EE 422 / ECE 622

Lecture 19 April 10, 2013

A21.19) $A_v = -g_m r_{ON} \| r_{OP}$

$r_{ON} = 10\,M\Omega$ $\quad r_{OP} = 8\,M\Omega$

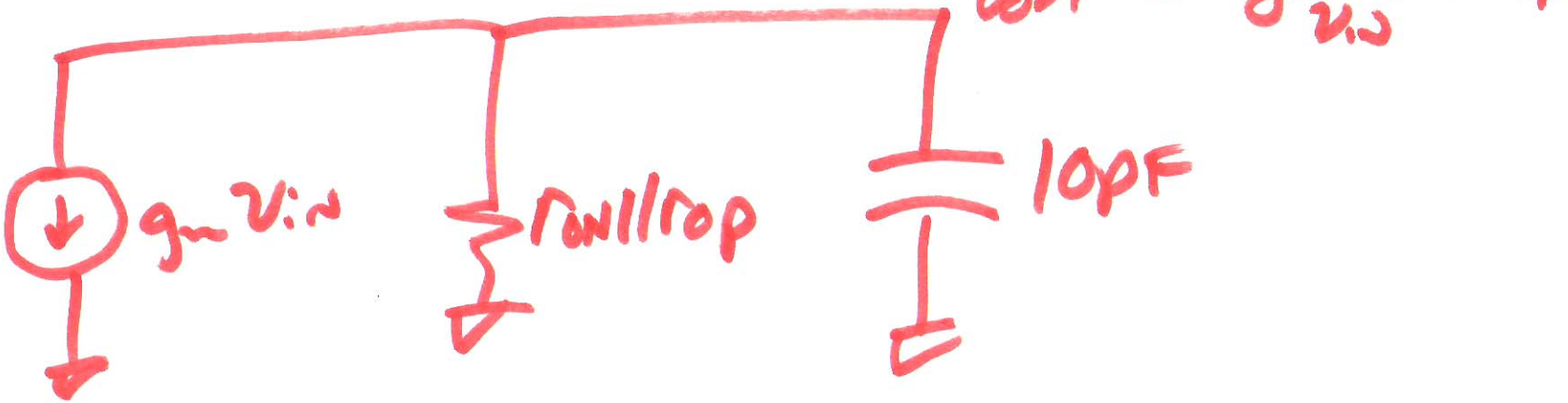
$g_m = \sqrt{2 I_{OB}} = 150\mu A\,(10/2,\ 20\mu A)$

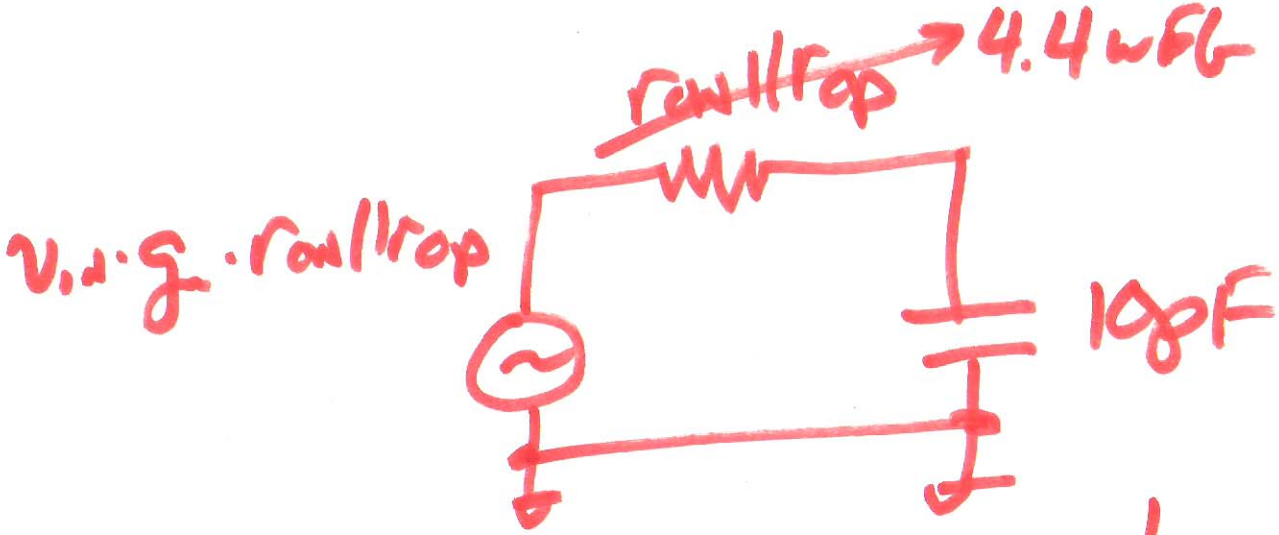
$10\mu A \xrightarrow{\frac{20}{2}} g_m = 150\mu A$

