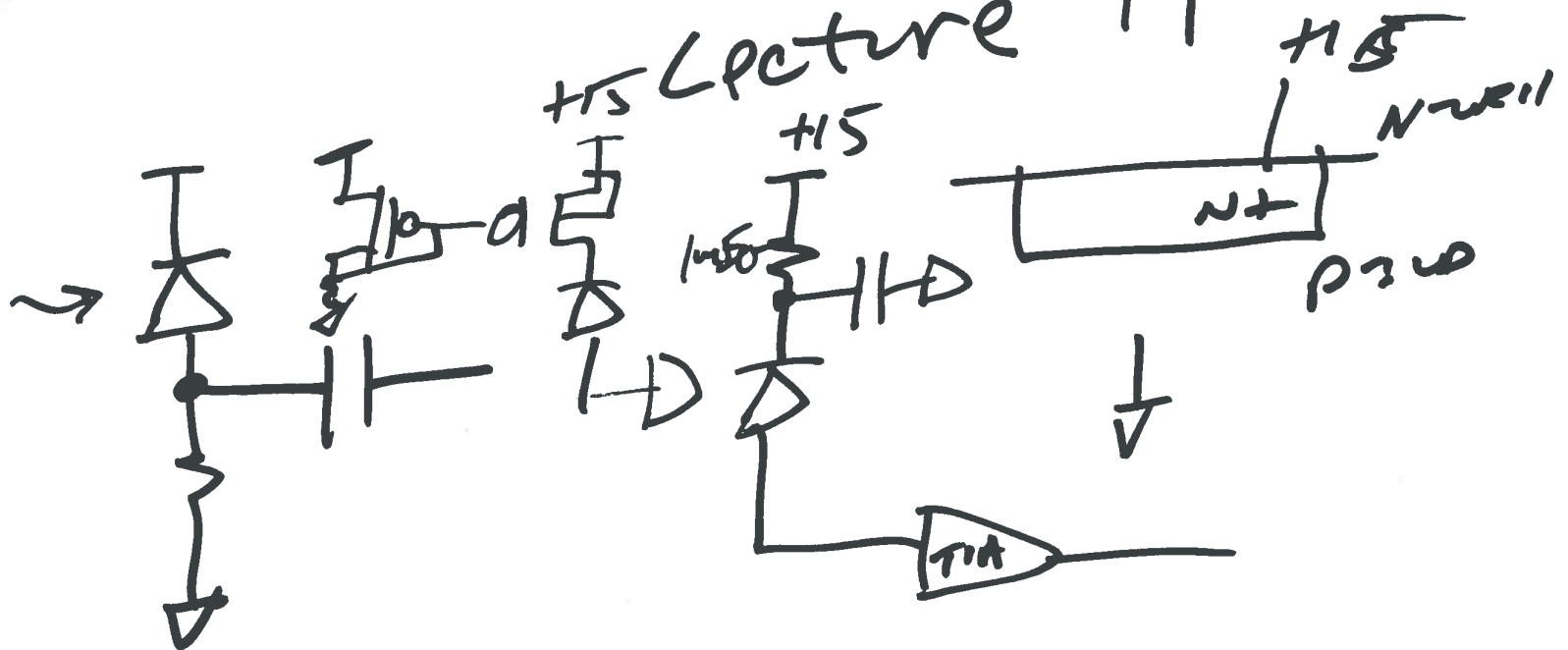


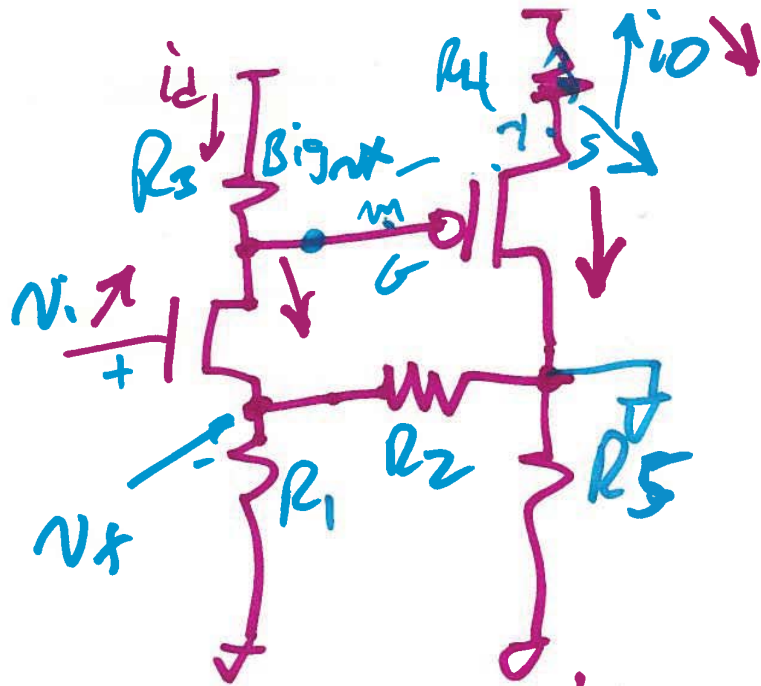
ECG 720

Advanced Analog IC Design

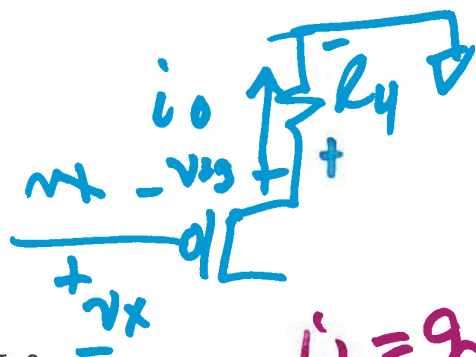
March 31, 2016

Lecture 19





Series-series
Voltage Current



$$i_o = g_m v_x$$

$$-i_o = g_m v_x$$

$$\frac{-R_3}{\frac{1}{g_m} + R_1 \parallel R_2} = \frac{v_x}{v_i}$$

$$\frac{v_x}{v_i} = \frac{-i_o \cdot R_3}{\frac{v_x}{g_m} + R_1 \parallel R_2 \cdot i_o}$$

