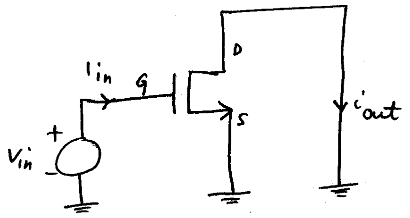
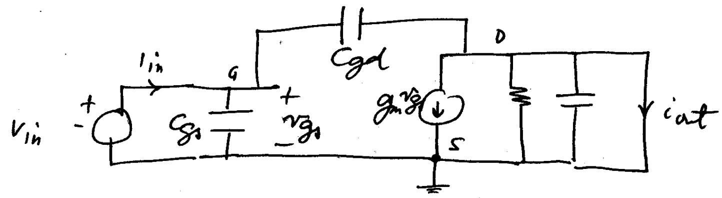
9.20





$$A_i \equiv \frac{i_{out}}{i_{in}} \qquad i_{out} = -g_m v_{gs}$$

$$i_{in} = \frac{v_{gs}}{Z_{Cequiv}} = \frac{v_{gs}}{\left[j\omega(C_{gs}+C_{gd})\right]^{-1}}$$

$$|A_i| = \left|\frac{i_{out}}{i_{in}}\right| = \frac{g_m}{\omega(C_{gs}+C_{gd})} \simeq \frac{g_m}{\omega C_{gs}}$$

$$|A_i| = 1 \implies 1 = \frac{g_m}{2\pi f_T C_{gs}} \iff f_T \simeq \frac{g_m}{2\pi C_{gs}}$$

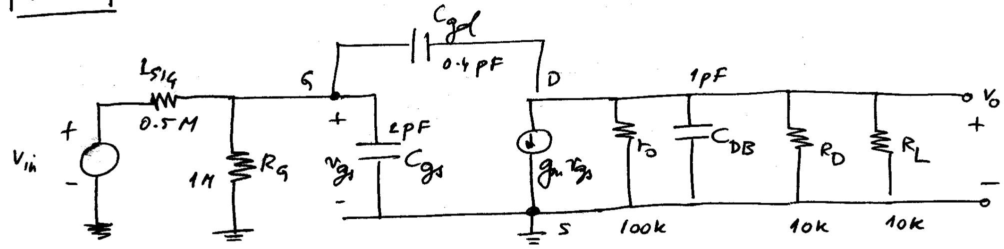
$$I = \frac{1}{2}\mu C_{ox}\frac{W}{L}(V_{GS}-V_T)^2$$

$$g_m \equiv \frac{\partial I}{\partial V_{GS}} = 2\cdot\frac{1}{2}\mu C_{ox}\frac{W}{L}(V_{GS}-V_T) \quad ; \quad C_{gs} = C_{ox}\cdot W\cdot L$$

$$f_T \simeq \frac{\mu C_{ox}\frac{W}{L}(V_{GS}-V_T)}{2\pi C_{ox}\cdot W\cdot L} \implies \boxed{f_T \simeq \frac{\mu(V_{GS}-V_T)}{2\pi L^2}}$$

$$f_T = \frac{450\times10^{-4}\times 0.2}{2\times3.14\times(0.18\times10^{-6})^2} \simeq 44\ \text{GHz}$$

9.33



$$A_v = -g_m (r_o \| R_D \| R_L) \frac{R_G}{R_G + R_{SIG}} \simeq -5\times10^{-3} \times 5\times10^{3} \frac{1\times10^{6}}{1.5\times10^{6}} \simeq -17$$

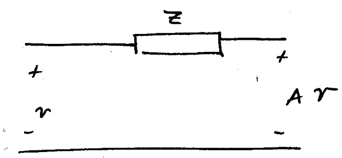
$$C_{eq} = C_{gs} + C_{gd}\left(1 + g_m (r_o \| R_D \| R_L)\right) = 2\times10^{-12} + 0.4\times10^{-12} \times 26 = 12.4\,pF$$

$$f_{p1} = \frac{1}{2\pi\, C_{eq} (R_{SIG} \| R_G)} = \frac{1}{2\pi \times 12.4\times10^{-12} \times 0.33\times10^{6}} \simeq 38\ kHz$$

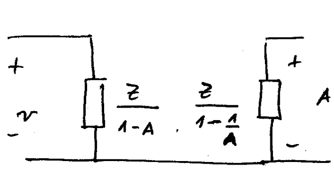
$$f_{p2} = \frac{1}{2\pi\, (C_{db} + C_{gd})(r_o \| R_D \| R_L)} \simeq 22\ MHz$$

