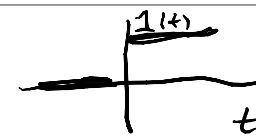
EE 610
09/19/13

Note Title 9/19/2013

$$i(t) = C\frac{dv(t)}{dt} \quad ; \quad 1(t) = \begin{cases} 1 & t>0 \\ 0 & t<0 \end{cases}$$

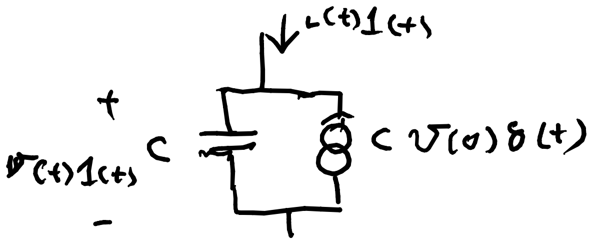


$$i(t)1(t) = C\frac{dv(t)}{dt}\cdot 1(t).$$

$$\frac{d(v(t)1(t))}{dt} = \frac{dv(t)}{dt}\cdot 1(t) + v(t)\frac{d1(t)}{dt} \quad ; \quad \frac{d1(t)}{dt} = \delta(t) = \text{unit impulse}$$

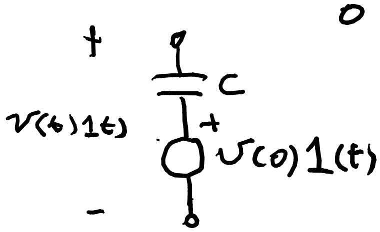
$$= \frac{dv(t)}{dt}\cdot 1(t) + v(0)\delta(t)$$

$$i(t)1(t) = C\frac{d(v(t)1(t))}{dt} - Cv(0)\delta(t)$$



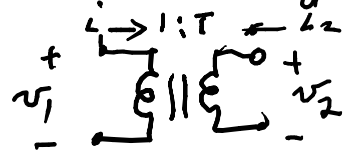
$$\int_{-\infty}^{t} i(\tau)1(\tau)d\tau = \int_{-\infty}^{t} C\frac{d(v(\tau)1(\tau))}{d\tau}d\tau - Cv(0)\int_{-\infty}^{t}\delta(\tau)d\tau$$

$$\Rightarrow \left(\int_0^t i(\tau)1(\tau)d\tau\right)1(t) = Cv(t)1(t) - Cv(0)1(t)$$



Cases for $Av = Bi$ where A^{-1} and/or B^{-1} don't exists

Ex: ideal transformer



$$Tv_1 = v_2 \quad , \quad i_1 = -Ti_2$$

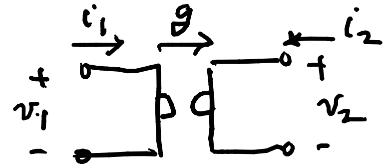
has power in zero

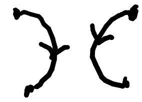
$$P_{in} = v_1 i_1 + v_2 i_2 = v_1 i_1 + v_1 T i_2$$

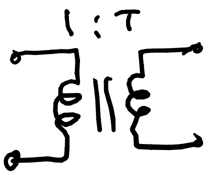
$$= v_1(i_1 + Ti_2) = 0$$

$$\begin{bmatrix} -T & 1 \\ 0 & 0 \end{bmatrix}\begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 1 & T \end{bmatrix}\begin{bmatrix} i_1 \\ i_2 \end{bmatrix} \quad ; \quad \det A = \det B = 0$$

Gyrator $\quad Y_{gyr} = \begin{bmatrix} 0 & g \\ -g & 0 \end{bmatrix} = -Y_{gyr}^T$







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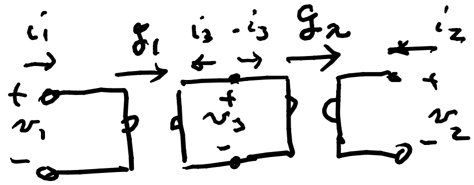
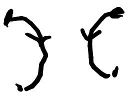
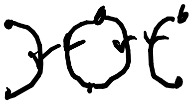






