

EE 420 / ECG 620

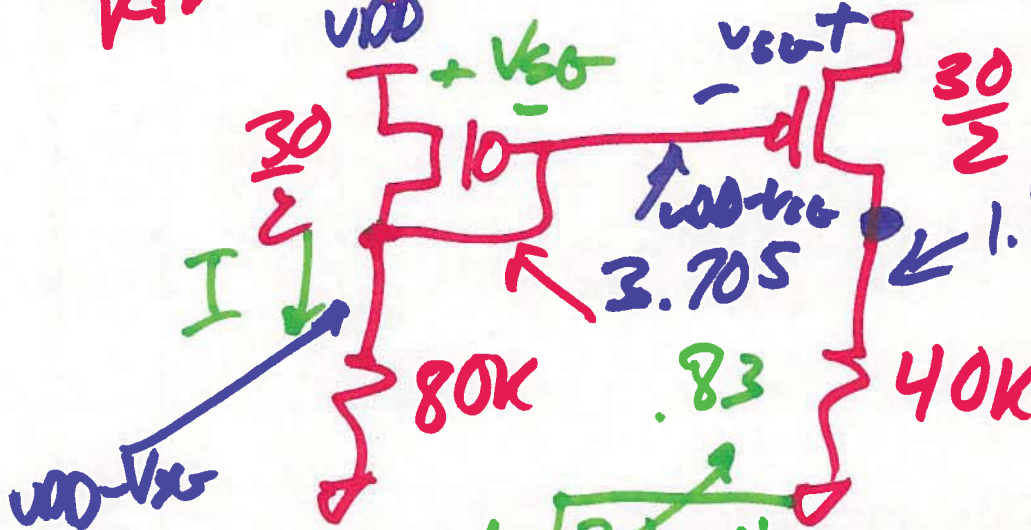
Feb. 25, 2019

Lecture 9

Design

$V_{TP} = 0.9V$
 $V_{PO} = 40\mu A$

Analog I_Q



$$\frac{V_{DD} - V_{SG}}{80k} = \frac{40\mu A \cdot 30}{2} (V_{SG} - V_{TP})$$

$$V_{DD} - V_{SG} = 24 (V_{SG}^2 - 1.8V_{SG} + 0.81)$$

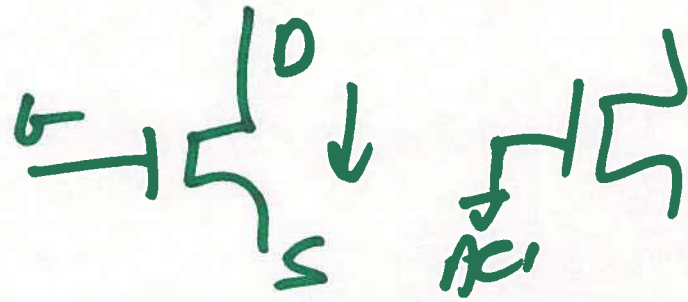
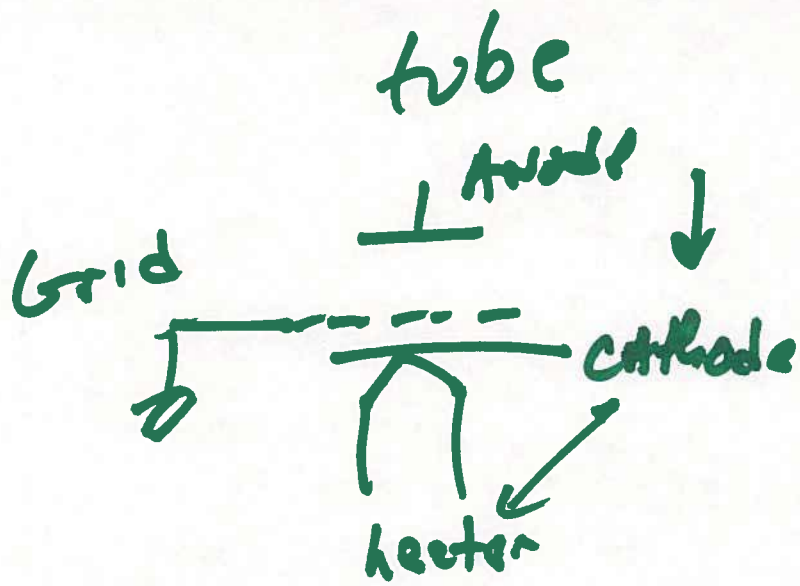
$$24V_{SG}^2 - 43.2V_{SG} + 14.44 = 0$$

