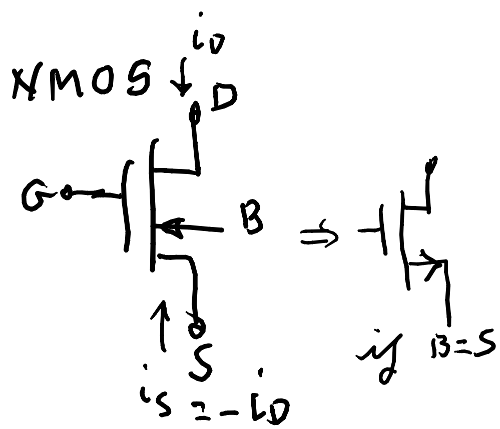
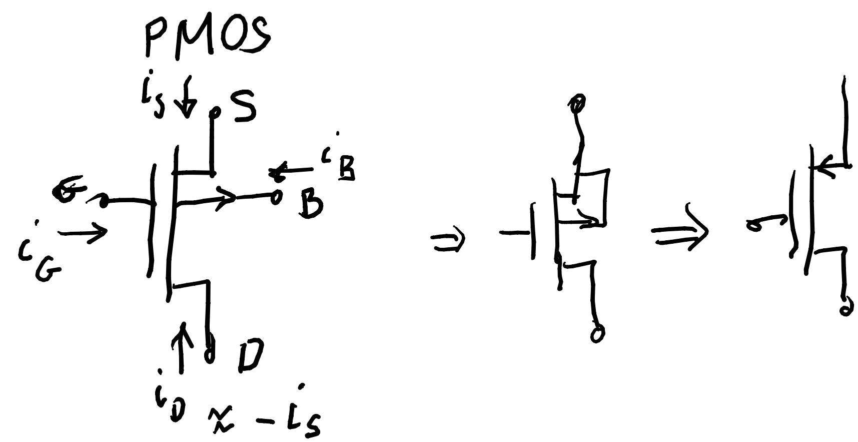
Note Title

02/02/11
EE 303

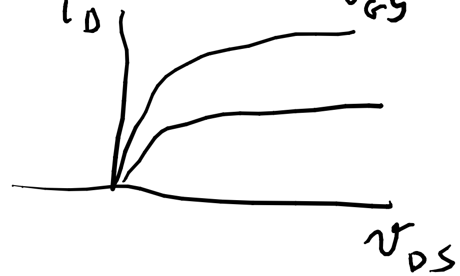
2/2/2011

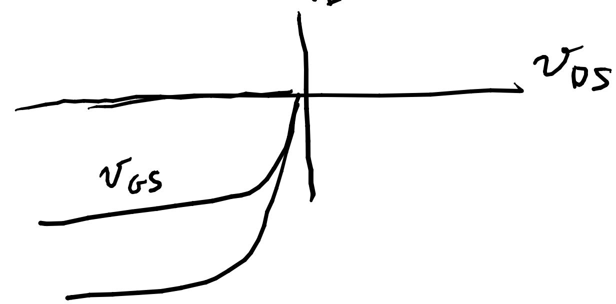
1. Next period & after, meet in CSI 1115
2. Homework new due date next M
3. on M bring a copy of preliminary choice of paper





