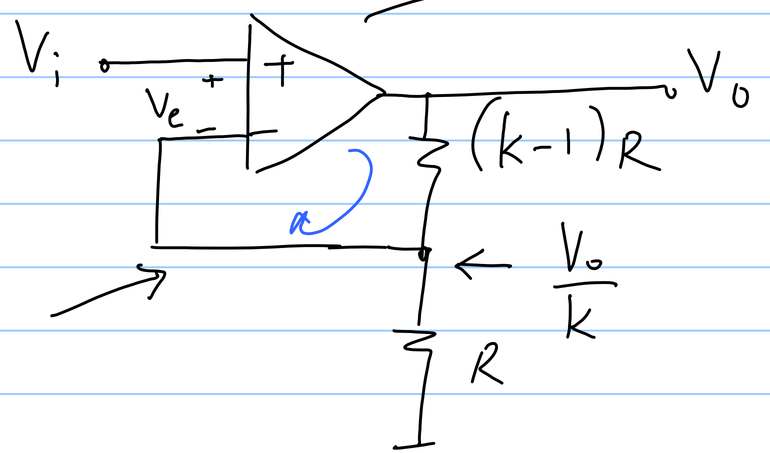
25|1|19

Lec 5



opamp $\frac{V_o}{V_e}(s) = \frac{G_m R_o}{1+sCR_o}$

$G_m R_o = A_o$

$\frac{V_o}{V_e}(s) = \frac{A_o}{1+s\frac{CA_o}{G_m}}$

$= \frac{A_o}{1+s\frac{A_o}{\omega_u}}$

$V_i =$ DC

In steady state: opamp gain $= A_o$

$$\left.\begin{aligned} V_e &= V_i - \frac{V_o}{k} \\ V_o &= A_o(V_e) \end{aligned}\right\} \quad V_o = A_o\left\{V_i - \frac{V_o}{k}\right\}$$

$$V_o\left\{\frac{1}{A_o}+\frac{1}{k}\right\} = V_i \Rightarrow V_o = V_i \cdot \left\{\frac{kA_o}{k+A_o}\right\}$$

ideal $V_o = kV_i$

non ideal : $V_o = kV_i \left[1 - \frac{k}{k+A_o} \right]$

$V_i =$ ac $\quad V_p \cos \omega t$

ideal: $V_o = k V_p \cos \omega t$

$$\frac{V_o}{V_i}(s) = ?$$

$$V_e(s) = V_i(s) - \frac{V_o(s)}{k}$$

$$V_o(s) = \frac{A_o}{1 + s\frac{A_o}{\omega_u}} \cdot V_e(s)$$

$$\left(1 + s\frac{A_o}{\omega_u}\right) \frac{1}{A_o} \cdot V_o(s) = V_i(s) - \frac{V_o(s)}{k}$$

$$V_o(s)\left[\frac{1}{K}+\frac{1}{A_o}+\frac{s}{\omega_u}\right] = V_i(s)$$

$$H(s) = \frac{V_o(s)}{V_i(s)} = \frac{k A_o \omega_u}{A_o\omega_u + k\omega_u + skA_o} = k\cdot\left[\frac{1}{1+\frac{k}{A_o}+\frac{sk}{\omega_u}}\right]$$

$$V_i = V_p \cos\omega t$$

$$V_o = V_p\cdot|H(j\omega)|\cdot\cos\left(\omega t + \angle H(j\omega)\right)$$

$$|H(j\omega)| = k\cdot\frac{1}{\sqrt{\left(1+\frac{k}{A_o}\right)^2+\frac{k^2\omega^2}{\omega_u^2}}}$$

