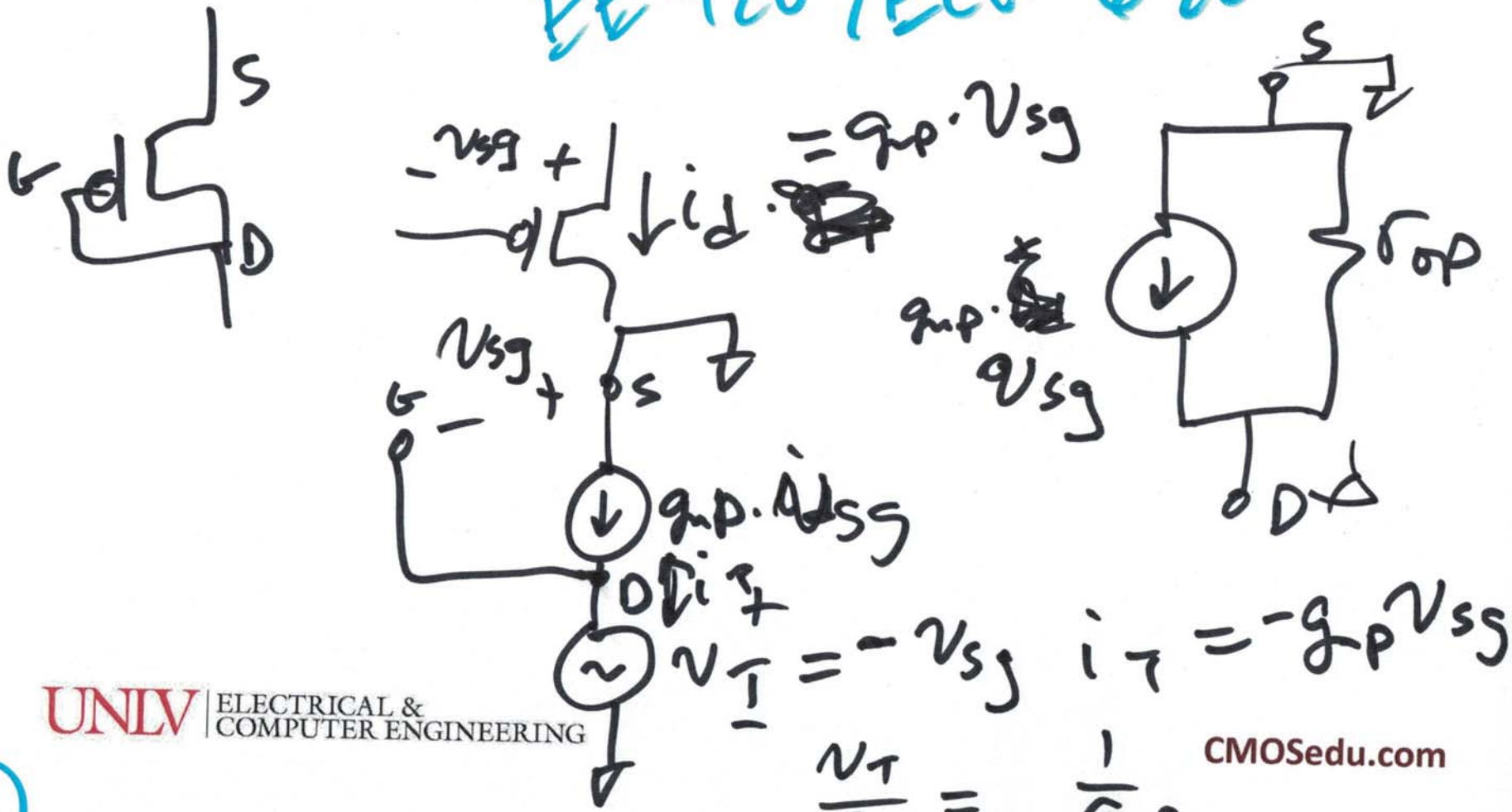
