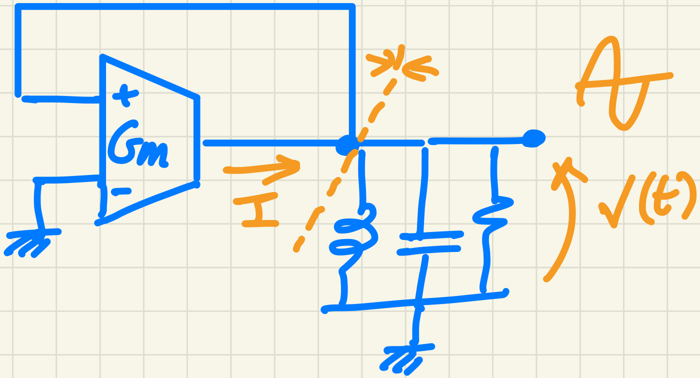
Q & A

8/6/2021

Gain margin in an oscillator



G_m is real number

$$LG(s) = G_m \cdot Z(s)$$

$$G_m \cdot |Z(j\omega_0)| = 1$$

$$\angle Z(j\omega_0) = 0$$

Startup :

$$\boxed{LG(j\omega_0) = EG}$$

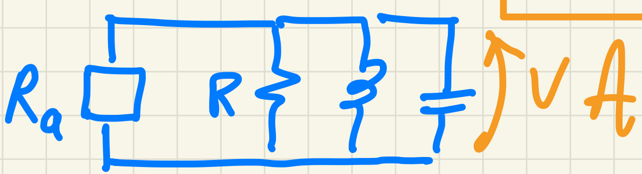
$$Z_a = -Z(j\omega_0) \quad \text{oscillation condition}$$

$$-\frac{1}{G_m} = -Z(j\omega_0)$$

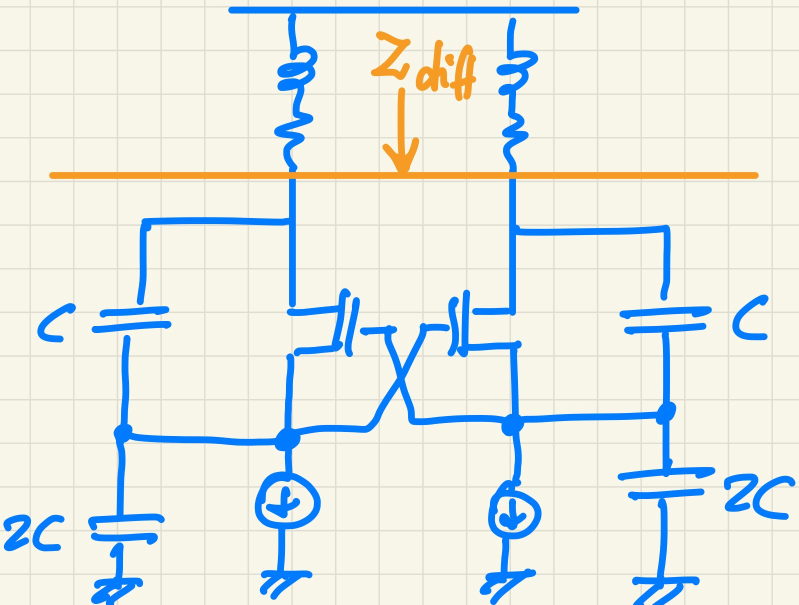
$$G_m V^2 = \frac{V^2}{R} \qquad \text{active power} = \text{dissipated power}$$

Startup :

