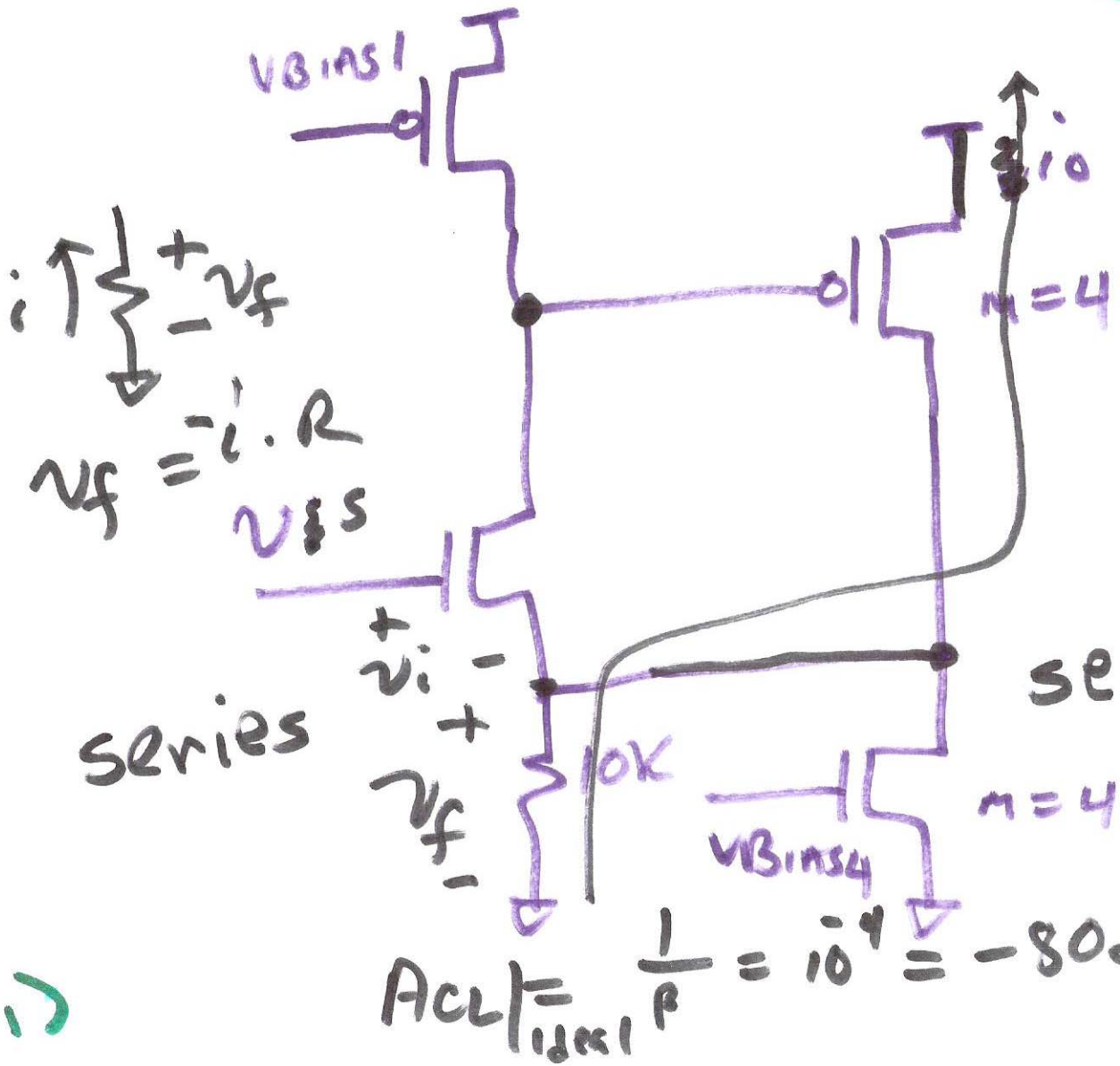
ECE 614 Advance Analog IC Design

BOISE STATE UNIVERSITY

Sept. 6, 2011

Lecture 6



TRANSconductance

$A_{CL} = \frac{i_o}{v_s}$ N.f.b.

