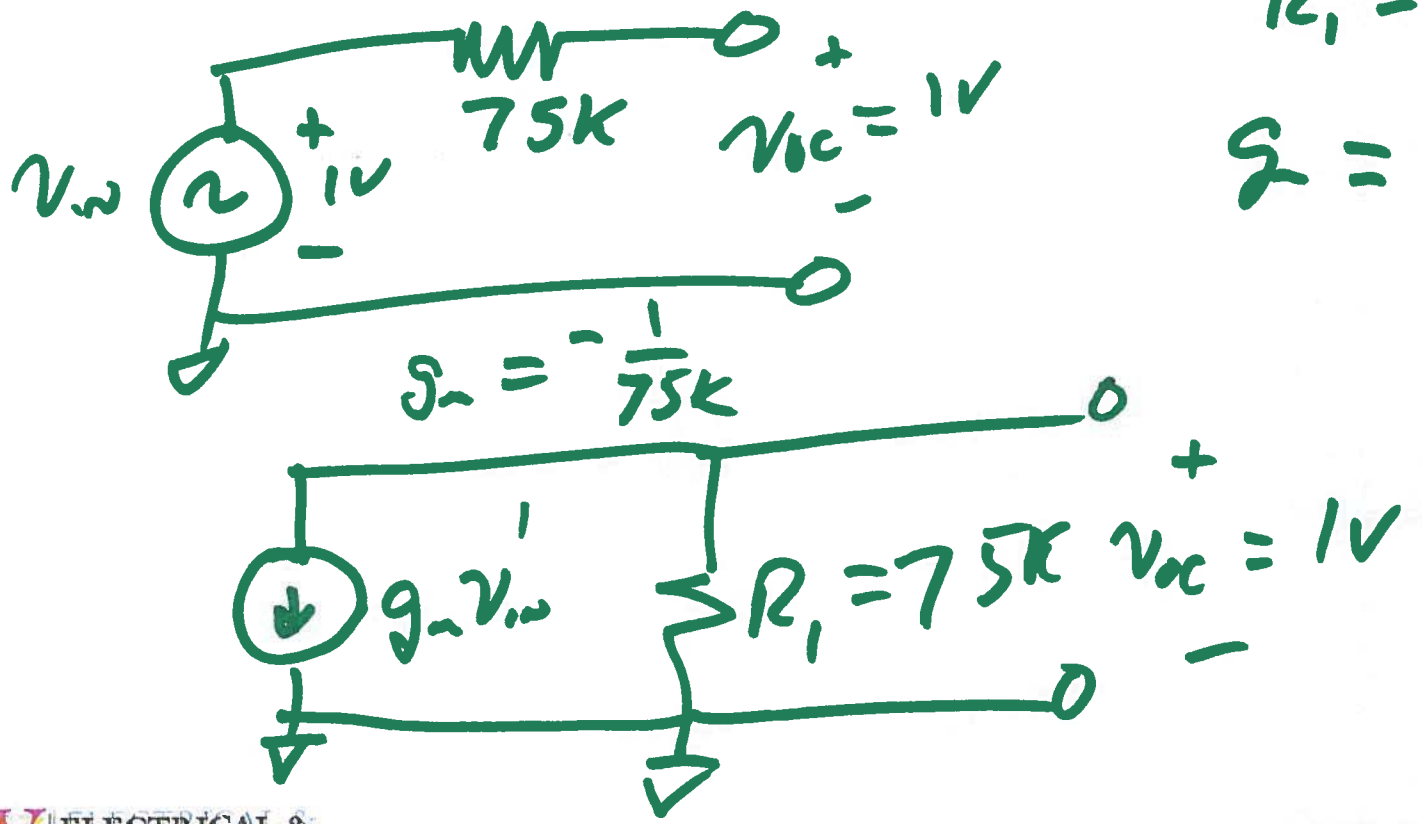
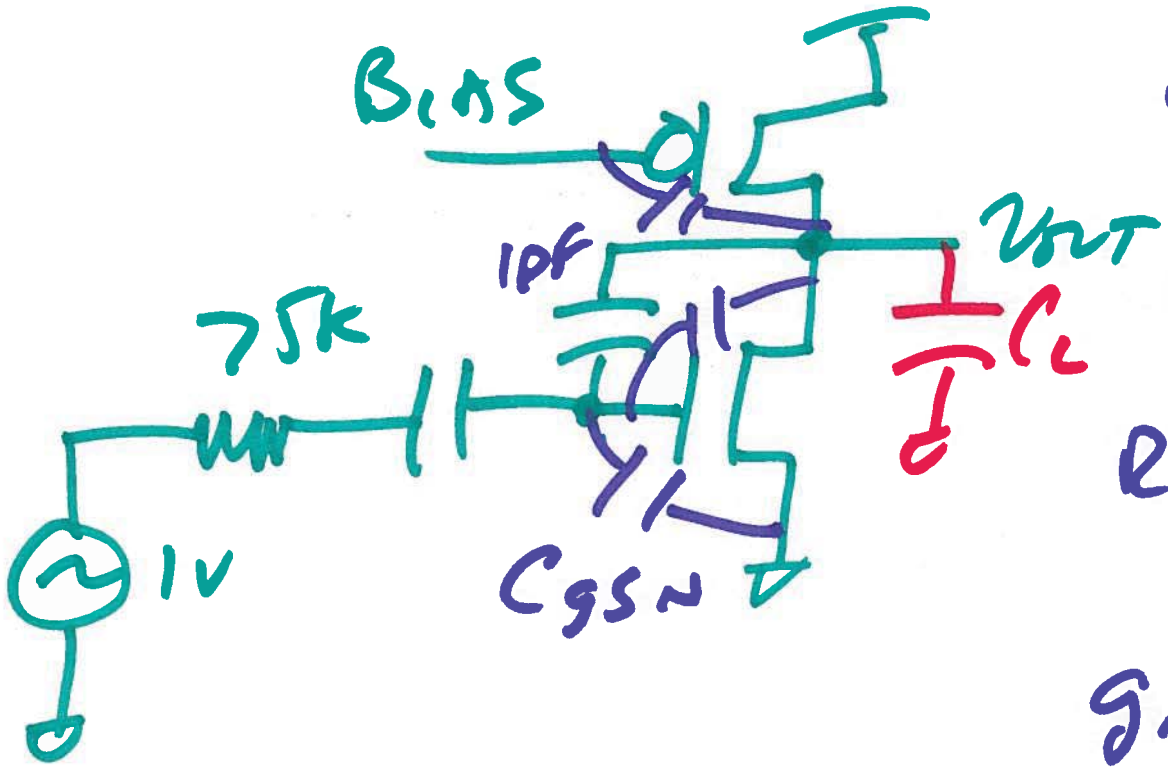
EE 420 / ECE 620
Analog IC Design
April 8, 2019
Lecture 18