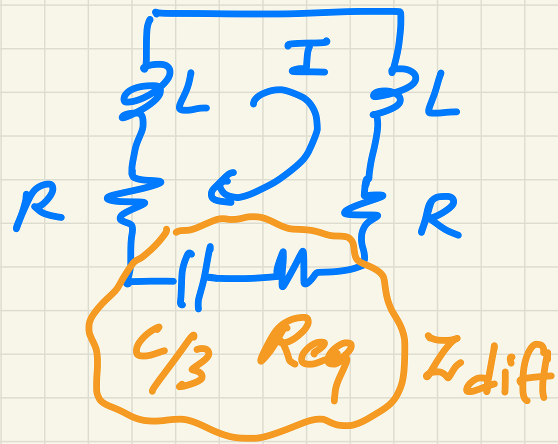
$$\boxed{EG = \frac{\text{active power}}{\text{dissipated power}}}$$



$$EG = \frac{V^2/|R_a|}{V^2/R} = \frac{R}{|R_a|} > 1$$



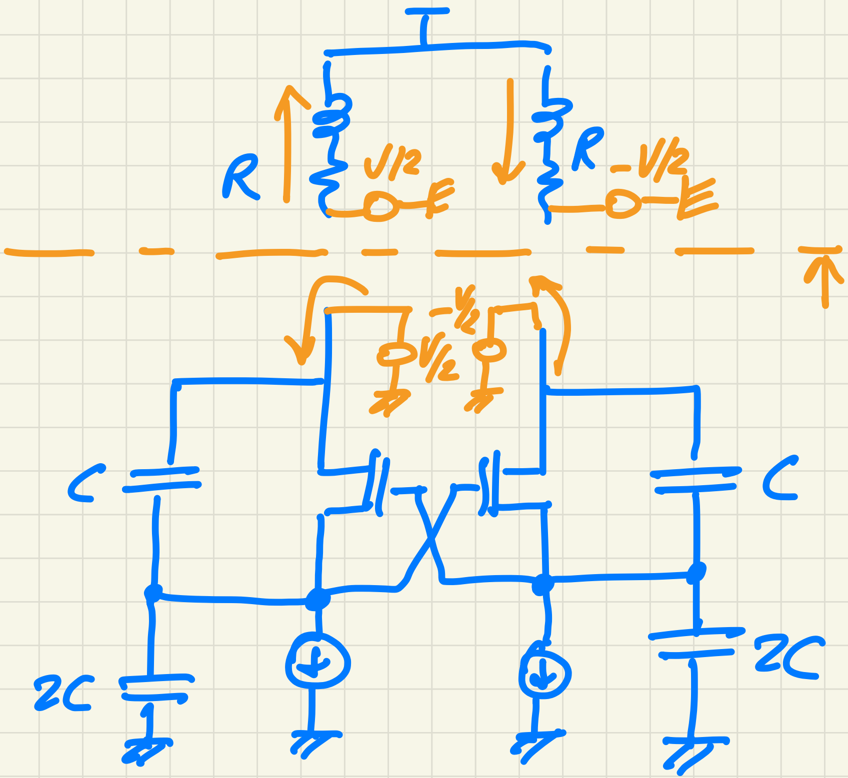
$$Z_{diff} = \underbrace{-\frac{2 g_m}{\omega^2 C^2}}_{R_{eq}} + \frac{3}{j\omega C}$$



1) $2R = R_{eq}$

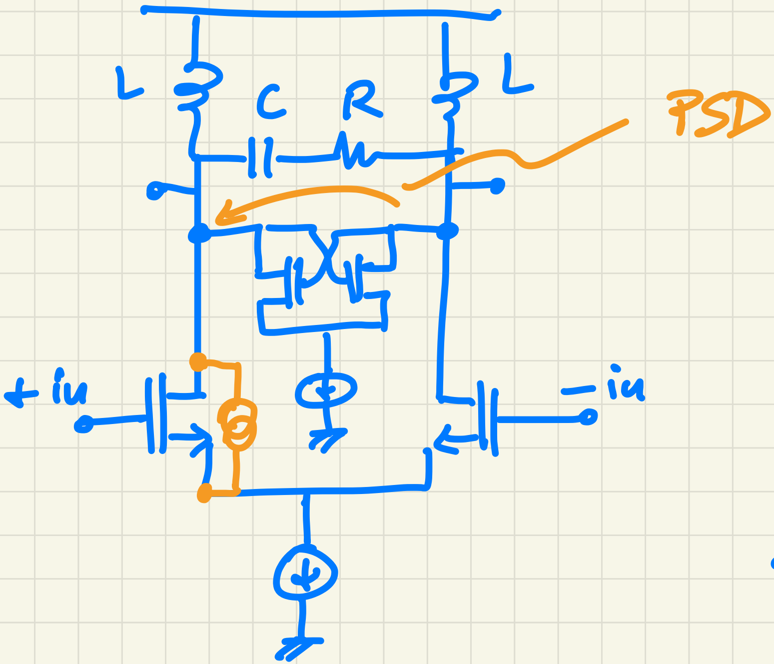
2) $\omega_0 = \frac{1}{\sqrt{2L \cdot C/3}}$

