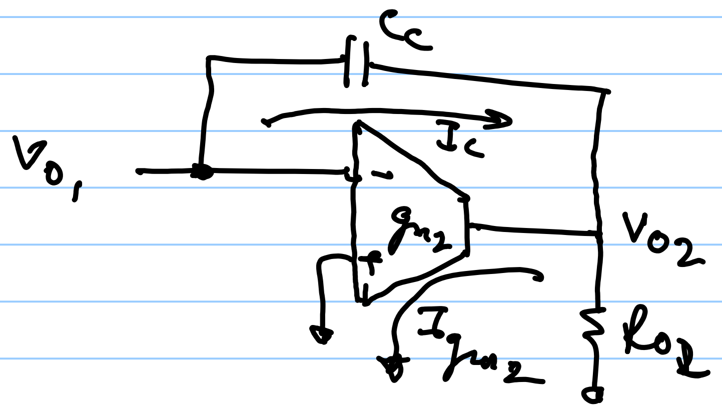
EE2019

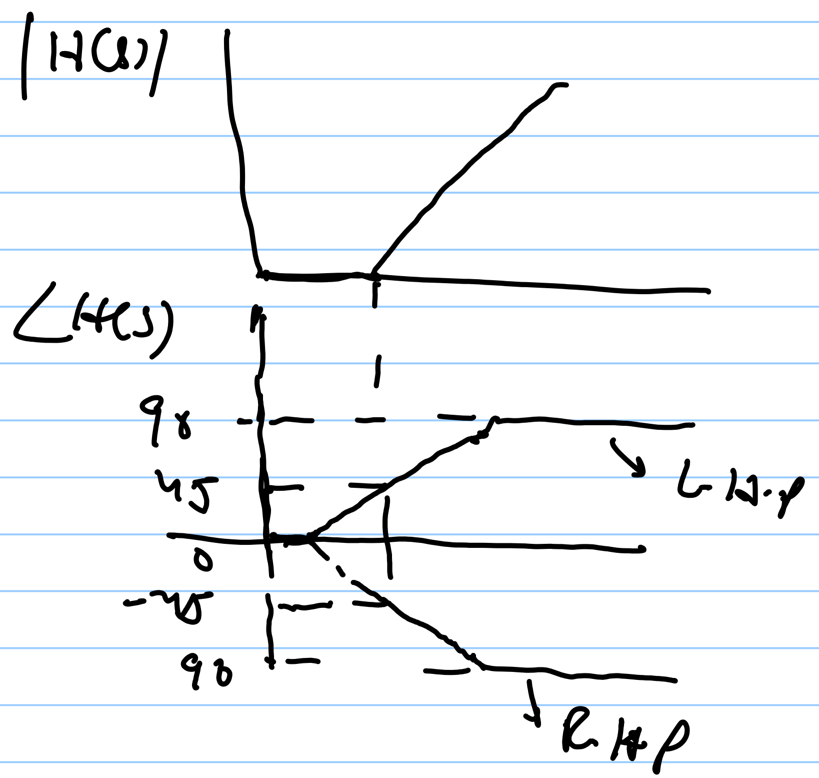
Note Title 3/5/2019

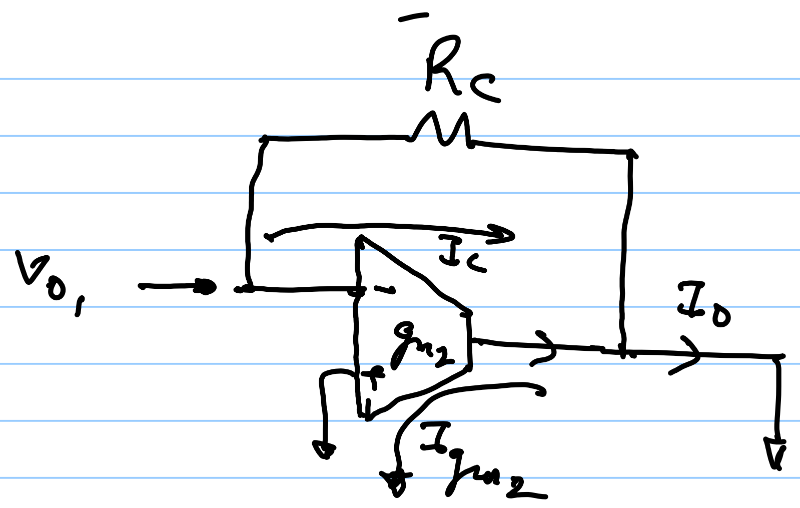
$$\omega_{p_1} = \frac{1}{(g_{m_2} R_{o_2}) R_{o_1} C_c}$$