$$V_{SG}^2 - 1.76V_{SG} + 0.6 = 0$$

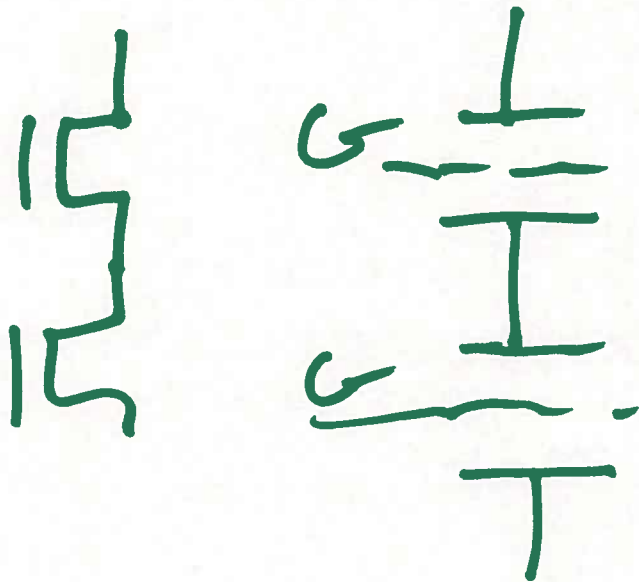
$$V_{SG} = \frac{1.76 \pm \sqrt{3.1 - 4.6}}{2} = 1.295V$$

$$I = \frac{5 - 1.295}{80k} = 46.34A$$

1)

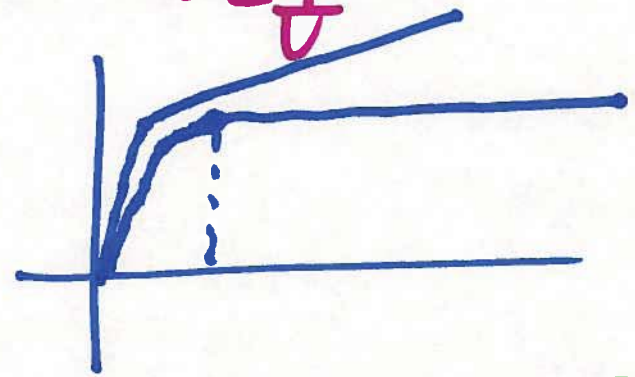
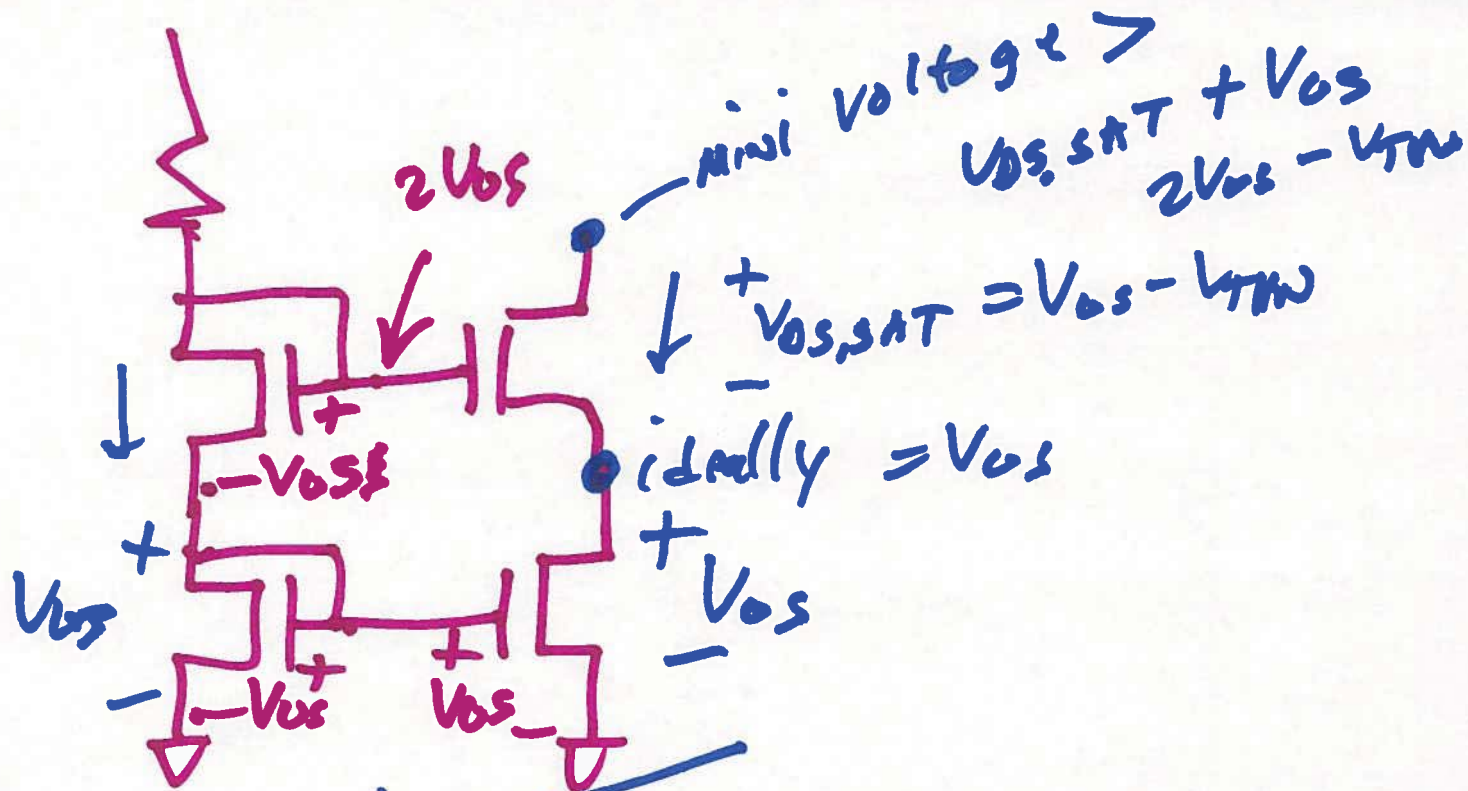