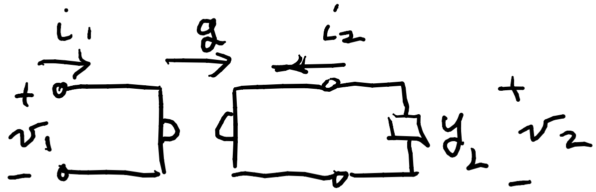
$i_1 = g_1 v_3$

$i_3 = -g_1 v_1 = -(g_2 v_2)$

$i_2 = -g_2 \cdot v_3$

$$\left.\begin{aligned} v_3 = \frac{i_1}{g_1} = -\frac{i_2}{g_2} &\Rightarrow i_1 = -\frac{g_1}{g_2} i_2 \\ -g_1 v_1 = -g_2 v_2 &\Rightarrow v_2 = \frac{g_1}{g_2} v_1 \end{aligned}\right\} \text{gives } T = \frac{g_1}{g_2}$$

Ex:

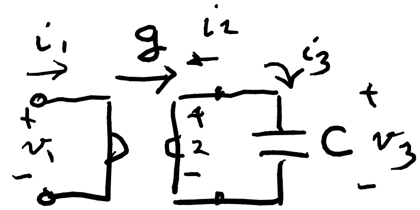
= 

$i_1 = g\, v_2,$

$\underbrace{i_2 = -y_L v_2 = -g\, v_1}_{v_2 = \frac{g}{y_L} v_1}$

$$i_1 = \frac{g^2}{y_L} v_1 \Rightarrow y_{in} = \frac{i_1}{v_1} = \frac{g^2}{y_L}$$

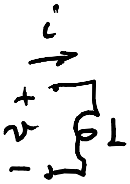
if $y_L = sC \Rightarrow y_{in} = g^2/sC = 1/Ls \Rightarrow \frac{1}{L} = g^2/C$

$L = \frac{C}{g^2}$  = 

$= r^2 C$

if $C = 1\mu$ & $r = 1k\Omega$

then $L = 1$ Henry



$\Rightarrow Av = Bi$

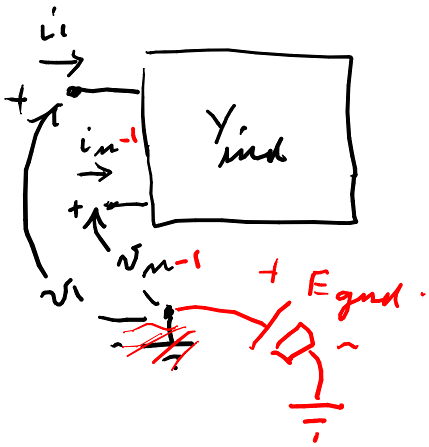
$v = L\, di/dt$

$= sLi$

$[1]v = \underbrace{[sL]}_{\text{derivative in B}}i$

$$\begin{bmatrix} 0 & g & 0 \\ -g & 0 & 0 \\ 0 & 0 & Cs \end{bmatrix}\begin{bmatrix} v_1 \\ v_2 \\ v_3 \end{bmatrix} = \underbrace{\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}}_{\text{no derivative in B}}\begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix}$$

Indefinite admittance



$$i = \begin{bmatrix} i_1 \\ \vdots \\ i_n \end{bmatrix} = \begin{bmatrix} & & \\ & Y_{ind} & \\ & & \end{bmatrix} \begin{bmatrix} v_1 \\ \vdots \\ v_n \end{bmatrix}$$

$$= \begin{bmatrix} & & \\ & Y_{ind} & \\ & & \end{bmatrix} \begin{bmatrix} v_1 + E_{gnd} \\ \vdots \\ v_n + E_{gnd} \end{bmatrix}$$

$$= Y_{ind}\, v + E_{gnd} \underbrace{\begin{bmatrix} y_{11} + y_{12} + \cdots y_{1n} \\ \vdots \qquad \vdots \\ y_{n1} + y_{n2} + y_{nn} \end{bmatrix}}_{0}$$

as i is unchanged so

the entries in a row sums to 0

also all currents sum to zero

Y_{ind}, all entries in any row sum to 0

" " " " column " " 0