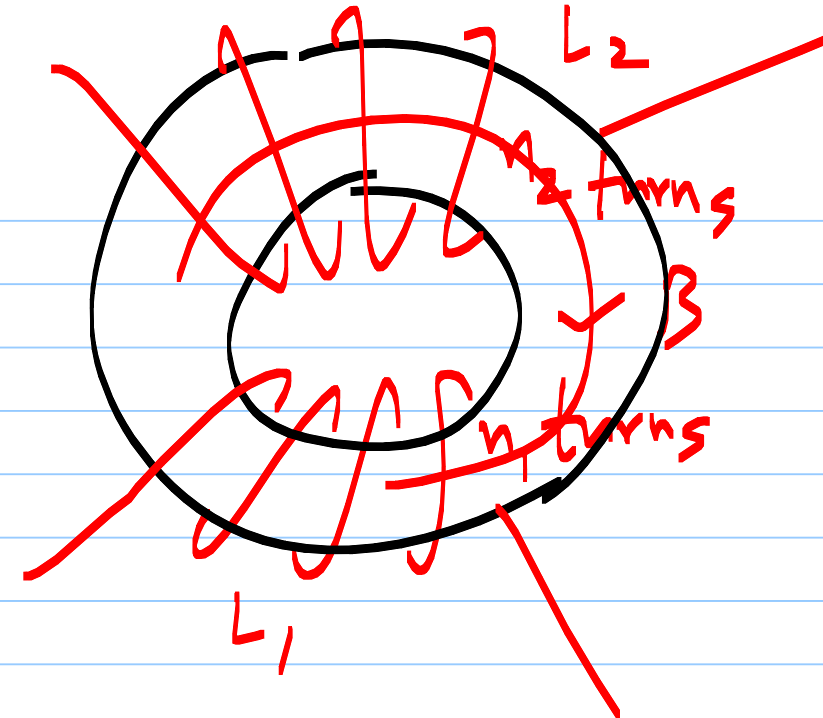
$k \to 1$: All the flux from one coil links with the second coil

L_1, L_2 are "large" : Reactance of each coil @ ω is much greater than the impedance magnitude connected across it



$n_1 \cdot B_1 \cdot A$

$n_2 \cdot B_2 \cdot A$



$$\frac{L_1}{L_2} = \frac{n_1^2}{n_2^2}$$

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

$$\bar{V}_2 = -Z \cdot \bar{I}_2$$

$$\bar{I}_1 = \frac{\bar{V}_2 \left(1 + \frac{j\omega L_2}{Z}\right)}{j\omega M}$$

$$\bar{V}_1 = j\omega L_1 \cdot \bar{V}_2 \frac{\left(1 + \frac{j\omega L_2}{Z}\right)}{j\omega M} - j\omega M \cdot \frac{\bar{V}_2}{Z}$$

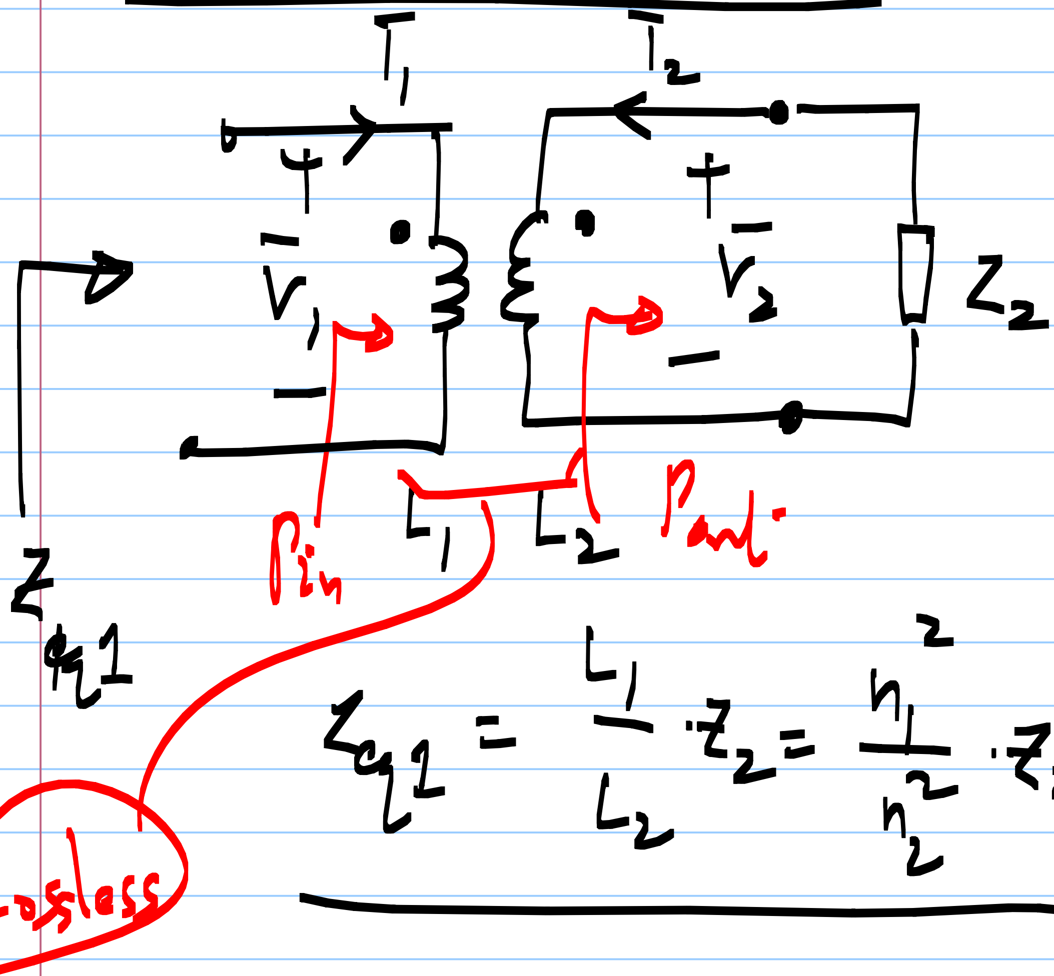
$$\bar{V}_1 = j\omega L_1 \cdot \bar{V}_2 \frac{\left(1 + \frac{j\omega L_2}{Z}\right)}{j\omega M} - j\omega M \cdot \frac{\bar{V}_2}{Z}$$

