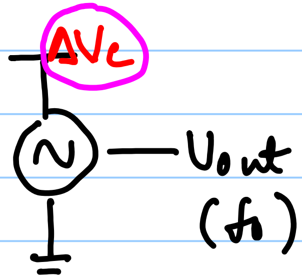
Lecture # 35

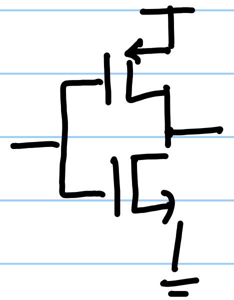
Note Title — 16-11-2020

$$\mathcal{L}(f) = \frac{2kT}{I}\left(\frac{1}{V_{DD}-V_t}(\gamma_N+\gamma_p) + \frac{1}{V_{DD}}\right)\left(\frac{f_0}{f}\right)^2$$



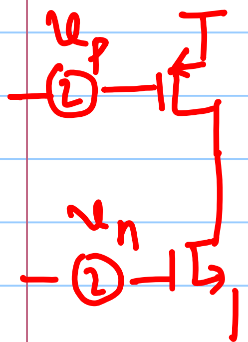
$$\frac{df_0}{\partial V_c} = K_v \Rightarrow S_{f_0}(f) = K_v^2 S_{V_c}(f)$$

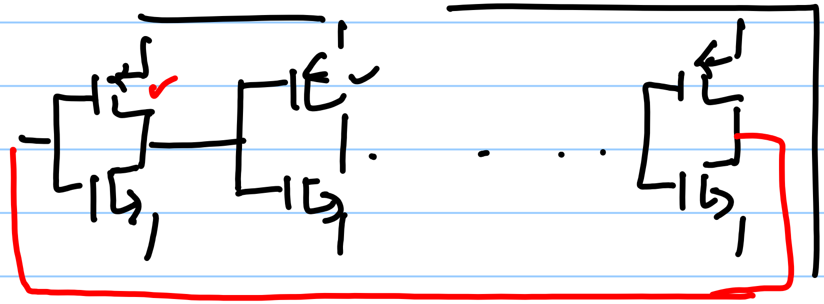
$$\mathcal{L}(f) = \frac{S_\phi(f)}{2} = \frac{K_v^2}{4f^2} S_{V_c}(f)$$



$$S_{V_n}^{1/f} = \frac{K_{fn}}{WLC_{ox}f} \checkmark \quad ; \quad S_{V_p}^{1/f} = \frac{K_{fp}}{WLC_{ox}f}$$

$$\tau = \frac{CV_{DD}}{2}\left(\frac{1}{I_{N1}} + \frac{1}{I_{P2}} + \frac{1}{I_{N3}} + \cdots + \frac{1}{I_{NM}} + \frac{1}{I_{P1}} + \frac{1}{I_{N2}} \cdots + \frac{1}{I_{PM}}\right)$$





$$f_0 = \frac{2}{CVDD}\left[\sum_{j=1}^{M}\left(\frac{1}{I_{N_j}} + \frac{1}{I_{P_j}}\right)\right]^{-1}$$

$$\frac{\partial f_0}{\partial I_{Nk}} = \frac{2}{CVDD}\left[\sum_{j=1}^{M}\left(\frac{1}{I_{N_j}} + \frac{1}{I_{P_j}}\right)\right]^{-2} \frac{1}{I_{Nk}^2} = \frac{f_0}{2MI}$$

$$\mathcal{L}(f) = \frac{1}{4f^2}\left(\frac{f_0}{2MI}\right)^2 S_{i_{Nk}}^{1/f}(f)$$

$$\mathcal{L}(f) = \frac{1}{4f^2}\left(\frac{f_0}{2MI}\right)^2 \times M\left(S_{i_{Nk}}^{1/f} + S_{i_{Pk}}^{1/f}\right)$$

$$= \frac{1}{16MI^2}\left(S_{i_N}^{1/f} + S_{i_P}^{1/f}\right)\left(\frac{f_0}{f}\right)^2$$

$$\mathcal{L}(f) = \frac{1}{4M(VDD-V_t)^2}\left(\frac{K_{fn}}{W_N L_N} + \frac{K_{fP}}{W_P L_P}\right) \times \frac{f_0^2}{f^3}$$

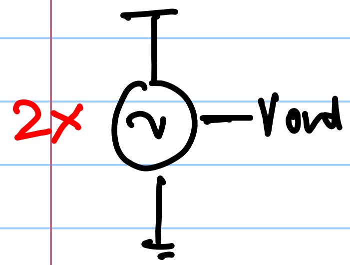
$$= \frac{C_{ox}}{8MI}\left(\frac{K_{fn}\mu_n}{L_n^2} + \frac{K_{fp}\mu_p}{L_p^2}\right)\frac{f_0^2}{f^3}$$ ✓ (flicker noise)

