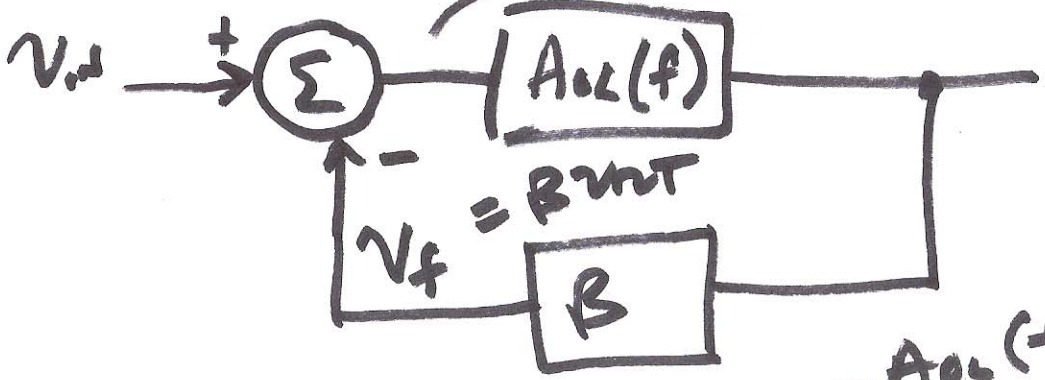
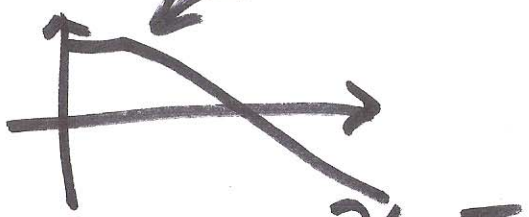
$v_{in} - \beta v_{out} = v_{out}$

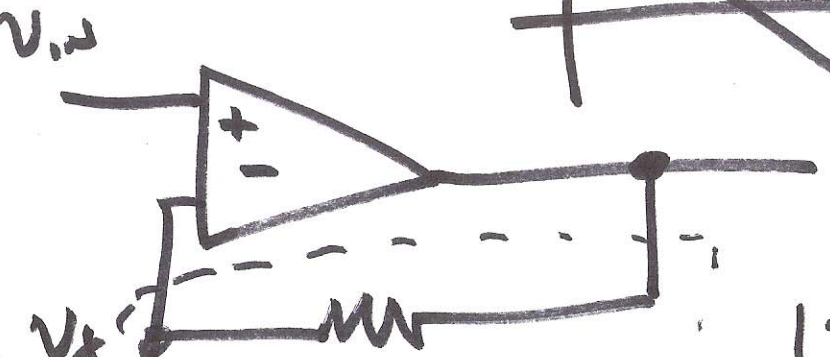
$\frac{v_{out}}{v_{in}} = \frac{A_{OL}}{1+\beta A_{OL}}$



$A_{OL}(f) = \frac{A_{OLDC}}{1 + j\frac{f}{f_{3\,dB}}}$



$R_1 = 1K$
$R_2 = 9K$
0.1



top.

$A_{OLDC} = 10^3$

$f_{3dB} = 1kHz$

$\frac{R_1}{R_1+R_2} v_{out} = v_f$

$\frac{R_1}{R_1+R_2}$ B

$1 + \frac{R_2}{R_1}$

$A_{CL,\,ideal}$

$\frac{}{1 + \frac{R_2}{R_1}}$

$$A_{CL}(f) = \frac{A_{OL}(f)}{1 + \beta A_{OL}(f)}$$

Becomes unstable when $\beta A_{OL}(f) = -1$

$\beta = 0.1 \rightarrow A_{CL}|_{ideal} = 10$

$$A_{CL} = \frac{1}{\frac{1}{A_{OL}} + \beta}$$

$A_{OL} \rightarrow \infty$ (ideal)

$$A_{CL} = \frac{1}{\beta}$$

$|\beta A_{OL}(f)| = 1$

$\beta = 1$

$|A_{OL}| = 1$

$\beta = 0.1, A_{CL} = 10$

$|A_{OL}| = 10$

$\angle \beta A_{OL}(f) = 180^\circ$

$\beta = 1$ (worst case)

