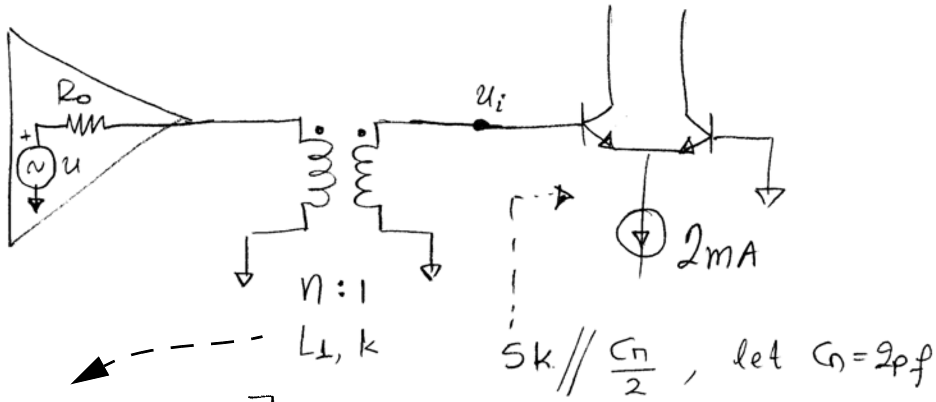
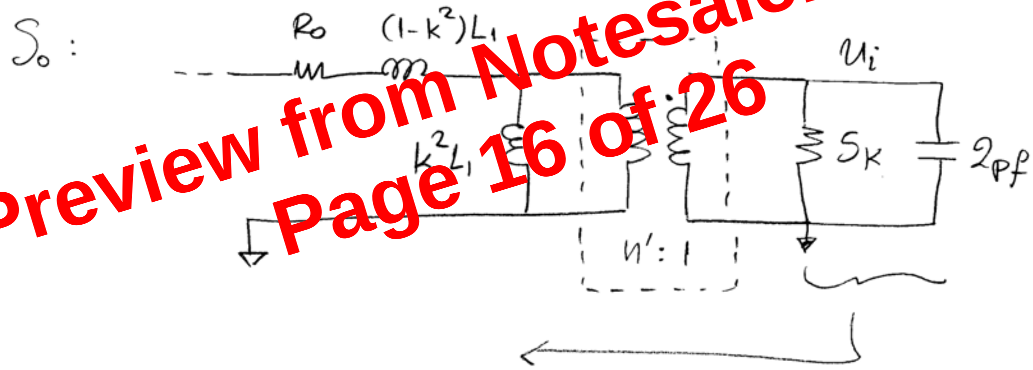
Example: Impedance Matching

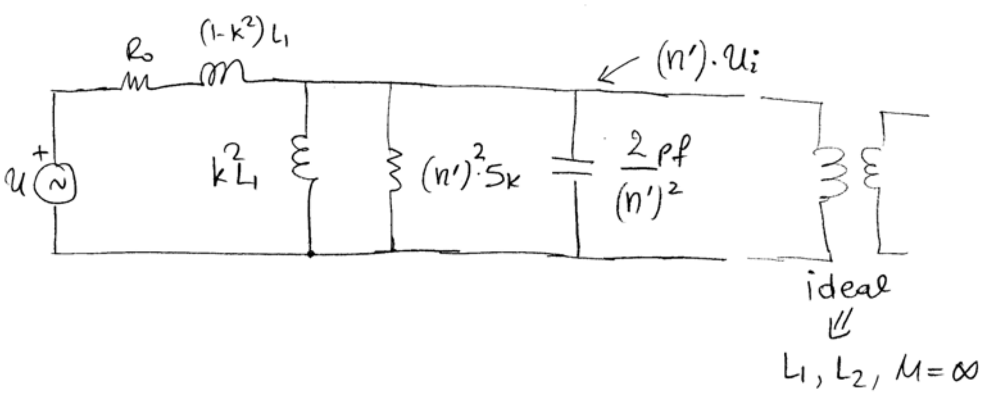


$$\left[L_2 = \frac{L_1}{n^2}, \quad M = k \cdot \sqrt{L_1 L_2} \right]$$



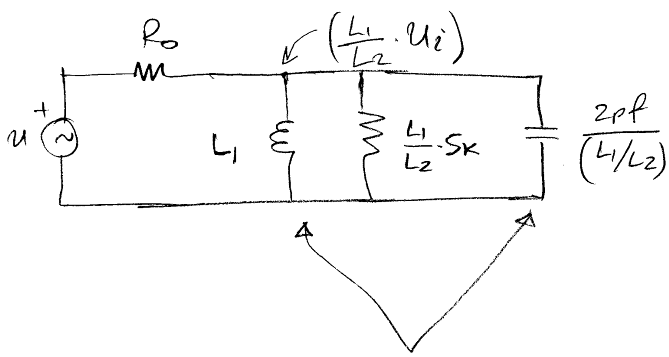
move them to the primary

We know: $n' = k\sqrt{\frac{L_1}{L_2}}$



Example: Impedance Matching (cont.)

if $k \simeq 1$ then: $1-k^2 \simeq 0$, $k^2 \simeq 1$, $n' \simeq \sqrt{\frac{L_1}{L_2}}$