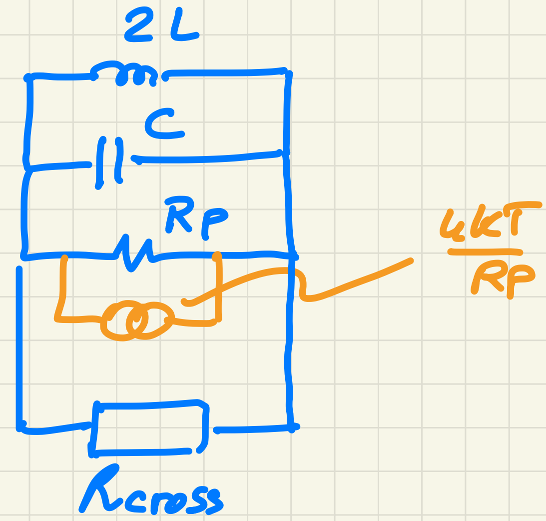
$$EG = \frac{|R_{eq}| I^2}{2R \cdot I^2} > 1 \; ; \quad \frac{\cancel{2} g_m}{\omega^2 C^2} = \cancel{2} \cdot R \cdot EG \; ; \quad g_m = \omega^2 C^2 R \cdot EG$$



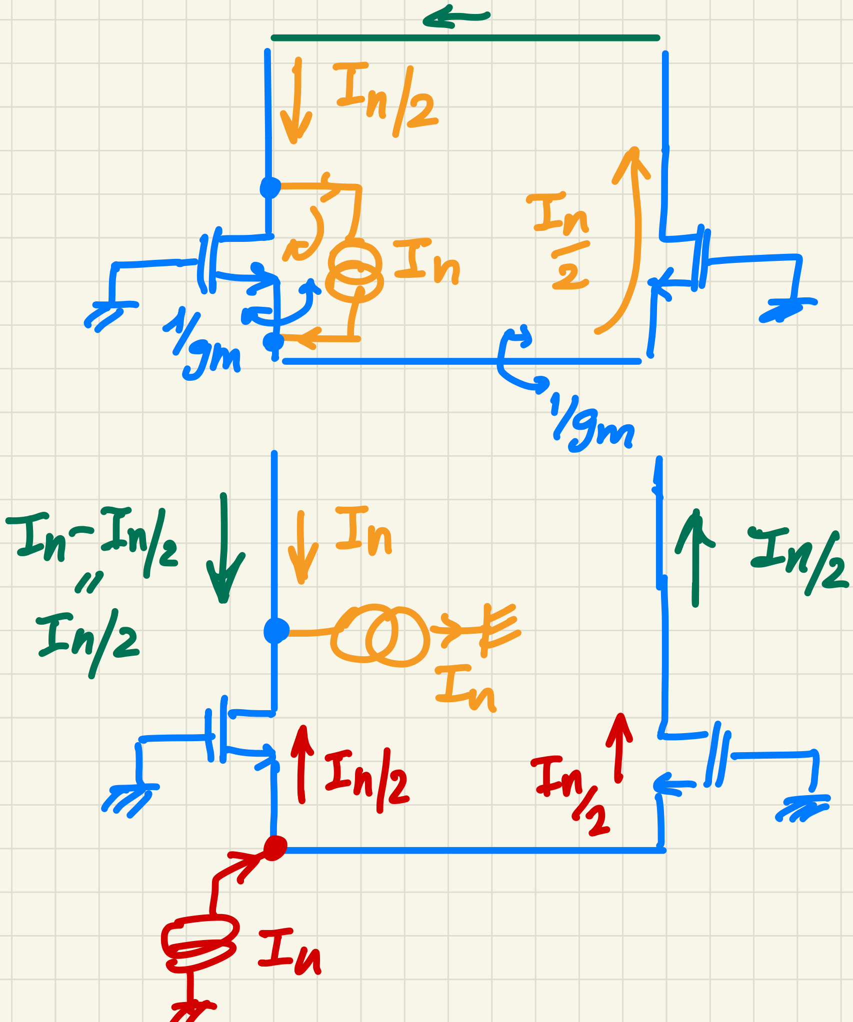
$$Z(s) = 2sL + 2R$$

T7.3





$$S_{V_{out}}(\omega_0) = \frac{4kT}{R_P} \cdot \left(R_P \parallel R_{cross}\right)^2$$



