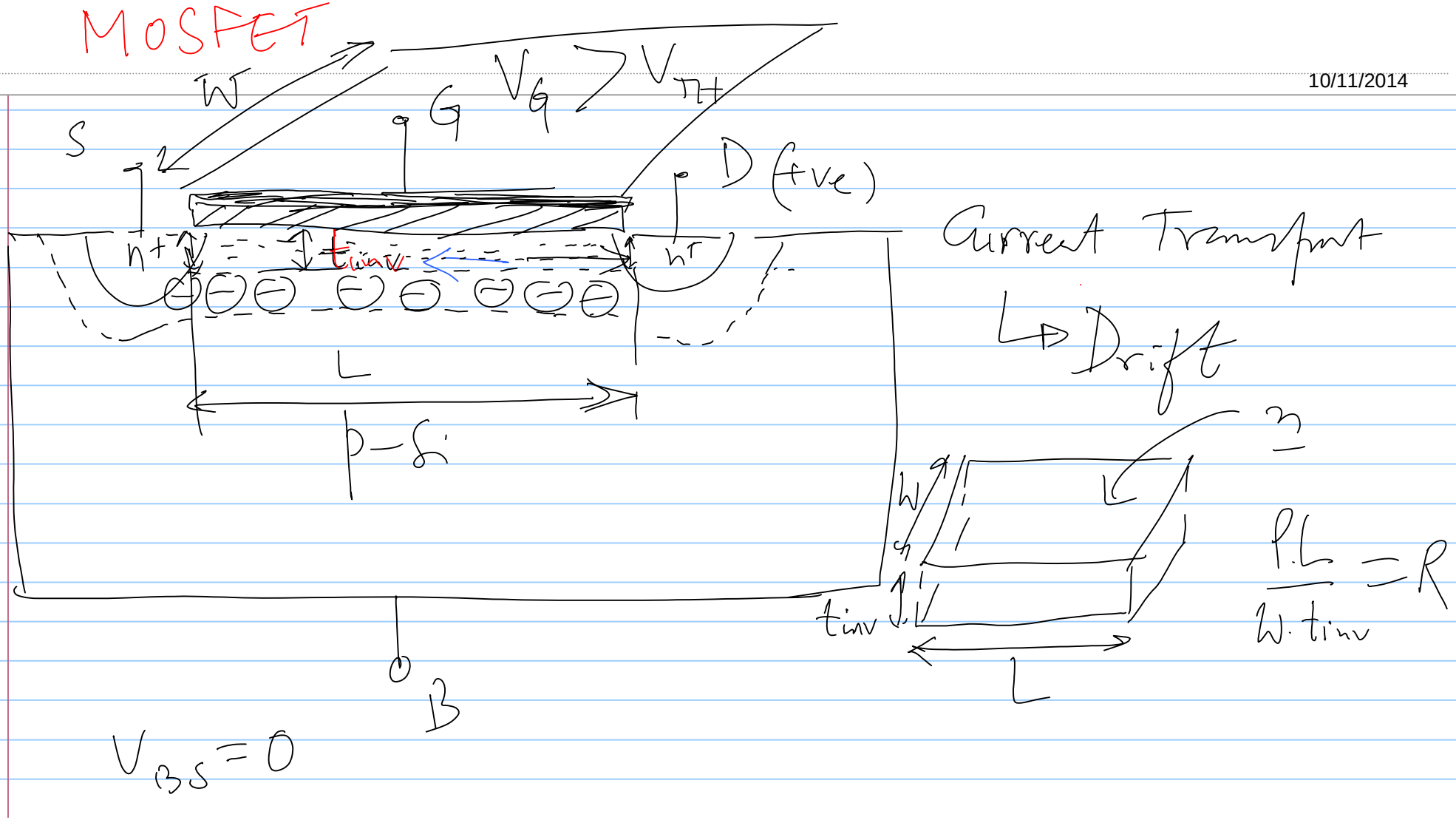
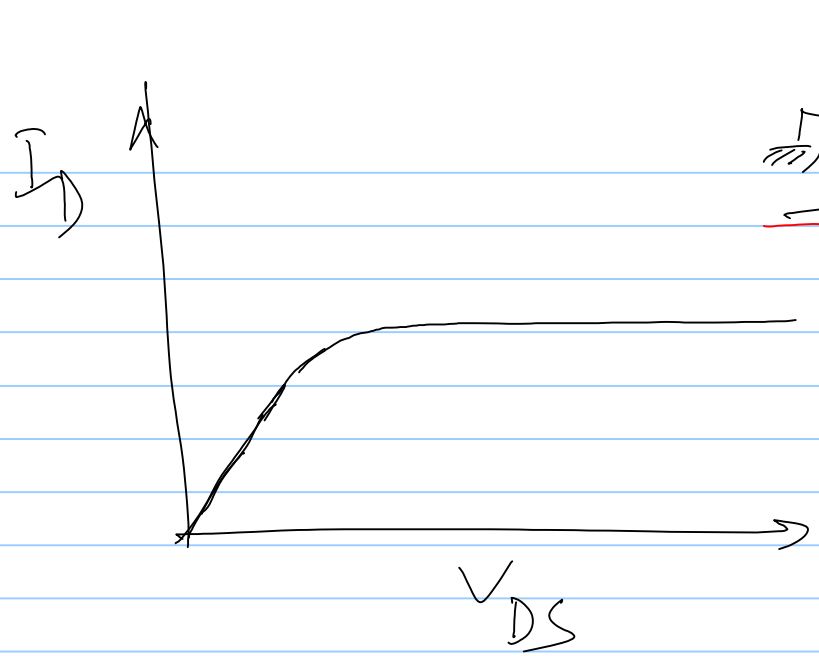
