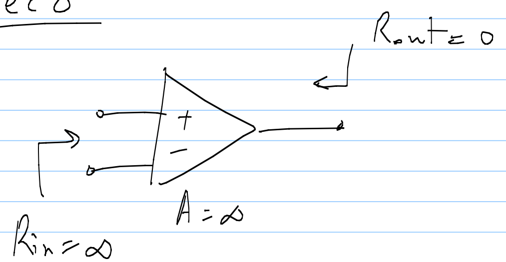
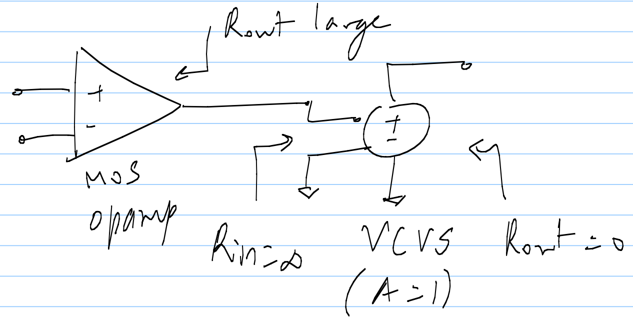
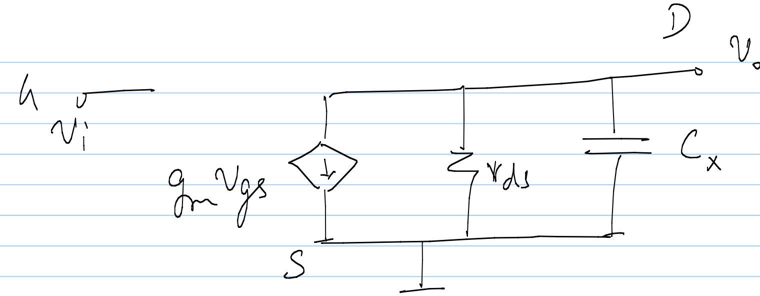
12/8/14

# lec 8

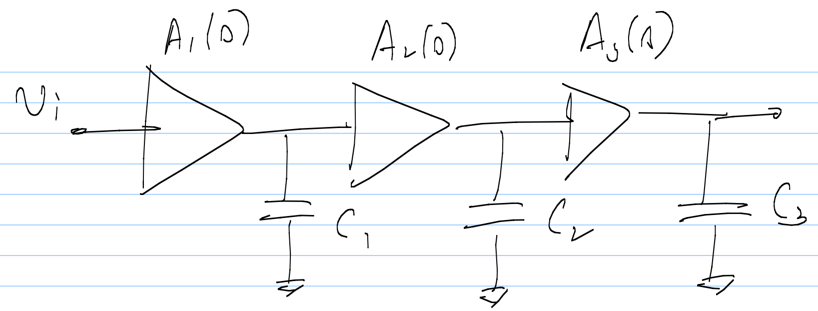
$R_{out} = 0$



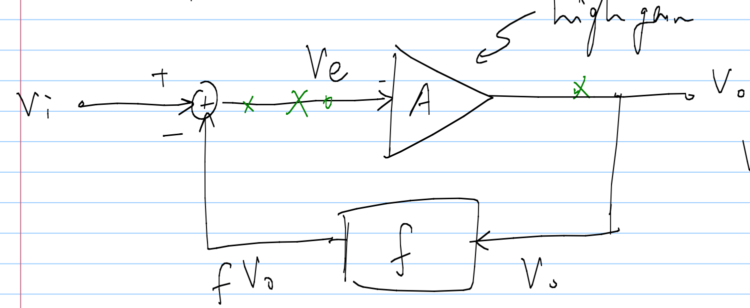

$$Z_x = \frac{1}{\omega C_x}$$




$$A(\Omega) = \prod A_i(\Omega)$$

## Negative f.b.

1) Measure desired value
2) Compare with known reference
3) If different, drive D.S. towards R.S.




$V_e = V_i - fV_o$

$V_o = AV_e$

$$\frac{V_o}{V_i} = \frac{A}{1+Af} = \frac{1}{f} \cdot \frac{Af}{1+Af}$$

$$\approx \frac{1}{f} \text{ if } Af \gg 1$$

"amplifier" $\Rightarrow$ $f \leq 1$

$A = A(s)$

$$\frac{V_o}{V_i} = \frac{1}{f} \cdot \frac{A(s)\cdot f}{1 + A(s)\cdot f}$$

$$= \frac{1}{f} \text{ if } A(s)\cdot f \gg 1$$

* Stability

Closed loop gain (CLG) $\quad \frac{V_o}{V_i}(s) = \frac{1}{f} \cdot \frac{A(s)\cdot f}{1 + A(s)\cdot f} = \frac{1}{f} \cdot \frac{N(s)}{D(s)}$