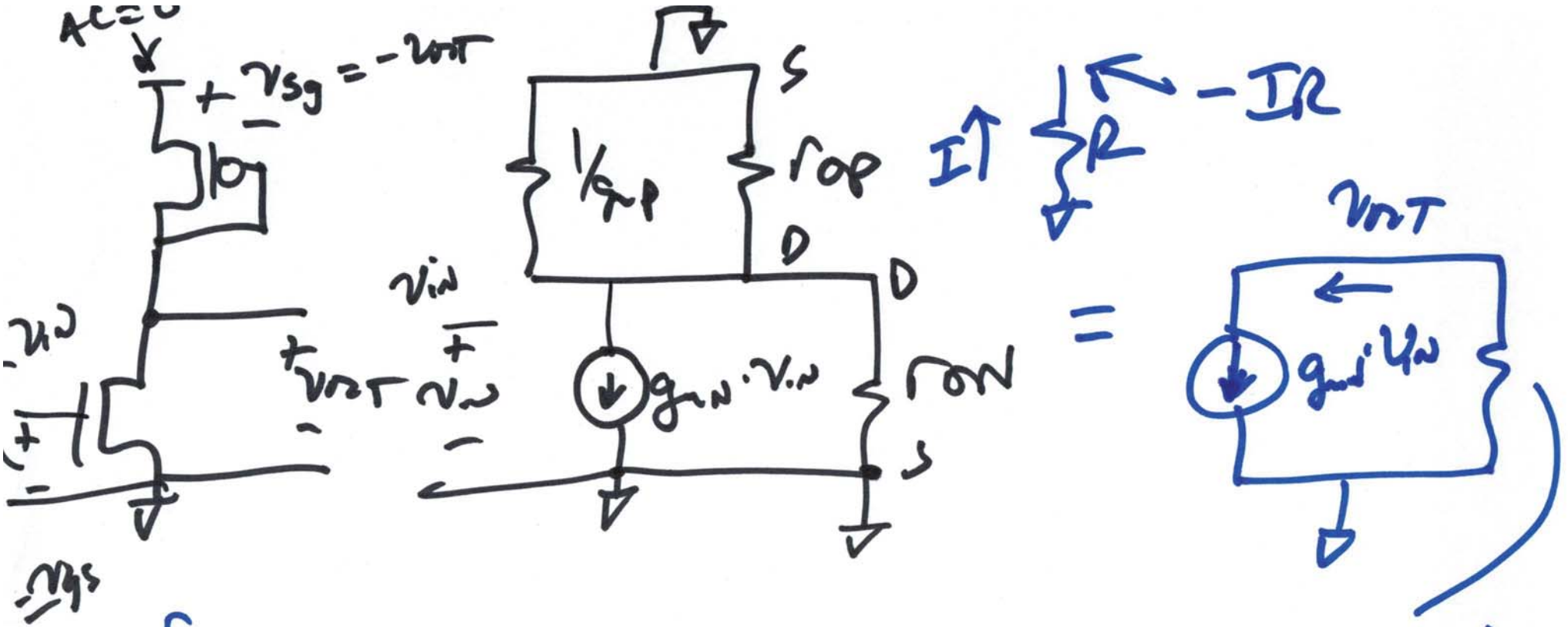
Lecture 15