$$= \bar{V}_2 \left[\frac{j\omega L_1 - \frac{\omega^2 L_1 L_2}{Z} + \omega^2 M^2 / Z}{j\omega M} \right]$$

$$\frac{\bar{V}_2}{\bar{V}_1} = \frac{j\omega M}{\frac{\omega^2 (M^2 - L_1 L_2)}{Z} + j\omega L_1}$$

if $k=1$: $\frac{M}{L_1}$

Ideal transformer:



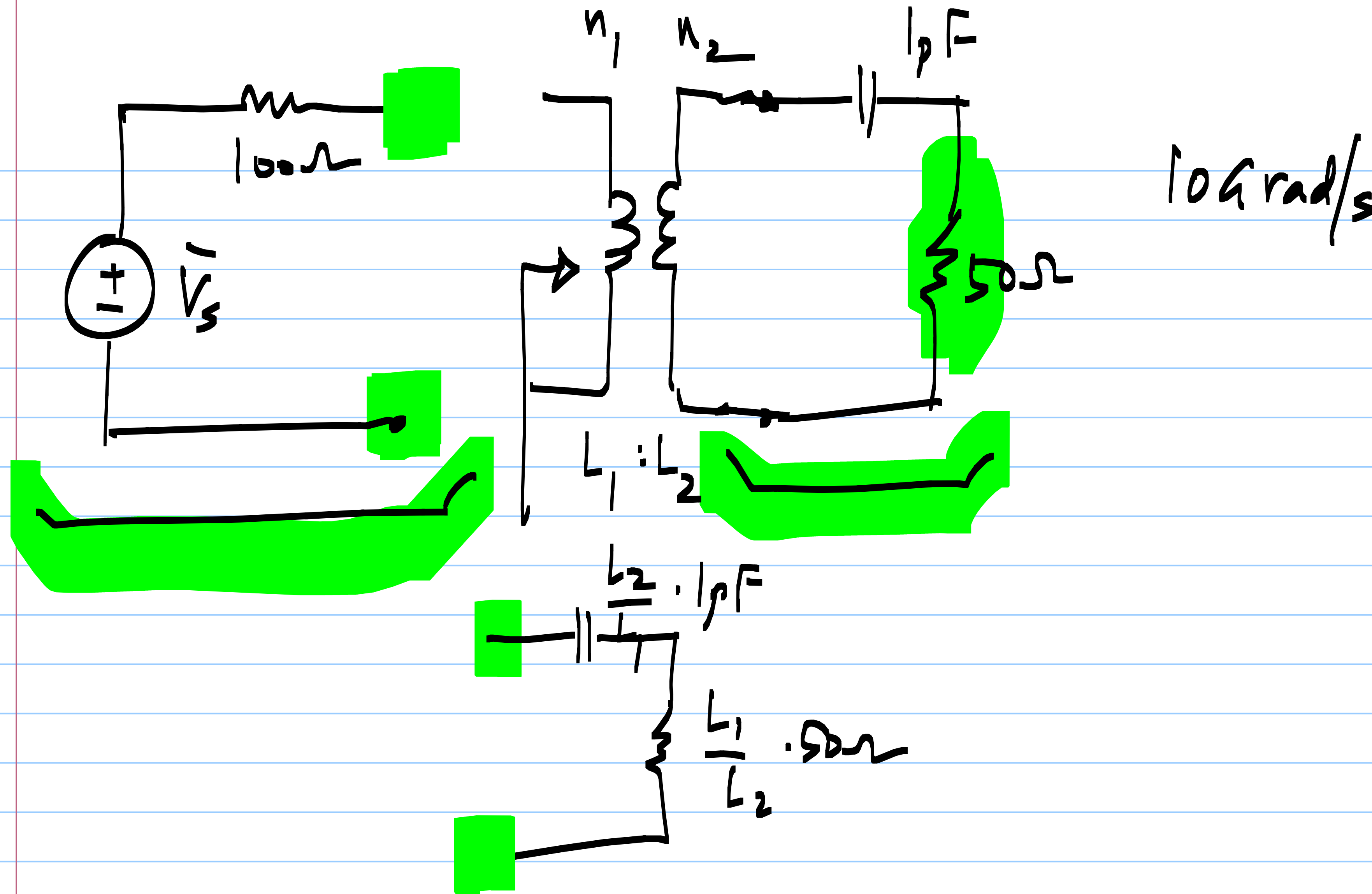
$$Z_{eq1} = \frac{L_1}{L_2} \cdot Z_2 = \frac{n_1^2}{n_2^2} \cdot Z_2$$