small ω

$$\equiv \omega \ll \frac{\omega_u}{k}$$

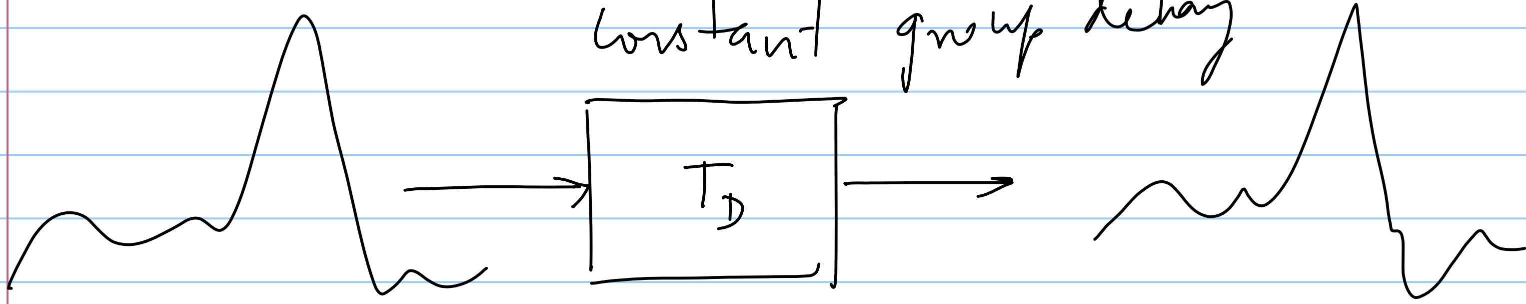
also, $\frac{k}{A_o} \ll 1$

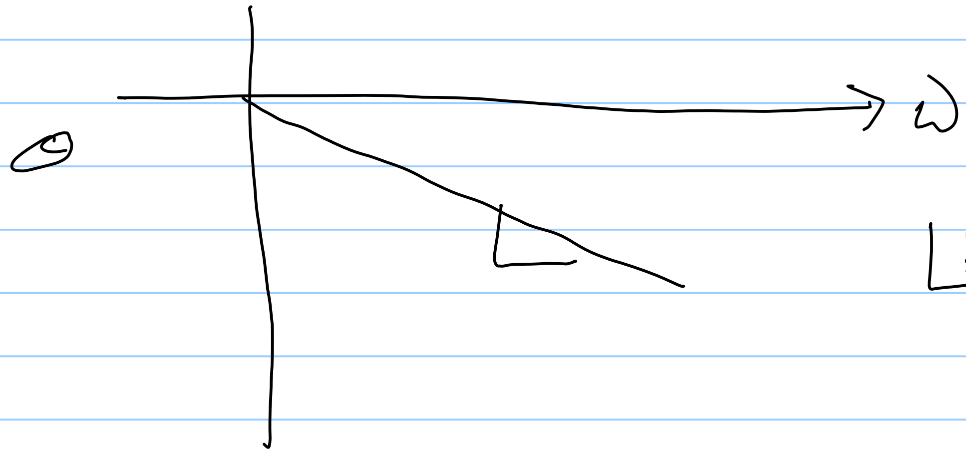
$$\angle H(j\omega) = -\tan^{-1}\left[\frac{\omega K/\omega_u}{1+\frac{K}{A_o}}\right]$$