NMOS

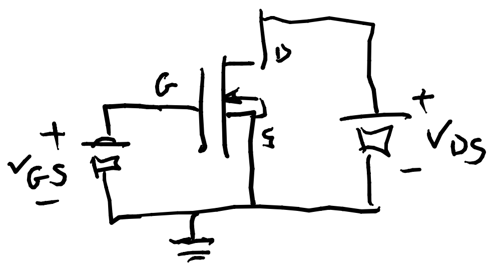


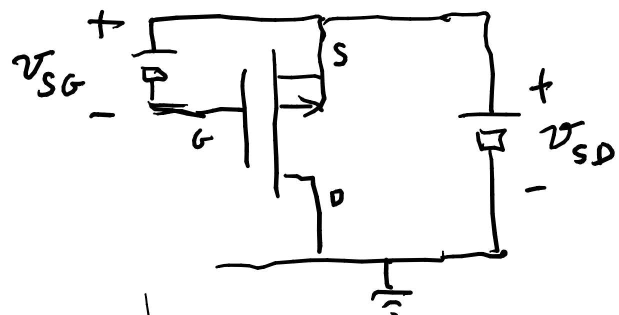


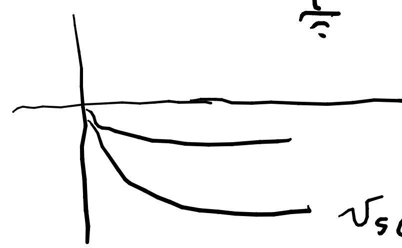
$\Rightarrow$ complentary

$\Downarrow$

CMOS
if NMOS &
PMOS







in saturation

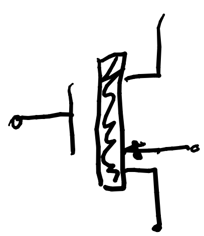
$$i_{D_n} = \frac{KP}{2} \cdot \frac{W}{L} \left(v_{GS_n} - VTO_n \right)^2 (1 + \lambda_n v_{DS_n}) \qquad i_{D_p} = -\frac{KP}{2} \cdot \frac{W}{L} \left(-v_{GS_p} - VTO_p \right)^2 (1 - \lambda_p v_{DS})$$

VTO = threshold voltage when B=S

(> 0 for NMOS enhancement mode

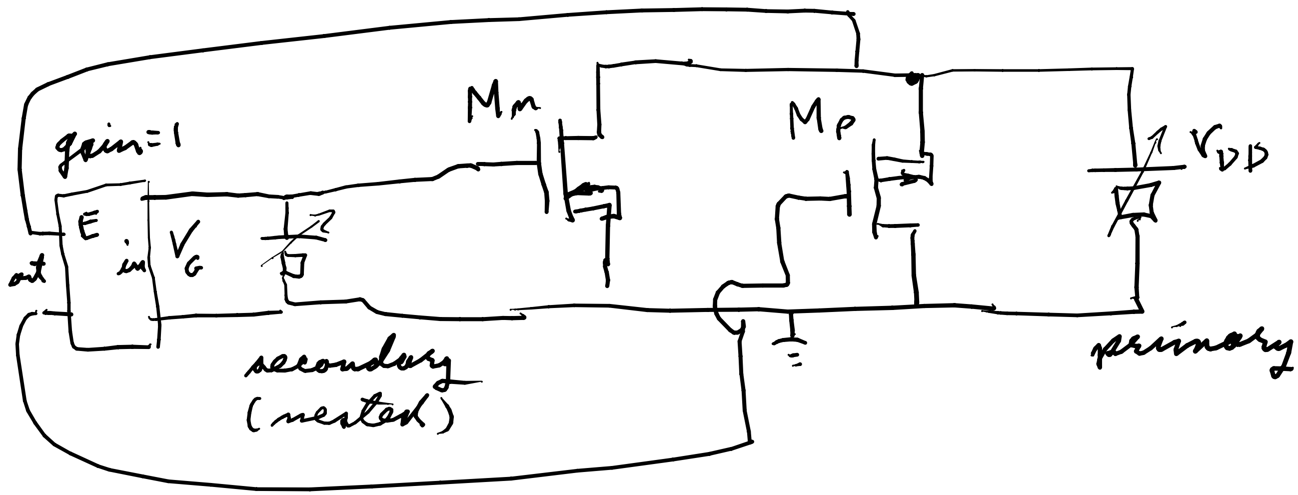
< 0 for PMOS " " mode

for depletion mode get opposite signs to these



depletion mode

To get both N & P MOS together with 2 sources



Voltage controlled voltage source VCVS } E in Spice analog library

(E_ & G_ value components are in ABM library

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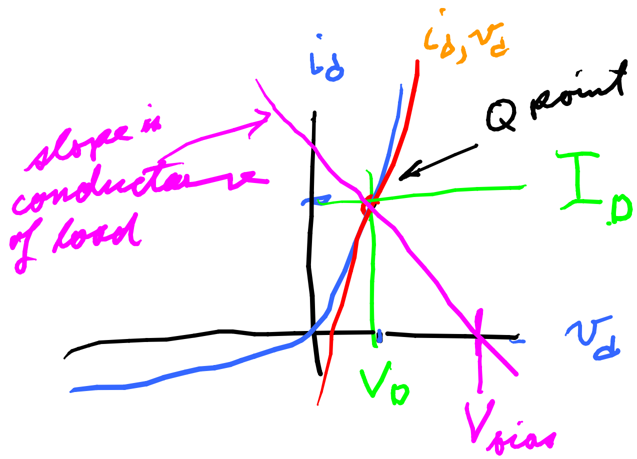
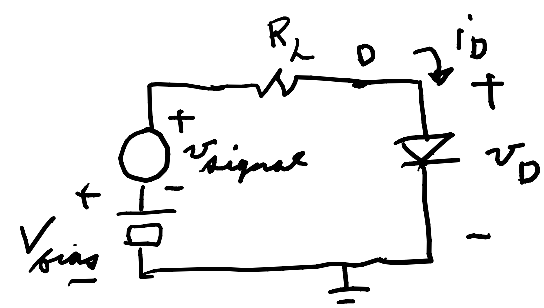
diode small signal behavior, p. 184 shows idea