$R_1 = 75k$

$C_1 = C_{GSN} = 23.3fF$

$C_c = 1pF$

$R_2 = r_{ON} \| r_{ON}$

$= 2.2M\Omega$

$g_{m2} = 150 \frac{\mu A}{V}$

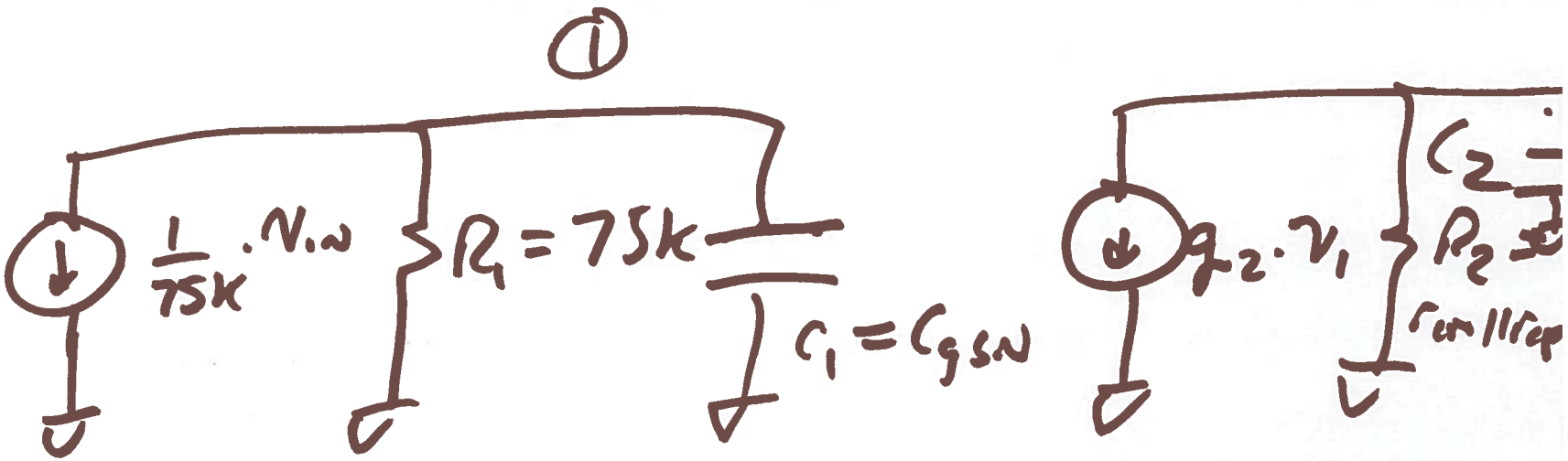
$C_2 = C_{gdp} = 6fF$

f_1

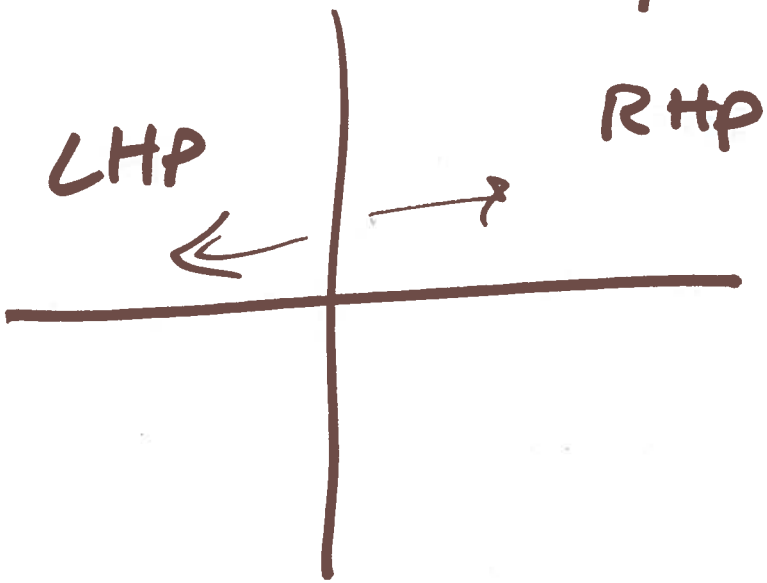
f_2

$$f_2 = \frac{g_{m2}}{2\pi C_c} = \frac{150\mu}{2\pi \cdot 1p} = 23MHz$$

C_L



$$1 - \frac{f}{f_z} = 1 - \frac{2\pi f}{2\pi f_z}$$



$$s = j\omega$$

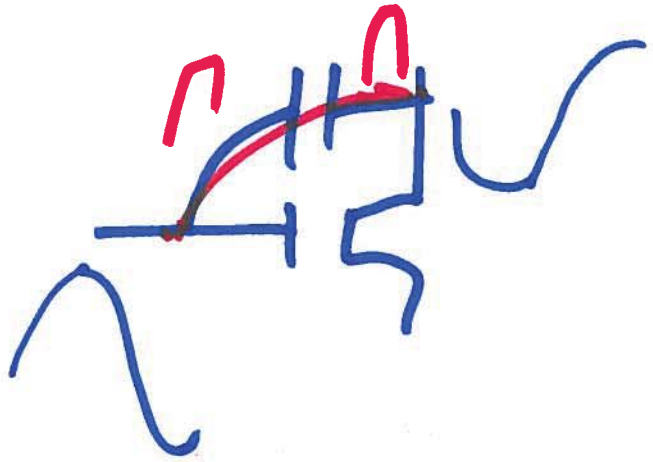
$$\left(1 - \frac{s}{2\pi f_z}\right)\Bigg|_{s = 2\pi f_s} \stackrel{?}{=} 0$$