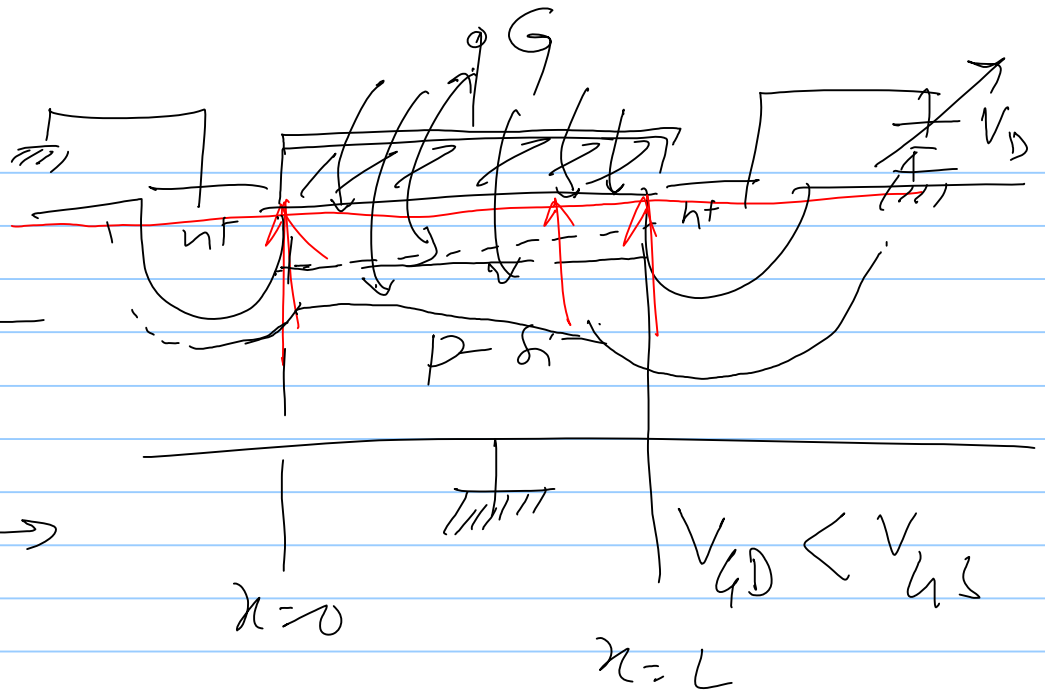
MOSFET

10/11/2014



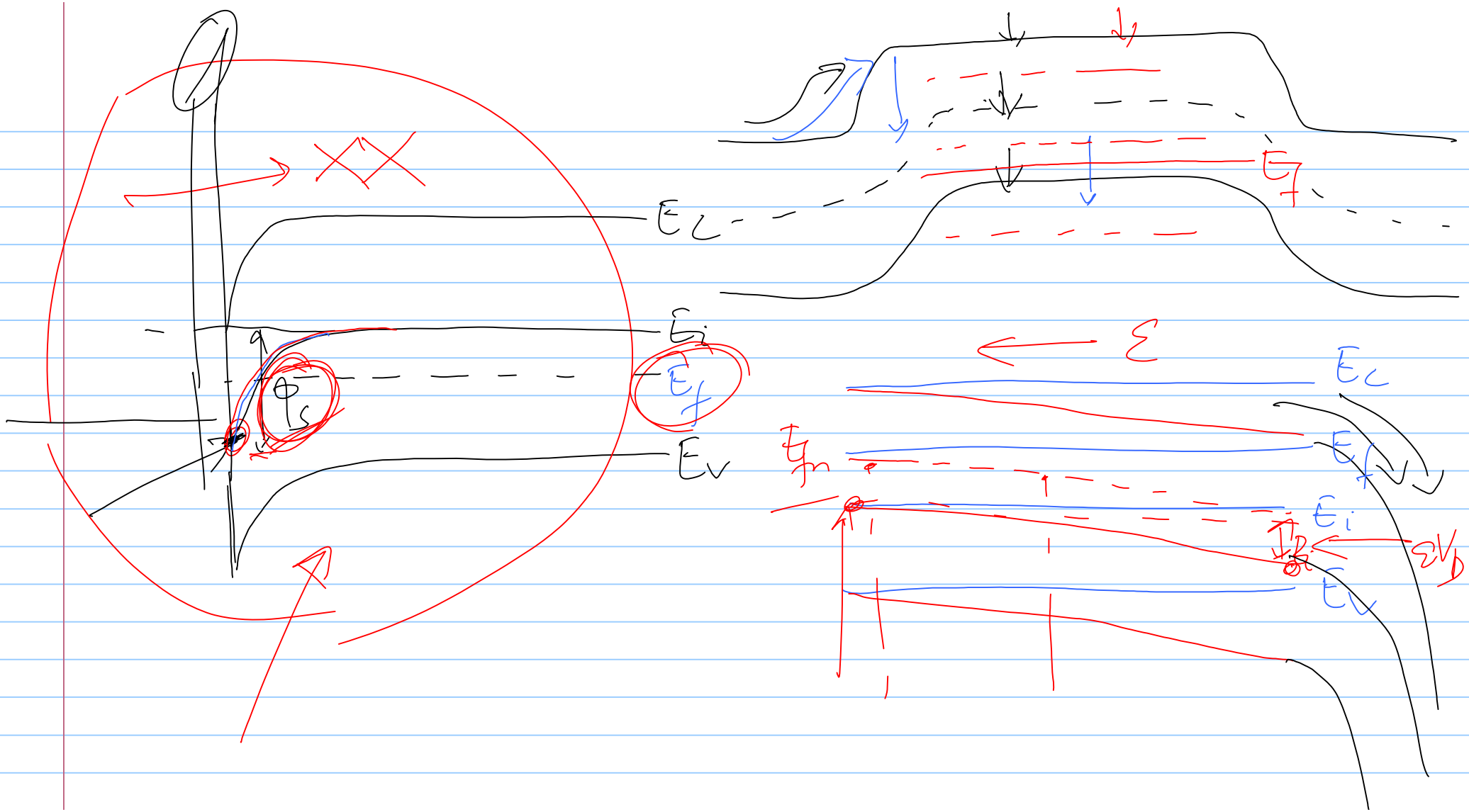