$$v_x = -v_{sg} + i_o \cdot R_4$$

$$v_x = i_o \left(R_4 + \frac{1}{g_m} \right)$$

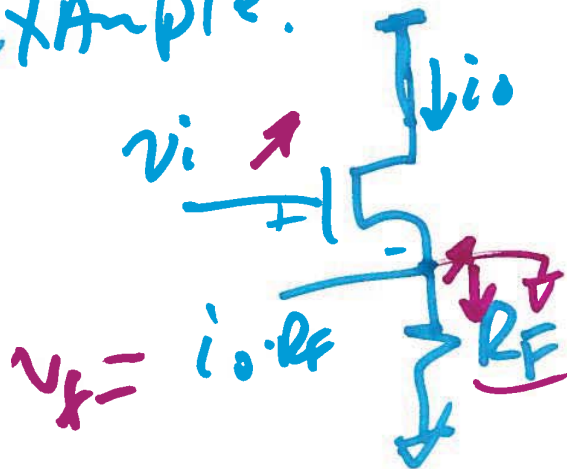
$$i_o = \frac{v_x}{R_4 + \frac{1}{g_m}}$$

$$A_{OL} = \frac{i_o}{v_i} = \frac{-R_3}{\frac{1}{g_m} + R_1 || R_2} \cdot \frac{1}{R_4 + \frac{1}{g_m}}$$



$$= \frac{-1}{\frac{1}{g_m \cdot R_3} + \frac{R_1 || R_2}{R_3}} \cdot \frac{g_m}{1 + g_m \cdot R_4}$$

Example:



