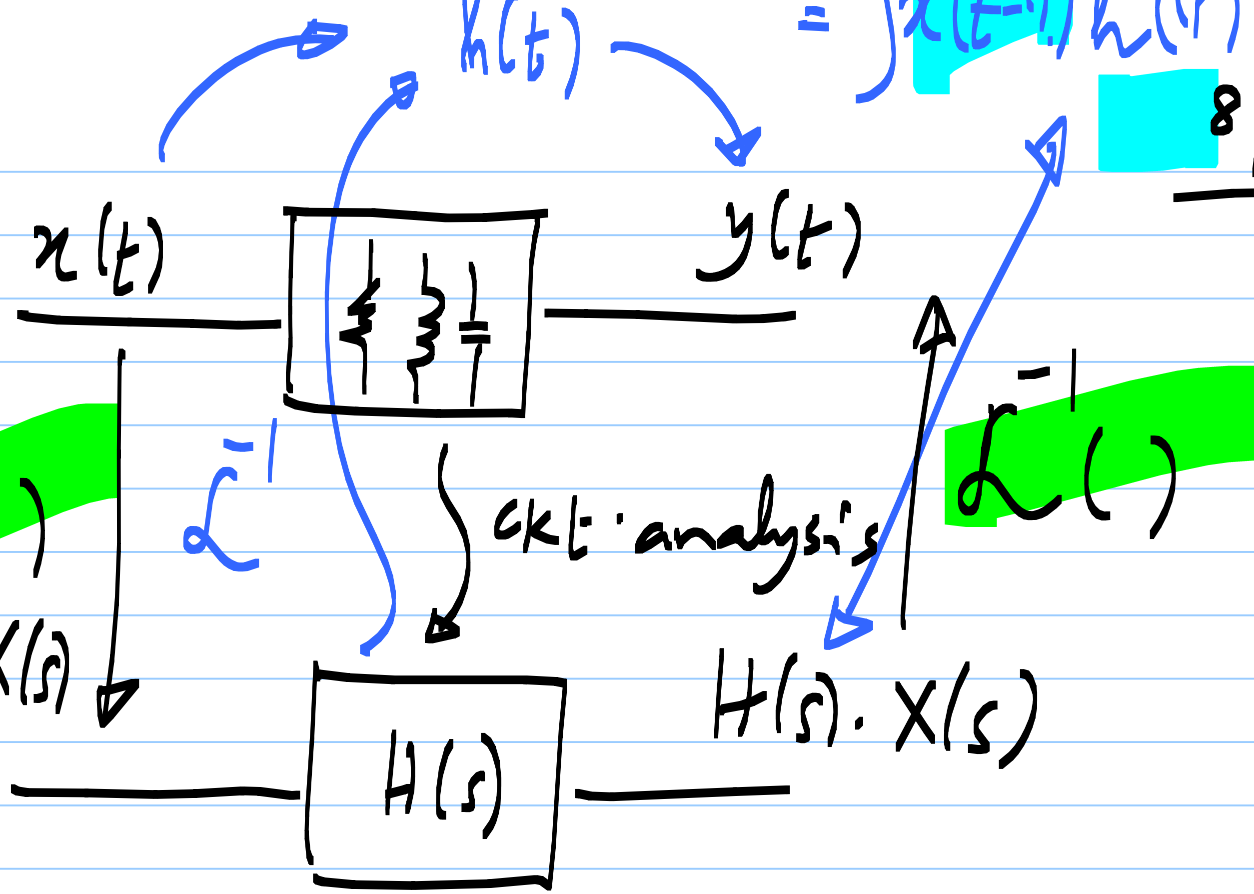
EE 2015

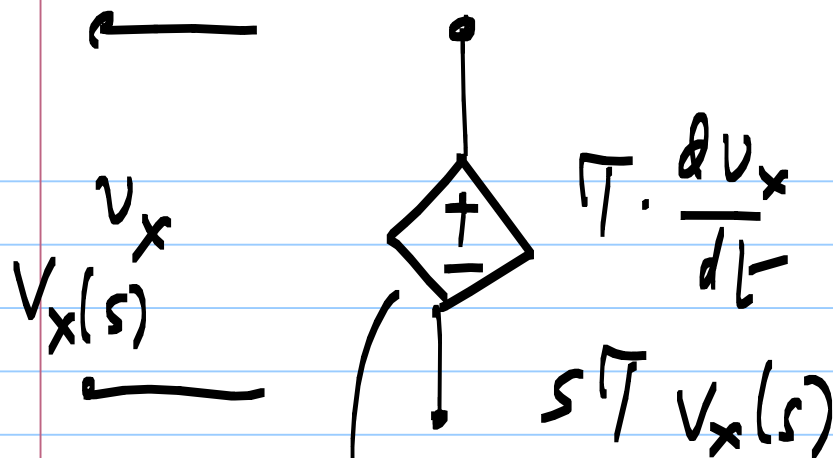
8/11/2017

$y(t) = \int x(t-\tau)\, h(\tau) \cdot d\tau$



$$X(s) = \int_{0^-}^{\infty} x(t) \exp(-st) \cdot dt$$

unilateral laplace transform



$$\boxed{G(s) = \frac{1 + s/z_1}{(1 + s/p_1)(1 + s/p_2)}}$$

Lumped R, L, C circuits

$$H(s) = \frac{[\text{illegible}] + b_{M-1}s^{M-1} + \dots + b_1 s + [\text{illegible}]}{a[\text{illegible}] + a_{N-1}s^{N-1} + \dots + a_1 s + a_0} \quad \begin{cases} N(s) \\ D(s) \end{cases}$$

Roots of $N(s)$: zeros

Roots of $D(s)$: poles