$A_v = -150\frac{\mu A}{V} \cdot 10 \| 8 \quad (10 \| 8 = 4.4\,M\Omega)$

$= -150 \cdot (4.4) = -660\frac{V}{V}$

DC gain





$$f_{3dB} = \frac{1}{2\pi \cdot 4.4 M\Omega \cdot 10pF}$$

$$= \frac{1}{6.28 \cdot 44 \cdot 10^{-6}}$$

$$\approx 4 KHz \rightarrow 3.6 KHz$$

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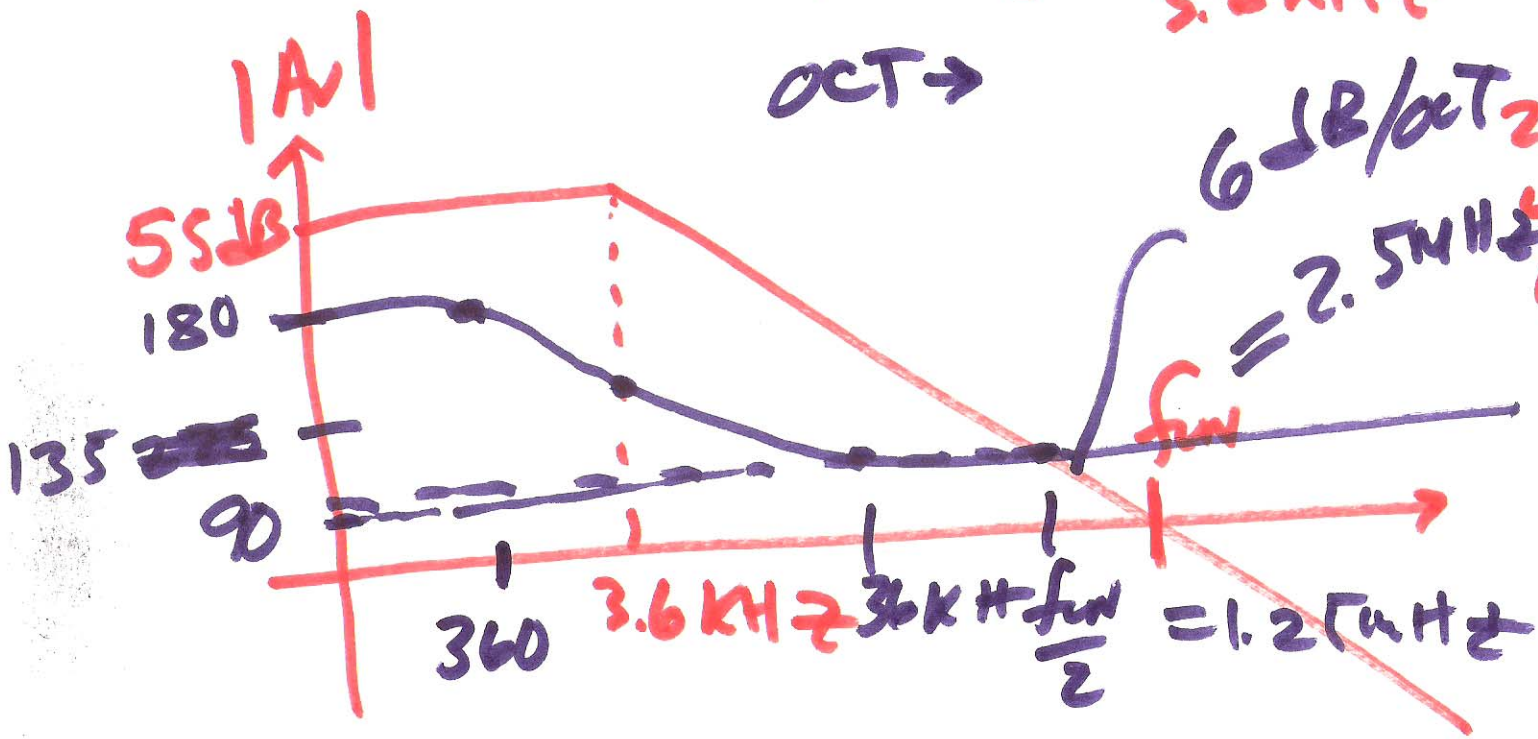
2)