$$v_f = \beta \cdot i_o \Rightarrow \beta = R_F$$

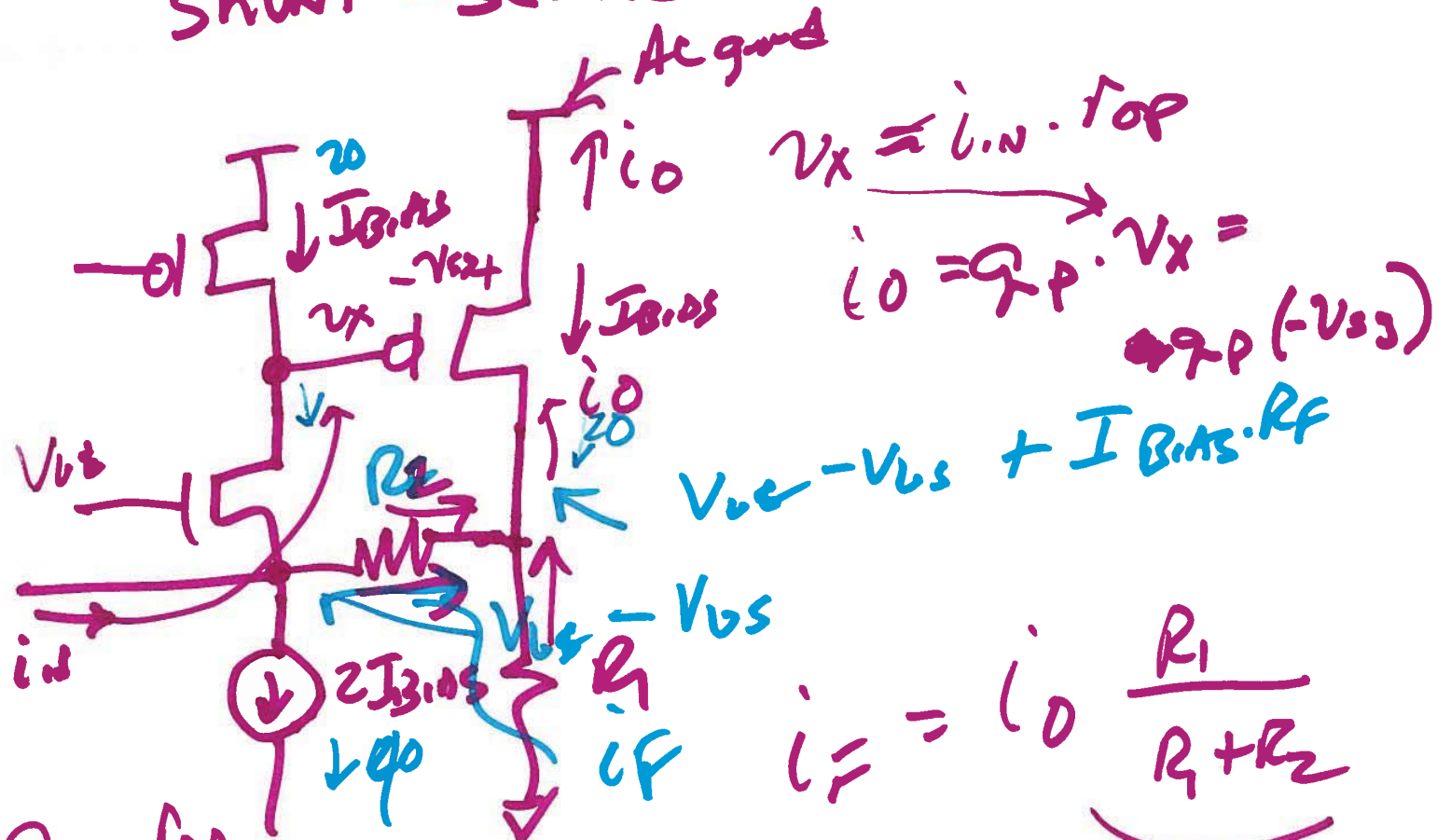
$$A_{OL} = \infty, \quad A_{CL} = \frac{1}{\beta}$$

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

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

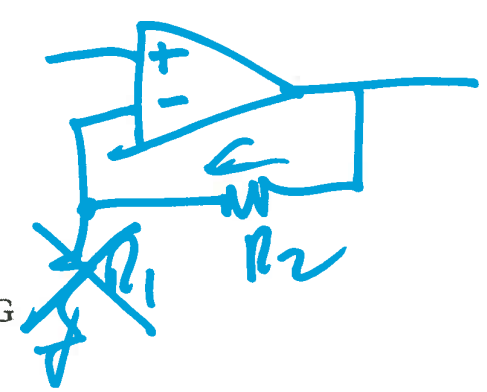
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SHUNT - SERIES