CASCODE a common grid & common cathode CS

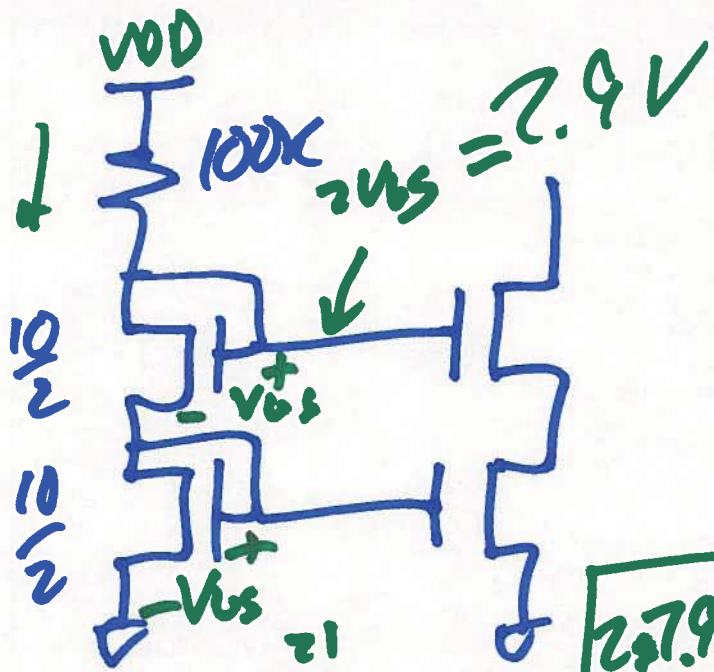


CASCODE

vestige of tube days



CASCO DE CURRENT MIRROR



$$\frac{100 - 2V_{GS}}{100k} = \frac{120 \mu \frac{10}{2}}{2} \cdot \frac{10}{L} (V_{GS} - V_{THN})^2$$

$$5 - 2V_{GS} = 10^5 \cdot 120 \cdot 10^{-8} \cdot \frac{10}{4} (V_{GS} - V_{THN})^2$$