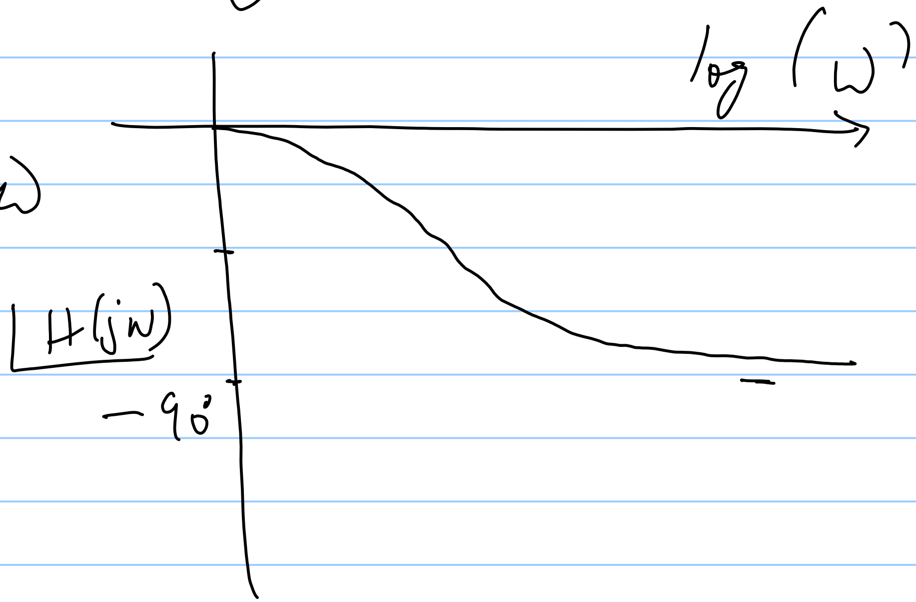
linear phase when $\frac{K}{A_o} \ll 1$

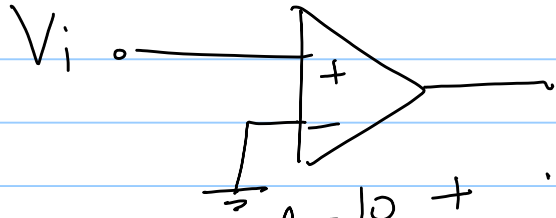
& $\omega \ll \frac{\omega_u}{K}$

constant group delay