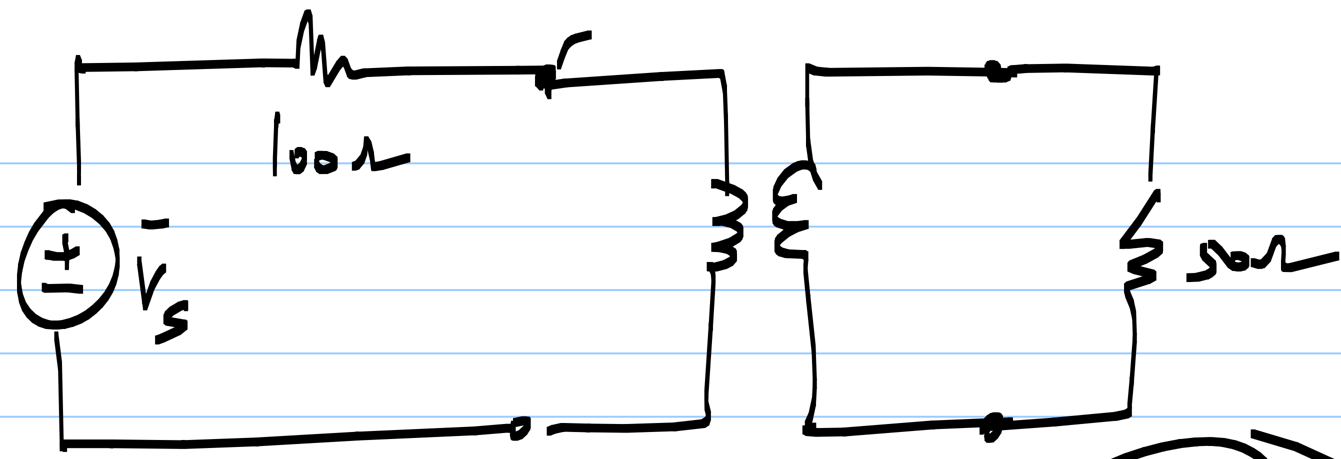
$\frac{n_1}{n_2}$: turns ratio

$$\frac{L_1}{L_2} = \frac{n_1^2}{n_2^2}$$

$$\frac{\bar{V}_2}{\bar{V}_1} = \frac{M}{L_1} = \sqrt{\frac{L_2}{L_1}} = \frac{n_2}{n_1}$$

$$\frac{\bar{I}_2}{\bar{I}_1} = -\frac{n_1}{n_2}$$


100Ω
$\tilde{V}_s$
n_1
n_2
1pF
50Ω
10G rad/s
$L_1 : L_2$
$\frac{L_2}{L_1} \cdot 1pF$
$\frac{L_1}{L_2} \cdot 50Ω$



$n_1 : n_2$

$$\frac{n_1}{n_2} = \frac{\sqrt{2}}{1}$$

$$\frac{L_1}{L_2} = \frac{2}{1}$$