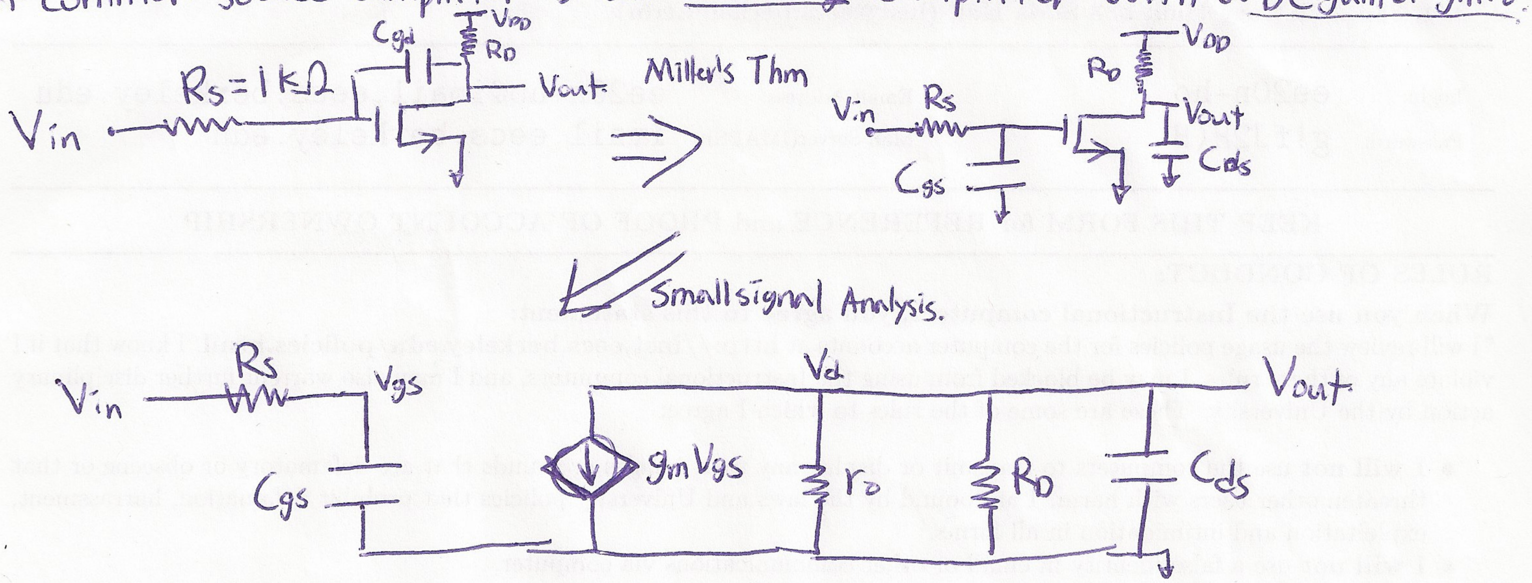
Final Review Problem #2: Common Source Amplifier

A common source amplifier is an <u>inverting</u> amplifier with a <u>DC gain of $g_m r_o$</u>.



$$R_S = 1\,k\Omega, \quad g_m = \frac{2I_D}{V_{Dsat}}, \quad r_o = \frac{1}{\lambda I_D} \quad I_D = 1mA \quad V_{DSAT} = 1V, \quad \lambda = 0.05/V$$

$$C_{gs} = 300fF + (1+A_o)\,100fF, \quad C_{ds} = \frac{100fF}{1+A_o} \qquad R_D \approx \infty$$

$A_o \approx$ DC gain $= |g_m r_o|$, Approximate $A_o + 1 \approx A_o$

(Disclaimer: All the approximations I've made are not 100% correct. They are there to make the math easier. -YJC)

Easier: ① Find $H_1(j\omega) = \frac{V_{gs}}{V_{in}}$, the transfer function of the first stage.

② Identify the type of filter (you should be able to do this before ①)

③ Draw the magnitude bode plot, $|H_1(j\omega)|$ vs ω.

Harder: ④ Find $H_2(j\omega) = \frac{V_{out}}{V_{gs}}$. the transfer function of the second stage.

⑤ Identify the type of filter (again, you should be able to do this before ④)

⑥ Draw the magnitude plot, $|H_2(j\omega)|$ vs. ω.

⑦ Express $H(j\omega) = \frac{V_{out}}{V_{in}}$, the transfer function of the entire system, in terms of $H_1(j\omega)$ and $H_2(j\omega)$.

Even harder: ⑧ Draw $|H(j\omega)|$ vs. ω plot.

Sanity check: $H(j\omega)$ examplifies a transfer function of an inverting amplifier with a DC gain > 1