$$A_v(s) = \frac{-660 \rightarrow 180}{1 + j\frac{f}{3.6\,kHz}}$$



$$1 = \frac{660}{\sqrt{1 + \left(\frac{f_{UN}}{3.6\,kHz}\right)^2}}$$

f_{UN}

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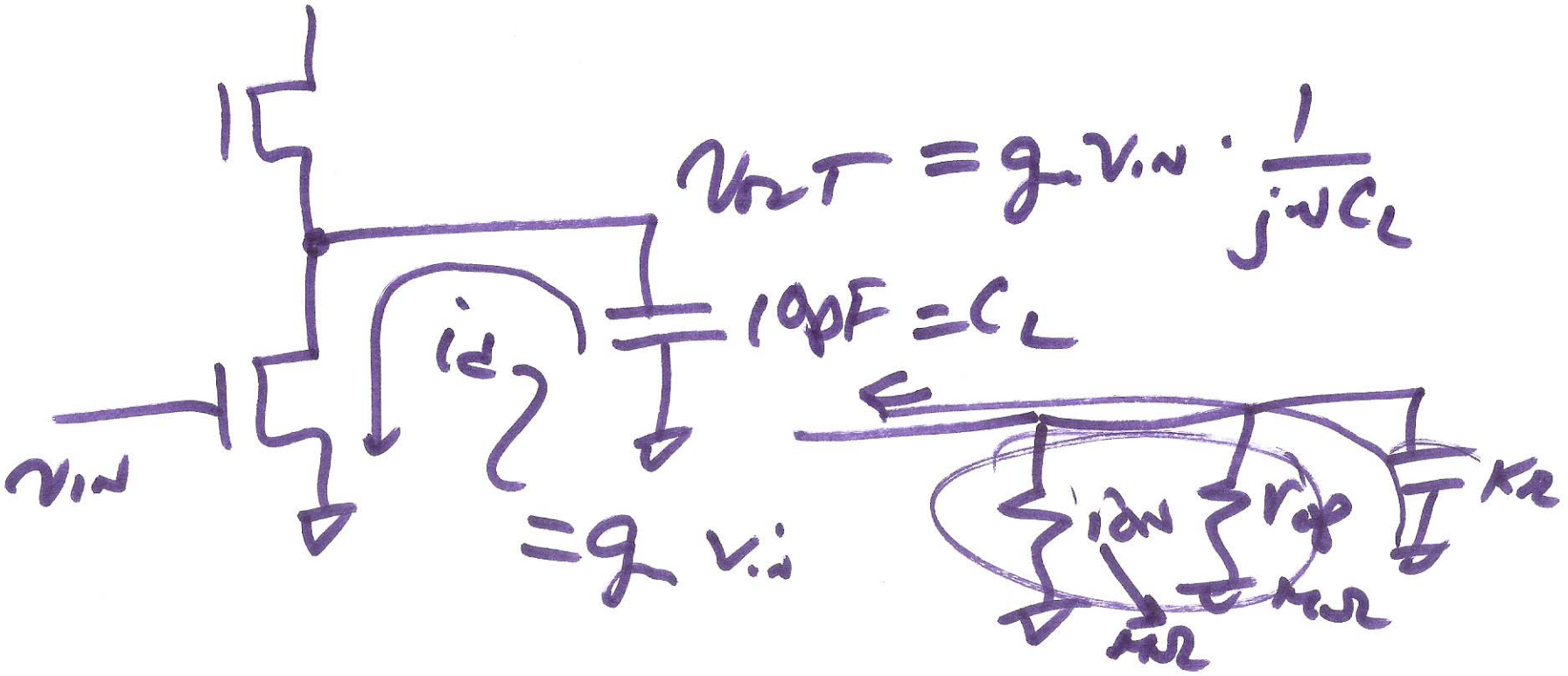


