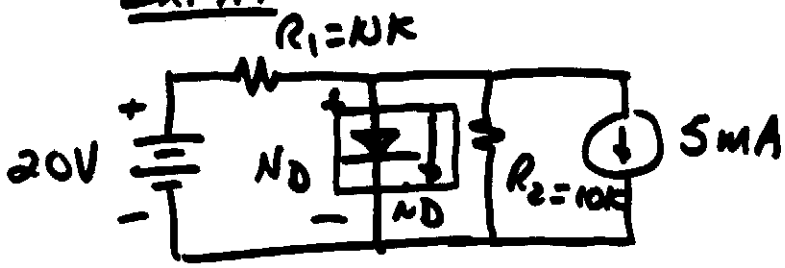
Diodes - Continued

Ex. 1.1



Find V_D & I_D if
$V_T = 0.025\,V$ and
$n = 1$ & $I_S = 100\,fA$

$V_{TH} = 10V - 5V = 5V$ $\quad R_{TH} = 5K$

SC-OC model:

$I_D = \frac{5V}{5K} \cong 1mA$

$V_D = 0$

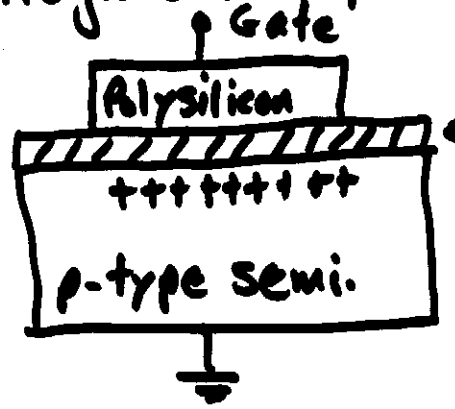
Guess at N_D	$i_D = \frac{5 - N_D}{5K}$	$i_D = I_S \exp\left(\frac{N_D}{V_T}\right)$
0.6	0.88mA	2.331 mA
↓	↓	↓
0.572	0.885mA	0.885mA

Multiple Diode CKts.

Examine all possible states and use a-priori knowledge to ~~indo~~ identify valid states.

Chapter 4 - Field Effect Transistors

1.) Regions of operation



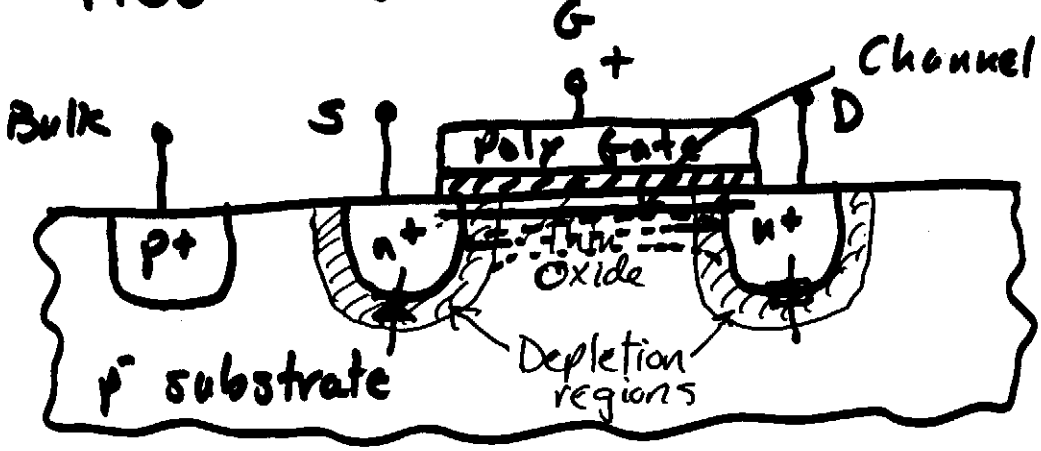
a.) Accumulation - the impurities > background impurities

b.) Depletion - the impurities are less than the background impurities.

c.) Inversion - the impurities are opposite type and greater than the background impurities

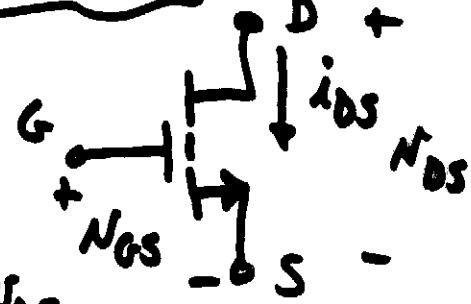
2.) Physical aspects of NMOS transistor

"MOS" - metal-oxide-semiconductor



3.) Large-signal model

a.) Linear region



$$i_{DS} = K_n' \frac{W}{L}\left[(v_{GS} - V_{TN} - \frac{v_{DS}}{2})\right] v_{DS}$$

