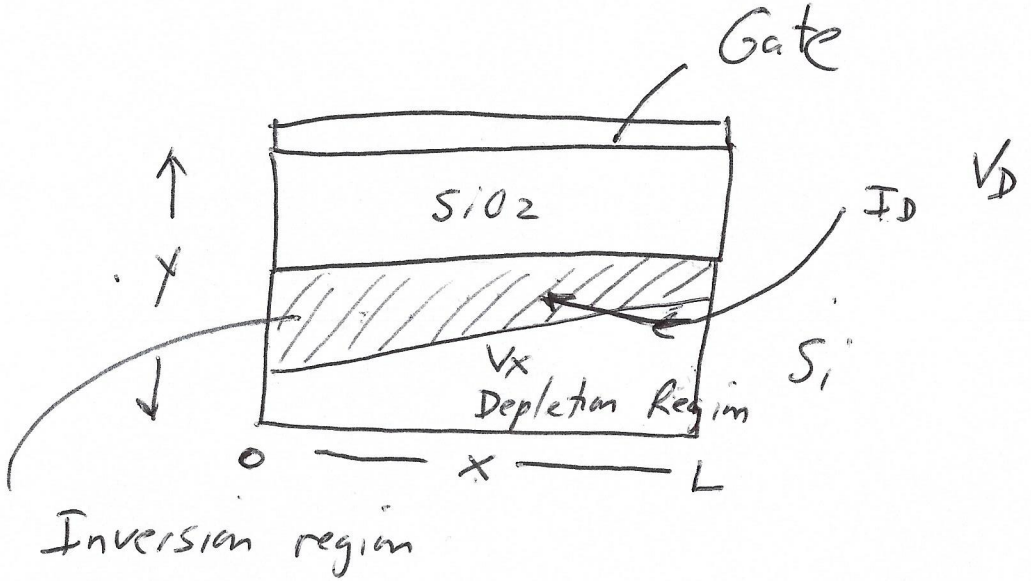
April 15th 2020

$$Q_n = -C_i\left[V_G - V_{FB} - 2\phi_F - V_x - \frac{1}{C_i}\sqrt{2q\epsilon_s N_a(2\phi_F + V_x)}\right]$$

$$= -C_i\left[V_G - V_T - V_x\right]$$

Conductance



dx → conductance goes as $\frac{\bar{\mu}_n Q_n(x) Z}{dx}$

$\bar{\mu}_n \equiv$ surface electron mobility

$Z \equiv$ channel width

$L \equiv$ channel length

$$I_D\,dx = \bar{\mu}_n Z \left| Q_n(x) \right| dV_x$$

. . . .

$$I_D = \frac{\bar{\mu}_n Z C_i}{L}\left[(V_G - V_T)V_D - \frac{1}{2}V_D^2\right] \qquad 6\text{-}49$$

$\hookrightarrow k_W$

$Q_d \equiv$ Charge associated depletion region
uncompensated ionized dopants

$$I_D = \frac{\bar{\mu}_n Z C_i}{L}\left[(V_G - V_{FB} - 2\phi_F - \frac{1}{2}V_D)V_D - \frac{2}{3}\frac{\sqrt{2\epsilon_s q N_a}}{C_i}\left[(V_D + 2\phi_F)^{3/2} - (2\phi_F)^{3/2}\right]\right]$$

Transconductance

$$g_{m(SAT)} \equiv \frac{\partial I_{D(SAT)}}{\partial V_G} \quad *$$

$$I_{D(SAT)} = \frac{1}{2} \bar{\mu}_n C_i \frac{Z}{L} \left(V_{D(SAT)}\right)^2$$

$$= \bar{\mu}_n C_i \frac{Z}{L} V_{D(SAT)}$$

$$= \bar{\mu}_n C_i \frac{Z}{L} (V_G - V_T)$$