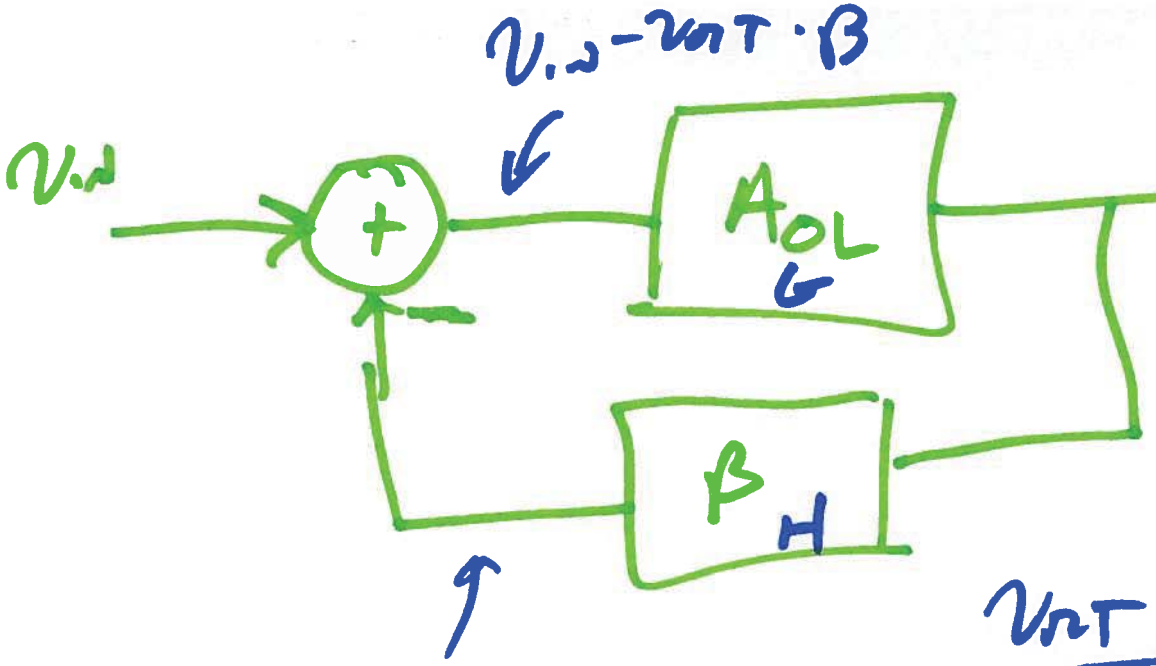
$$-\tan^{-1}\frac{\omega f}{2\pi f_z}$$

$$\left| \frac{1+j\frac{f}{f_{z}}}{1+j\frac{f}{f_{p}}} \right| = \frac{\sqrt{1+\left(\frac{f}{f_{z}}\right)^2}}{\sqrt{1+\left(\frac{f}{f_{p}}\right)^2}}$$