$$= k' \frac{(s-z_1)(s-z_2)\dots(s-z_M)}{(s-p_1)(s-p_2)\dots(s-p_N)}$$

$$= \frac{r_1}{s-p_1} + \frac{r_2}{s-p_2} + \dots + \frac{r_N}{s-p_N}$$

$$\frac{r_1}{s-p_1} + \frac{r_1^*}{s-p_1^*}$$

$$\frac{2\,\mathrm{Re}(r_1)\cdot s - 2\,\mathrm{Re}(r_1 p_1^*)}{s^2 - 2\cdot \mathrm{Re}(p_1)\cdot s + |p_1|^2} = \frac{b_1 s + b_0}{s^2 + a_1 s + a_0}$$

$$\exp(\sigma t)\cos(\omega t + \phi)$$

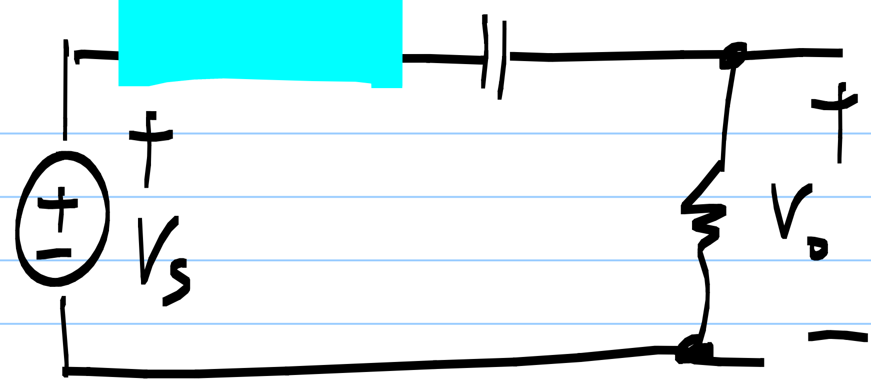
$$\frac{b_1 s + b_0}{s^2 + a_1 s + a_0}$$

$$= \frac{b_1\left(s+\frac{a_1}{2}\right)+\left(b_0 - \frac{b_1 a_1}{2}\right)}{\left(s+\ \right)^2 + \underbrace{\left(\ \ -\frac{a_1^2}{4}\right)}_{\omega_0^2}}$$