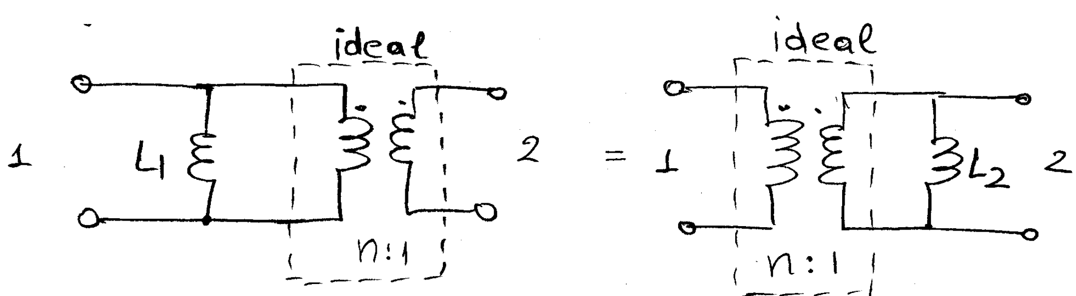
pick: $\frac{L_1}{L_2} 5k = R_o$

parallel resonant circuit (L-C tank)

O.k. if ωL_1, $\frac{1}{\omega \cdot \frac{2pf}{L_1/L_2}} \gg \frac{L_1}{L_2} 5k$ for all usefull ω's.

A Convenient Assumption (in General)

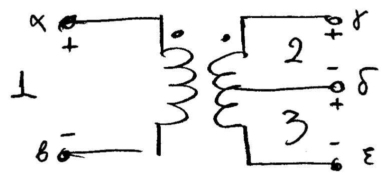
Coupling coeficient $k = 1$ $\Rightarrow$

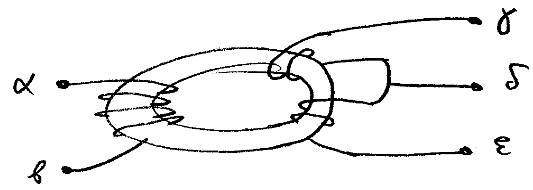


$n = \sqrt{L_1/L_2}$

Transformers & DC BIAS (cont.)

Transformers with intermediate connection.



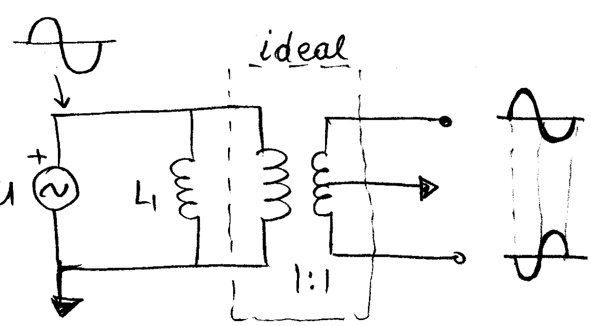


3 coupled coils

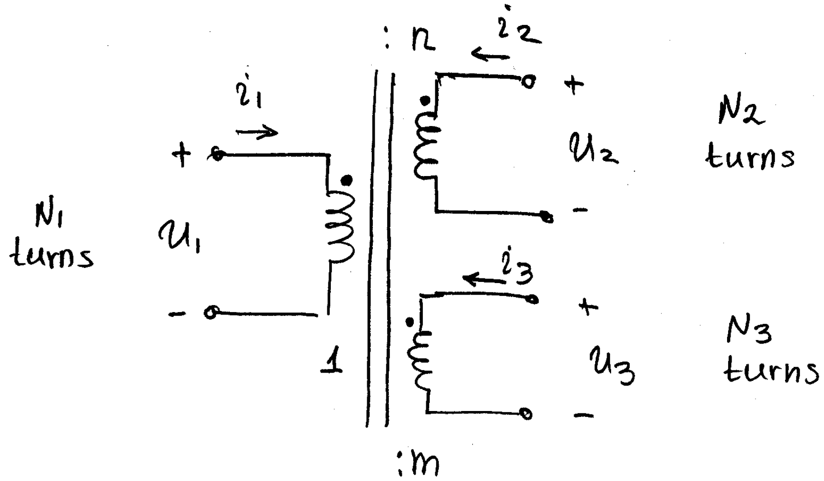
if $k_{12} = k_{23} = k_{13} = 1$ then

$$u_2 = u_3 = \frac{u_1}{2n}$$

$$n \cdot i_1 + i_2 + i_3 = 0$$



Transformers with 3 Windings



Ideally : $\begin{cases} u_1 = \frac{1}{n} u_2 = \frac{1}{m} u_3 \\ i_1 + n \cdot i_2 + m \cdot i_3 = 0 \end{cases}$

In Reality:

$$\begin{bmatrix} u_1 \\ u_2 \\ u_3 \end{bmatrix} = \begin{bmatrix} L_1 & M_{12} & M_{13} \\ M_{12} & L_2 & M_{23} \\ M_{13} & M_{23} & L_3 \end{bmatrix} \cdot \frac{d}{dt} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix}$$

$$\frac{L_1}{L_2} = \left(\frac{N_1}{N_2}\right)^2, \quad \frac{L_1}{L_3} = \left(\frac{N_1}{N_3}\right)^2$$

$$n = \frac{N_2}{N_1} = \sqrt{\frac{L_2}{L_1}}, \quad m = \frac{N_3}{N_1} = \sqrt{\frac{L_3}{L_1}}$$

$M_{12} = k_{12} \cdot \sqrt{L_1 L_2}$, $0 \le k_{12} \le 1$ coupling coef. 1-2

$M_{23} = k_{23} \cdot \sqrt{L_2 L_3}$ $0 \le k_{23} \le 1$ " " 2-3

$M_{13} = k_{13} \cdot \sqrt{L_1 L_3}$ $0 \le k_{13} \le 1$ " " 1-3

k_{12}, k_{23}, k_{13} : not (completely) independent