$$\left|\frac{V_{out}}{V_{in}}\right| = 1 = \left|\frac{g_m}{2\pi f_{UN} \cdot C_L}\right|$$

2. Smith $\frac{150\mu A/V}{2\pi \cdot 10pF}$ $\leftarrow f_{UN} = \frac{g_m}{2\pi C_L}$

$$\frac{v_{out}}{v_{in}} = \frac{-g_m \cdot r_{ON} \| r_{OP}}{1 + j\dfrac{f}{\frac{1}{2\pi r_{ON}\| r_{OP} \cdot C_L}}}$$

for large f the real part is small compared to the imaginary part

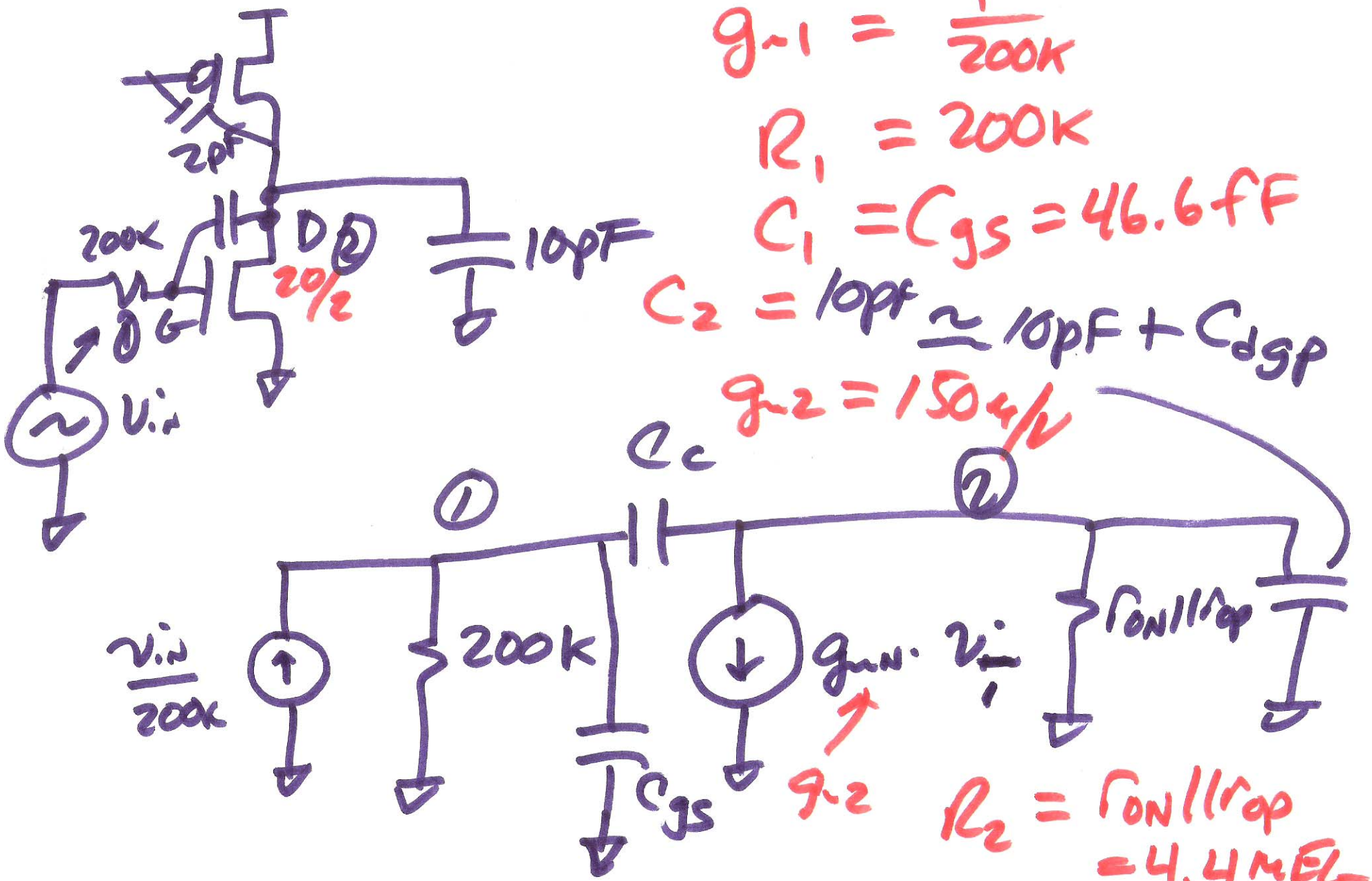
$$\frac{v_{out}}{v_{in}} \simeq \frac{-g_m \cancel{r_{OP}\| r_{ON}}}{j \cdot 2\pi \cancel{f} r_{ON}\| r_{OP} \cdot C_L}$$

$$\left|\frac{v_{out}}{v_{in}}\right| = 1 = \frac{g_m}{2\pi f_{UN} \cdot C_L}$$

5)

AT 1 MHz = 10^6

$$\frac{V_{out}}{V_{in}} = \frac{g_m \rightarrow 1/50\Omega}{2\pi \cdot 10^6 \cdot 10pF} \simeq 2$$