March 8, 2015

EE 420 / ECE 620





$$\frac{r_O}{1/g_m}$$

$$v_{DT} = g_{mN} v_{in} \left(r_{ON} \| r_{op} \| 1/g_{mp}\right) \quad r_{ON} \| r_{op} \| 1/g_{mp}$$

$$\frac{v_{DT}}{v_{in}} = -g_{mN} \cdot r_{ON} \| r_{op} \| 1/g_{mp}$$

$$\simeq -g_{mN} \quad \text{for} \quad \frac{r_{op}}{r_{ON}} \gg \frac{1}{g_{mp}}$$

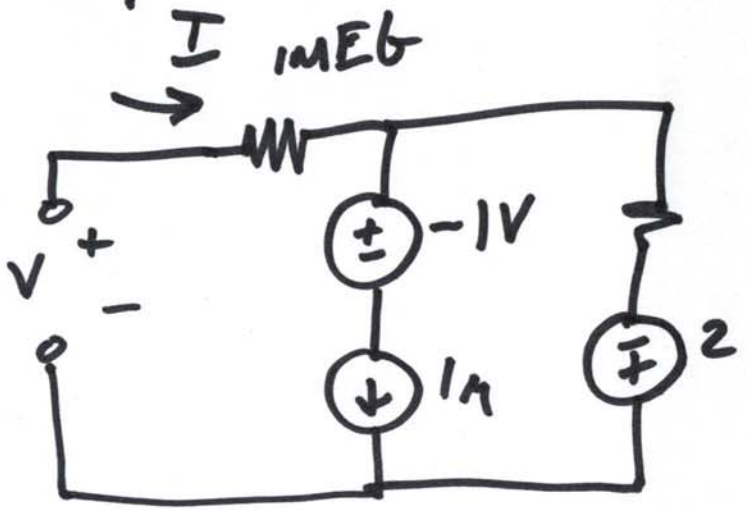
$$\frac{}{1/g_{mp}}$$

2)

