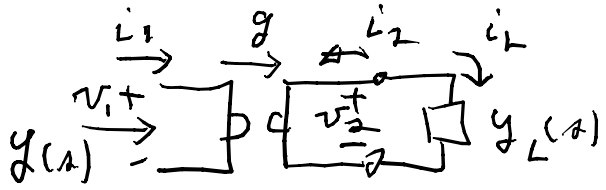
10/10/05

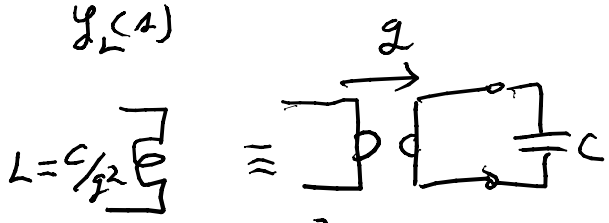


$i_1 = y(s) v_1$

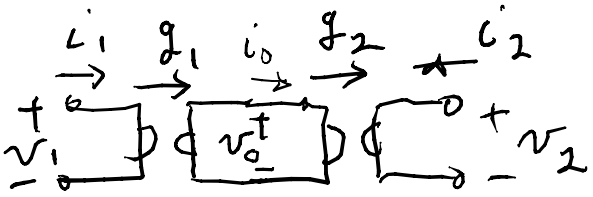
$i_2 = -g v_1 = -i_L = -y_L(s) v_2$

$i_1 = g v_2 = g\left(g / y_L(s)\right) v_1 = \dfrac{g^2}{y_L(s)} v_1$

$y(s) = \dfrac{g^2}{y_L(s)}$



$y = \dfrac{g^2}{Cs} = \dfrac{1}{Ls}$



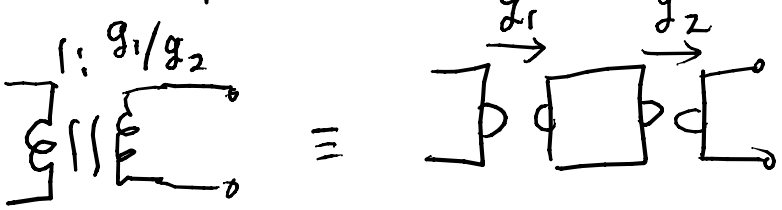
$L = C/g^2$

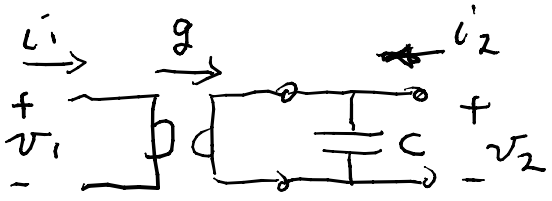
$i_1 = g_1 v_0 \qquad i_2 = -g_2 v_0 = -\dfrac{g_2}{g_1} i_1 = i_2 \Rightarrow 0 = i_1 + \dfrac{g_1}{g_2} i_2$

$i_0 = g_2 v_2$

$= +g_1 v_1$

$v_1 = \dfrac{g_2}{g_1} v_2 \Rightarrow v_2 = \dfrac{g_1}{g_2} v_1$

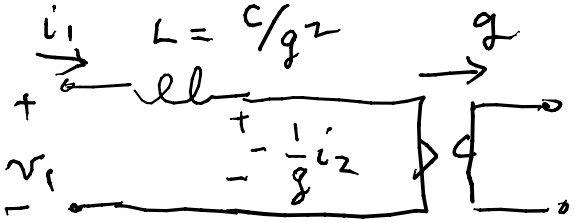




$i_1 = g v_2$

$i_2 = sC v_2 + (-g v_1)$

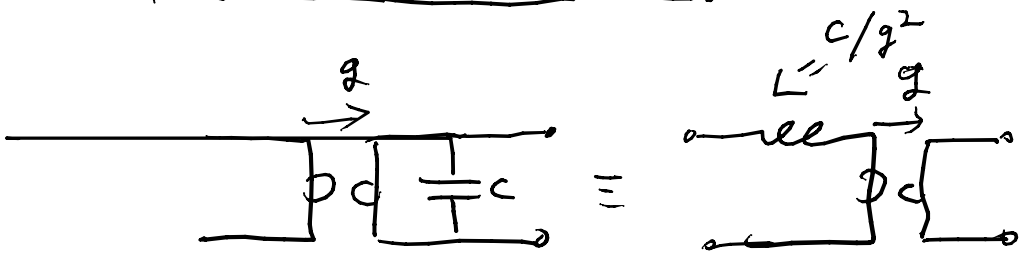
$v_2 = \dfrac{i_2 + g v_1}{sC} \Rightarrow i_1 = \dfrac{g}{sC} i_2 + \dfrac{g^2}{sC} v_1 \Rightarrow v_1 = \dfrac{sC}{g^2} i_1 - \dfrac{1}{g} i_2$