$|A_{OL}^{(f)}| = 1$

$\angle A_{OL}(f) = 180^\circ$

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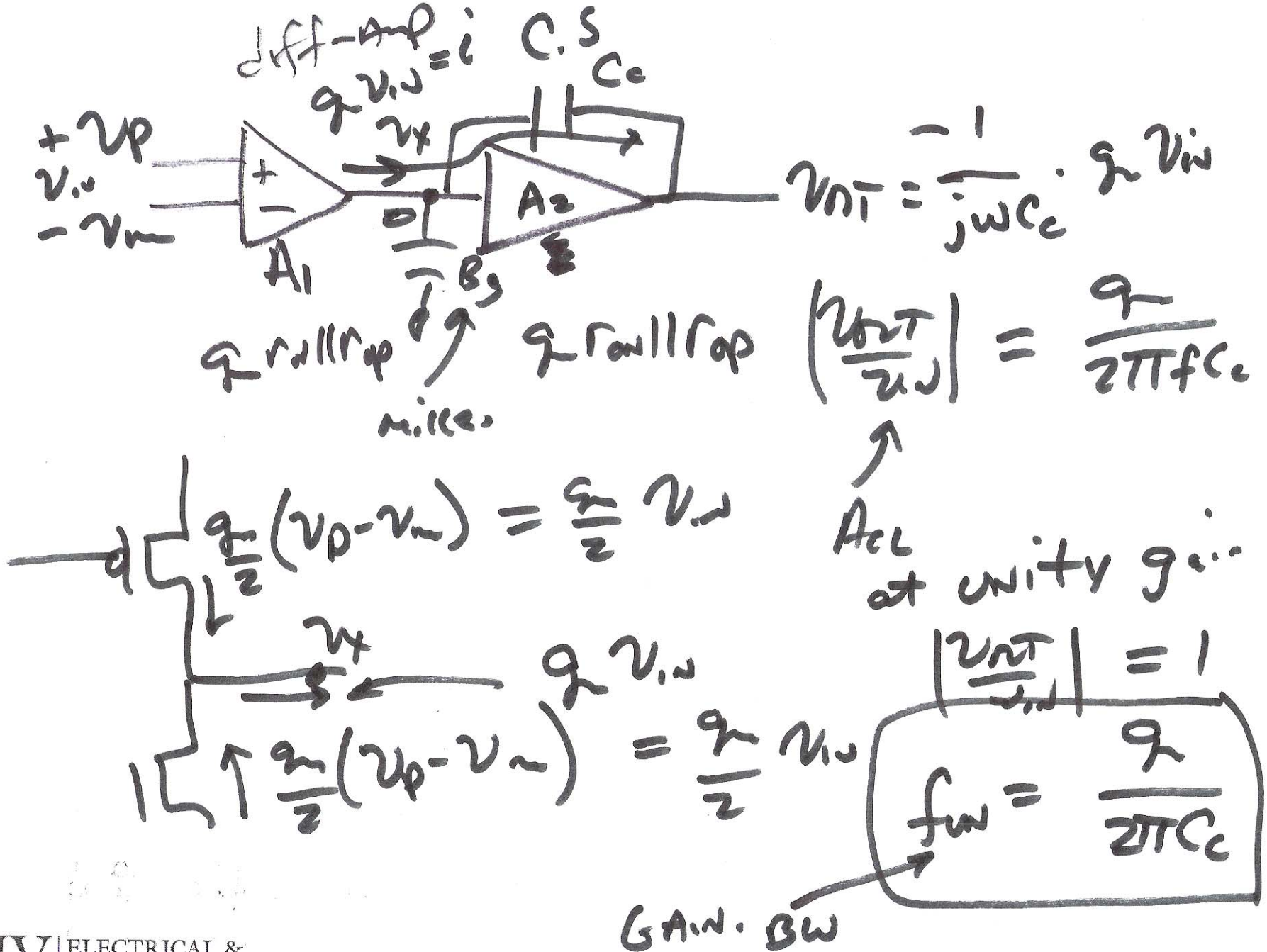
diff-Amp
$i = g_m v_{in}$
C.S
C_c
$+v_p$
v_{in}
$-v_m$
v_x
A_1
A_2
D
B
S
$g_m r_{ds} \| r_{op}$
$g_m r_{ds} \| r_{op}$
mirror
$v_{out} = \frac{-1}{j\omega C_c} \cdot g_m v_{in}$
$\left|\frac{v_{out}}{v_{in}}\right| = \frac{g_m}{2\pi f C_c}$
A_{CL}
at unity g...
$\left|\frac{v_{out}}{v_{in}}\right| = 1$
$f_u = \frac{g_m}{2\pi C_c}$
GAIN. BW
$\frac{g_m}{2}(v_p - v_m) = \frac{g_m}{2} v_{in}$
v_x
$g_m v_{in}$
$\frac{g_m}{2}(v_p - v_m) = \frac{g_m}{2} v_{in}$