$$I = \frac{5 - 2.9}{100k} = 21 \mu A$$

$$5 - 2V_{GS} = 30(V_{GS}^2 - 1.6V_{GS} + .64)$$

$$5 - 2V_{GS} = 30V_{GS}^2 - 48V_{GS} + 19.2$$

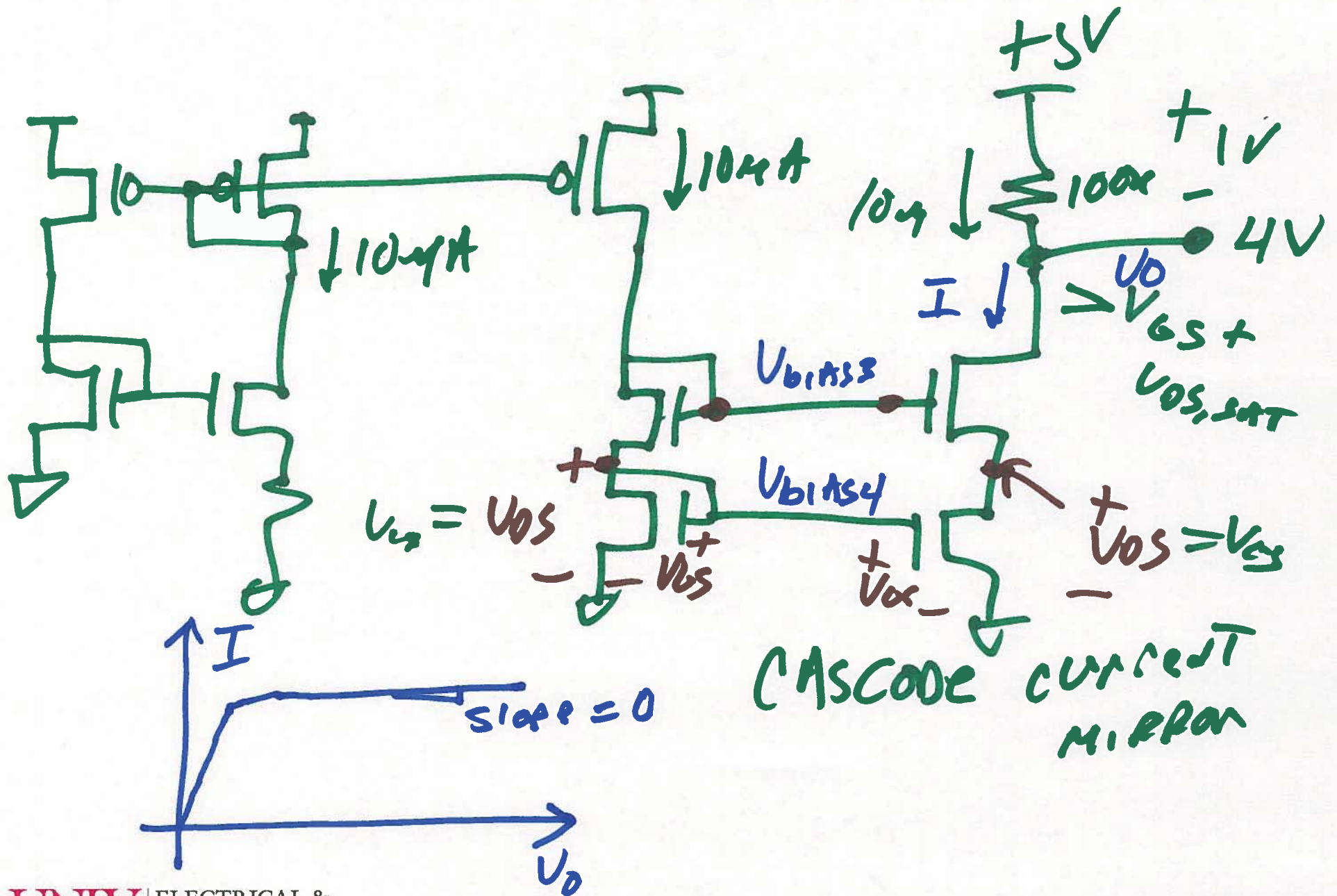
$$V_{GS} = \frac{1.53 \pm \sqrt{1.87^2 - 0}}{2} = 30V_{GS}^2 - 46V_{GS} + 14.2$$