$$\omega_{p_2} = \frac{g_{m_2}}{C_{o_1} + C_{o_2}}$$



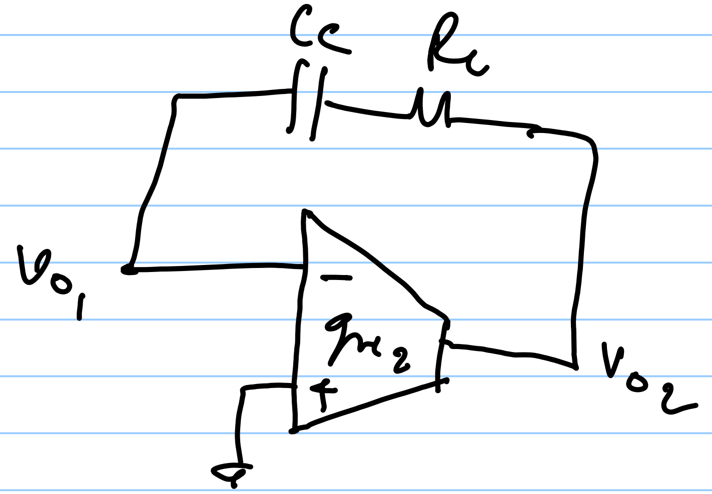
$H(s) = (1 + RCs)$





$$-v_{o_1} g_{m_2} + v_{o_1}/R_c = 0$$

$$R_c > \frac{1}{g_{m_2}}$$



g_{m_2} path will always be stronger than R_c path

$$\omega_z = \frac{g_{m2}}{C_c}$$ without R_c

with R_c

$$\omega_z = \frac{-1}{\left(R_c - \frac{1}{g_{m2}}\right) C_c}$$

$R_c > \frac{1}{g_{m2}}$ then ω_z will be in R.H.P

$R_c = \frac{1}{g_{m2}}$, $\omega_z \to \infty$

$$\frac{v_{o_2}}{v_{o_1}} = \frac{A_0 \left[1 + \left(R_c - \frac{1}{g_{m_2}}\right) C_c s\right]}{\left(1 + s/\omega_{p_1}\right)\left(1 + s/\omega_{p_2}\right)}$$

if $R_c > \frac{1}{g_{m_2}}$ then R.H.P zero moves to L.H.P

$$\omega_z = \omega_{p_2}, \qquad \omega_z = \frac{-1}{\left(R_c - \frac{1}{g_{m_2}}\right) C_c}$$

$$H(s) = \frac{A_0}{\left(1 + s/\omega_{p_1}\right)}$$

Pole-zero cancellation

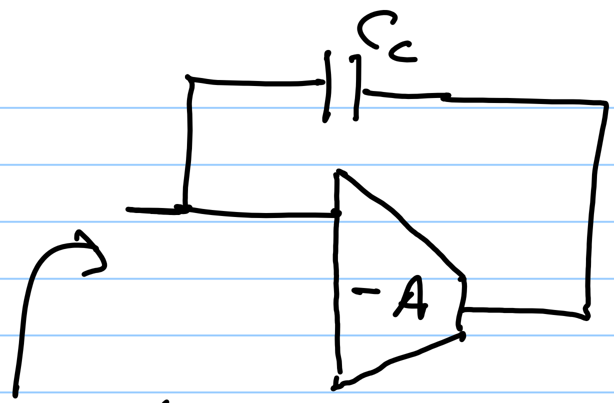
ω_z cancels ω_{p_2}

we can design a higher B.W. amplifier by cancelling 2nd pole.

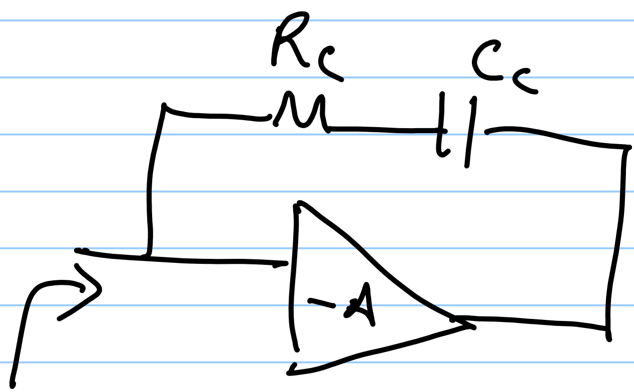
$$\omega_{P_2} = \frac{g_{m_2}}{C_1 + C_2} \quad , \quad \omega_2 = \frac{1}{\left(R_c - \frac{1}{g_{m_2}}\right) C_c}$$

$$\frac{\cancel{g_{m_2}}}{C_1 + C_2} = \frac{\cancel{g_{m_2}}}{(R_c g_{m_2} - 1) C_c}$$

$$1 + \frac{C_1 + C_2}{C_c} = R_c g_{m_2} \Rightarrow R_c = \frac{1}{g_{m_2}} \left(1 + \frac{C_1 + C_2}{C_c}\right)$$