r_o is big comp. to 10K

$\beta i_o = v_f$

$\beta = -10K\Omega$

$= -\frac{r_o}{4} \| 10K$

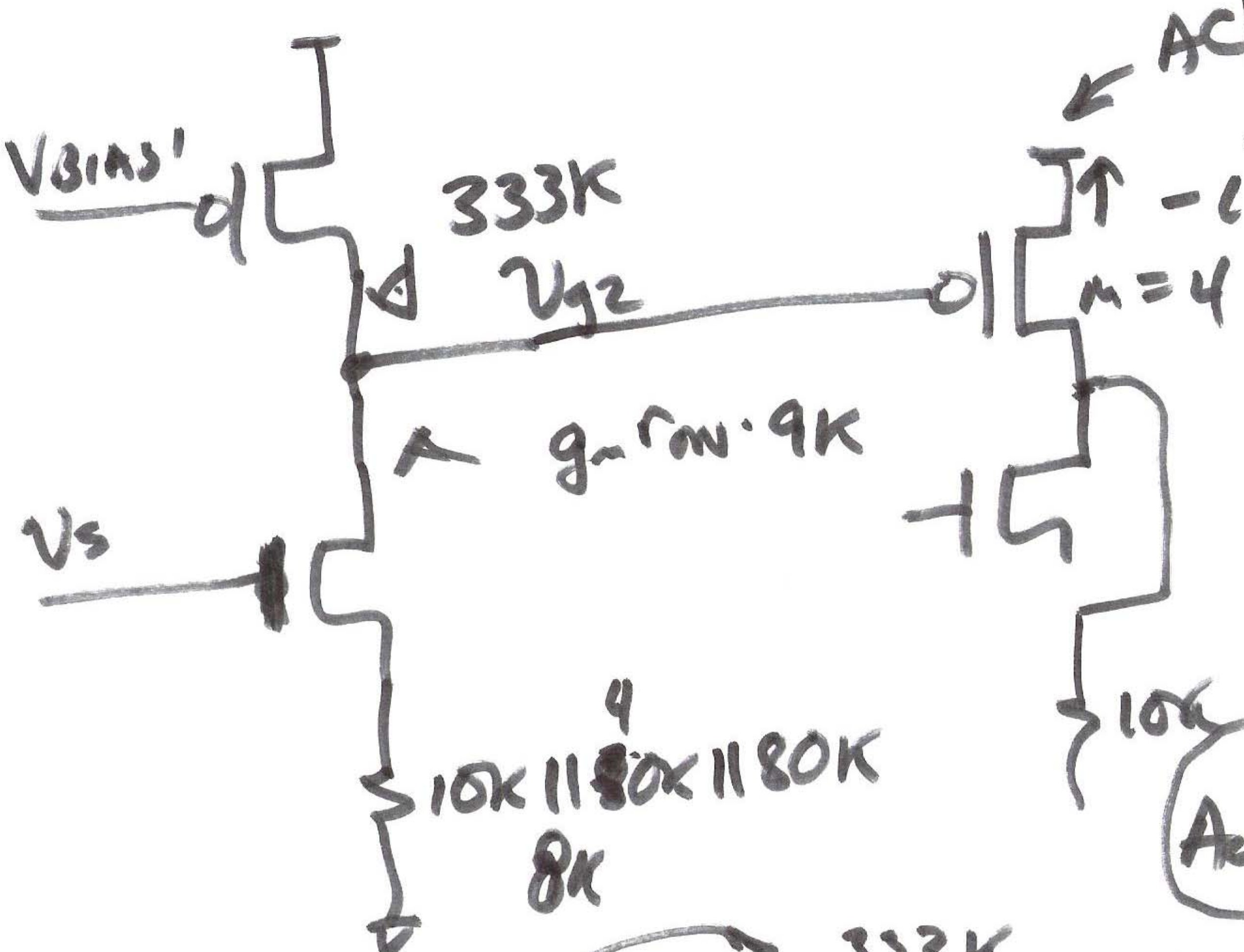
$\frac{167K}{4}$

R_{Bi} & R_{Bo}

10K 10K

$A_{CL}|_{ideal} \frac{1}{\beta} = 10^{-4} = -80dB$

17



$-i_d = i_o = g_{mp}(-v_{g2})$

$4 \cdot 150\mu$

$i_o = -20 \cdot 600\mu \cdot v_s$

$A_{R2} = \frac{i_o}{v_s} = 12\,\frac{mA}{V}$