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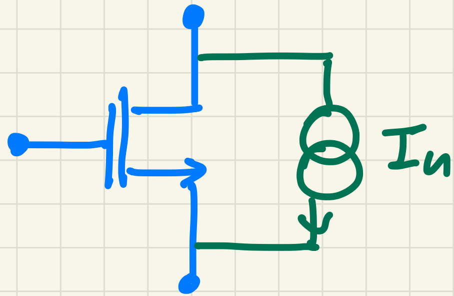
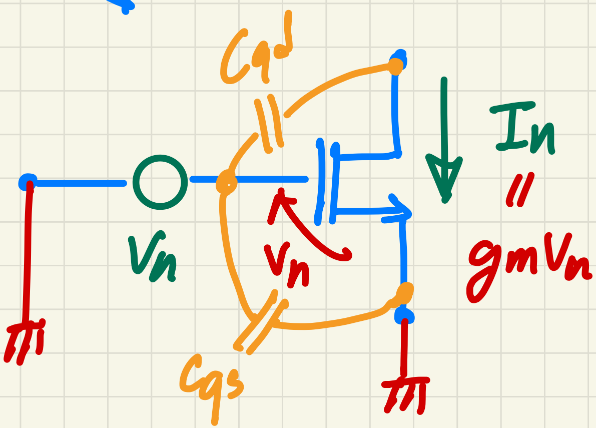


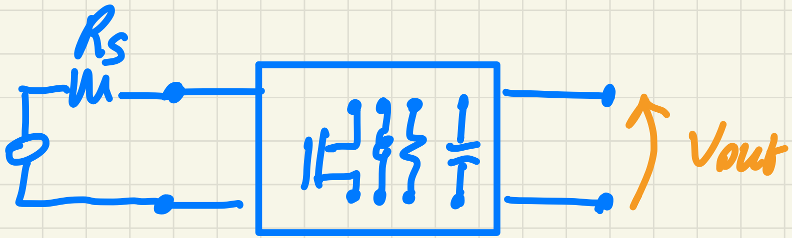
input-referred

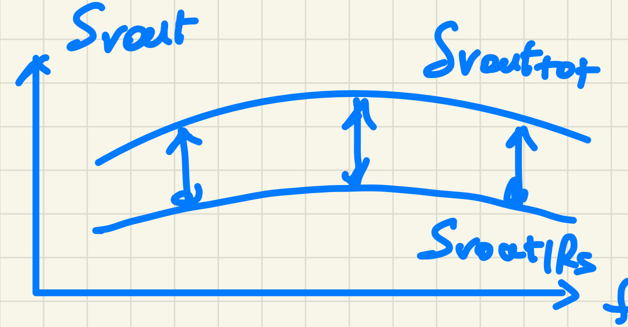


$$\frac{\langle I_n^2 \rangle}{\Delta f} = 4kT\frac{\gamma}{\alpha} g_m$$

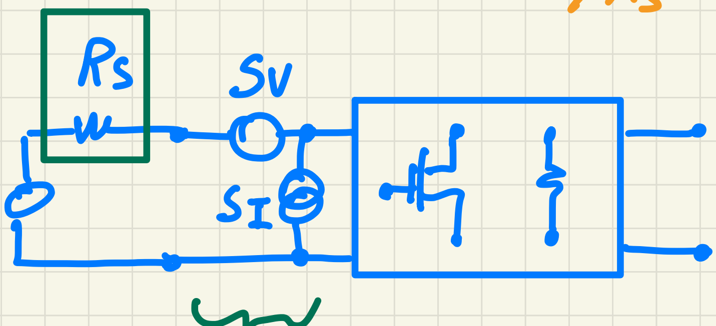
$$\frac{\langle V_n^2 \rangle}{\Delta f} = \frac{\langle I_n^2 \rangle / g_m^2}{\Delta f} =$$