$C_{in} = (1+A)C_c$

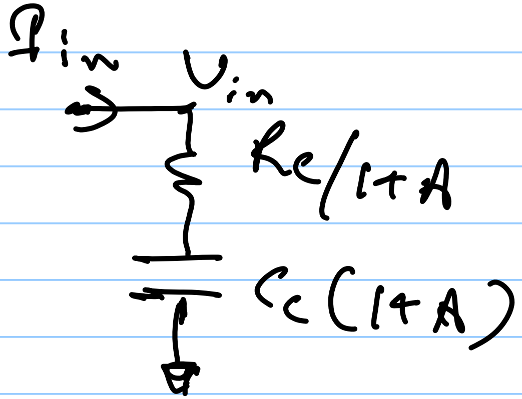


Z_{in}

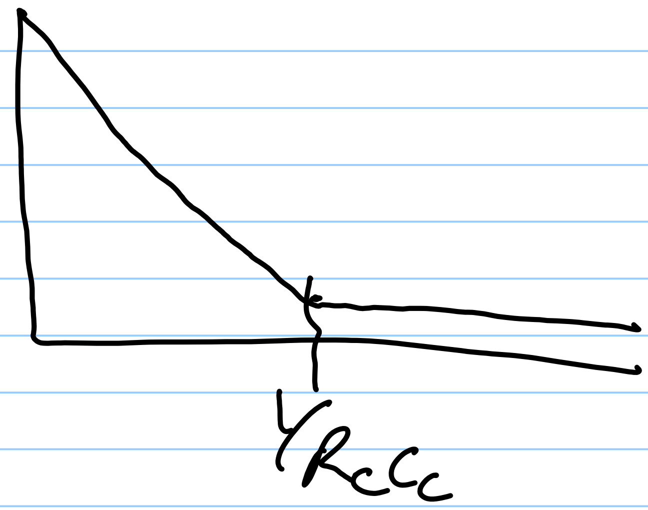
$$Z_{in} = \frac{1}{1+A}\left(R_c + \frac{1}{sC_c}\right) = \frac{R_c}{1+A} + \frac{1}{(1+A)C_c s}$$