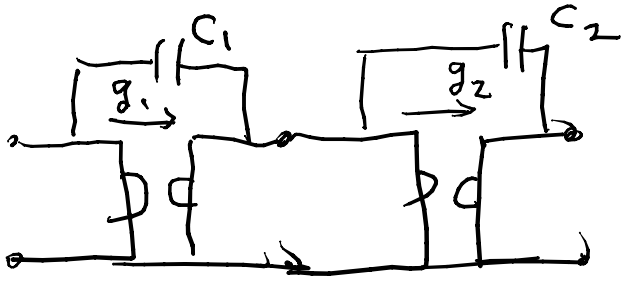
$$v_1 = -\frac{1}{g} i_2$$

$$i_2 = -g v_1$$

$$i_1 = g v_2$$



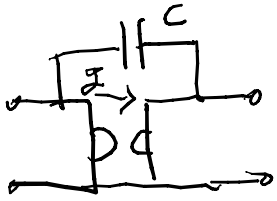
Ex:



$$y(s) = \frac{s^2 + 2s + 4}{s^2 + s + 6.25}$$

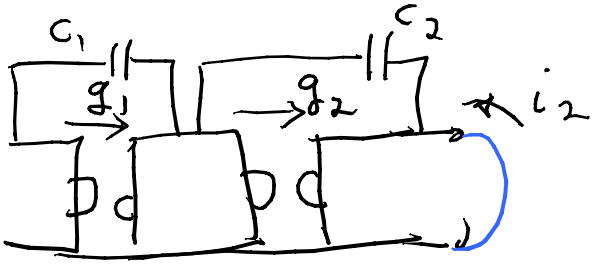
Eig $y(s) = 0$ @

$s = \pm 1 \pm j2$

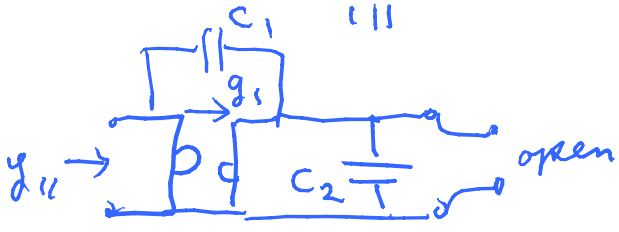


$$\Leftrightarrow \quad Y(s) = \begin{bmatrix} sC & -sC + g \\ -sC - g & sC \end{bmatrix}$$

note $y_{11} = \left.\frac{I_1}{V_1}\right|_{V_2 = 0}$ = short



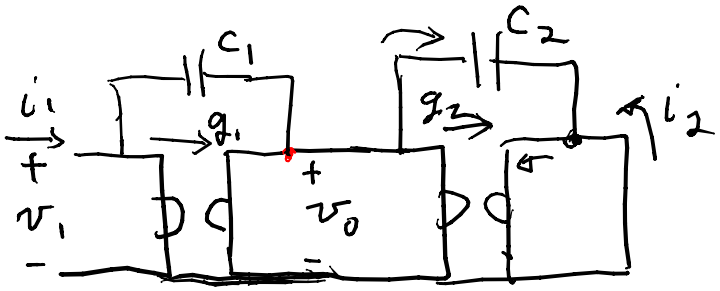
$$y_{11} = Y_{11} - (Y_{12}) \frac{1}{Y_{22} + Y_L} (Y_{21})$$



$$= \frac{g_1^2 + sC_1 \, sC_2}{sC_1 + sC_2} = \frac{s^2 C_1 C_2 + g_1^2}{s(C_1 + C_2)}$$

$$y_{22}(s) = \frac{s^2 C_2 C_1 + (-g_2)^2}{s(C_2 + C_1)}$$

$$y_{21} = \left.\frac{I_2}{V_1}\right|_{V_2 = 0}$$



$$KCL = sC_2 v_0 + i_2 - (-g_2 v_0) = 0$$

$$i_2 = -(g_1 + sC_2) v_0$$

- $KCL = 0 = sC_1(v_1 - v_0) - (-g_1 v_1) - sC_2 v_0 + \left(i_1, g_2 = 0\right)$

$$(sC_1 + sC_2) v_0 = (sC_1 + g_1) v_1 \Rightarrow v_0 = \frac{sC_1 + g_1}{s(C_1 + C_2)} \cdot v_1$$