$V_{TN} = V_{GS}$ where the channel is inverted

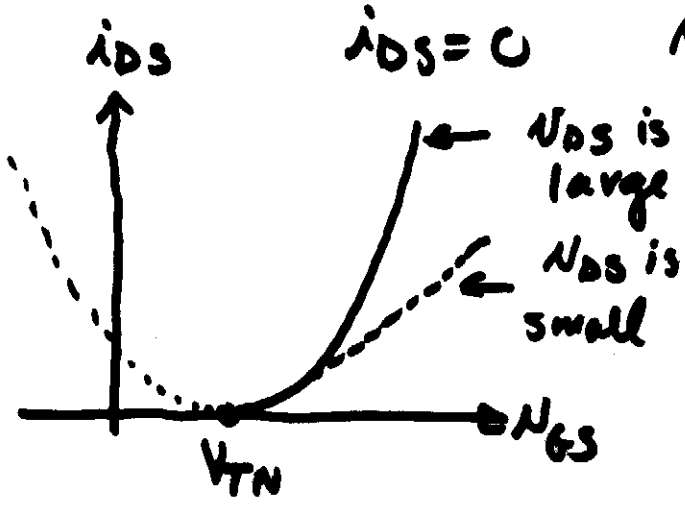
3.) Cont'd

b.) Saturation region

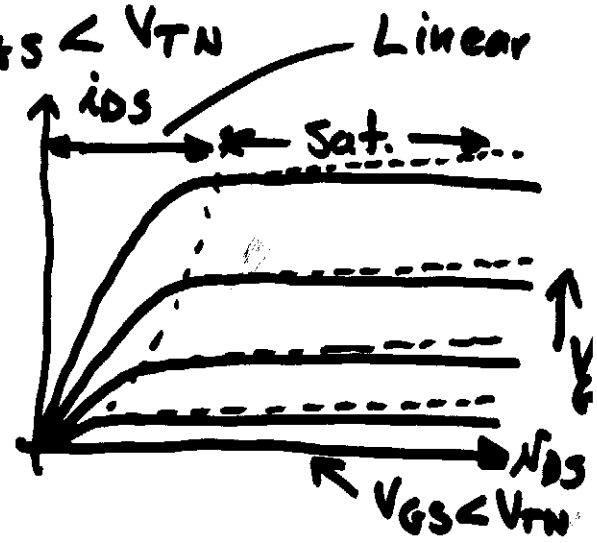
Small λ

$$i_{DS} = \frac{K_n' W}{2L}(v_{GS} - V_{TN})^2 (1 + \lambda v_{DS}) \qquad \lambda = \frac{1}{V_A}$$