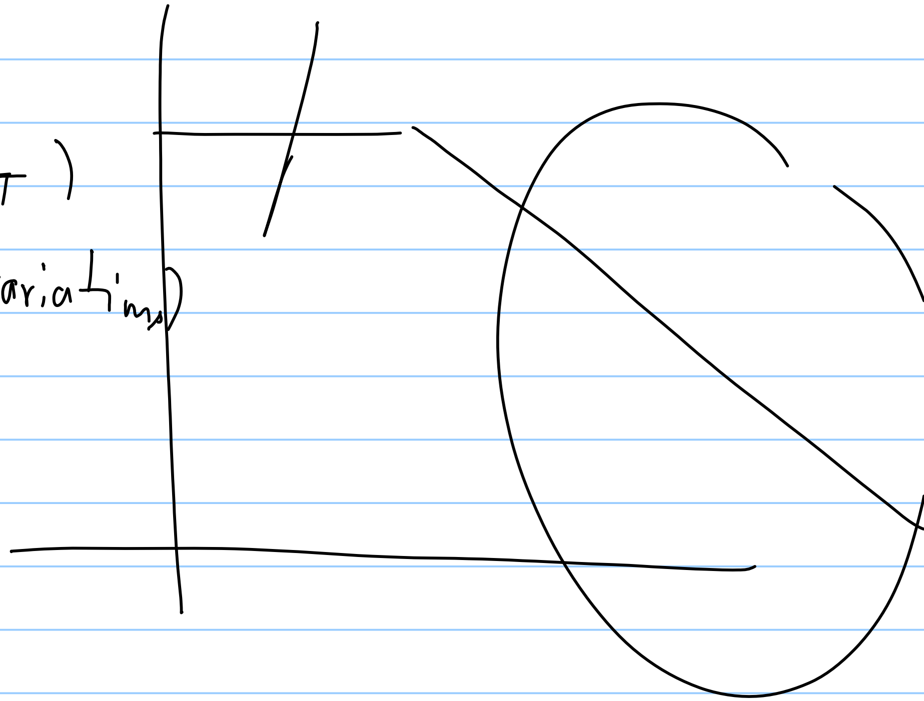


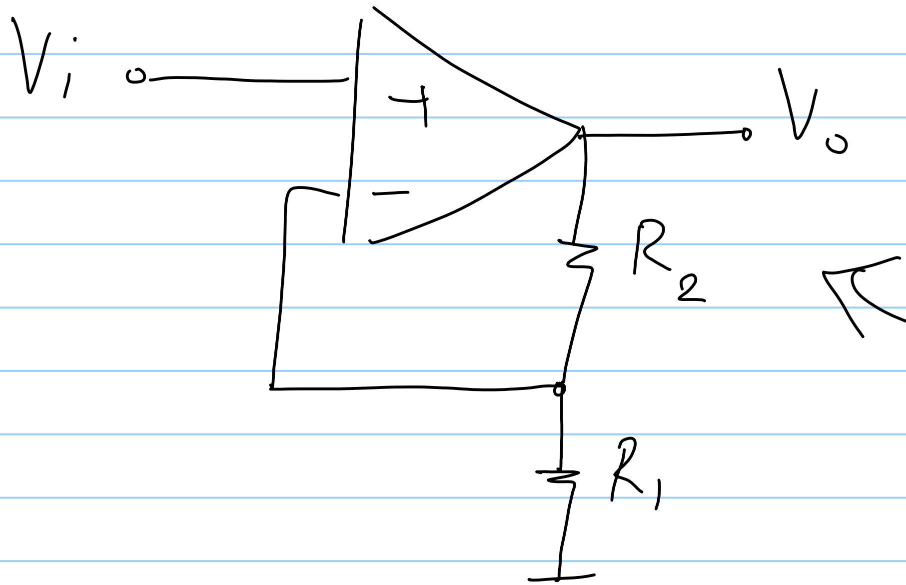


$A = 10 \pm \%$

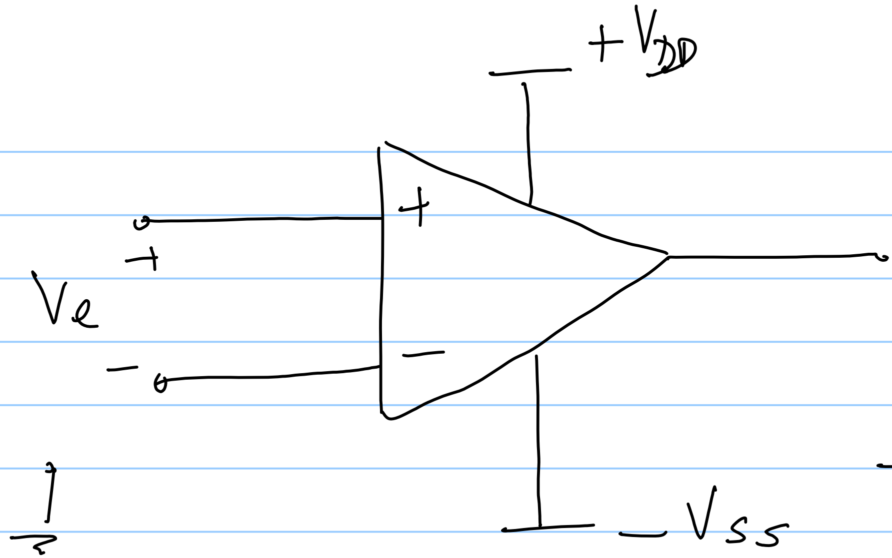
$f(T)$

$f(\text{variations})$

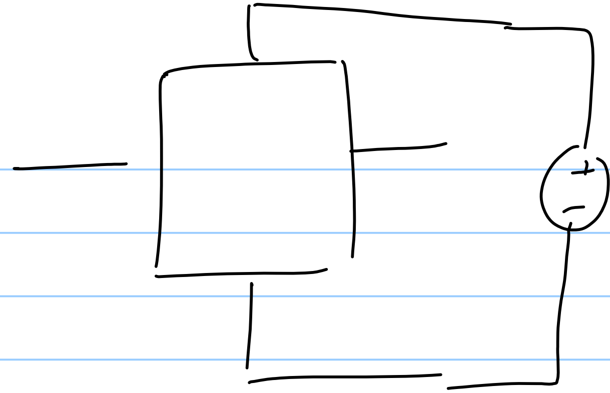