$$= 4kT\frac{\gamma}{\alpha}\frac{1}{g_m}$$

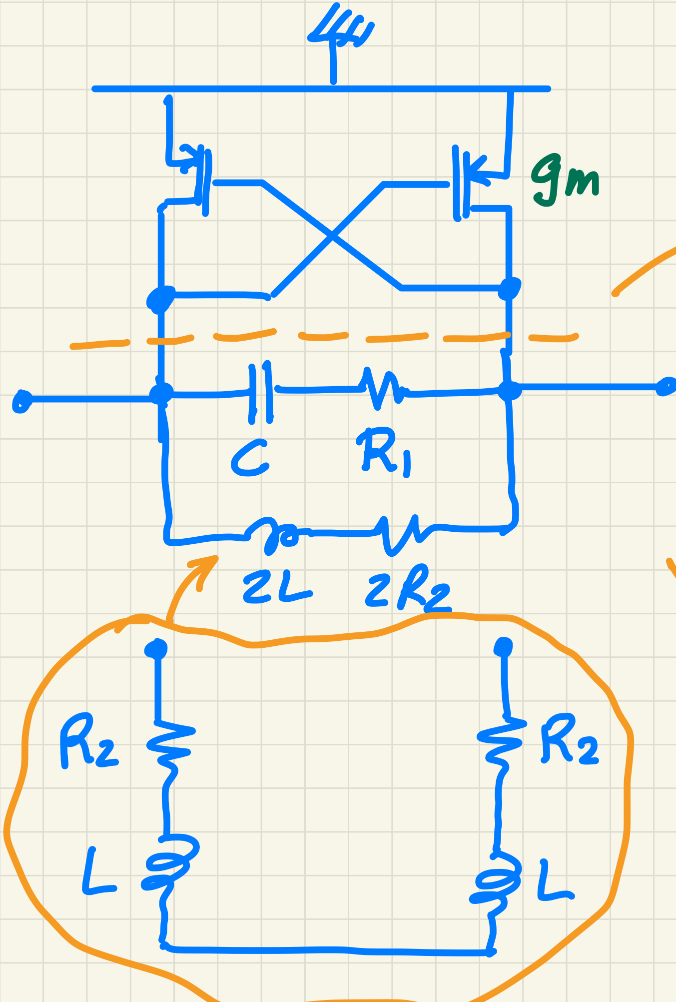


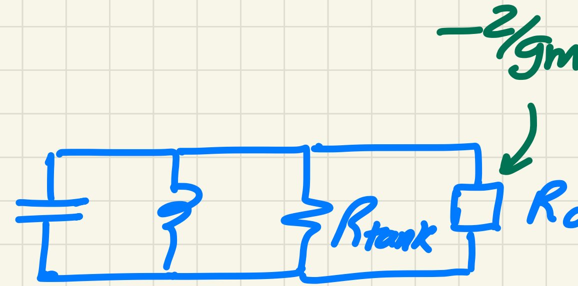


$$NF = \frac{S_{V_{out}\,tot}}{S_{V_{out}/R_s}}$$

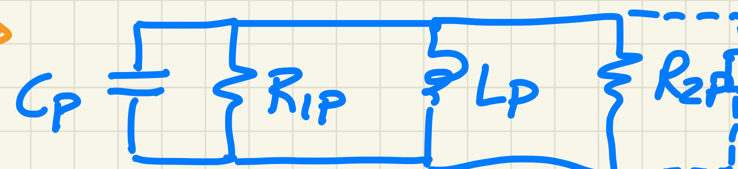


input-referred
noise source



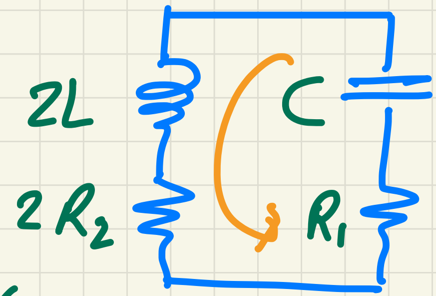


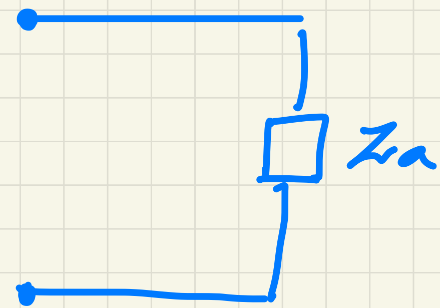
long method



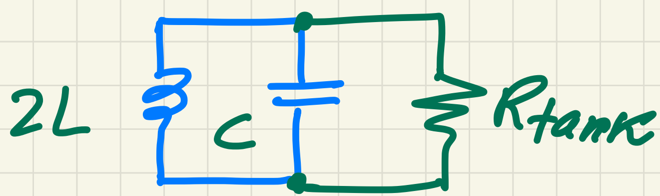
$$R_{tank} = R_{1p} \,//\, R_{2p}$$

fast method





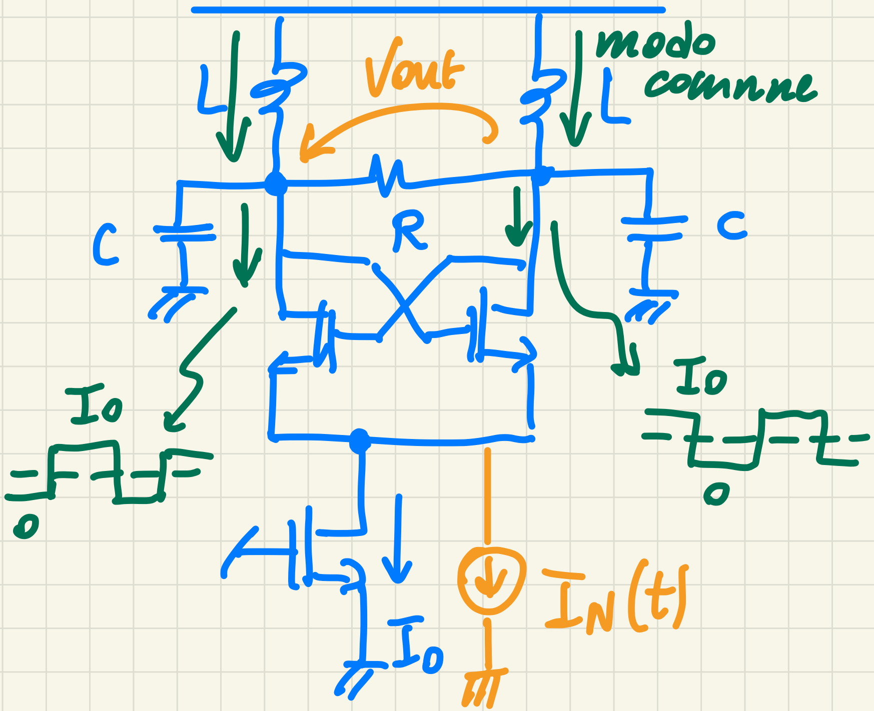