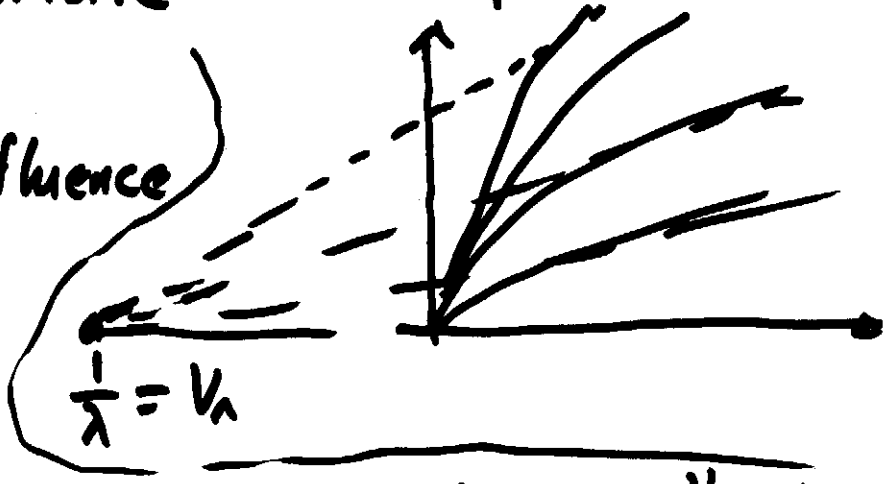
c.) Cutoff



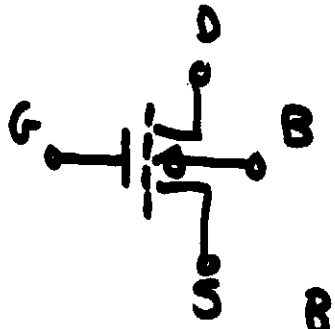
Transconductance Characteristic



Deep Submicron



4.) Bulk influence

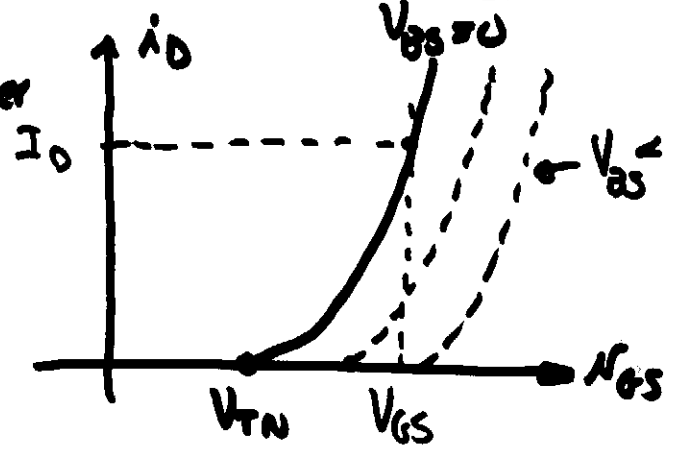


Model:

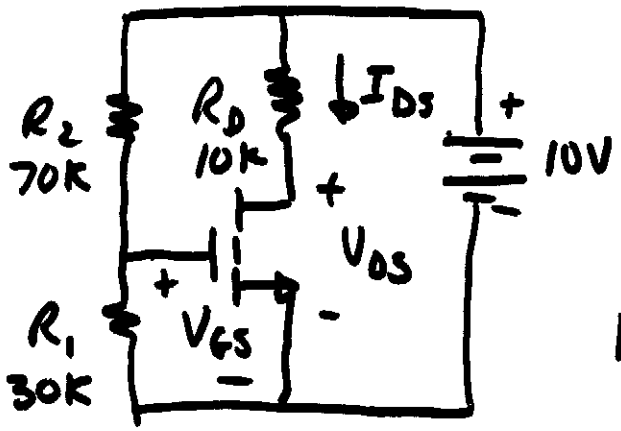
Bulk threshold parameter

$$V_{TN} = V_{TO} + \gamma\left(\sqrt{v_{SB} + 2\phi_F} - \sqrt{2\phi_F}\right)$$

ϕ_F = Fermi potential



5) Biasing the MOSFET

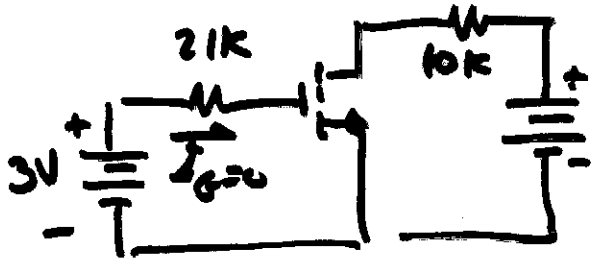


1.) Find the Thevenin eq. ckt. seen from the gate
2.) Assume sat.
3.) Solve for V_{GS}, V_{DS}, I_{DS}

Let $K_n' = 25\frac{mA}{V^2}$, $\frac{W}{L} = 10$, $V_{TN} = 1V$
$\lambda_N = 0$. Find Q point.

$V_{TH} = V_{GS} = \frac{R_1}{R_1+R_2}\,10V = 3V \longrightarrow \underline{\underline{V_{GS} = 3V}}$

$R_{TH} = R_1 \| R_2 = 21K$



$I_{DS} = \frac{K_n'}{2}\cdot 10(3-1)^2 = \underline{\underline{174\mu A}}$

$V_{DS} = 10 - (174\mu A)(10K)$

$= \underline{\underline{3.05V}}$

$V_{DS} = 3.05 \quad V_{GS} - V_{TN} = 2V \quad \therefore$ Sat.

$V_{DS} \geq V_{GS} - V_T \longrightarrow$ Cond. for saturation