EE 420 / ECG 620

Analog IC Design

May 6, 2015

Lecture 29

Review for final

1 to 3 pm

Monday May 11, 2015

UNLV | ELECTRICAL & COMPUTER ENGINEERING

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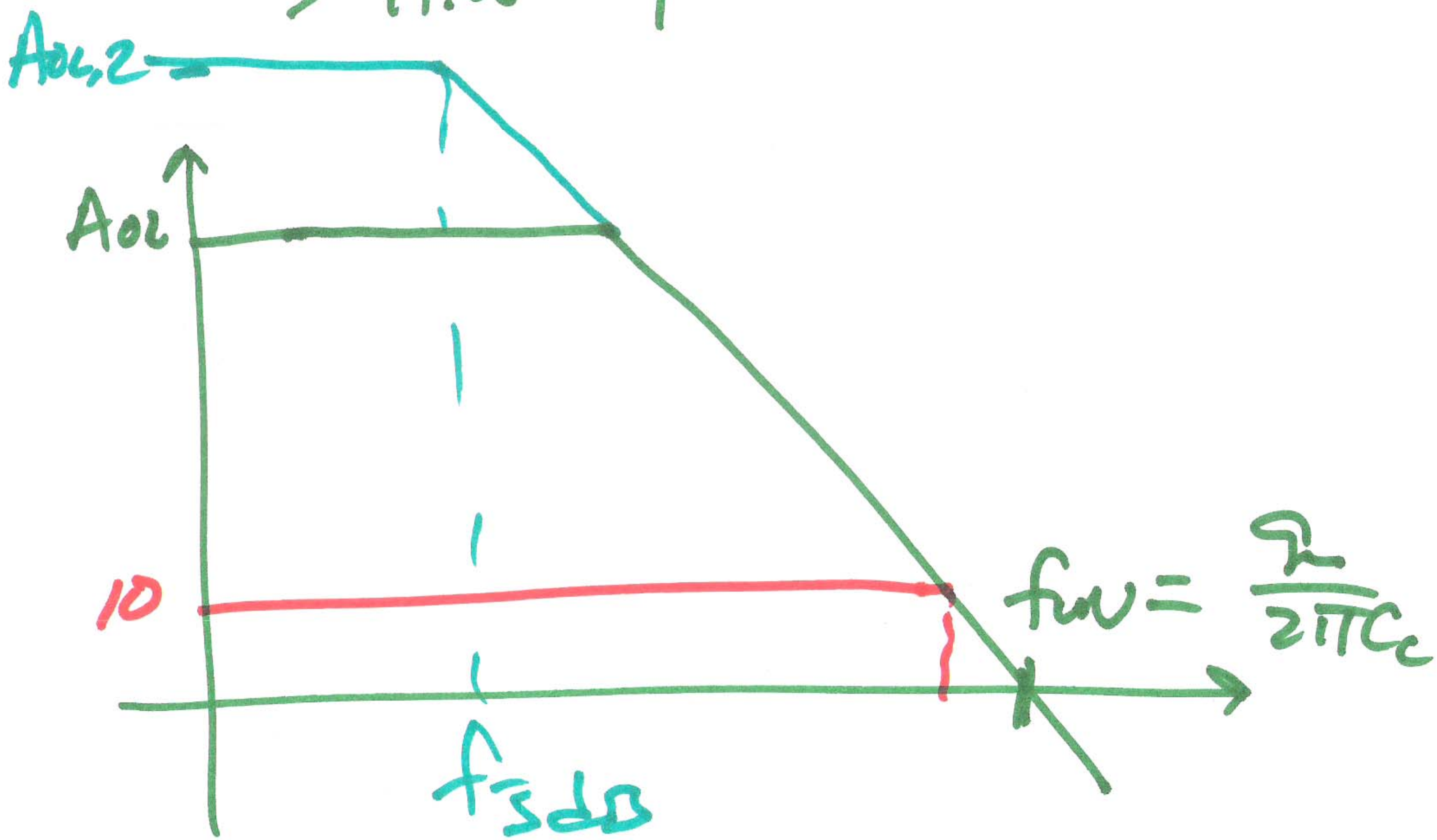
study for the final