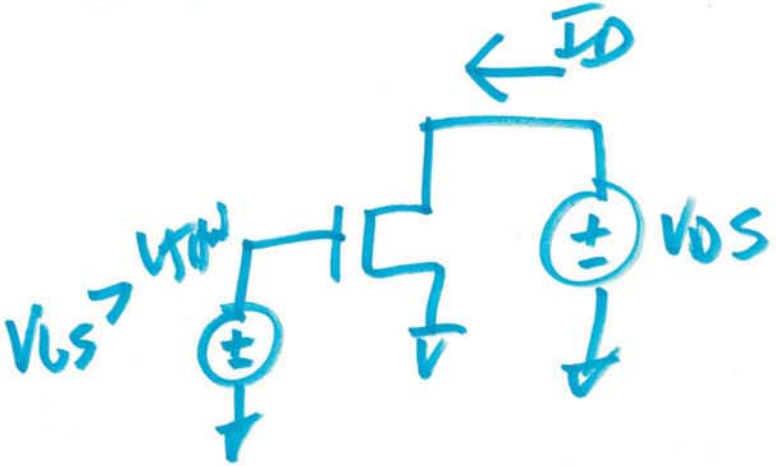
What to study

- IV plots

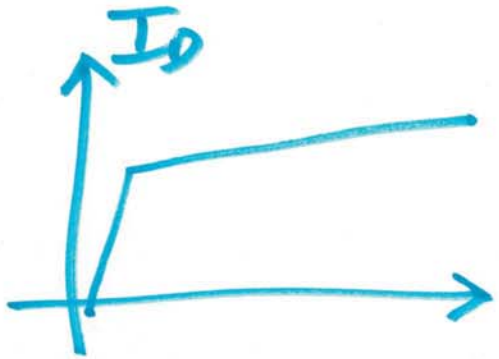
study your H.W. & Quizzes EOC

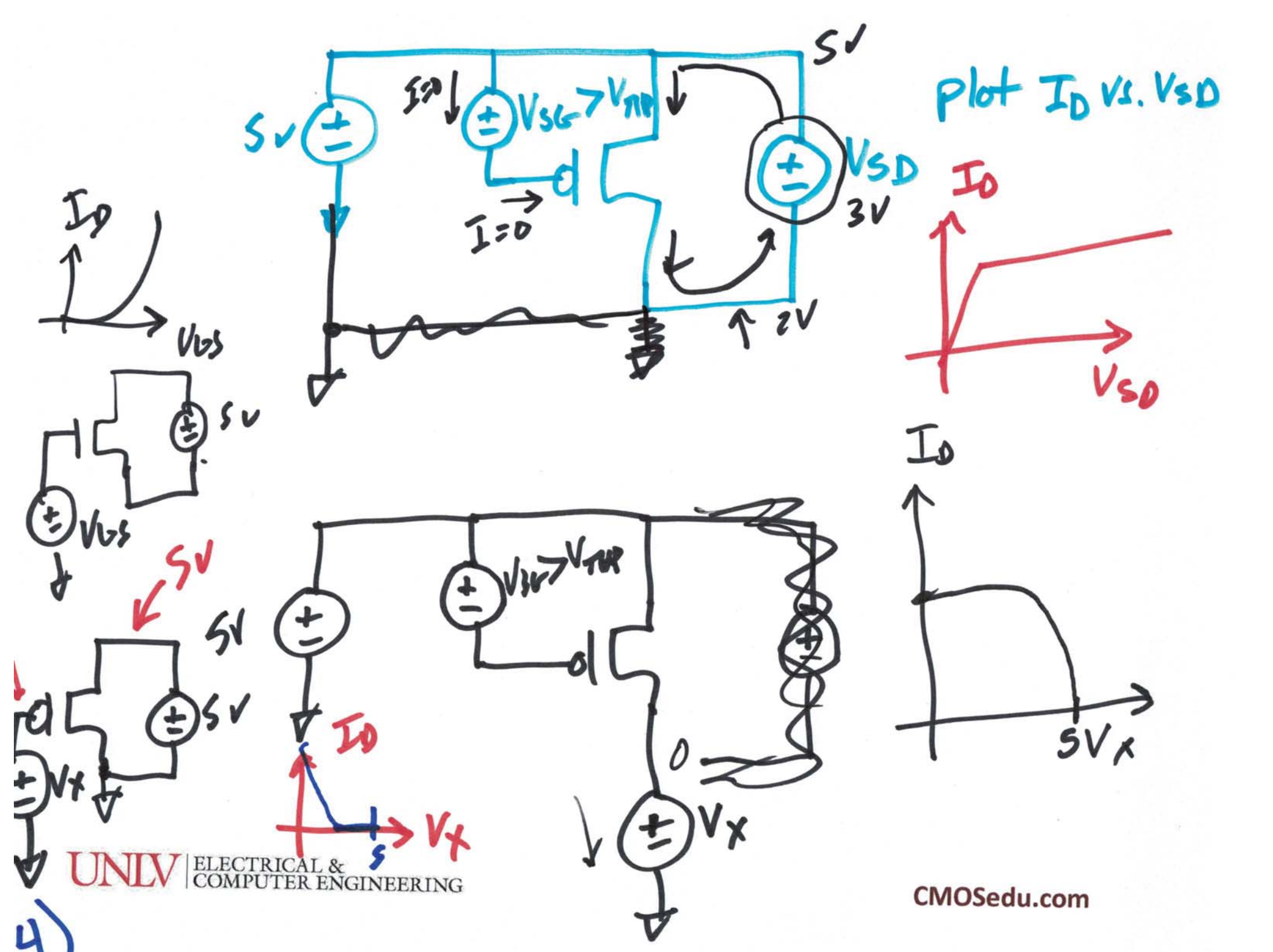


* MOSFET OPERATION, IV curves



sKetch V_{DS} v. I_D




Plot I_D vs. V_{SD}
I_D
V_{GS}
5V
$V_{GS} > V_{TH}$
$I=0$
V_{SD}
3V
2V
I_D
V_{SD}
5V
V_{GS}
5V
5V
5V
V_X
I_D
V_X
$V_{GS} > V_{TH}$
0
V_X
I_D
$5V_X$
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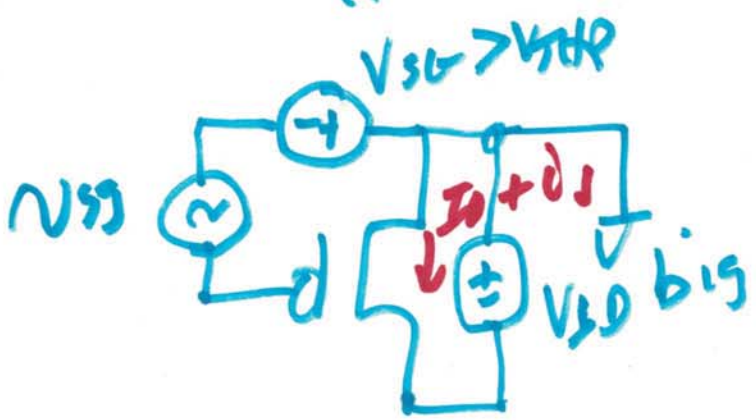
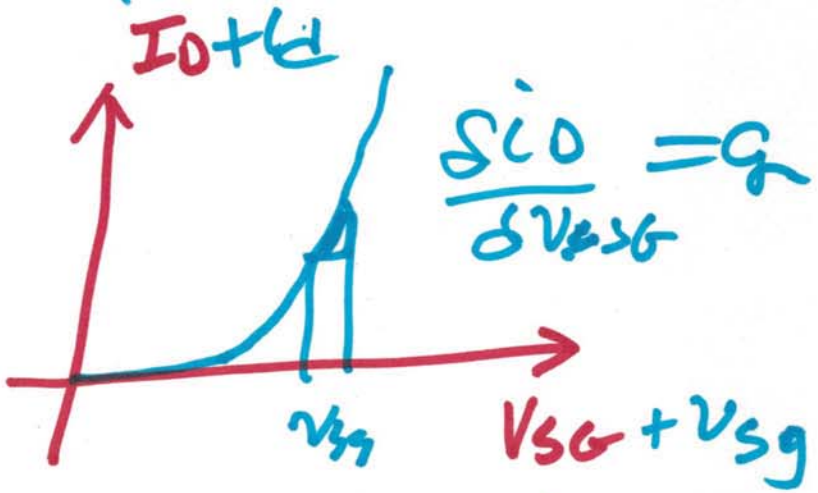
4)

$\frac{\delta(x-A)}{\delta t}$ ≡ Small-Signal parameters

How to derive & use g_m & r_o





$$I_D + i_d = \frac{K_P}{2} \cdot \frac{W}{L} \left(\underbrace{V_{SG} + V_{sg}}_{V_{SG}} - V_{THP} \right)^2$$

$$g_m \equiv \frac{\delta i_D}{\delta V_{SG}} \Bigg| = K_P \cdot \frac{W}{L} \left(V_{SG} + V_{sg} - V_{THP} \right)$$

$I_D = \text{const}$ $\quad V_{sg} << V_{SG}$

$V_{SG} = \text{const}$

How to select W, L, I_D

$g_m r_o$ $g_m r_o f_T \Rightarrow$ BFT

Why doesn't width influence the f_T of a transistor?