$\cos \omega_0 t : \dfrac{s}{s^2+\omega_0^2}$

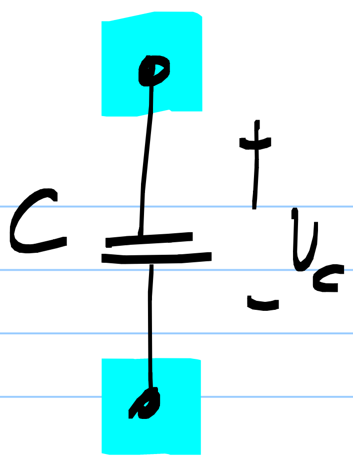
$\exp\left(-\frac{a_1}{2}t\right)\cdot \cos \omega_0 t :$

$$b_1 \exp\left(-\frac{a_1}{2}t\right) \cos(\omega_0 t) + \frac{b_0 - \frac{b_1 a_1}{2}}{\omega_0} \exp\left(-\frac{a_1}{2}t\right) \sin(\omega_0 t)$$

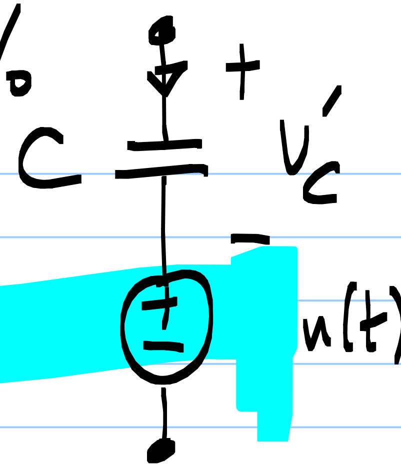


$$\boxed{} = H(s)$$

$$\frac{+b_1 s}{D_2(s)}$$

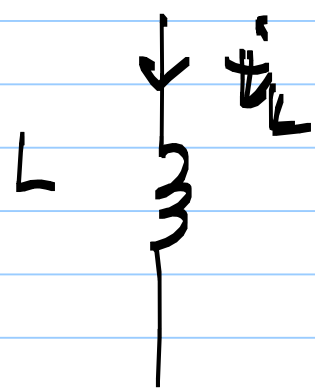