→ H.W. & Quizzes ←



Ch. 9 → EX 9.5

width — current

length — speed, gain

overdrive — speed

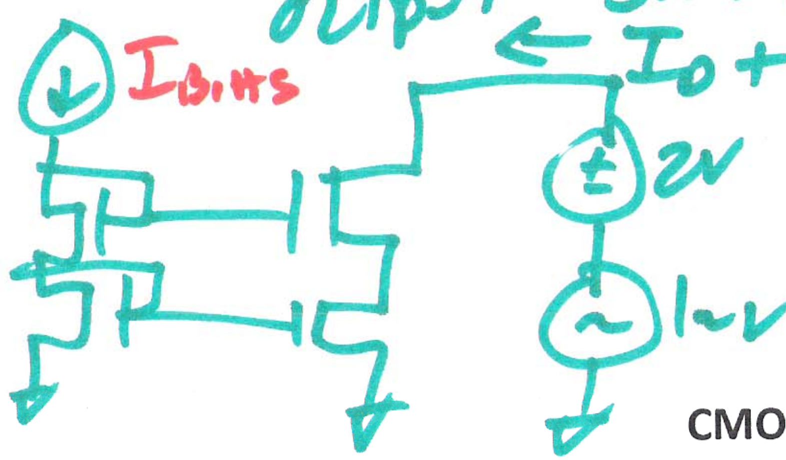
output swing

f_T

Ch. 20 → current mirrors