——— // ———

teorema de Miller



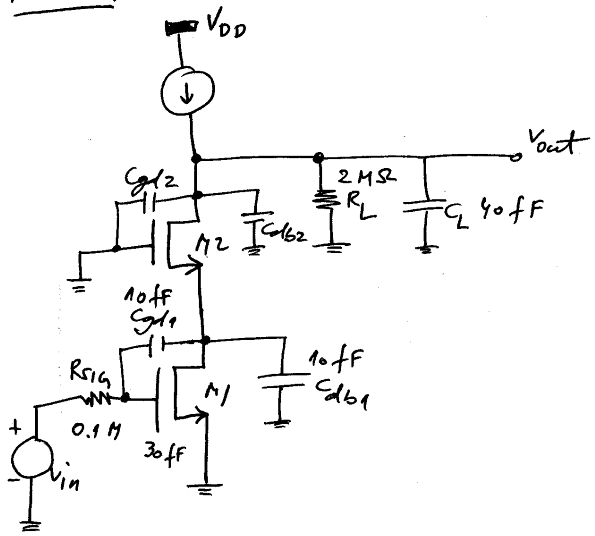
<=>



$$Z = \frac{1}{sC}$$

$$\frac{1}{sC(1-A)} \qquad \frac{1}{sC(1-\frac{1}{A})}$$

9.79



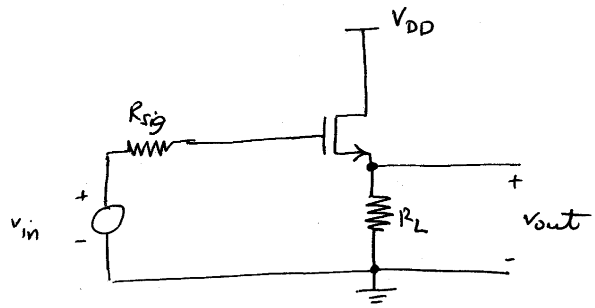
$$A_v \simeq -g_m\left[r_{o1}(g_{m2}r_{o2}) \| R_L\right]$$

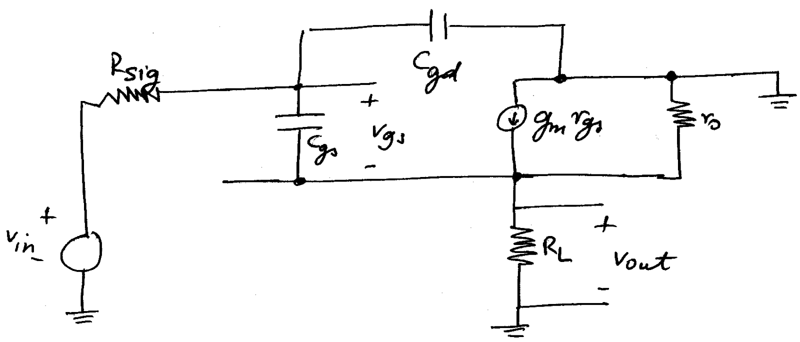
$$f_{p1} = \frac{1}{2\pi\, C_{eq} R_{sig}} \simeq \frac{1}{2\pi\,(C_{gs1} + 2C_{gd1}) R_{sig}} = \frac{1}{2\pi \times 40\times10^{-15} \times 0.1\times10^{6}} = 40\ MHz$$

$$f_{p2} = \frac{1}{2\pi\,(C_{gd2} + C_{db2} + C_L)(R_L \| R_{out})} = \frac{1}{2\pi \times 60\times10^{-15} \times 1.1\times10^{6}} = 2.4\ MHz$$

$$f_{p3} \simeq \frac{1}{2\pi \frac{1}{g_m}(C_{db1} + 2C_{gd1} + C_{gs2})} = \frac{1}{2\pi \times 1\times10^{3} \times 60\times10^{-15}} = 2.6\ GHz$$

9.85





$$v_{out} = (R_L \| r_o)\, g_m v_{gs}$$

$$v_{in} = v_{gs} + v_{out} = v_{gs} + (R_L \| r_o)\, g_m v_{gs}$$

$$A_V = \frac{v_{out}}{v_{in}} = \frac{(R_L \| r_o)\, g_m}{1 + (R_L \| r_o)\, g_m} \simeq 1$$

$$C_{eq} = C_{gs} + C_{gd}\left(1 + g_m (r_o \| R_L)\right) = 2\times10^{-12} + 0.1\times10^{-12}(1+9.09)$$
$$= 2\times10^{-12} + 1\times10^{-12} = 3\ pF$$

$$f_{P1} = \frac{1}{2\pi \times (R_{sig} + R_L) \times C_{eq}} = \frac{1}{2\pi \times 22\times10^{3} \times 3\times10^{-12}} = 2.4\ MHz$$