$A_{OL0C} = 1{,}000$

$f_{UN} = 10^7\ Hz = A_{CL} \cdot BW$

$A_{CL} = 1$, $BW = 10\ MHz$

$A_{CL} = 10$, $BW = 1\ MHz$

$A_{CL} = 100$, $BW = 100K Hz$

$A_{CL} = 1K$, $BW = 10K$

$A_{CL} = 10K$, $BW = 1K$

$$A_{CL}(f) = \frac{1{,}000}{1 + j\frac{f}{10K}}$$

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$A_{CL} = 10$, $\beta = 0.1$

$$A_{CL} = \frac{A_{OL}}{1 + \beta A_{OL}} \quad , \quad A_{OL} = \frac{10^3}{1 + j\frac{f}{10^4}}$$

$$= \frac{10^3}{1 + j\frac{f}{10^4} + \frac{1}{10} \cdot 10^3}$$

$$= \frac{10^3 \cdot \frac{1}{100}}{101 + j\frac{f}{10^4} \cdot \frac{1}{100}}$$

$$A_{CL} = \frac{10}{1 + j\frac{f}{10^6}}$$

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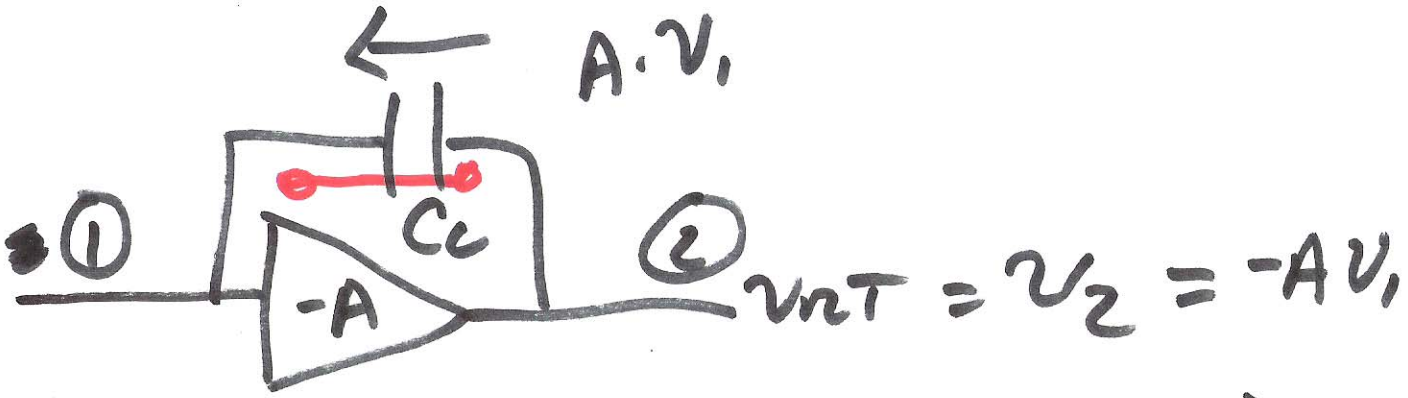
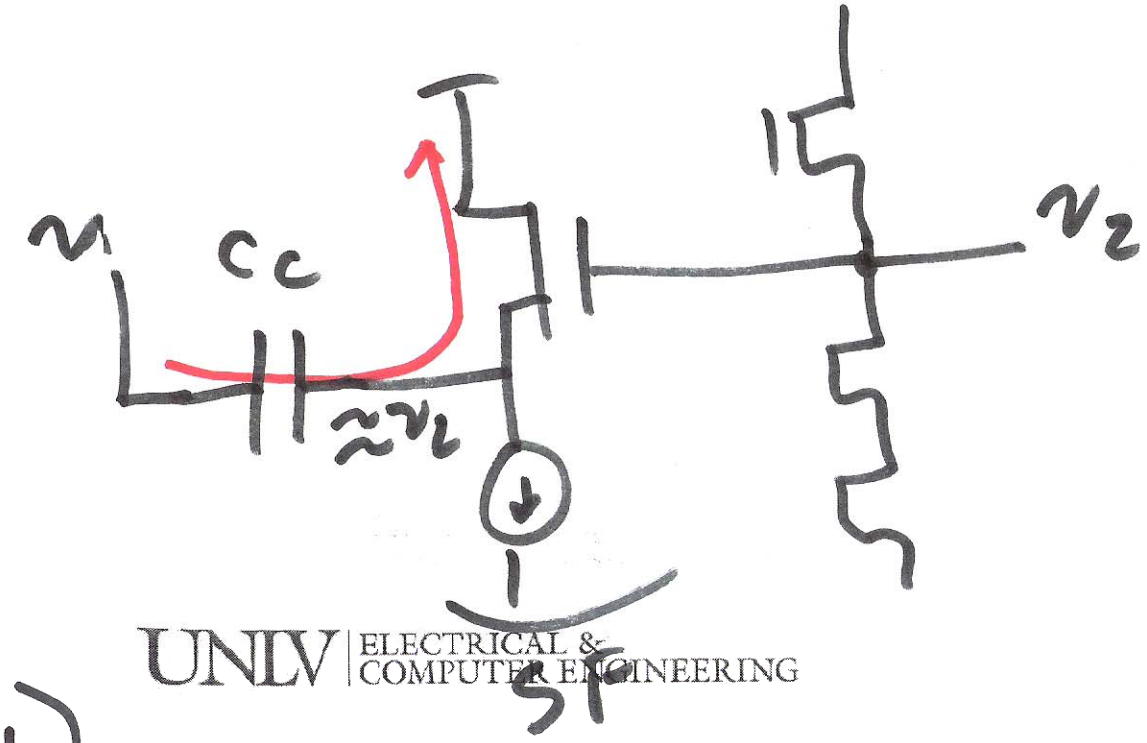
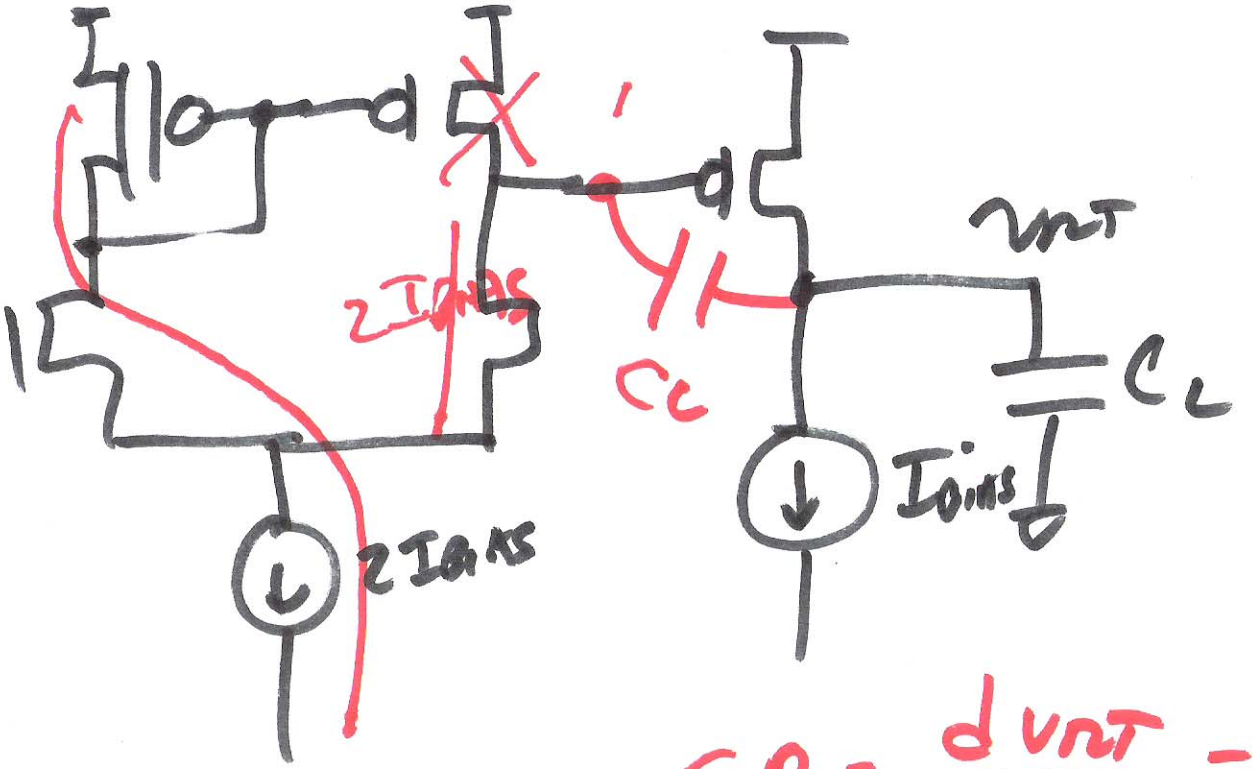


$$\frac{v_2 - v_1}{1/j\omega C_c} = \frac{-v_1(A+1)}{1/j\omega C_c}$$

$$= \frac{-v_1}{\frac{1}{j\omega C_c(1+A)}}$$





$$\frac{dV_{OUT}}{dt} = \frac{I_{BIAS}}{C_L}$$

$$SR = \frac{dV_{OUT}}{dT} = \frac{2I_{BIAS}}{C_C}$$

$$\frac{dV_{OUT}}{dt} = \frac{20\mu A}{2.4pF} = 8.33\ V/\mu s$$

$$t_{1/2} = \frac{1}{2} / 8.33\ V/\mu s$$

$t_{1/2}$ to half a VOLT

$= 60ns$