$g_{-1} = \frac{1}{200K}$

$R_1 = 200K$

$C_1 = C_{gs} = 46.6fF$

$C_2 = 10pF \simeq 10pF + C_{dgp}$

$g_{-2} = 150\mu/V$

$R_2 = r_{ON} \| r_{op}$

$= 4.4M\Omega$

$C_2 \simeq 10pF$

$$f_z = \frac{1}{2\pi \cdot 10pF} = 2.3\,MHz$$

$$602 = f_1 = \frac{1}{2\pi \cdot 150\Omega \cdot 200k \cdot 4.4mF \cdot 2pF}$$

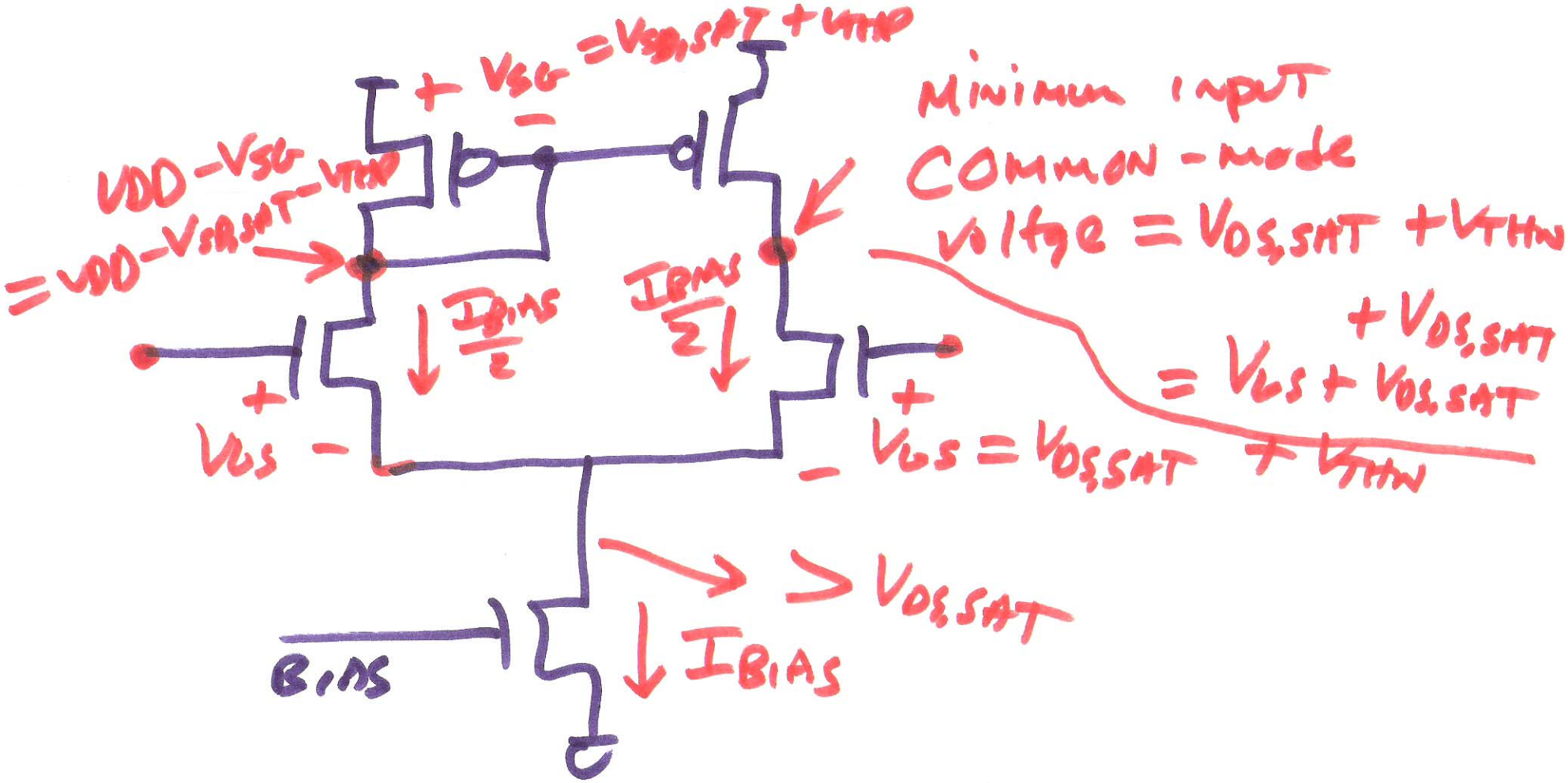
$$= f_2 = \frac{1}{2\pi \cdot \frac{1}{g_{m2}} \cdot \left(C_{gs1} + \frac{g_{m2}C_{gs2}}{g_{m1}} + C_{gs2}\right)}$$

$g_{m2} \rightarrow 6.5k$

$C_{gs2} \rightarrow 10pF$

$$2.5MHz \cong \frac{1}{2\pi \cdot .65} \cdot GHz$$

8)