output swing

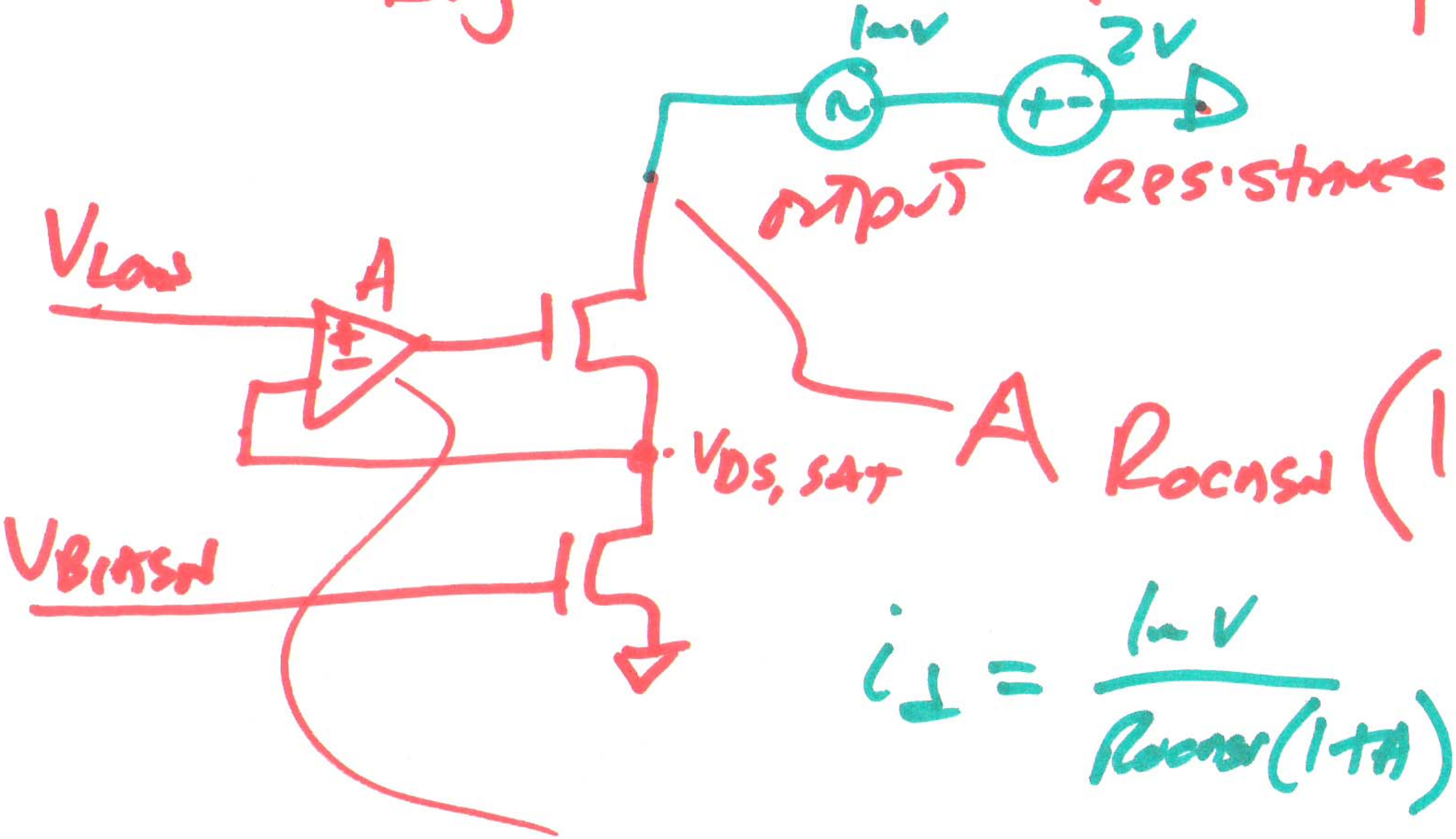
output ← $I_D + i_d = i_D$



$I_D = I_{BIAS}$

$\frac{1mV}{R_{BIAS}}$

Regulated Drain topology



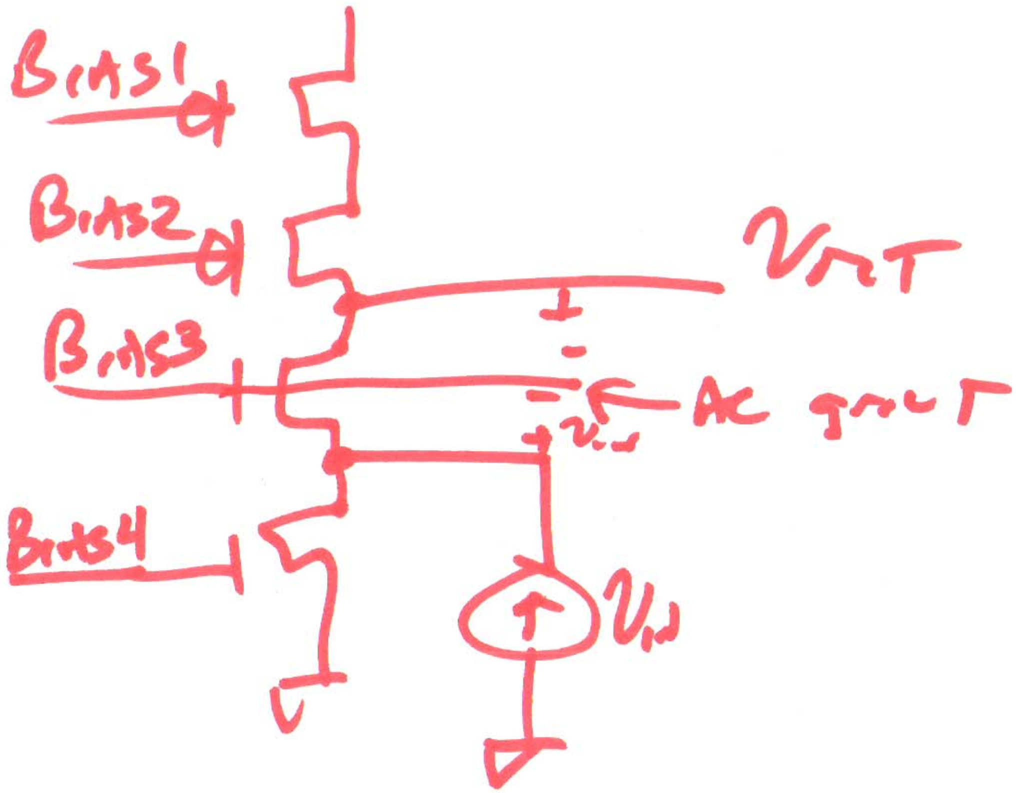