small losses



$$R_{tank} = \frac{Q}{\omega_0 C} = \frac{\omega_0 L}{Q}$$

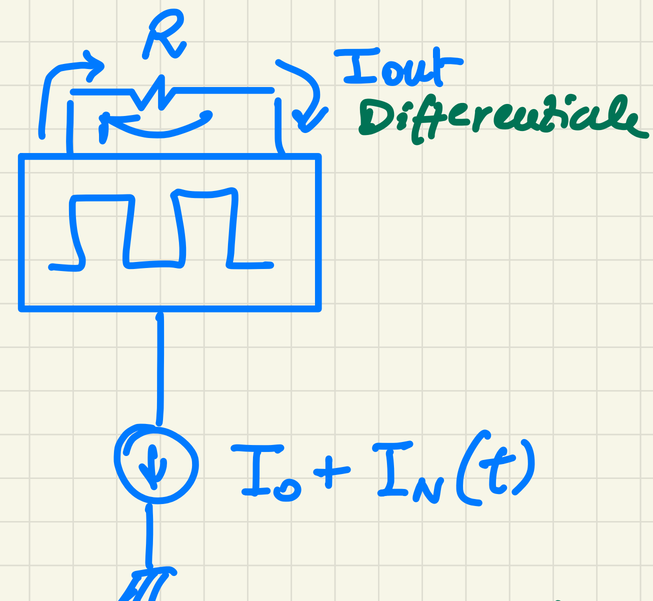
Compute Q of a network : $Q = \dfrac{2\omega_0 L}{R_1 + 2R_2}$

26.06.18 Problem #2

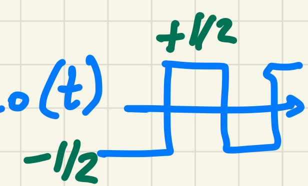


$I_N = 0.5\,mA \cdot \cos 2\omega_0 t$

$I_0 = 1\,mA$



$$I_{out}(t) = [I_0 + I_N(t)] \cdot X_{LO}(t)$$

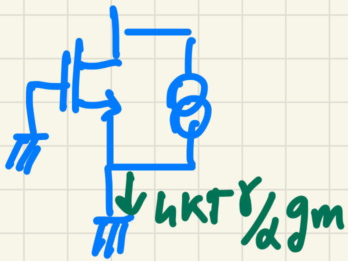


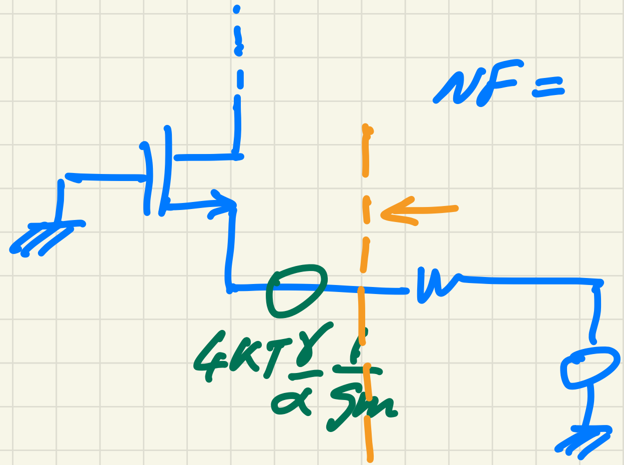