$\frac{v_{g2}}{v_s} = \frac{-333K}{8K + \not{4} \to 6.5K} \quad \frac{400}{500}$

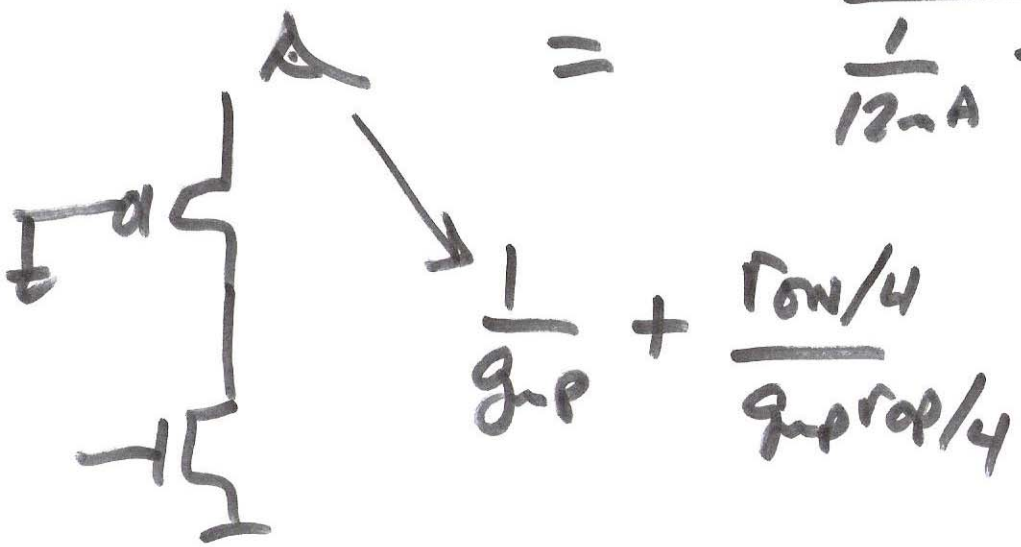
$\frac{333K}{15K} \approx 20 = \frac{v_{g2}}{v_s}$

2)

$\beta = -10K \qquad A_{OL} = 12mA/V$

$$A_{CL} = \frac{A_{OL}}{1 + \beta A_{OL}}$$

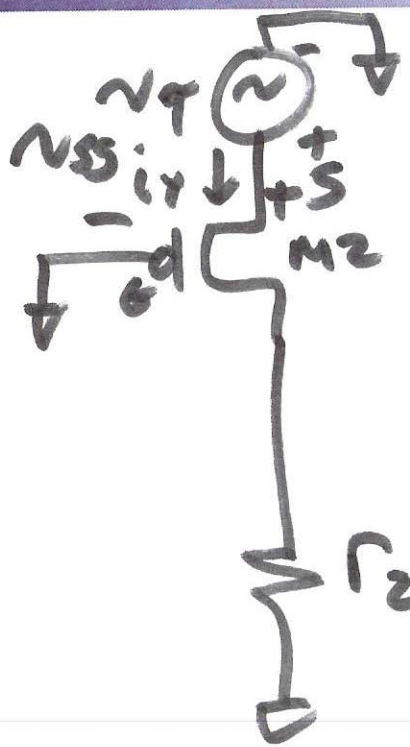
$$= \frac{1}{\frac{1}{12mA} - 10K} \simeq -\frac{1}{10K} = -$$