$$A \quad R_{ocasn}(1+A)$$

$$i_d = \frac{1\,mV}{R_{ocasn}(1+A)}$$

Ch. 21 Amplifiers

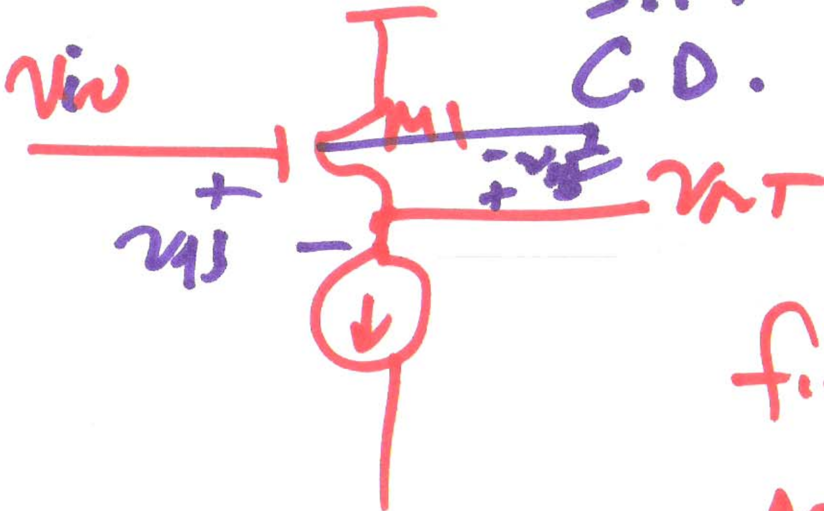
derive g_m

Gains for C.S., C.D., C.G.



S.F.

C.D.

