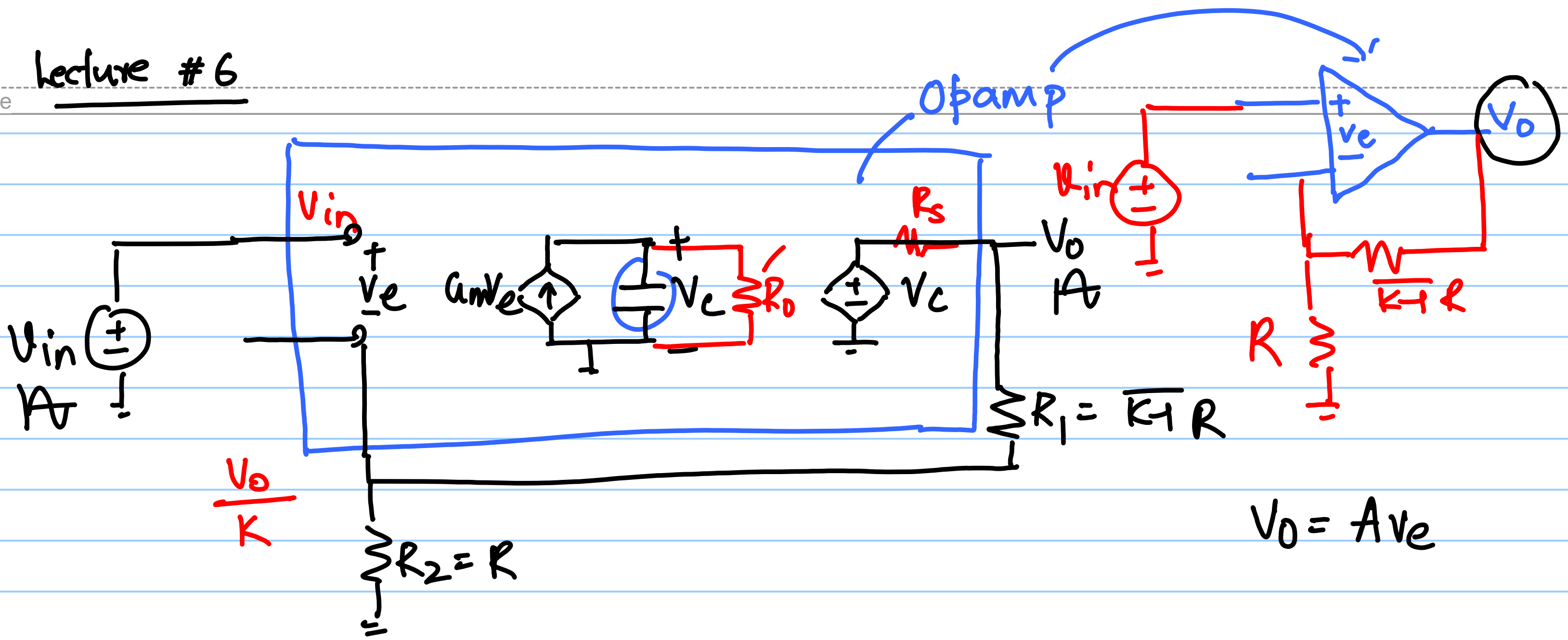
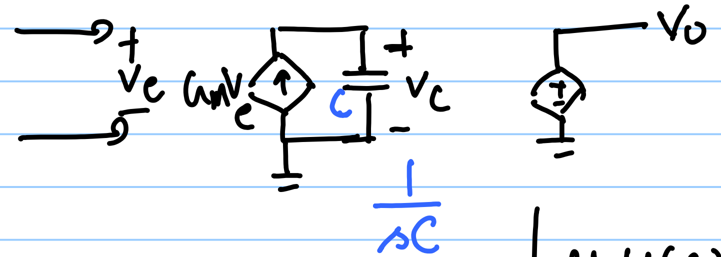
Note Title 24-01-2020