$$\Rightarrow \quad \underset{\text{Differenziale}}{I_{out}(t)} = \left[I_0 + \underline{I_2 \cos 2\omega_{Lo} t} \right] \cdot \frac{1}{2} \left(\frac{4}{\pi} \cos \omega_{Lo} t - \underline{\frac{4}{3\pi} \cos 3\omega_{Lo} t} + o.t. \right) =$$

$$= \frac{2}{\pi} I_0 \cos \omega_{Lo} t +$$

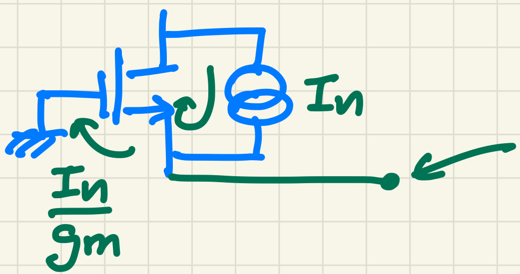
$$+ \frac{\cancel{2}}{\pi} \cdot \frac{I_2}{\cancel{2}} \cos \omega_{Lo} t +$$

$$- \frac{\cancel{2}}{3\pi} \cdot \frac{I_2}{\cancel{2}} \cdot \cos \omega_{Lo} t \quad + o.t.$$