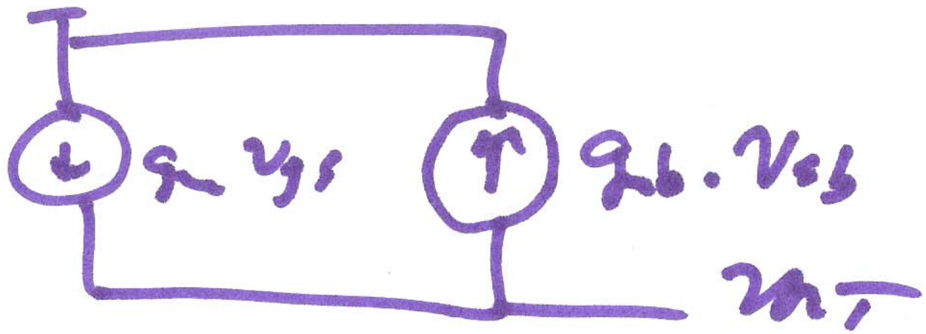


$$v_{gs} = v_{in} - v_{out}$$

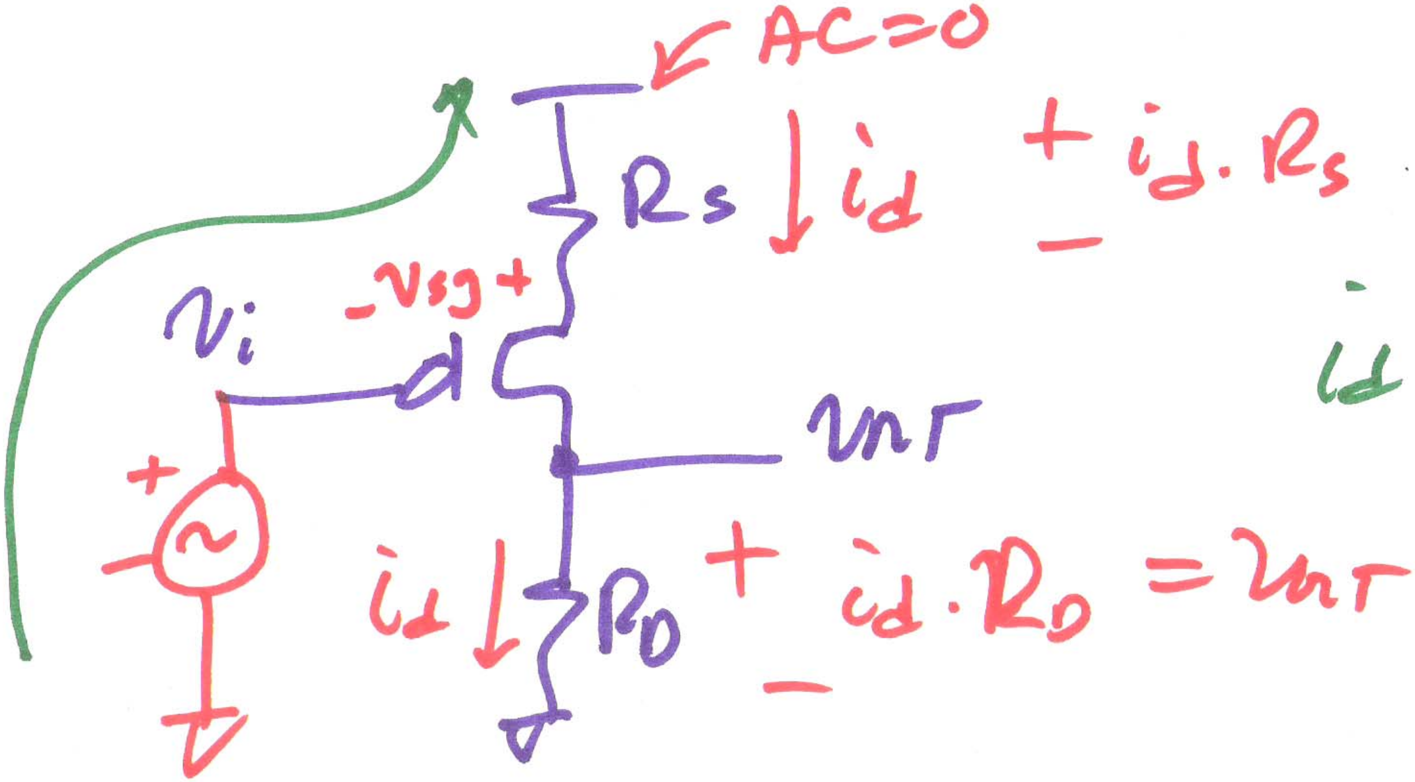
$$v_{sb} = v_{out}$$

find $\frac{v_{out}}{v_{in}}$

Note M1 has body effect.



b)