$$\downarrow$$

$$-\tan^{-1}\frac{f}{f_{z}} - \tan^{-1}\frac{f}{f_{p}}$$

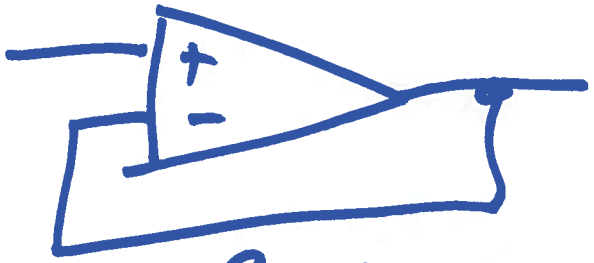




$= A_{OL}(V_{in} - V_{OUT}\cdot\beta)$

$V_{OUT}(1+\beta A_{OL}) = A_{OL}V_{in}$

$$\frac{V_{OUT}}{V_{in}} = \frac{A_{OL}}{1+\beta A_{OL}}$$



$\beta = 1$

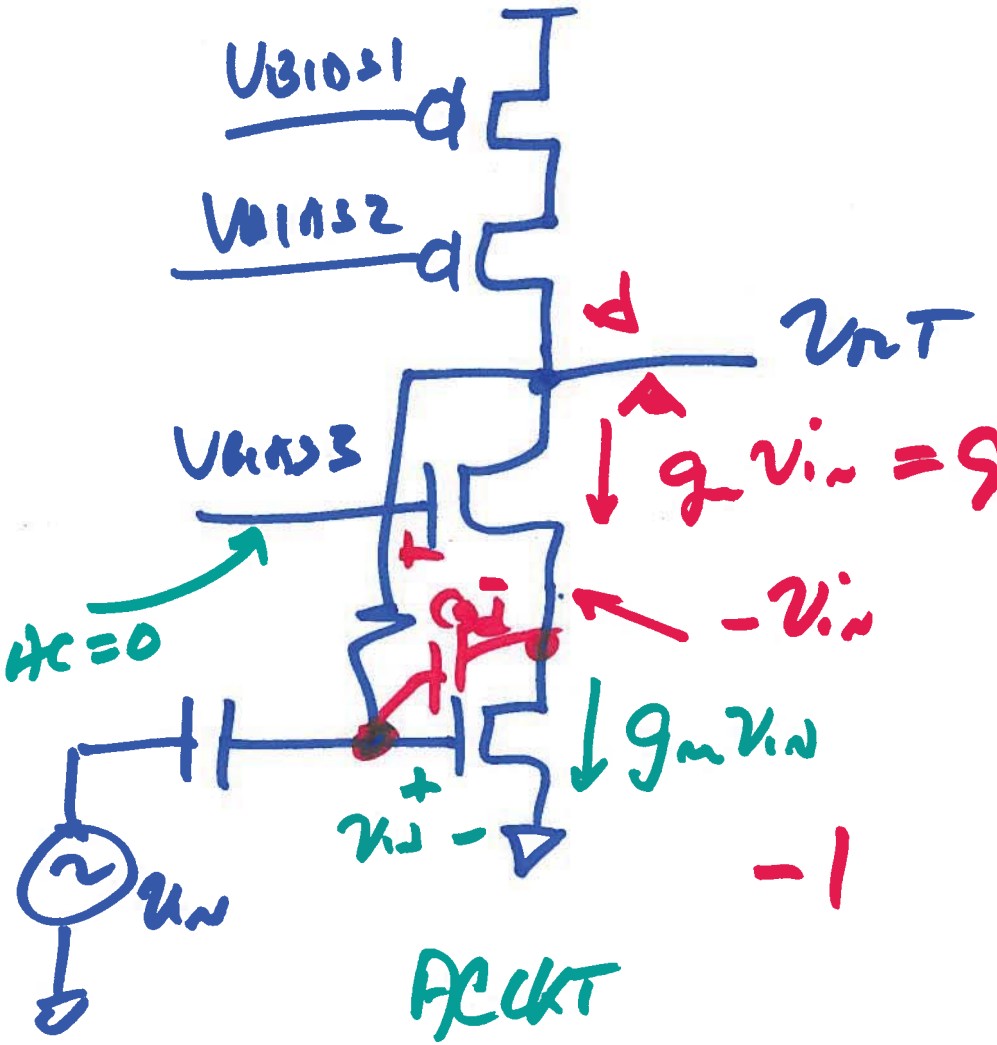
Unstable when

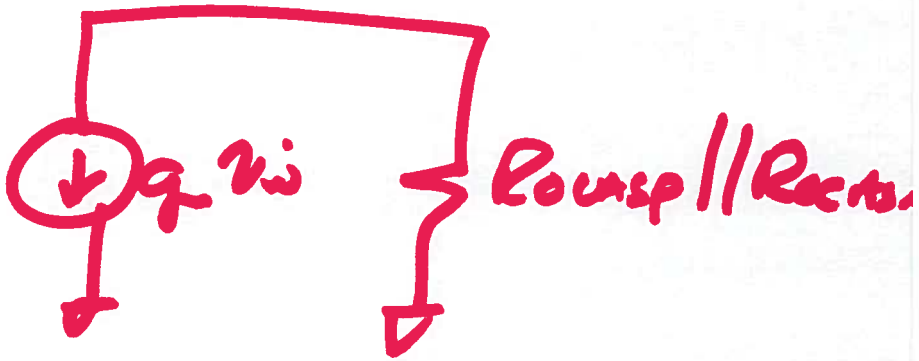
$\beta \cdot A_{OL} = -1$

$|\beta \cdot A_{OL}| = 1$

$\angle \beta \cdot A_{OL} = \pm 180$

CASCODE Amplifier (Miller killer)