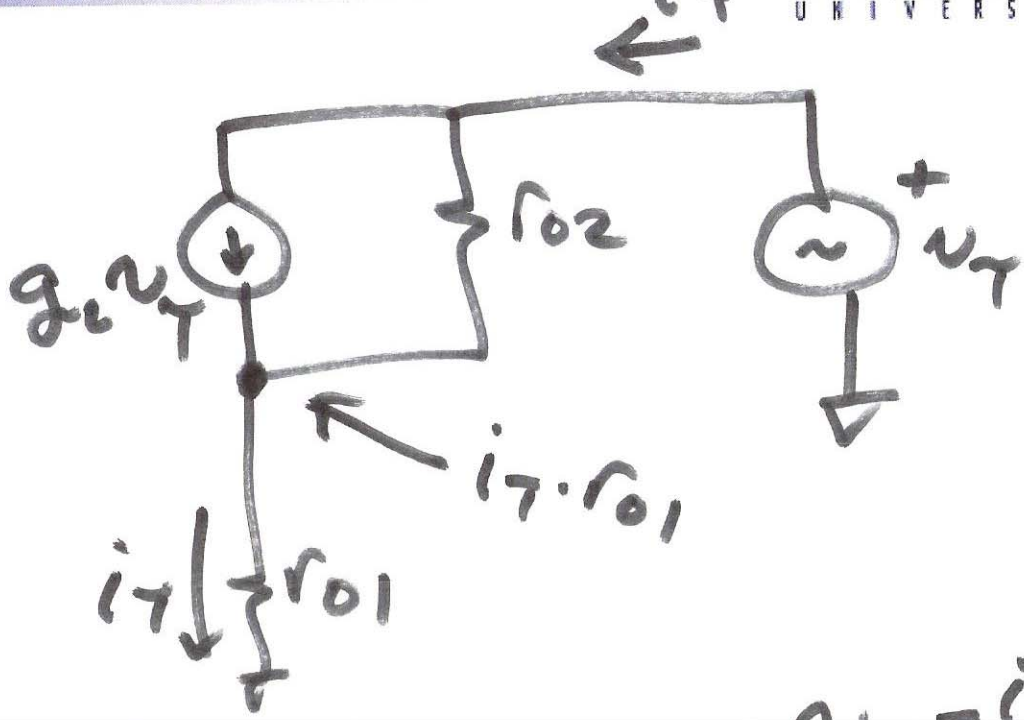


$$\frac{1}{g_{mp}} + \frac{r_{ON/4}}{g_{mp} r_{op/4}}$$

802B L1800

3)



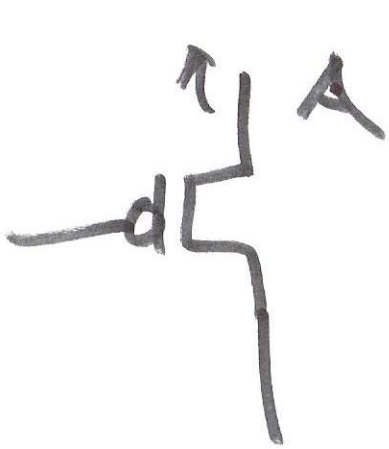


$$v_T = v_{sg}$$

$$i_T = g_{m2} v_T + \frac{v_T - i_T r_{o1}}{r_{o2}}$$

$$i_T\left(1 + \frac{r_{o1}}{r_{o2}}\right) = v_T\left(g_{m2} + \frac{1}{r_{o2}}\right)$$

4) $$\frac{v_T}{i_T} = \frac{1 + \frac{r_{o1}}{r_{o2}}}{g_{m2} + \frac{1}{r_{o2}}} \approx \frac{2}{g_{m2}}$$