$C_{ox} = C_{ox}' \cdot W \cdot L$

$g_m r_o$ $r_o = \frac{1}{I_D \cdot \lambda}$

$\frac{\varepsilon_{ox}}{t_{ox}}$

$g_m = \sqrt{2 K_p' \frac{W}{L} I_D}$

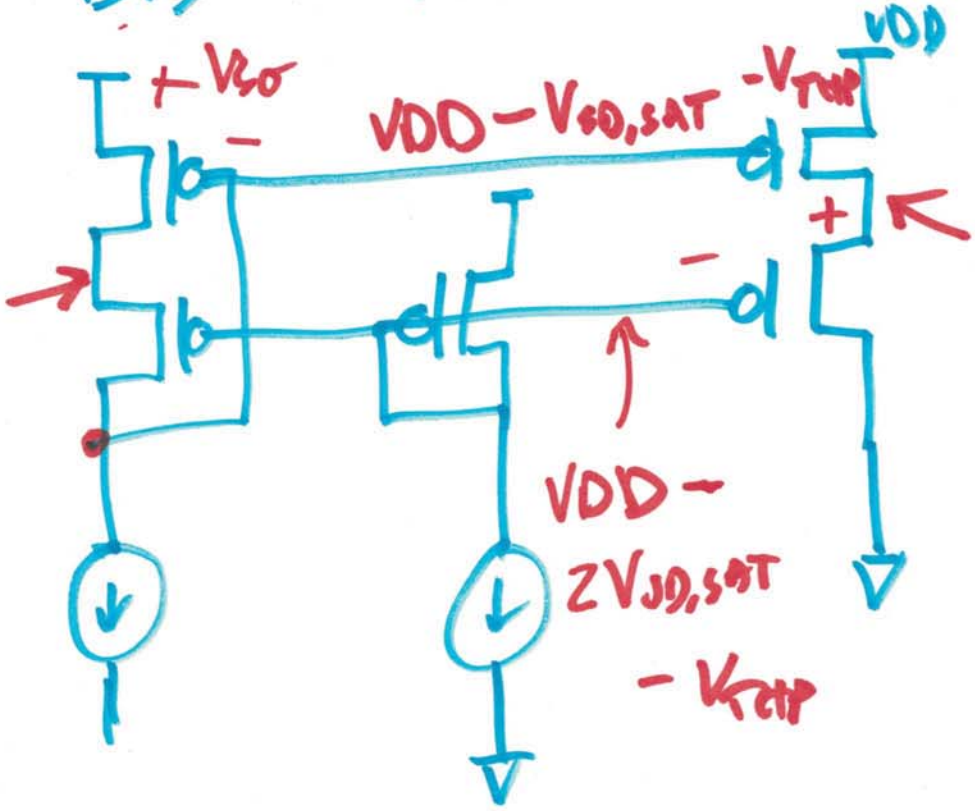
$I_D \downarrow \; g_m r_o \uparrow$

Study
- Quizzes
- EOC
- H.W.