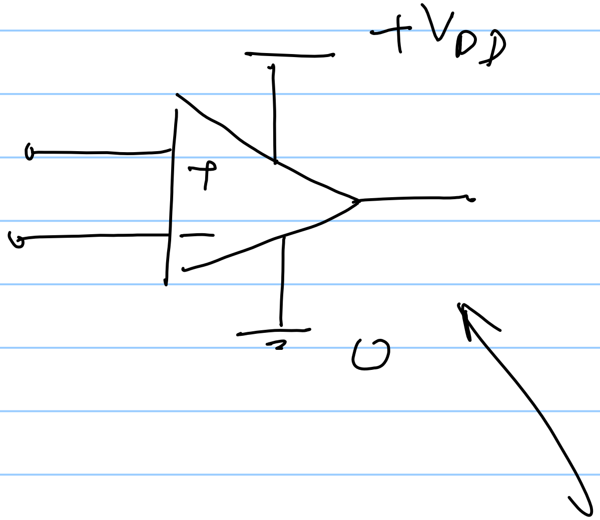


Non-inverting amplifier $\Big\}$ $k > 0$

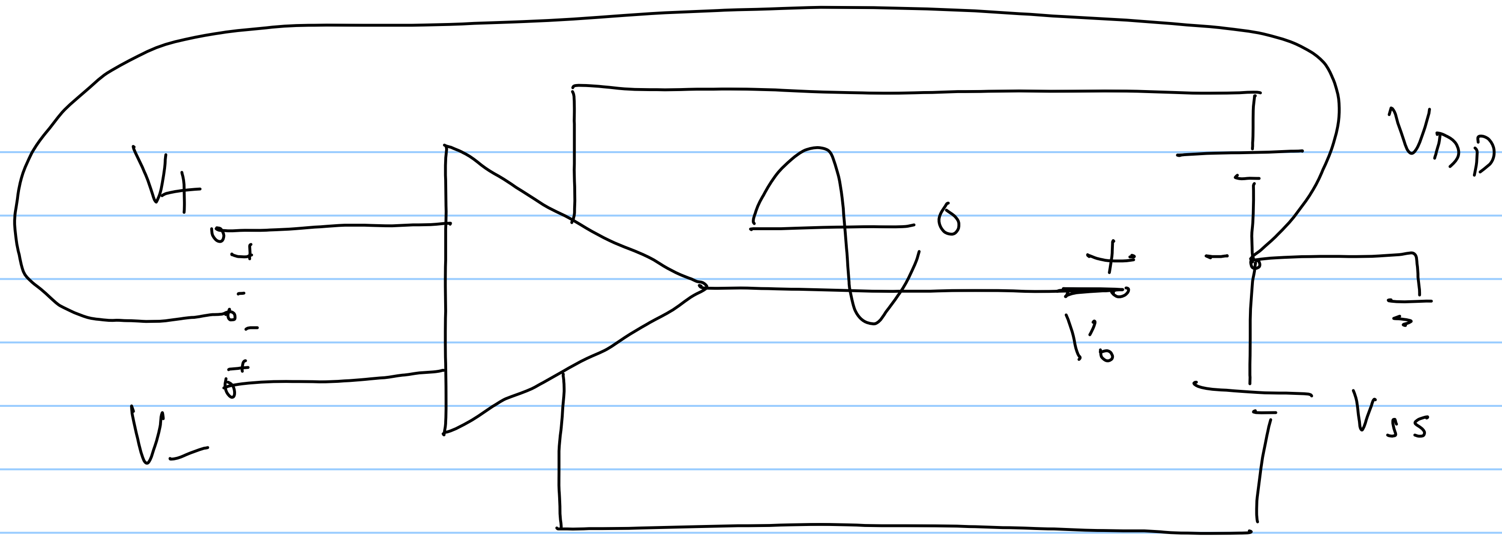


+VDD
Ve
Vo
-VSS





+VDD
0



V+
V−
VDD
VSS
V'o