$$\therefore \left.\frac{i_2}{v_1}\right|_{v_2 = 0} = \frac{-(g_2 + sC_2)}{s(C_1 + C_2)} \times (sC_1 + g_1) = g_{21}$$

$$y_{12} = \left.\frac{i_1}{v_2}\right|_{v_1 = 0} = -\frac{(-g_1 + sC_1)(-g_2 + sC_2)}{s(C_2 + C_1)}$$

$$Y(s) = \frac{1}{s(C_2 + C_1)} \begin{bmatrix} s^2 C_1 C_2 + g_1^2 & -(-g_1 + sC_1)(-g_2 + sC_2) \\ -(g_1 + sC_1)(g_2 + sC_2) & s^2 C_1 C_2 + g_2^2 \end{bmatrix}$$

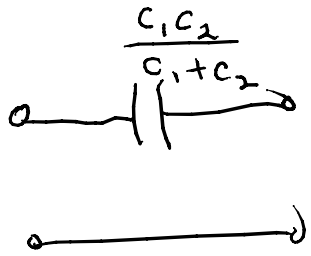
$$= s \begin{bmatrix} \frac{C_1 C_2}{C_1 + C_2} & -\frac{C_1 C_2}{C_1 + C_2} \\ -\frac{C_1 C_2}{C_1 + C_2} & \frac{C_1 C_2}{C_1 + C_2} \end{bmatrix} + \begin{bmatrix} 0 & \frac{g_1 C_2 + g_2 C_1}{C_1 + C_2} \\ \frac{-g_1 C_2 - g_2 C_1}{C_1 + C_2} & 0 \end{bmatrix} + \frac{1}{s} \begin{bmatrix} \frac{g_1^2}{C_1 + C_2} & -\frac{g_1 g_2}{C_1 + C_2} \\ -\frac{g_1 g_2}{C_1 C_2} & \frac{g_2^2}{C_1 + C_2} \end{bmatrix}$$

$$= s\left(\frac{C_1 C_2}{C_1 + C_2}\right) \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} + \frac{g_1 C_2 + g_2 C_1}{C_1 + C_2} \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} + \frac{1}{s\left(\frac{C_1 + C_2}{g_1^2}\right)} \begin{bmatrix} 1 & -\frac{g_2}{g_1} \\ -\frac{g_2}{g_1} & \left(\frac{g_2}{g_1}\right)^2 \end{bmatrix}$$

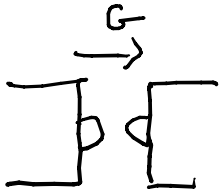
rank 1 (first matrix)

rank 1 (third matrix)

$\delta[Y(s)]$ = degree of the matrix $Y(s) = 2$
= minimum # of L's & C's needed to make Y



$$\Rightarrow Y_c(s) = s\left(\frac{C_1C_2}{C_1+C_2}\right)\begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix}$$



$$G = \frac{g_1C_2 + g_2C_1}{C_1+C_2} \Rightarrow Y_{gyr} = G\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$$

look at $Y_L = \frac{1}{sL}\begin{bmatrix} 1 & -g_2/g_1 \\ -\frac{g_2}{g_1} & \frac{g_2^2}{g_1^2} \end{bmatrix}$; $L = \frac{C_1+C_2}{g_1^2}$

$$= \frac{1}{sL}\begin{bmatrix} 1 \\ -\frac{g_2}{g_1} \end{bmatrix}\begin{bmatrix} 1 & -g_2/g_1 \end{bmatrix} = \begin{bmatrix} 1 \\ -\frac{g_2}{g_1} \end{bmatrix}\frac{1}{sL}\begin{bmatrix} 1 & -g_2/g_1 \end{bmatrix}$$

$L = \frac{C_1+C_2}{g_1^2}$ 1 : $T = \pm g_1/g_2$

$$y_{11} = \frac{I_1}{V_1}\Big|_{V_2=0} = \frac{1}{sL}$$

$$y_{21} = \frac{1}{z_{at2}}\Big|_{V_1=0} = \frac{1}{T^2 sL} \; ; \; T = \pm g_1/g_2$$

$$y_{12} = \frac{i_1}{V_2}\Big|_{V_1=0}$$

$$v_1 = \frac{1}{T}v_2$$

$$i_L = \frac{1}{sL}v_1 = -i_1 \Rightarrow i_1 = -\frac{1}{sL} + \frac{1}{T}v_2\Big|_{v_1=0}$$

$$= -\frac{1}{sL(g_1/g_2)}$$

$$\therefore \quad y_{12} = -\frac{1}{\alpha_L T} = \frac{-1}{\alpha_L (g_1/g_2)} \Longrightarrow T = +g_1/g_2$$

put these 3 circuits in parallel