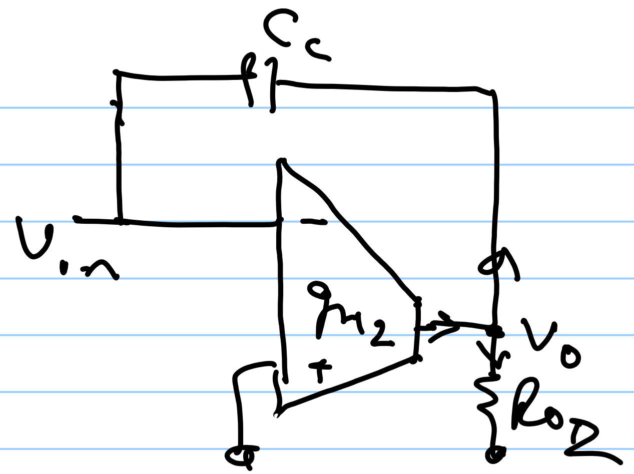
small

$$Z_{in} \approx \frac{1}{(1+A)C_c s} \Rightarrow C_{in} = (1+A)C_c$$



$$V_{in} = I_{in}\left(\frac{R_c}{1+A} + \frac{1}{C_c(1+A)s}\right)$$



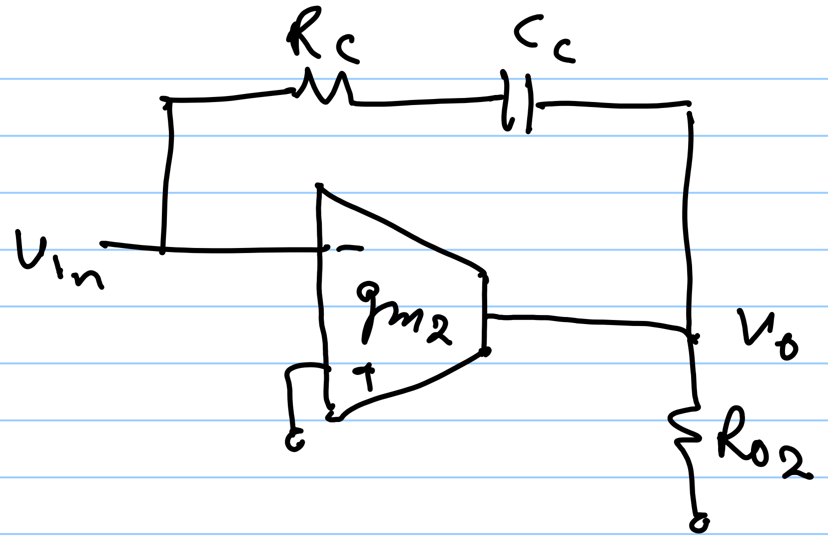


$$(V_o - V_{in})sC_c + \frac{V_o}{R_{o2}} = -V_{in}g_{m2}$$

$$V_o sC_c - V_{in}sC_c + \frac{V_o}{R_{o2}} = -V_{in}g_{m2}$$

$$V_o\left(sC_c + \frac{1}{R_{o2}}\right) = V_{in}\left(-g_{m2} + sC_c\right)$$

$$\frac{V_o}{V_{in}} = -R_{o2}g_{m2} \cdot \frac{\left(1 - \frac{C_c}{g_{m2}}s\right)}{1 + R_{o2}C_c s}$$



$$-v_{in} g_{m2} = \frac{v_o}{R_{o2}} + \frac{(v_o - v_{in})}{R_c + \frac{1}{sC_c}}$$

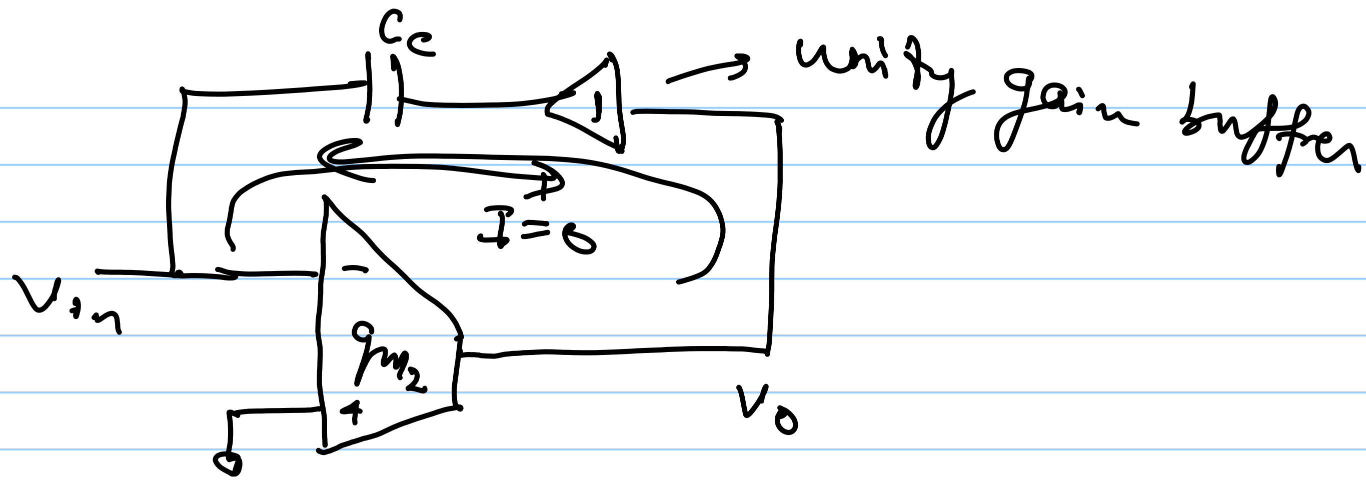
$$-v_{in} g_{m2} = \frac{v_o}{R_{o2}} + \frac{v_o sC_c}{1 + R_c C_c s} - \frac{v_{in} sC_c}{1 + R_c C_c s}$$

$$-V_{in}\left(g_{m_2} - \frac{sC_c}{1+R_cC_cs}\right) = V_o\left(\frac{1}{R_{o_2}} + \frac{sC_c}{1+R_cC_cs}\right)$$

$$-V_{in}\left(\frac{g_{m_2}(1+R_cC_cs) - sC_c}{\cancel{(1+R_cC_cs)}}\right) = V_o\,\frac{1+R_cC_cs+R_{o_2}C_cs}{R_{o_2}\cancel{(1+R_cC_cs)}}$$

$$\frac{V_o}{V_{in}} = -\frac{g_{m_2}R_{o_2}\left(1+R_cC_cs - \frac{C_c}{g_{m_2}}s\right)}{1+(R_c+R_{o_2})C_cs} =$$

$$= -g_{m_2}R_{o_2}\left[1+\left(R_c - \frac{1}{g_{m_2}}\right)C_cs\right] \Big/ 1+(R_c+R_{o_2})C_cs$$



C_c
1
−
+
g_{m_2}
$I = 0$
V_{in}
V_0
unity gain buffer