$v_c(0-) = V_0$

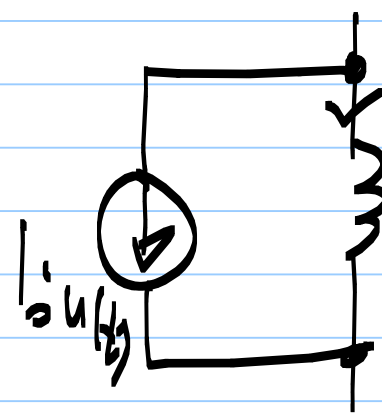


$v_c'(0-) = 0$

$t \geq 0$

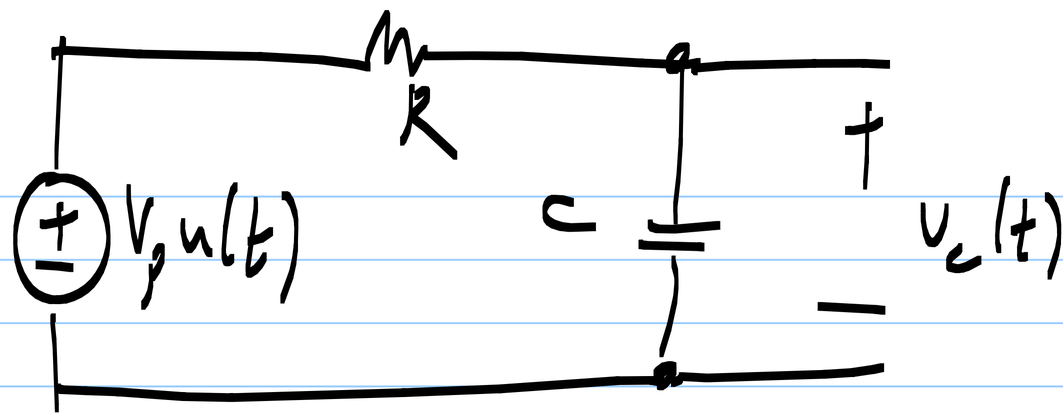


$i_L(0-) = I_0$

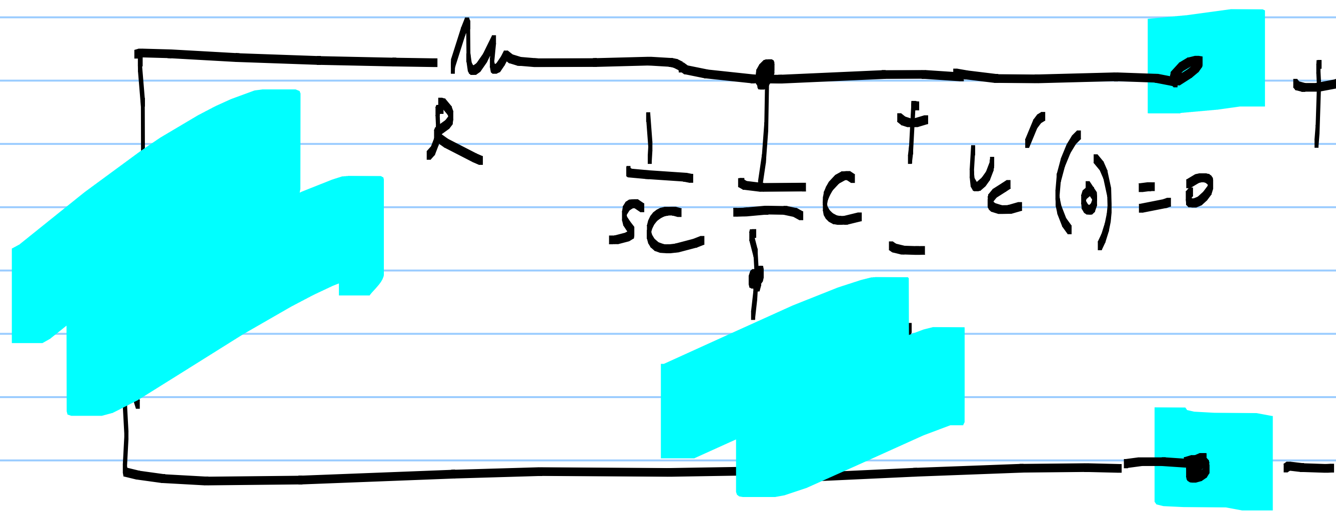


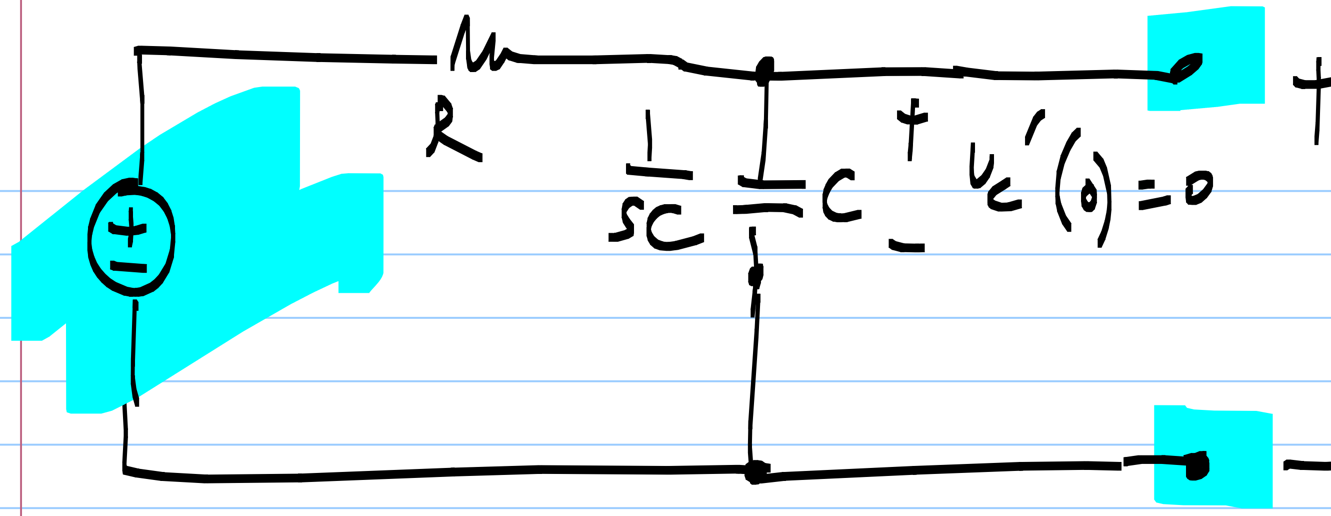
$i_L'(0-) = 0$

$v_c(0-) = V_0$

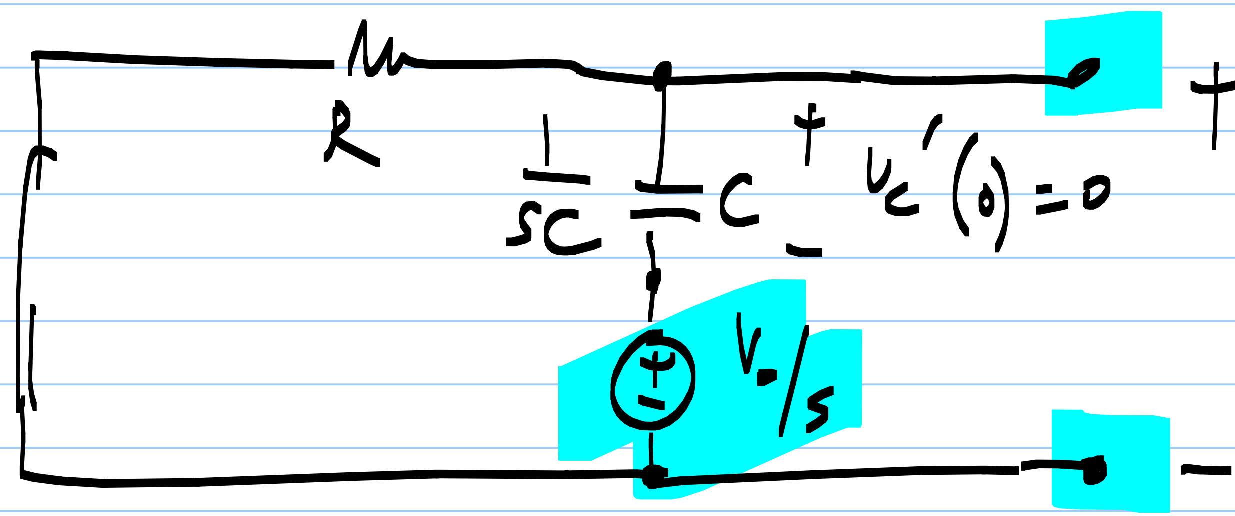


$$v_c(t) = V_p + (V_0 - V_p)\exp(-t/RC)$$





$$\underbrace{\frac{V_1}{s}\cdot\frac{1}{1+sCR}}$$