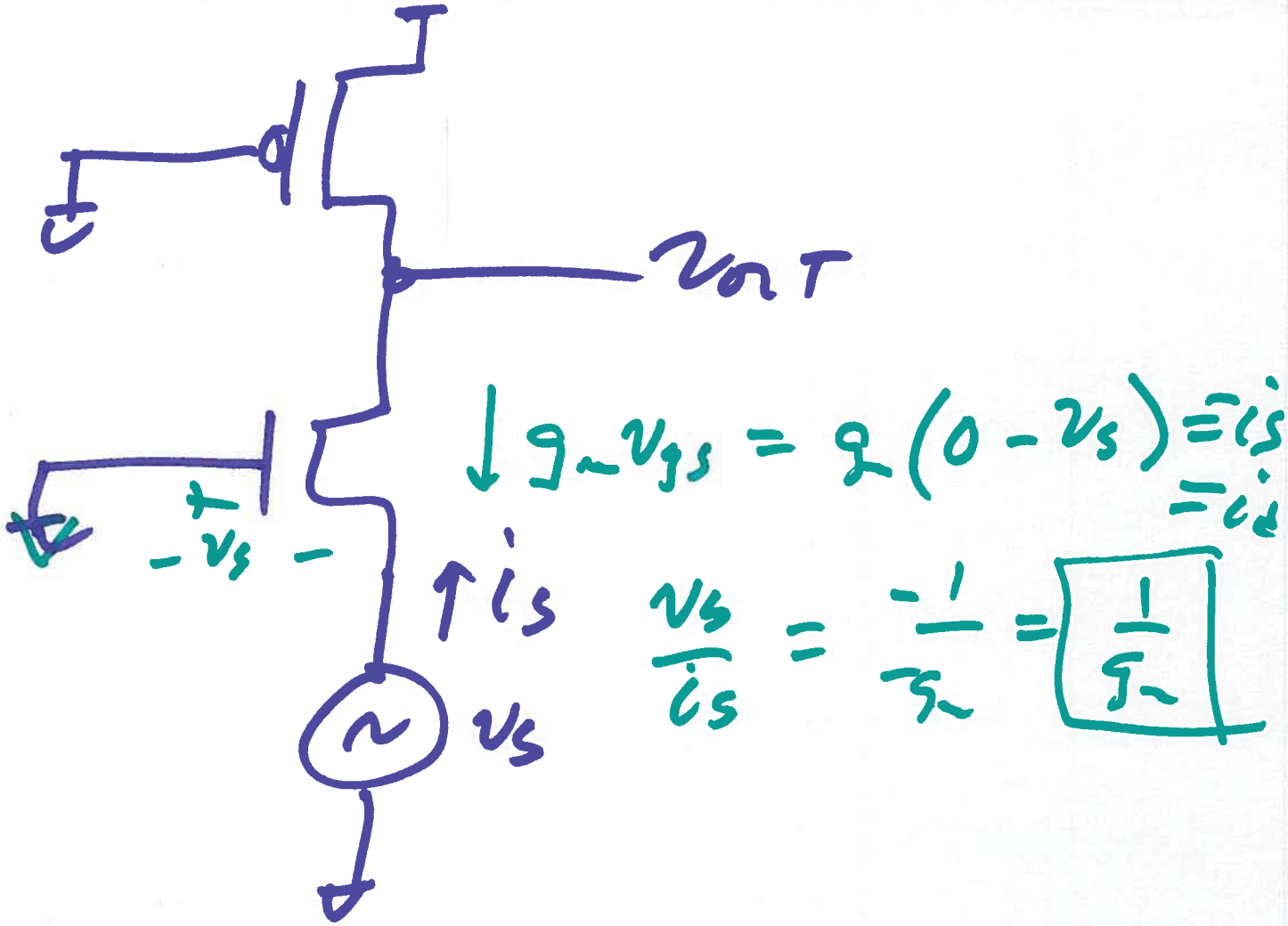


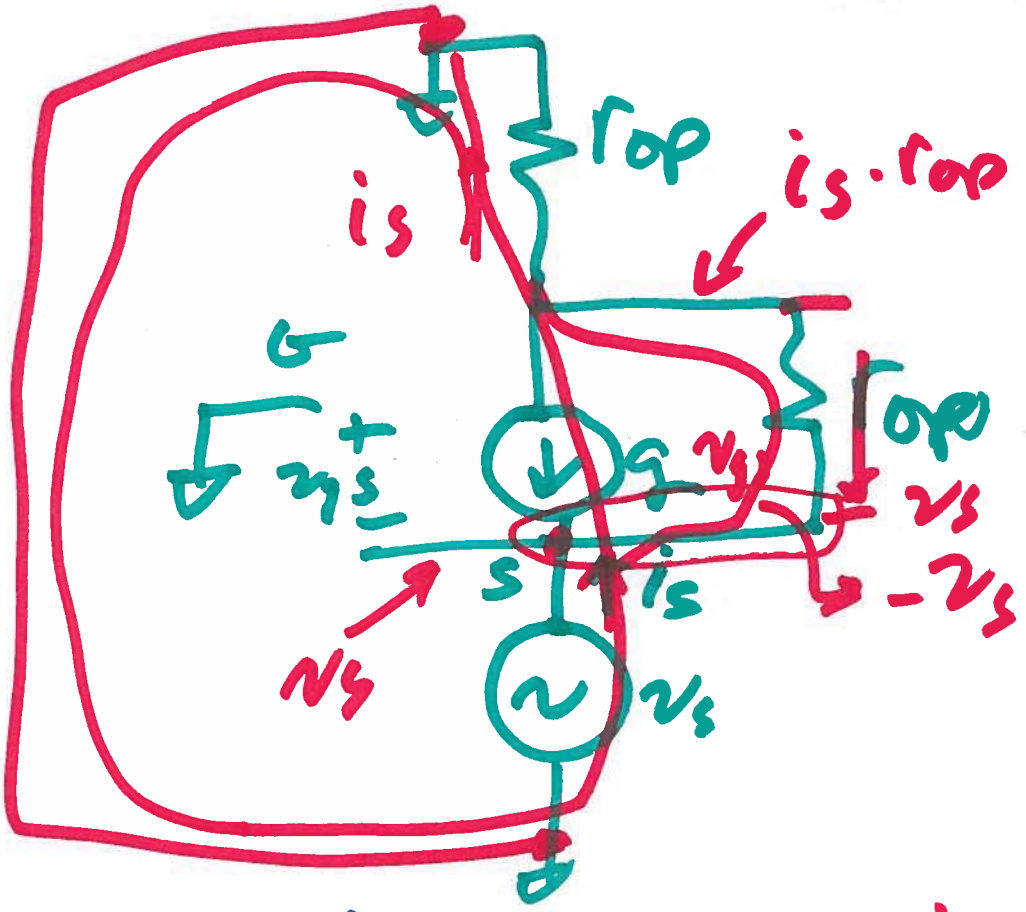


$$g_m v_{in} = g_m v_{gs} = g_m (0 - (-v_{in}))$$

$$\frac{v_{out}}{v_{in}} = -g_m (R_{cascp} // R_{casn})$$

-1


v_{out}
$v_{gs} = g(0 - v_s) = i_s$
$= i_d$
$+ v_s -$
i_s
v_s
$\frac{v_s}{i_s} = \frac{-1}{-g} = \frac{1}{g}$



$$i_s = -g_m(-v_s)$$

$$\frac{v_s}{i_s} = \frac{r_{on} + r_{op}}{1 + g_m \cdot r_{on}} = \frac{1 + \frac{r_{op}}{r_{on}}}{\frac{1}{r_{on}} + g_m} = \frac{1}{\frac{1}{r_{on}} + g_m} \approx \frac{2}{g_m}$$

$$i_s + g_m(-v_s) + \frac{i_s \cdot r_{op} - v_s}{r_{on}}$$

$$(r_{on} + r_{op})\, i_s = v_s (1 + g_m r_{on})$$