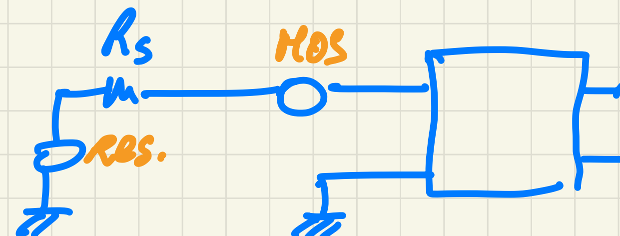


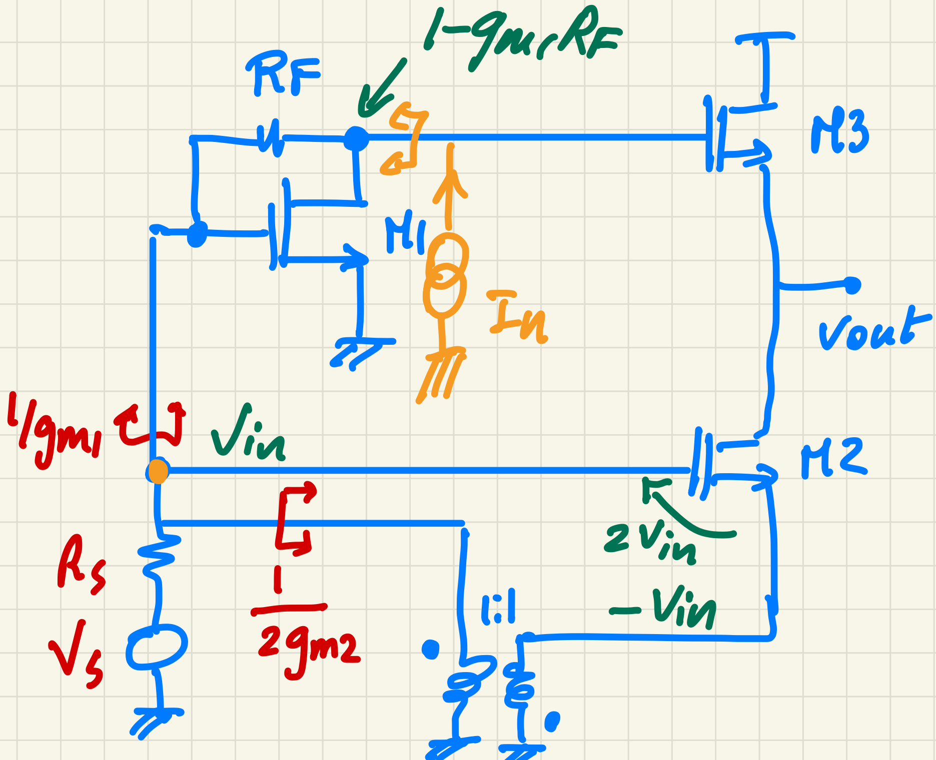
$$NF = \frac{4kT\,\gamma/\alpha\;1/g_m}{4kT R_s} + 1$$



$$\frac{4kT\,\frac{\gamma}{\alpha}\cdot g_m}{g_m^2}$$

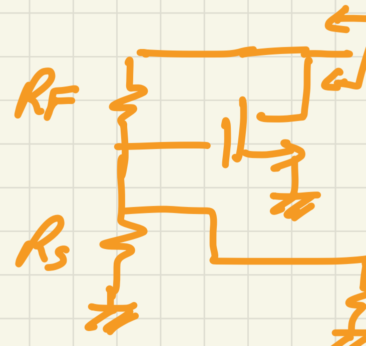
metodo di thevenin





$$Z_{in} = \frac{1}{\underbrace{g_{m1}} + \underbrace{2g_{m2}}}$$

$$\frac{V_{out}}{V_{in}} = \underbrace{1 - g_{m1}R_F}_{\text{path A}} + \underbrace{\frac{2g_{m2}}{g_{m3}}}_{\text{path B}}$$



$$\frac{R_F + R_S \parallel \frac{1}{2g_{m2}}}{2}$$

verifica

$$\frac{V_{out}}{I_n} = path_1 - path_2 = 0$$