Lecture #6



$V_0 = A V_e$

$\frac{V_0}{V_{in}} = K$



$V_c(s) = (G_m V_e(s)) \frac{1}{sC}$

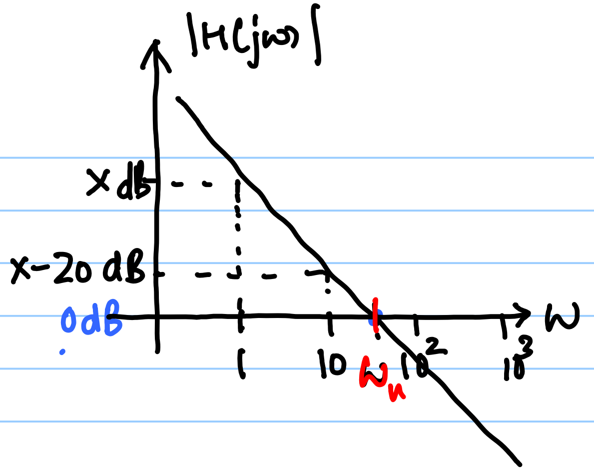
$V_0(s) = V_c(s)$

$H(s) = \frac{V_0(s)}{V_e(s)} = \frac{G_m}{sC}$

$\lim_{s \to 0} H(s) \Rightarrow \infty$

$\frac{0}{1} = 0$

$\frac{1}{0}$



$$H(s) = \frac{G_m}{sC}$$

$$|H(j\omega)| = \left| \frac{G_m}{j\omega C} \right|$$

$$H(j\omega) = \frac{G_m}{j\omega C}$$

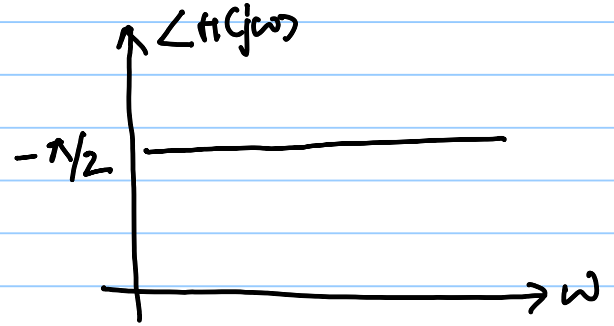
$$-\tan^{-1}\left(\frac{\omega C}{0}\right)$$

$$20 \log_{10} |H(j\omega)| \quad [dB]$$

"Bode Plot"

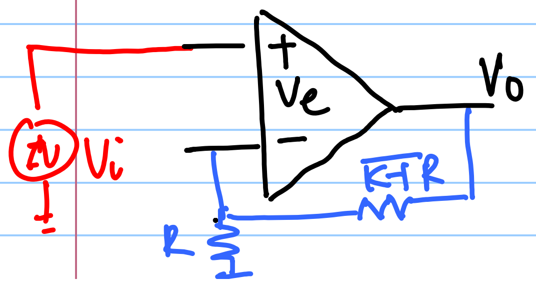
$$20 \log_{10} |H(j\omega)| = 0\ dB$$

$$\Rightarrow \quad |H(j\omega)| = 1 \quad \Rightarrow \quad \omega_u = \frac{G_m}{C} \quad \text{unity gain frequency.}$$



$$\angle H(j\omega) = -\pi/2 \ [rad]$$

$$-90^\circ$$



$$\frac{V_o}{V_e} = \frac{G_m}{sC} = \frac{1}{(s/\omega_u)}$$

$V_i = V_p \cos(\omega_0 t) \rightarrow V_o$

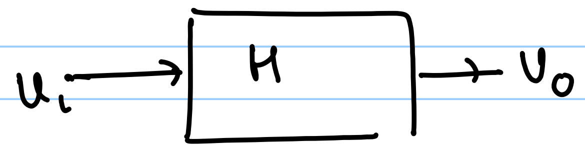
$$\underbrace{\left[V_i(s) - \frac{V_o(s)}{K} \right]}_{ve} \frac{1}{s/\omega_u} = V_o \Rightarrow V_o\left(\frac{s}{\omega_u} + \frac{1}{K}\right) = V_i \checkmark$$