Ch. 20

DC Biasing, Output Resistance topologies

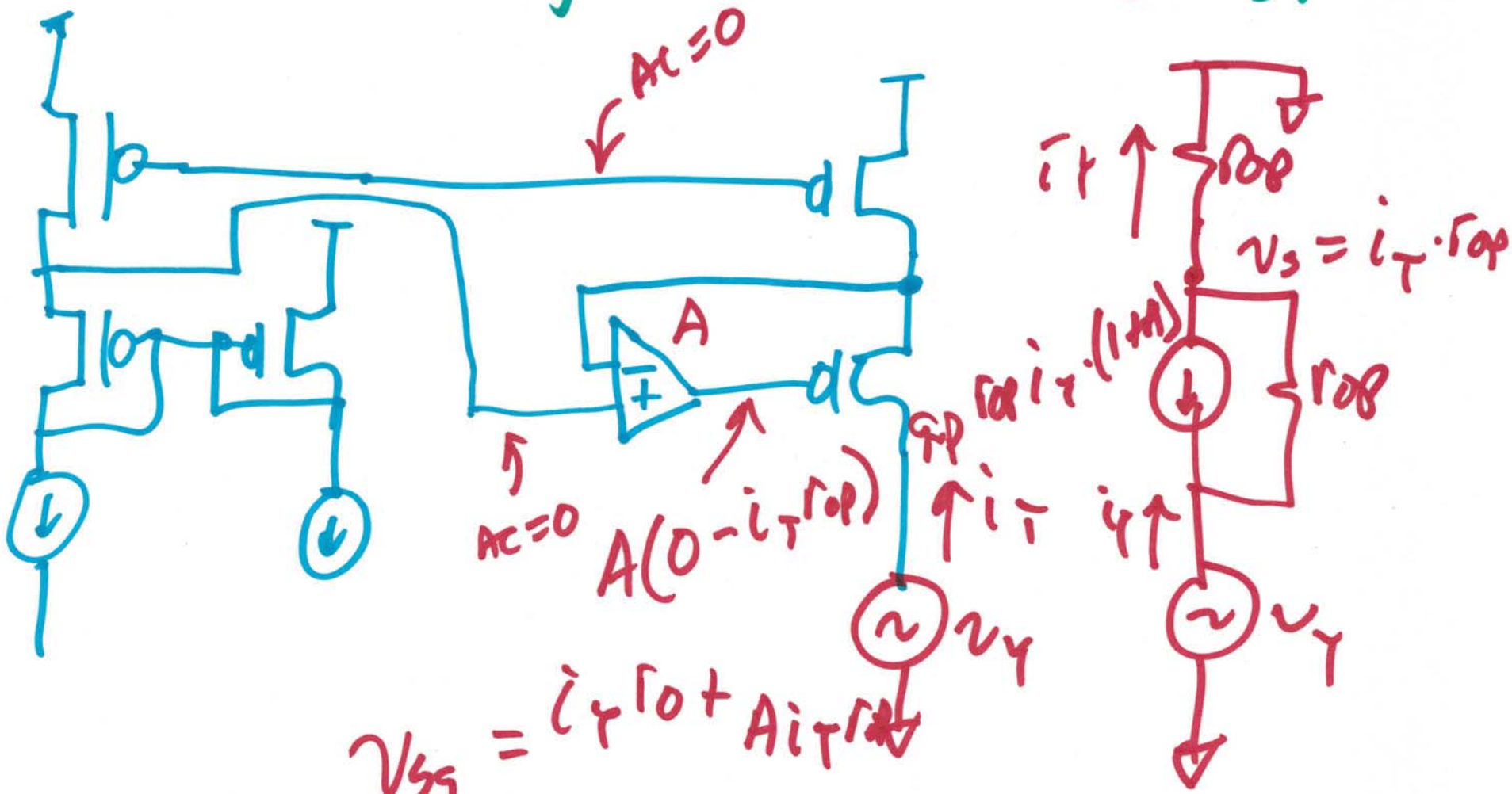
EX) in terms of $V_{SD,SAT}$ & V_{THP} & VDD



LABEL ALL DC Voltages in the following CKT

OUTPUT RESISTANCE

Regulated drain topology



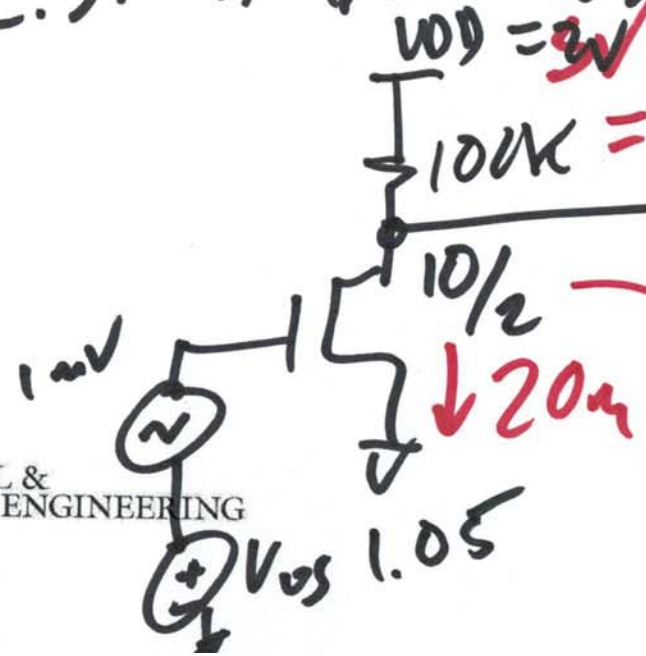
$$v_{sg} = i_T r_o + A i_T r_{op}$$

$$= i_T (1+A) r_{op}$$

Matching

BMR
- operation
- topologies
- start-up CKT
- qualitative questions about operation

C.S. Amps Using gate-drain loads



$V_{OUT} = -100K \cdot 1mA$

$i_d = 150u \cdot 1mV$