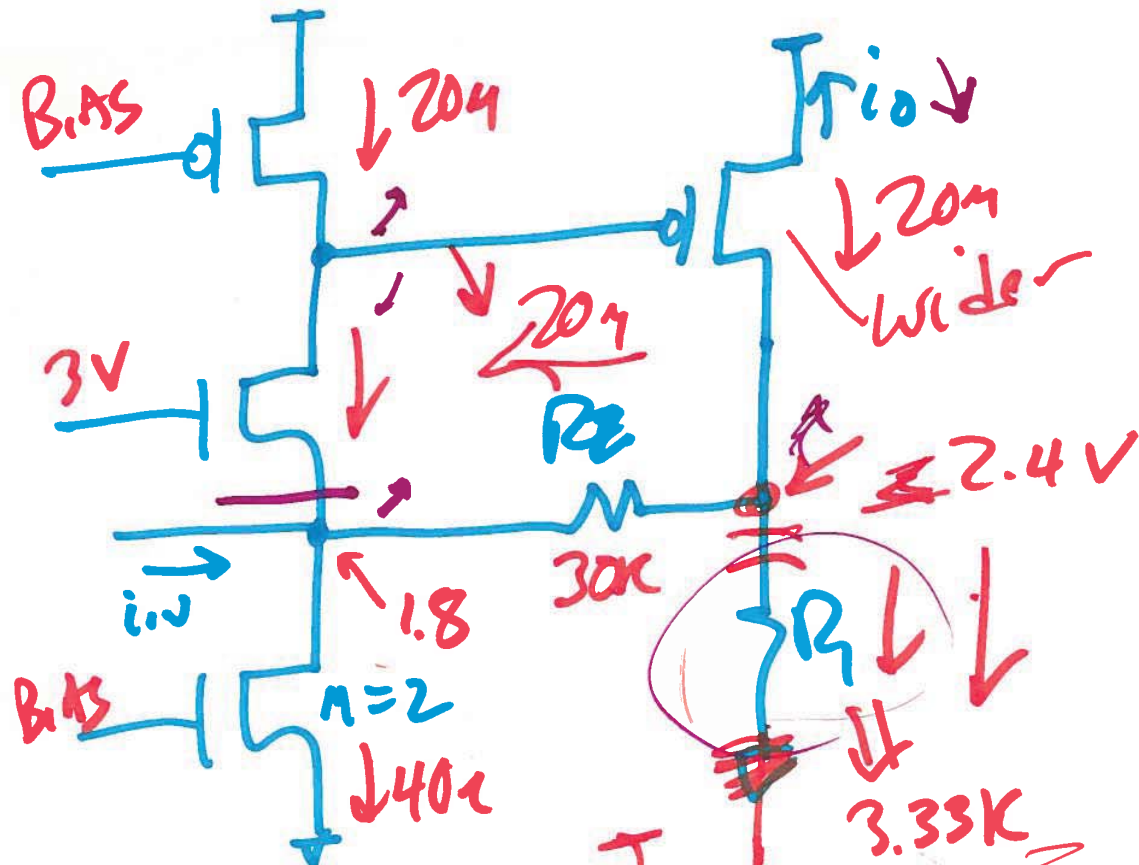


$$A_{OL} = \frac{i_{OL}}{i_{in}} = g_{mp} \cdot r_{op}$$

$$A_{CL} |_{ideal} = \frac{1}{\beta} = 1 + \frac{R_2}{R_1}$$



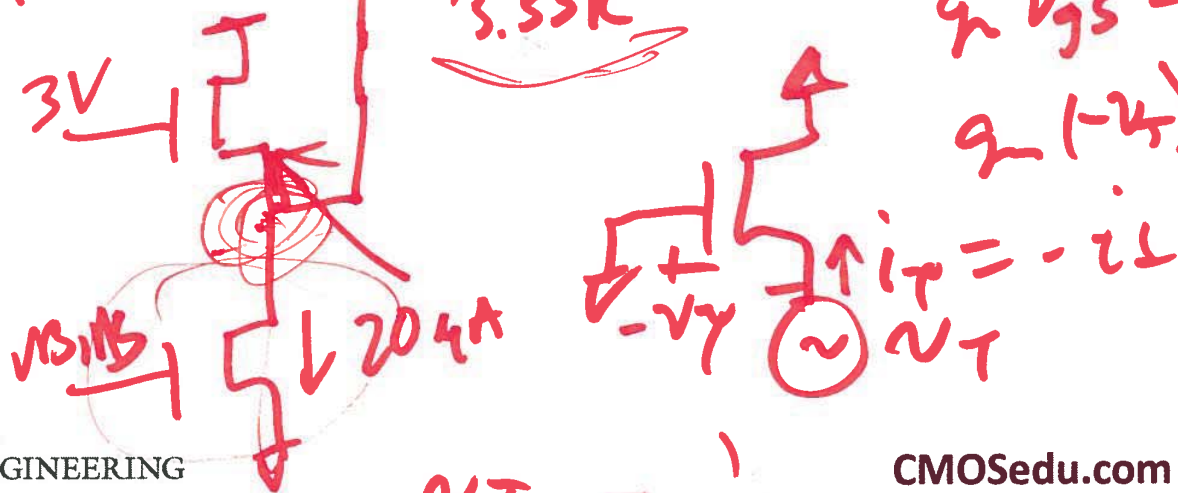
4)



$$\frac{i_o}{i_{in}} = 1 + \frac{R_2}{R_1}$$

$$g_m v_{gs} = i_d$$

$$g_m (-v_T) = -i_T$$



$$\frac{v_T}{i_T} = \frac{1}{g_m}$$

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