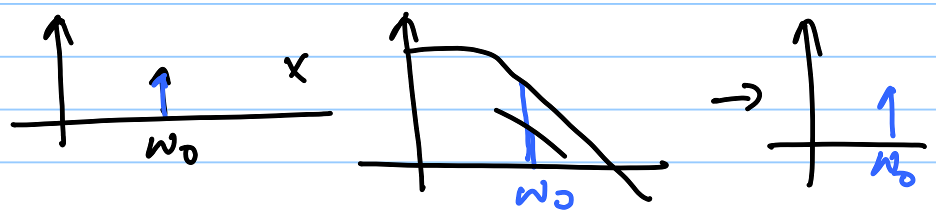
$$\frac{V_o}{V_i} = \frac{1}{\frac{1}{K} + \frac{s}{\omega_u}}$$

$$H(s) = \frac{V_o(s)}{V_i(s)} = \frac{K\omega_u}{\omega_u + s} = \frac{K}{1 + Ks/\omega_u} = \frac{K}{1 + s/(\omega_u/K)} \checkmark$$

$v_i(t) = V_p \cos(\omega_0 t)$

$v_o(t) = V_p |H(j\omega_0)| \cos(\omega_0 t + \phi)$





$$|H(j\omega_0)| = \frac{K}{\left| 1 + \frac{j\omega_0}{\omega_u/K} \right|}$$

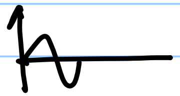
$$\phi = -\tan^{-1}\left(\frac{\omega_0}{\omega_u/K}\right)$$

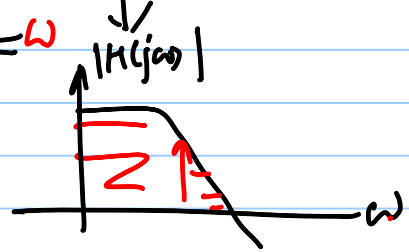
$x(t) \rightarrow \boxed{h(t)} \rightarrow y(t)$

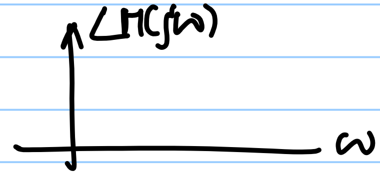
$X(s) \rightarrow \boxed{H(s)} \rightarrow Y(s)$

$Y(s) = X(s)\, H(s)$

$y(t) = x(t) * h(t)$







$v_i(t) = v_p \cos(\omega_0 t)\ u(t)$

$V_i(s) = \mathcal{L}\{v_i(t)\}$

$$v_o(t) = V_p \cdot \frac{K}{\sqrt{1+\left(\frac{\omega_0}{\omega_n/K}\right)^2}} \cos(\omega_0 t + \phi)$$

v_i as dc $\Rightarrow$ $V_o = K v_i$

$$\frac{G_m}{sC} = \frac{1}{s\,\omega_n}$$

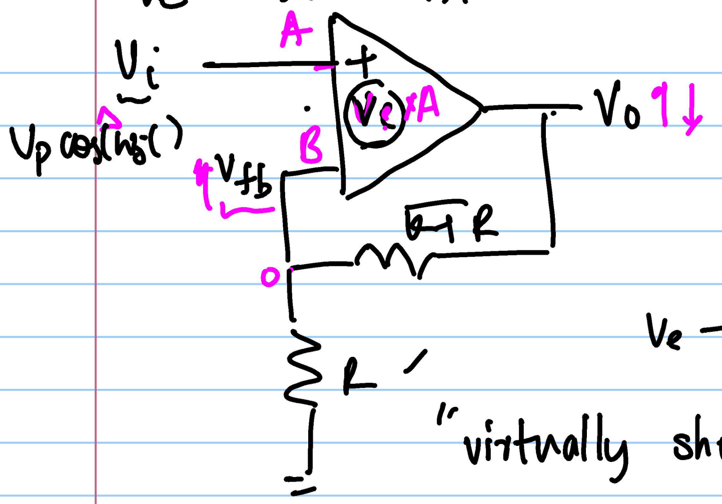
$$v_o(t) \approx K\, v_p \cos(\omega_0 t)$$

$$\frac{\omega_0}{\omega_n/K} \rightarrow 0,$$

$\omega_n \rightarrow \infty$

$$\frac{\omega_0}{\omega_n/K} \ll 1$$

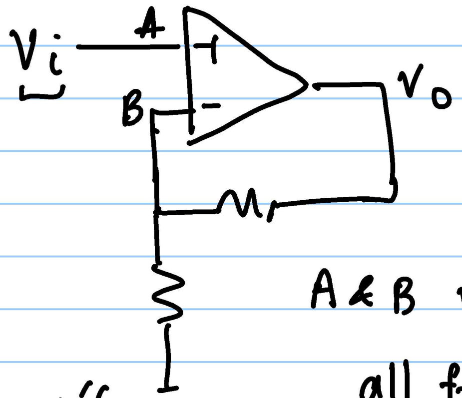
$\frac{V_o}{V_e} = \frac{G_m}{sC} = \frac{1}{s/\omega_u}$, ω_u is finite.