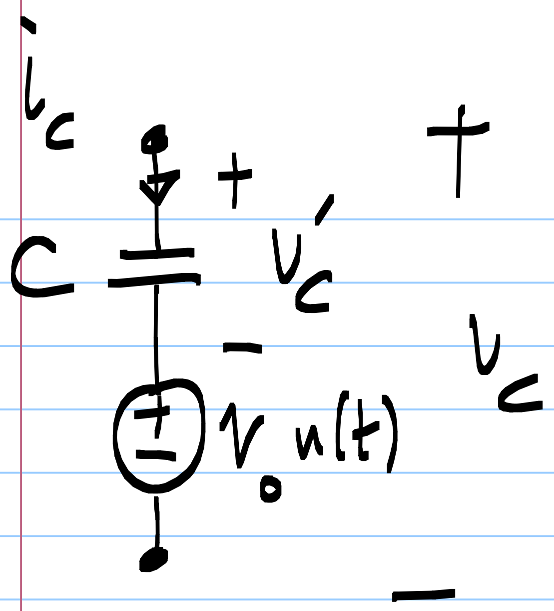
$$\frac{V_0}{s}\cdot\frac{sCR}{1+sCR}$$

$$V_{out}(s) = \underbrace{\frac{V_p}{s} \cdot \frac{1}{1+sCR}} + \frac{V_0}{s} \cdot \frac{sCR}{1+sCR}$$

$$= \frac{V_p}{s} - \underbrace{\frac{V_p}{\frac{1}{CR}+s}} + V_0 \cdot \frac{1}{\frac{1}{CR}+s}$$

$$\mathcal{L}^{-1}$$

$$= \underline{V_p u(t) - V_p \exp\left(-\frac{t}{RC}\right) \cdot u(t) + V_0 \cdot \exp\left(-\frac{t}{RC}\right) u(t)}$$