$$\frac{2}{g_{m2}} = R_o$$

$$\frac{1}{g_{m2}} = \frac{1}{150\mu \cdot 4} \approx 1.2k$$

$$R_o \approx 2.5k$$

$$R_{of} = (1 + \beta A_{o2}) \cdot 2.5k$$

$$\beta \cdot A_{OL} = \frac{12mA \cdot 10k}{1mA}$$

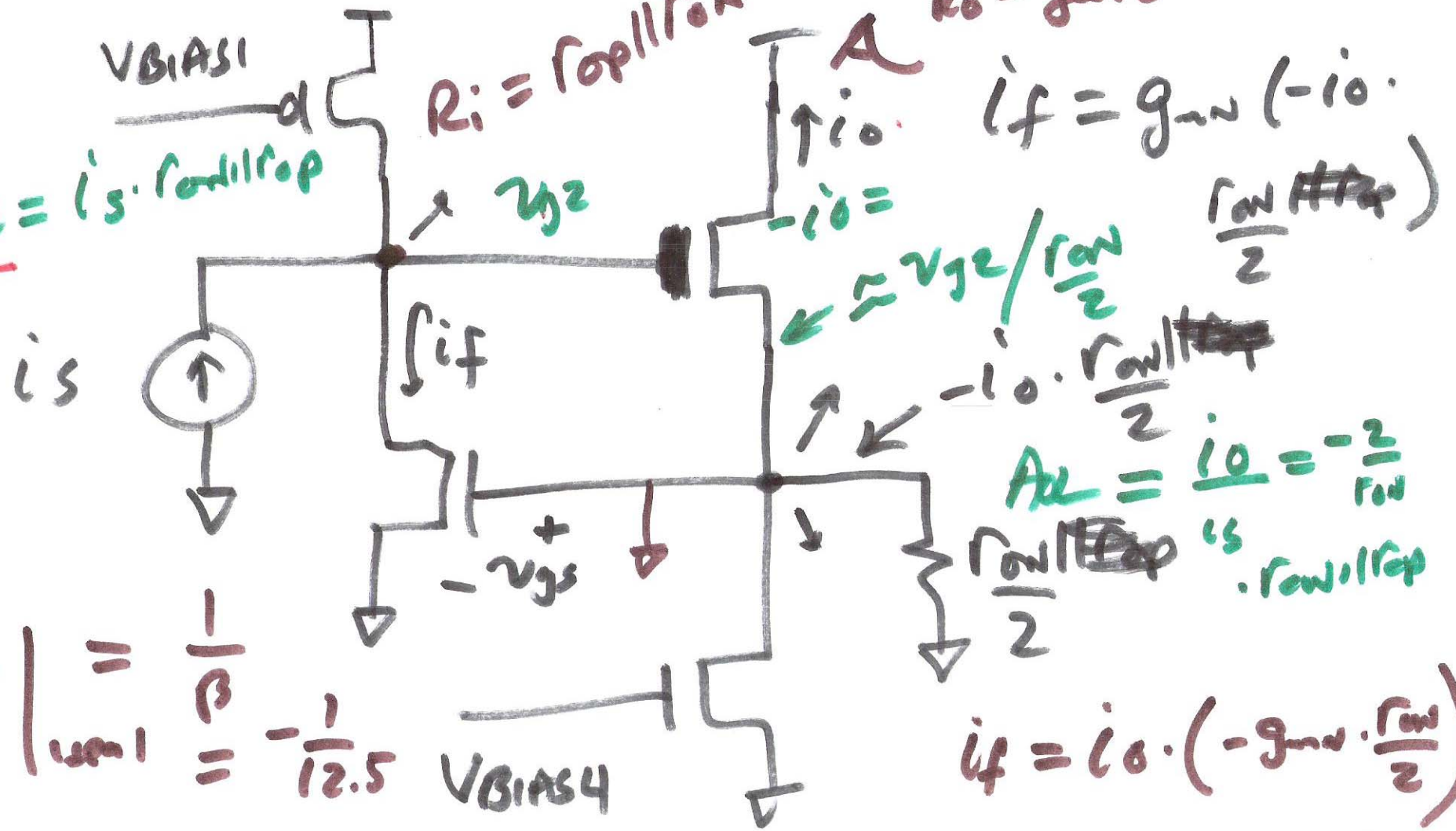
$$\beta A_{OL} \approx 1.2 \cdot 10^3$$

$$1 + \beta A_{OL} = 120$$

$$R_{of} = 2.5k \cdot 121$$

$$\approx 300k$$

5)



Aci = -.08 shunt - series

current current

β = -gmn · ron/2

β = -12.5

6)

$$A_{OL} = -\frac{2}{r_{ON}} \cdot r_{ON} \| r_{OP}$$

$$= -\frac{2}{167k} \cdot 167k \| 333k$$

100k

$A_{OL} = g_{mp} \cdot r_{ON} \| r_{OP}$

$$\simeq 1.5 \frac{A}{A}$$

$$A_{CL} = \frac{A_{OL}}{1 + A_{OL} \cdot B} = \frac{1}{\frac{1}{1.5} + \frac{1}{12.5}}$$

$$R_i = \frac{R_{OP} \| r_{ON}}{1 + \frac{1}{12.5} \cdot 1.5} = \frac{20k}{10k} \simeq \frac{1}{12.5}$$

$$= .08$$

$$R_O = g_m r_O^2 (1 + B A_{OL}) = M\Omega$$

7)