$$i_d = g_m v_{sg}$$

$$v_i + v_{sg} + i_d \cdot R_s = 0$$

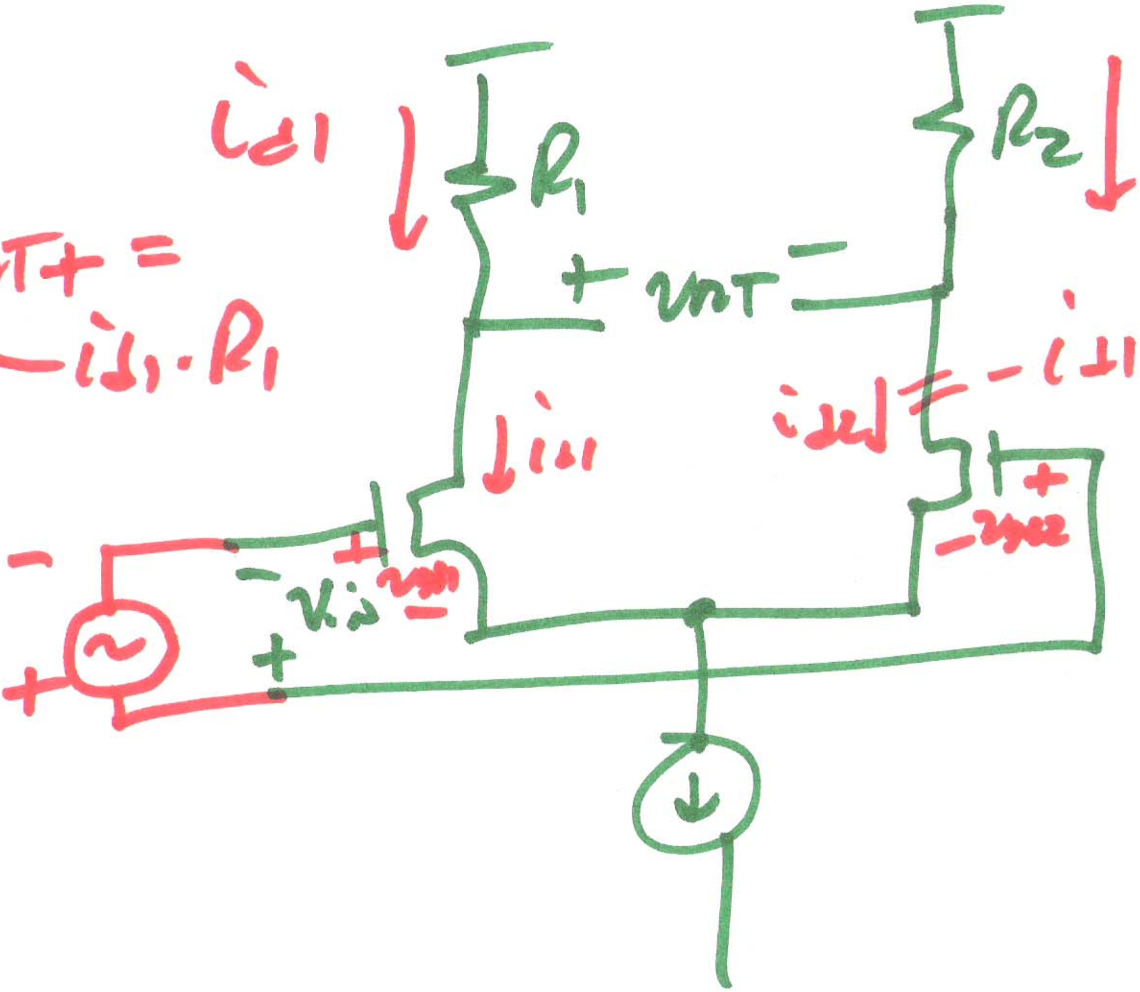
$$v_i = -i_d\left(\frac{1}{g_m} + R_s\right)$$