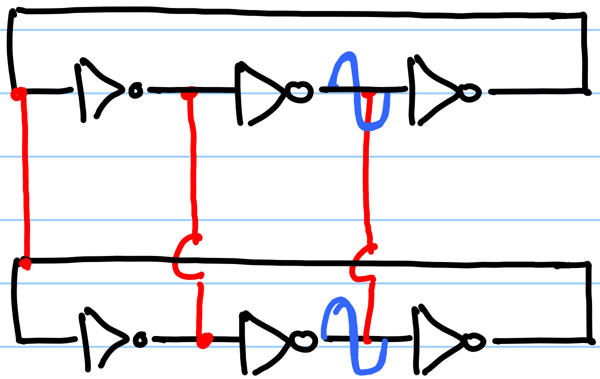
$$\Delta i = g_m \Delta v$$

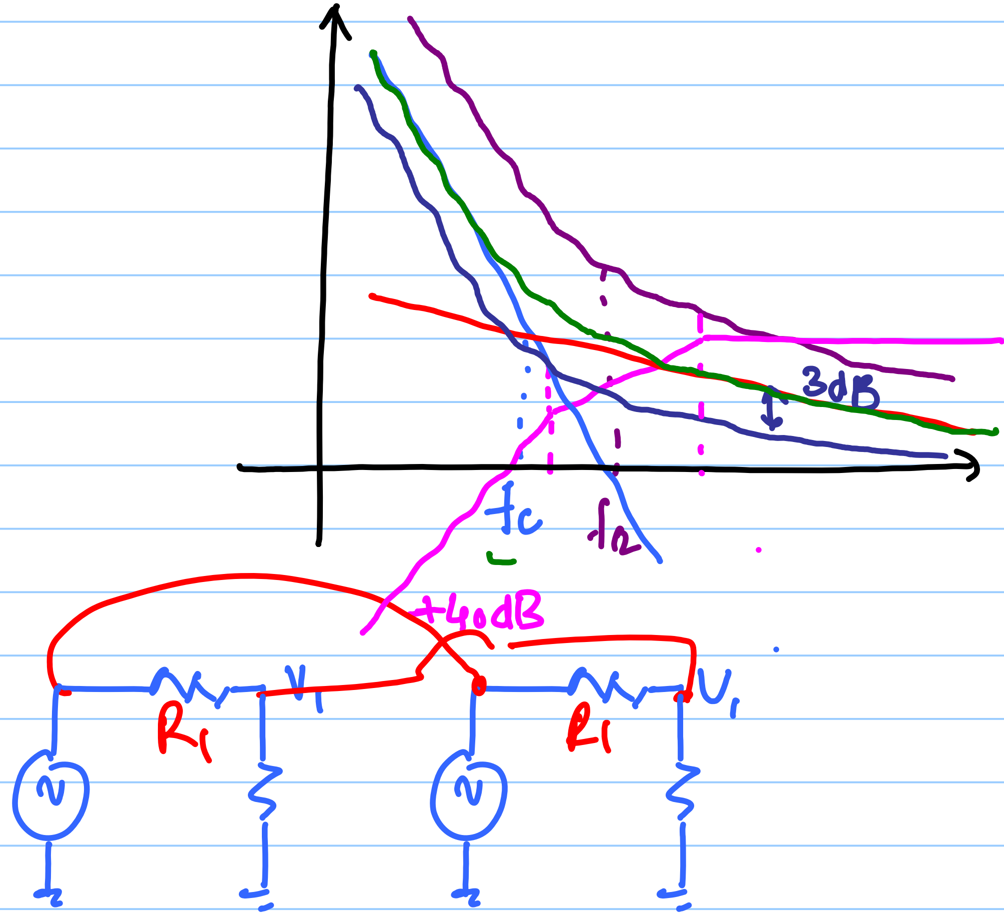
$$S_{i_n}^{1/f} = g_m^2 S_{v_n}^{1/f}$$

$$= \left(\frac{2I}{VDD-V_T}\right)^2 \frac{K_{fn}}{WLC_{ox}f}$$

$$\mathcal{L}(f) = \frac{2kT}{I}\left(\frac{1}{V_{DD}-V_t}(\gamma_N+\gamma_P) + \frac{1}{V_{DD}}\right)\frac{f_0^2}{f^2} \quad \text{(thermal noise)}$$







$$\chi(f) = \frac{1}{4M(V_{DD}-V_t)^2}\left(\frac{K_{fn}}{W_N L_N} + \frac{K_{fp}}{W_P L_P}\right) \times \frac{f_0^2}{f^3}$$

$$= \frac{C_{ox}}{8MI}\left(\frac{K_{fn}\mu_n}{L_n^2} + \frac{K_{fp}\mu_p}{L_p^2}\right)\frac{f_0^2}{f^3} \checkmark$$

$$I \propto \frac{W}{L}$$