$V_e \to 0$

"virtually short" ≠ "short"

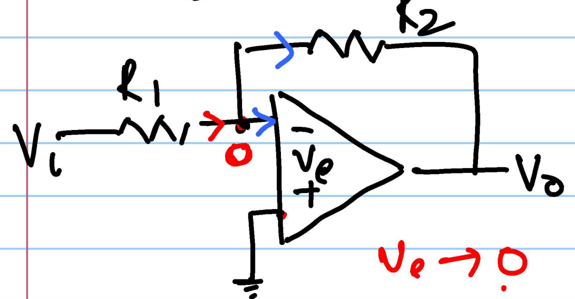
$\frac{V_o}{V_e} = \frac{1}{s/\omega_u}$ $\omega_u \to \infty$



A & B virtually short for all freq. $\omega_u \to \infty$.

$V_o = K V_i$

$V_{fb} = V_i$



$V_e \to 0$

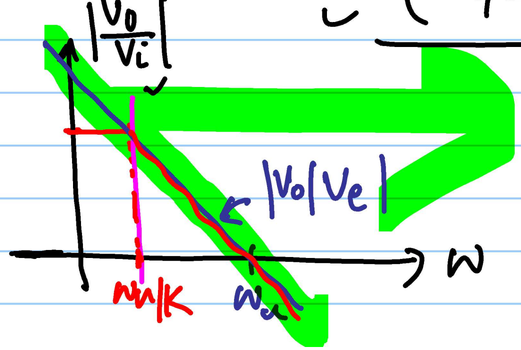
$\frac{V_o}{V_i}$

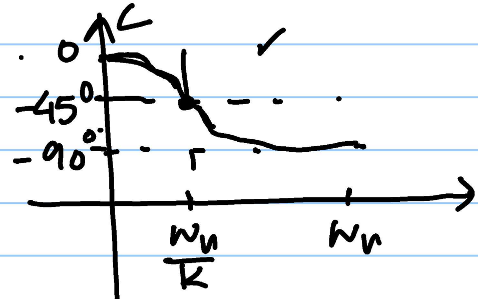
$\frac{V_i}{R_1} = -\frac{V_o}{R_2}$

$\frac{V_o(s)}{V_e(s)} = \frac{G_m}{sC}$

$\frac{V_o(s)}{V_i(s)} = \frac{K}{1 + \frac{s}{(\omega_u/K)}}$

$\omega_p = -\frac{\omega_u}{K}$

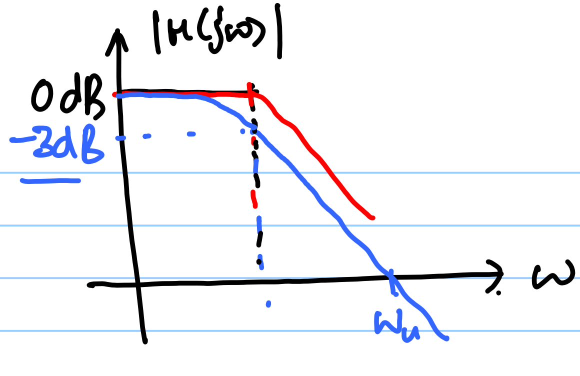




$$H(s) = \frac{1}{1 + s/\omega_p}$$

$$20\log_{10}|H(j\omega)|$$

$$= 20\log_{10}\left(\left|\frac{1}{\sqrt{1+\frac{\omega^2}{\omega_p^2}}}\right|\right)$$



-3 dB bandwidth.

$$\angle\left(\frac{V_o}{V_i}\right) = -\tan^{-1}\left(\frac{\omega}{m/k}\right)$$