$$\frac{v_{out}}{v_{in}} = \frac{-R_D}{1/g_m + R_s}$$

Diff - Amps

$v_{out-} = -i_{d2} \cdot R_2$

$v_{out+} = -i_{d1} \cdot R_1$



$\dfrac{v_{out}}{v_{in}}$

$v_{out} = -i_{d1} \cdot R_1 + i_{d2} \cdot R_2 = -i_{d1}(R_1 + R_2)$

$i_d = g_m v_{gs}$

$i_{d1} = -i_{d2}$

$v_{in} = v_{gs2} - v_{gs1}$

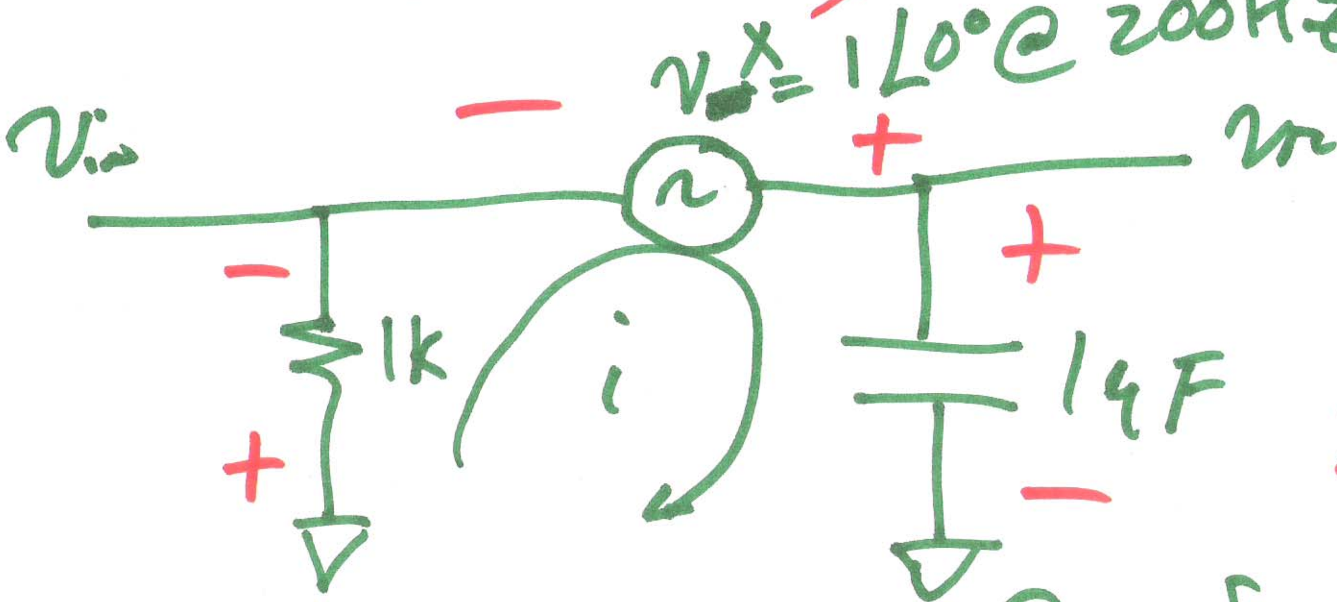
$= \dfrac{i_{d2}}{g_m} - \dfrac{i_{d1}}{g_m}$

$-v_{in} - v_{gs1} + v_{gs2} = 0$

$v_{in} = -i_{d1} \cdot \dfrac{2}{g_m}$

freq. Response

$1+j0$



$.6\angle -45$

$x = .6\cos(-45)$

$y = .6\sin(-45)$

$v_{in} = ?$ $\quad v_{out} = ?$ $\quad i = ?$

$$-i\cdot 1K + v_x - v_{out} = 0$$

$$v_{out} = i\cdot\frac{1}{j\omega C}$$

$$-i\cdot 1K + \overset{1+j0}{\cancel{1\angle 0°}} - i\cdot\frac{1}{j\omega C} = 0$$

$$i\left(1k + \frac{1}{j\omega C}\right) = 1 + j0$$

$$i = \frac{1 + j0}{1k + \frac{1}{j\omega C}}$$

$$= \frac{0 + j\omega C}{1 + j\omega C \cdot 10^{3}}, \quad C = 10^{-6}$$

$$= \frac{0 + j2\pi f \cdot 10^{-6}}{1 + j2\pi f \cdot 10^{-3}}$$

$$\angle = \overbrace{\tan^{-1}(\infty)}^{90} - \tan^{-1} 2\pi f \cdot 10^{-3}$$

$$|\cdot| = \frac{\sqrt{0 + (2\pi \cdot 200 \cdot 10^{-6})^2}}{\sqrt{1^2 + (2\pi \cdot 200 \cdot 10^{-3})^2}}$$

$f = 200$ Hz

Pole-splitting

Miller's Theorem

R_1 C_1 C_2 R_2

g_{m1} g_{m2}

f_1 f_2

Op-Amp → design