$$A(s)\cdot f = LG(s)$$

loop gain

if $D(s) = 0$ @ any freq. $\Rightarrow$ Instability

<u>Barkhausen Criteria</u>

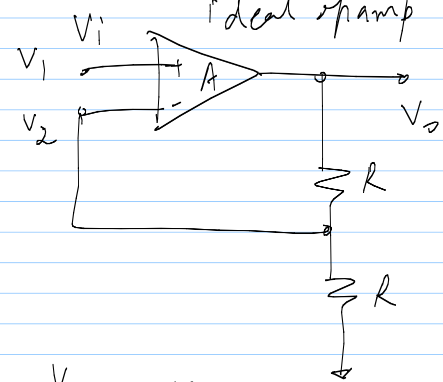
$$1 + A(s)\cdot f = 0$$

$$\boxed{\begin{array}{l} |A(s)\cdot f| = 1 \\ \angle A(s)\cdot f = 180^\circ \end{array}}$$

$$\left.\begin{array}{l} @ \ \angle A(s)\cdot f = 180^\circ, \\ \text{if } |A(s)\cdot f| \geq 1 \end{array}\right\} \ \underline{\text{Unstable}}$$

When $\angle LG = 180^\circ$, we want

$|LG| < 1$

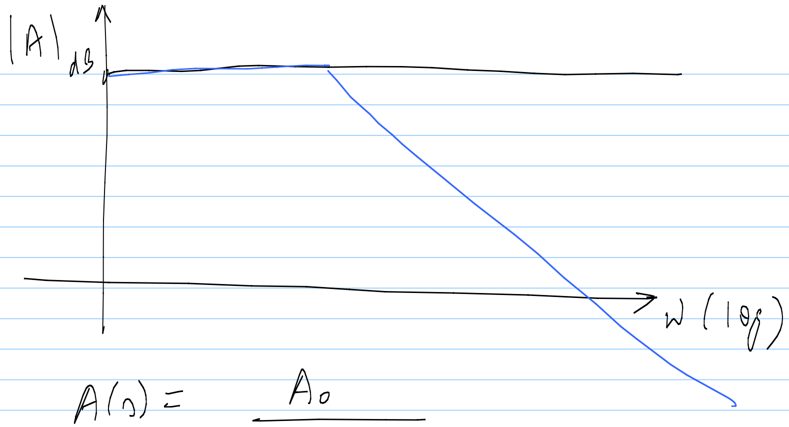



gain $= 2$

$$\left(V_i - \frac{1}{2}V_o\right)\cdot A = V_o$$

$$\frac{V_o}{V_i} = \frac{A}{1 + A/2} = 2 \cdot \frac{A/2}{1 + A/2} \approx 2$$

$$V_i = \frac{V_o}{2} \Rightarrow \frac{V_o}{V_i} = 2$$



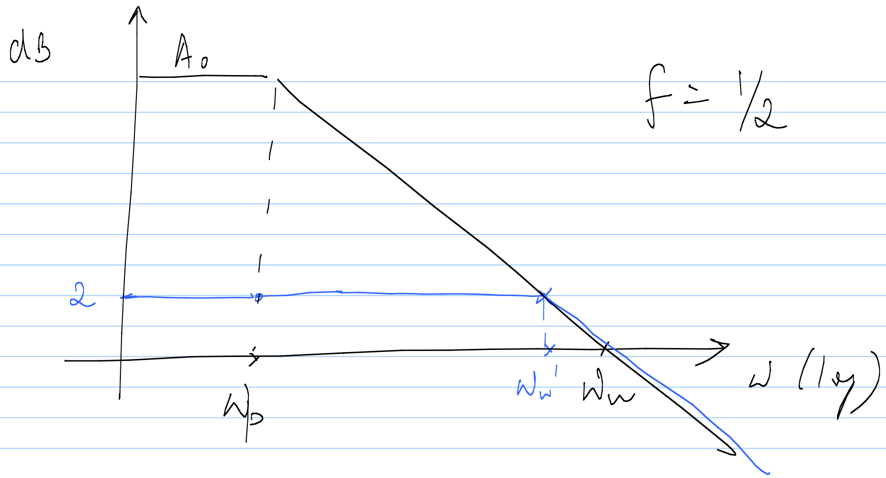

$$A(s) = \frac{A_0}{1 + s/\omega_p}$$

$$\frac{V_o}{V_i}(s) = \frac{1}{f} \cdot \frac{A(s)\cdot f}{\underbrace{1 + A(s)\cdot f}_{D(s)}}$$

$$\frac{V_o}{V_i}(s) = \frac{1}{f} \cdot \frac{\frac{A_0}{1+s/\omega_p}\cdot f}{1 + \frac{A_0}{1+s/\omega_p}\cdot f}$$

$$= \frac{1}{f} \cdot \frac{A_0 f}{1 + s/\omega_p + A_0 f}$$

$$= \frac{1}{f} \cdot \frac{A_0 f}{1 + A_0 f} \cdot \frac{1}{1 + \frac{s}{\omega_p (1 + A_0 f)}}$$




$f = 1/2$

$$\omega_u \approx A_0 \cdot \omega_p$$

$$\omega_u' = A_0 f \omega_p = \omega_u / 2$$