$$= \frac{1.53 + 1.87}{2} = V_{GS}^2 - 1.53V_{GS} + .47$$

$$= \frac{1.53 + 1.87}{2} = 1.70 V$$

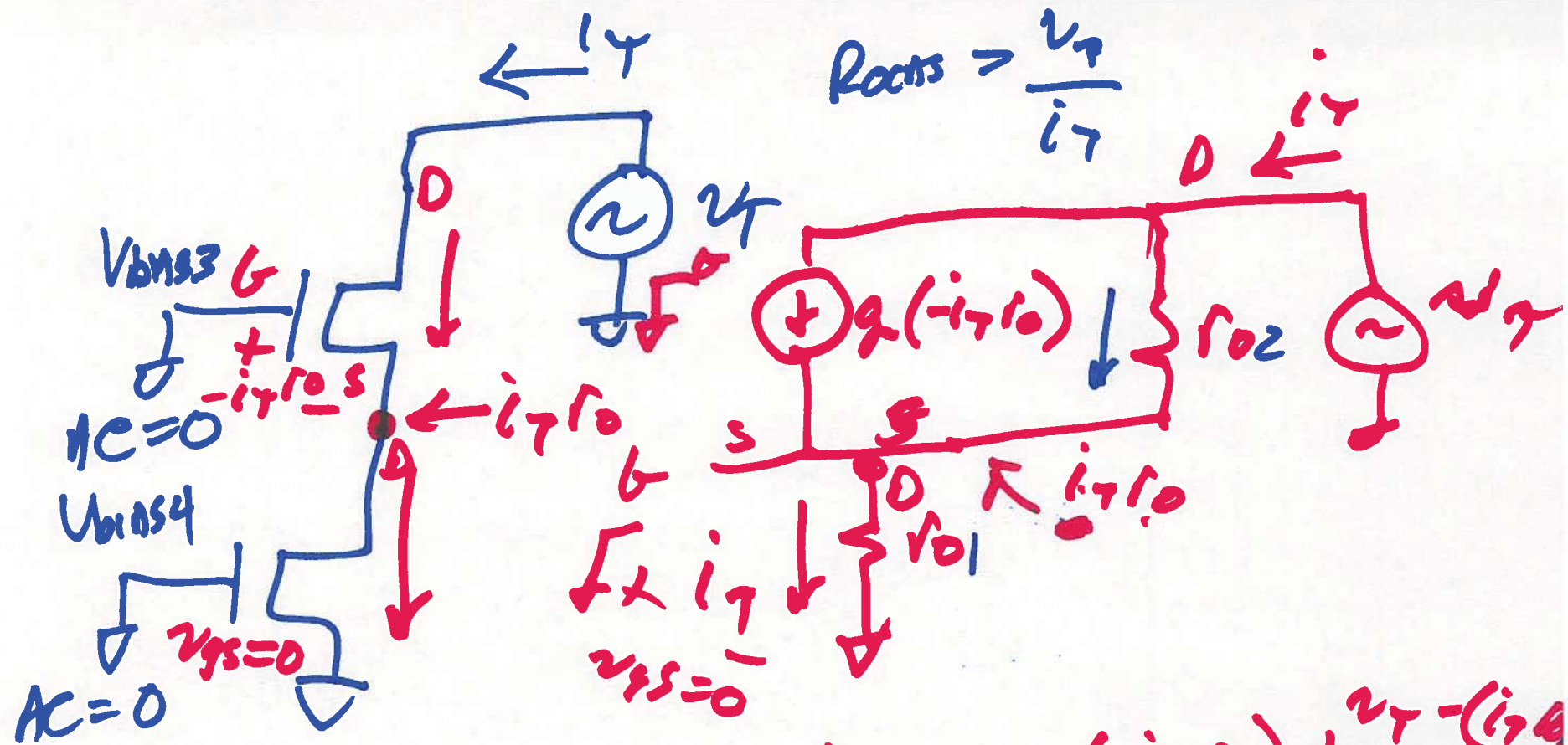
4)

