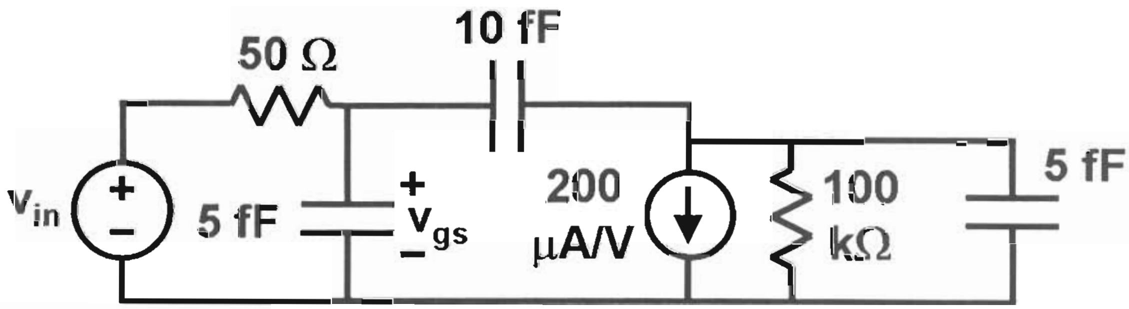
Quiz #3 **EEC210** **Fall 2008**

Name: Solutions

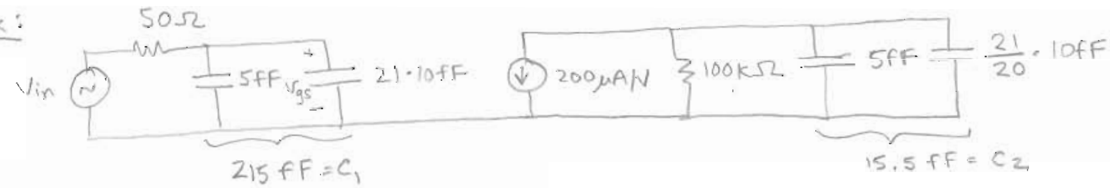
Lab Section:________

Problem 1 (10 points) For the following small-signal model of a MOS amplifier, use the method of <u>Zero-Value Time Constants</u> (Open-Circuit Time Constants) to estimate the dominant pole location. Use the Miller Approximation to simplify your analysis. Show all work and express your final answer in Hz.



$|A_v|^{(DC)} = g_m r_o = (200\ \mu A/V)(100\ k\Omega) = 20$ (2 pts.)

Miller Approx:



(3 pts.)

$R_{EQ1} = 50\,\Omega \quad \tau_1 = (215\ fF)(50\,\Omega) = 10.75\ ps$ (1 pt.)

$R_{EQ2} = 100\,k\Omega \quad \tau_2 = (100\,k\Omega)(15.5\,fF) = 1.55\ ns$ (1 pt.)

$f_{pole} = \left(\frac{1}{2\pi}\right)\left(\frac{1}{\sum \tau_i}\right) = \frac{1}{2\pi(1.56\ ns)} = 102\ MHz$ (2 pts.)

Harder Way:

$R_1 = 50\,\Omega,\ C_1 = 5\,fF \Rightarrow \tau_1 = 0.25\ ps$

$R_2 = 100\,k\Omega,\ C_2 = 5\,fF \Rightarrow \tau_2 = 0.5\ ns$

$R_3 = r_o + R_I(1 + g_m r_o) = 101\,k\Omega,\ C_3 = 10\,fF \Rightarrow \tau_3 = 1.01\ ns$

$f_{pole} = \frac{1}{2\pi}\frac{1}{\sum \tau_i} = \frac{1}{2\pi}\frac{1}{1.51\ ns} = 105\ MHz$

f_{POLE} **(Hz)** = 102 MHz (1 pt.)