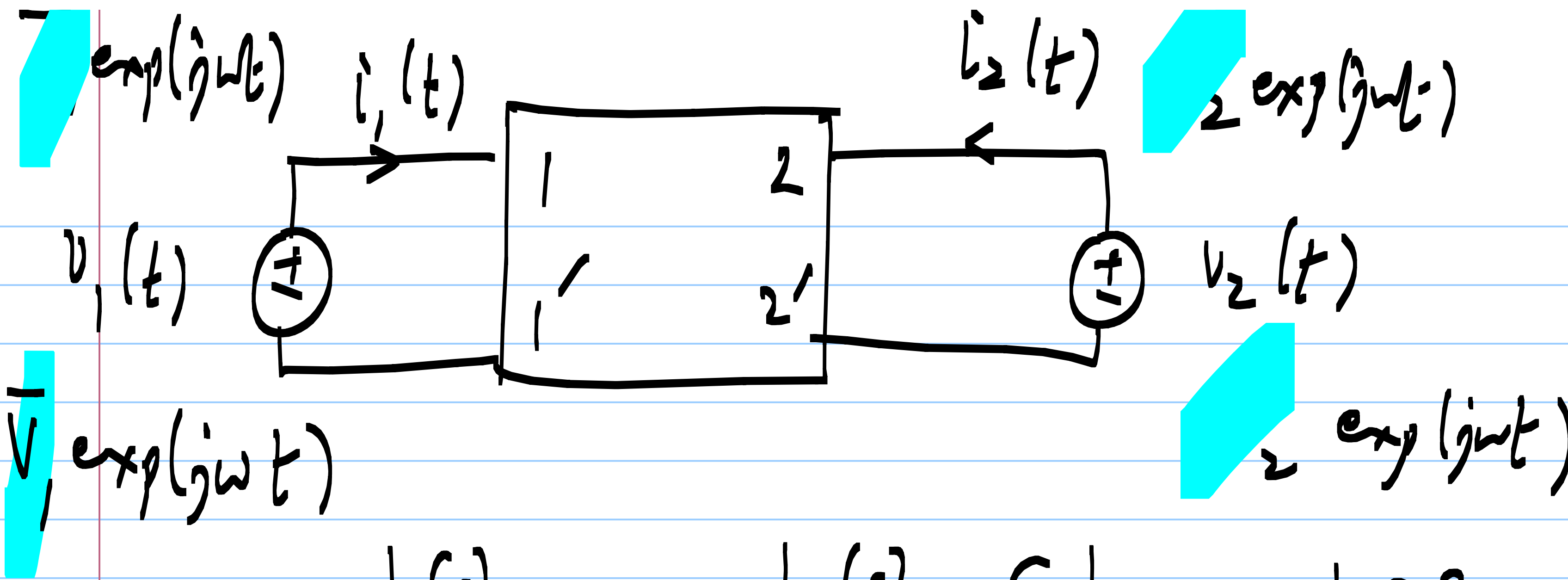


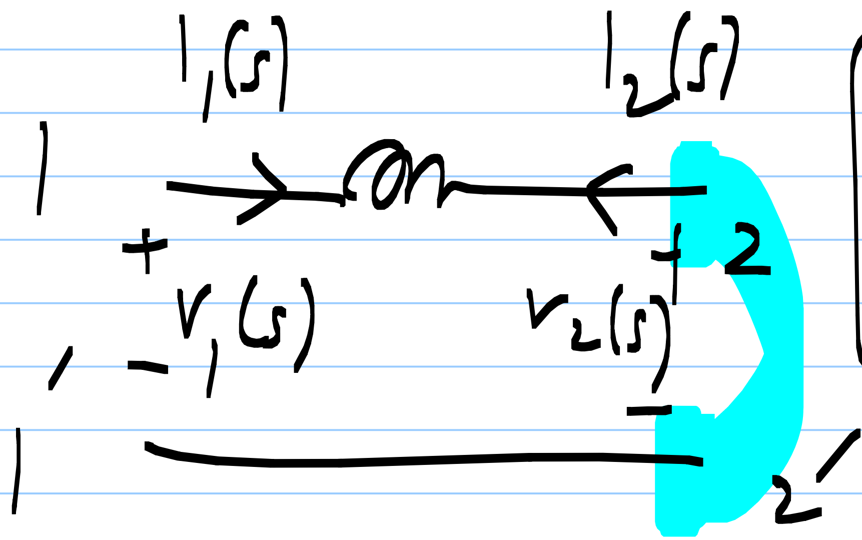
$$i_c' = C \cdot \frac{dv_c'}{dt}$$

$$= sC\left(V_c(s) - \frac{v_0}{s}\right)$$

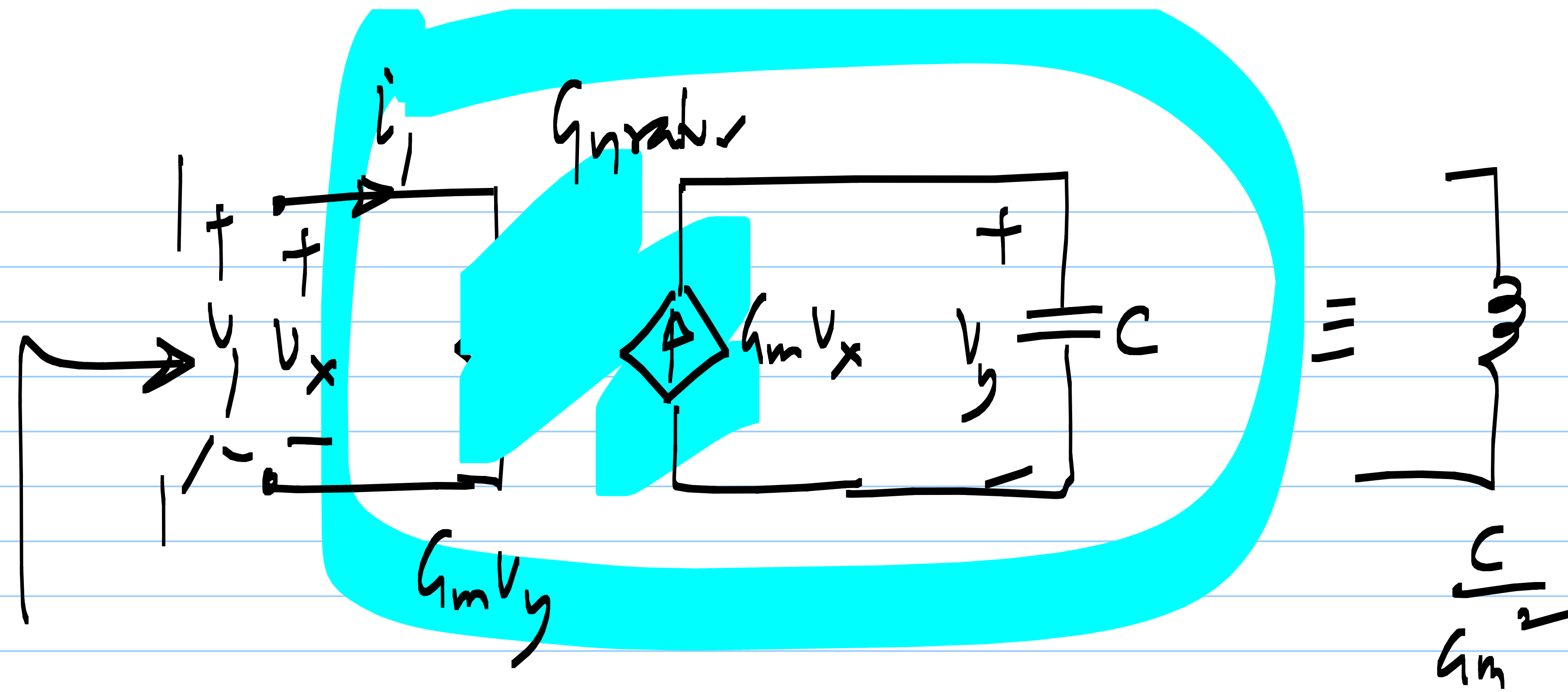
$$= sCV_c(s) - Cv_0$$

$$y = \frac{dx}{dt} \qquad Y(s) = sX(s) - x(0-)$$





$$\begin{bmatrix} \frac{1}{sL} & -\frac{1}{sL} \\ -\frac{1}{sL} & \frac{1}{sL} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$$



$$v_1 = \frac{C}{G_m^2} \cdot \frac{di_1}{dt}$$