Sketch CASCODE



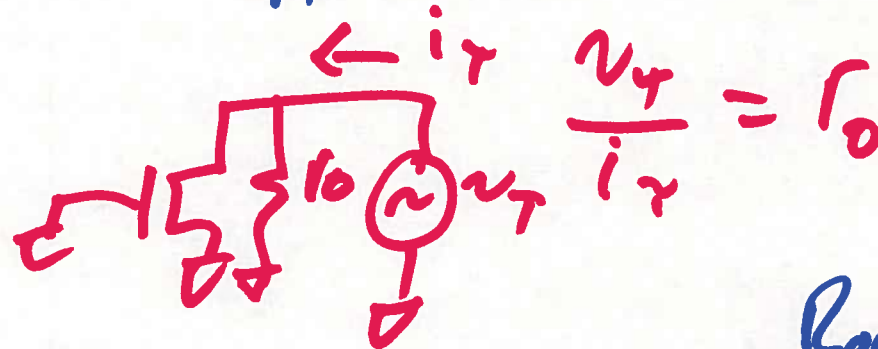
CASCODE CURRENT MIRROR

5)



$$R_{out} = \frac{v_T}{i_T}$$

AC-LKT

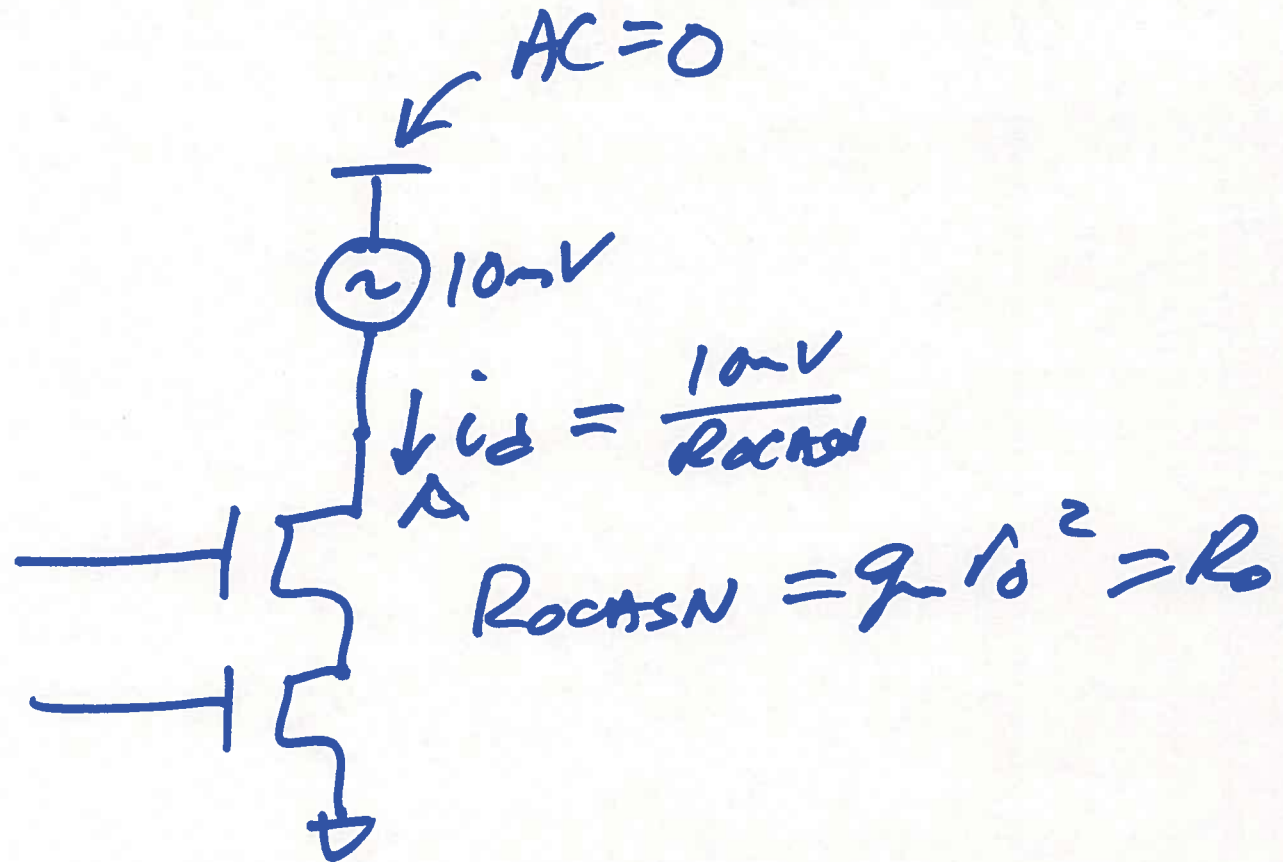


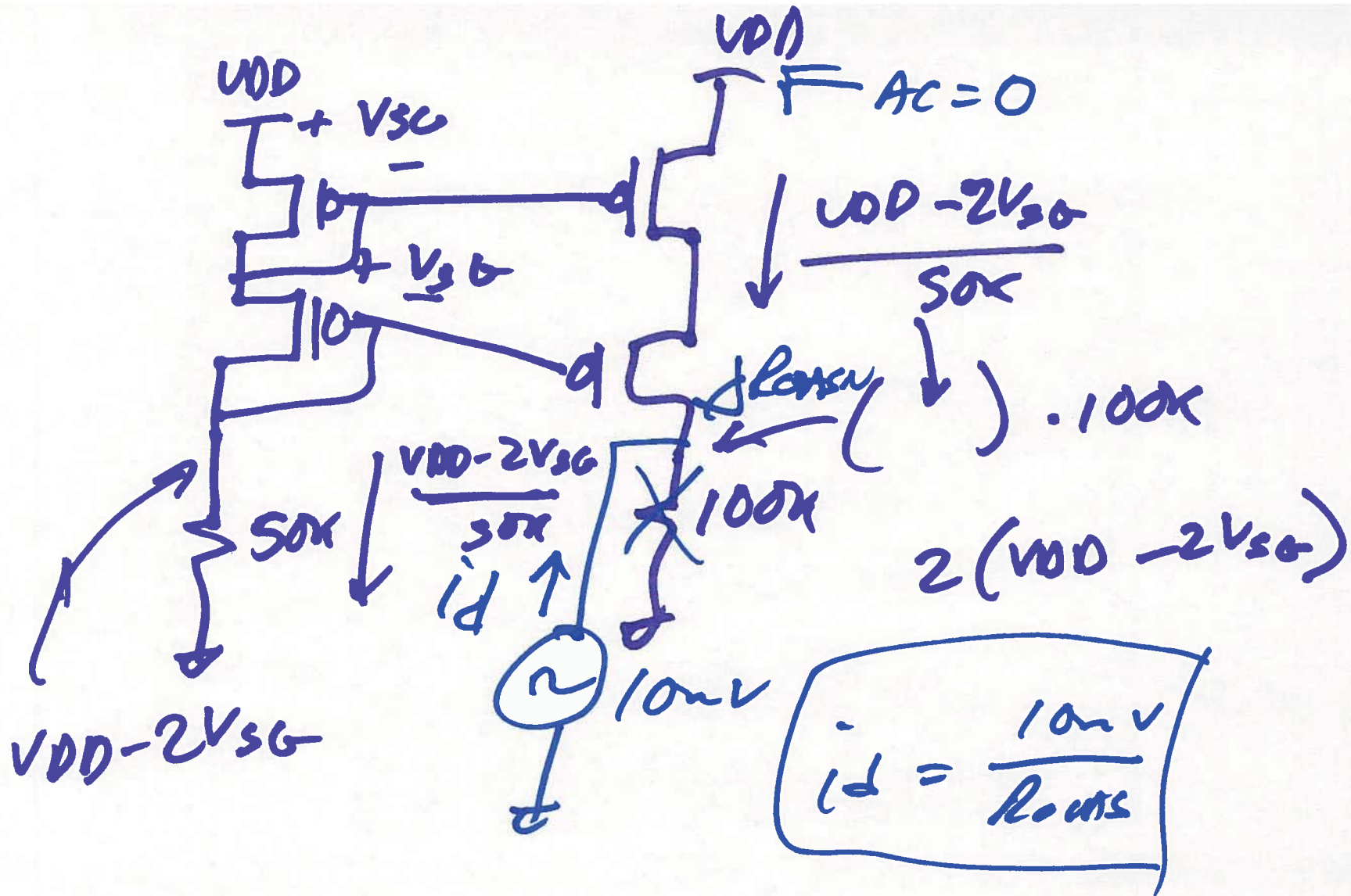
$$i_T = g_m(-i_T r_{o1}) + \frac{v_T}{r_{o2}}$$

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

$$R_{out} = \frac{v_T}{i_T} = r_{o2} \left(1 + g_m r_{o1} + \frac{r_{o1}}{r_{o2}} \right)$$

$$R_{out} \approx g_m r_{o2}^2$$





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