$$i_D = I_D + i_d$$



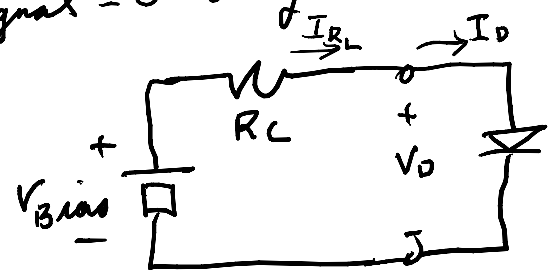
$i_D = I_D + i_d$

$v_D = V_D + v_d$

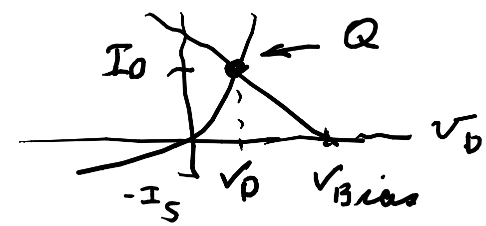


at $v_{signal} = 0$ only the bias circuit

$\frac{V_{Bias} - v_D}{R_L} = i_{R_L}$



at Q point operation



$i_D = I_S(e^{v_D/V_T} - 1) = G_L \cdot V_{BIAS} - G_L v_d$

↑ to get Q point

need to solve for $v_D = V_D$

For small signals, $|v_{signal}|$ small

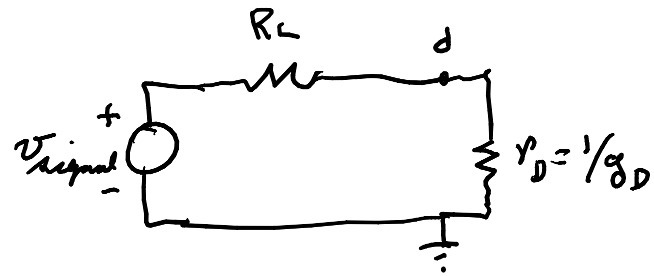
$$i_D = I_D + \frac{\partial i_D}{\partial v_D}\left(-[V_D - v_D]\right) + \frac{1}{2!}\frac{\partial^2 i_D}{\partial v_D^2}\left(-[V_D - v_D]\right)^2 + \cdots$$

drop these if $|v_{signal}|$ small

$$i_D - I_D = i_d$$

$$= \frac{\partial i_D}{\partial v_D} \cdot v_d = i_d = g_D \cdot v_d$$

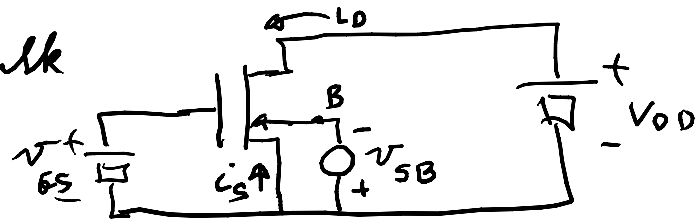
↑ diode conductance



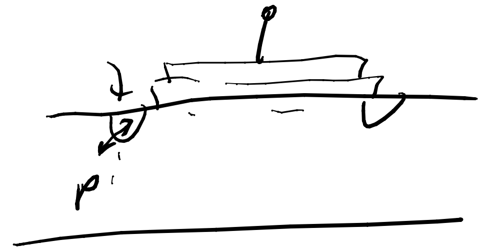
this is a (linear) small signal equivalent circuit

$$g_D = \frac{\partial}{\partial v_D}\left(I_S[e^{v_D/V_T} - 1]\right) = \frac{I_S}{V_T} \cdot e^{v_D/V_T}\Big|_{v_D = V_D}$$

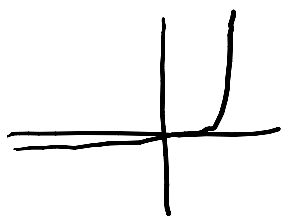
Look at bulk



$$i_S = -i_D + (-i_B)$$



back to diode



$\Rightarrow$ idealize