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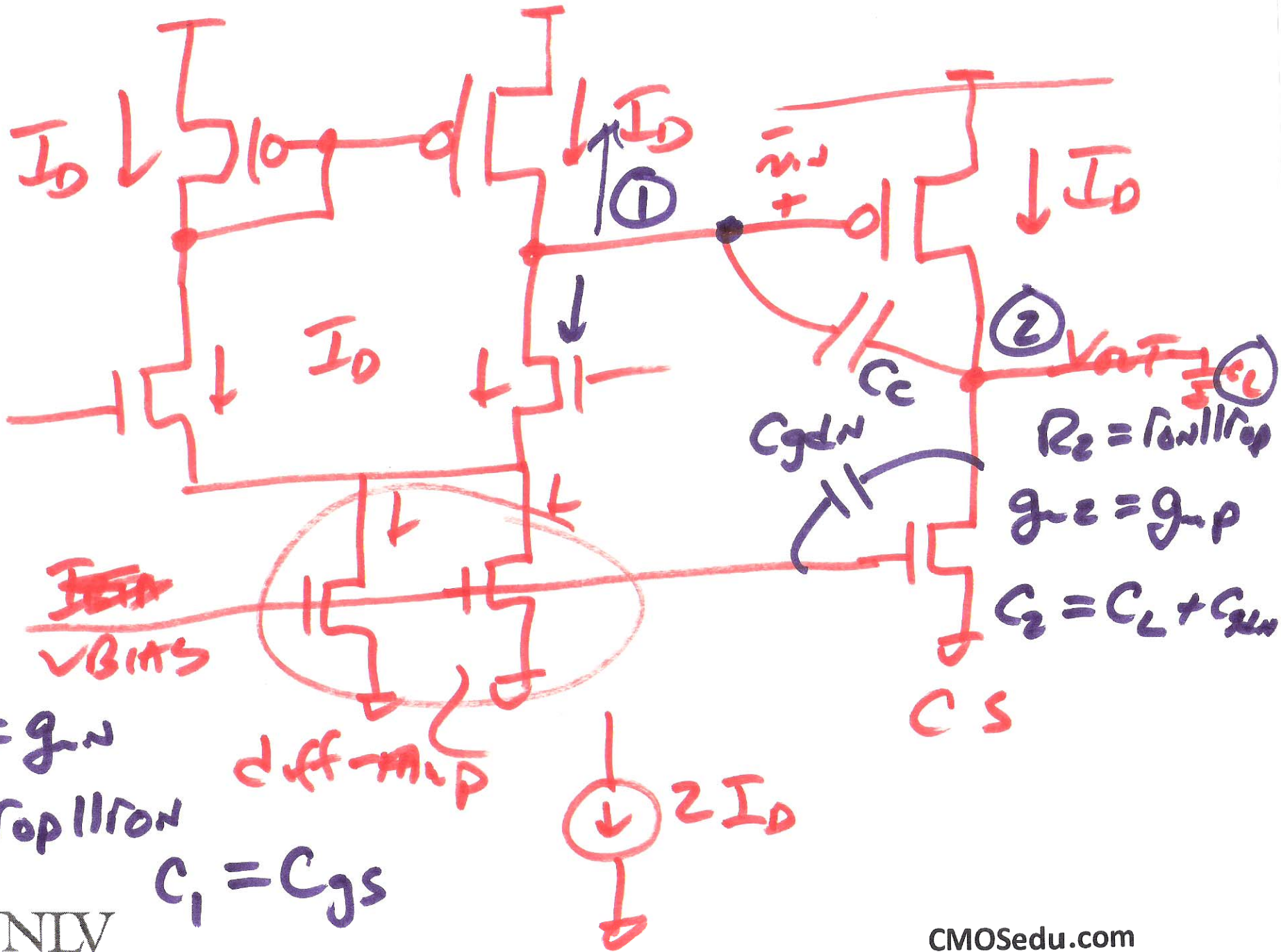

$g_{m1} = g_{mN}$

$R_1 = r_{op} \| r_{ON}$

$C_1 = C_{gs}$