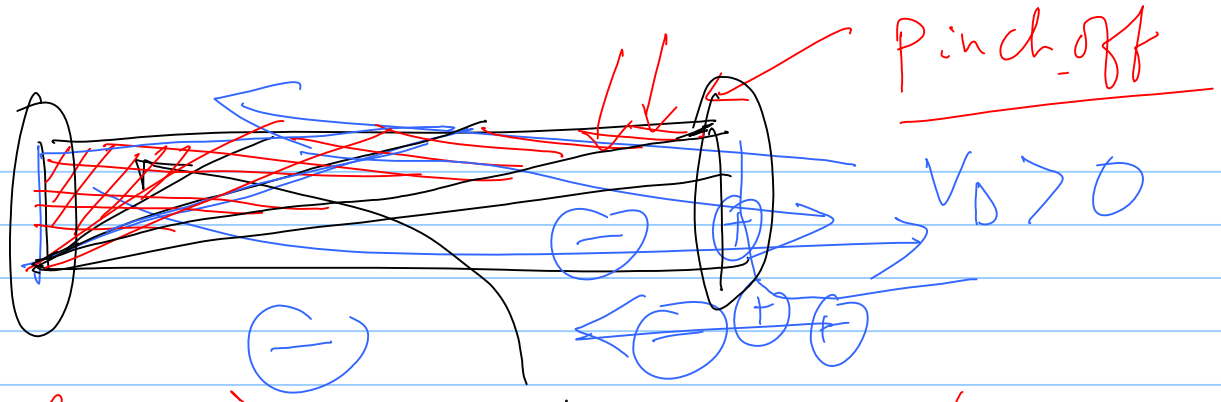


$V_{GC} = V_{GS}$ at $x=0$

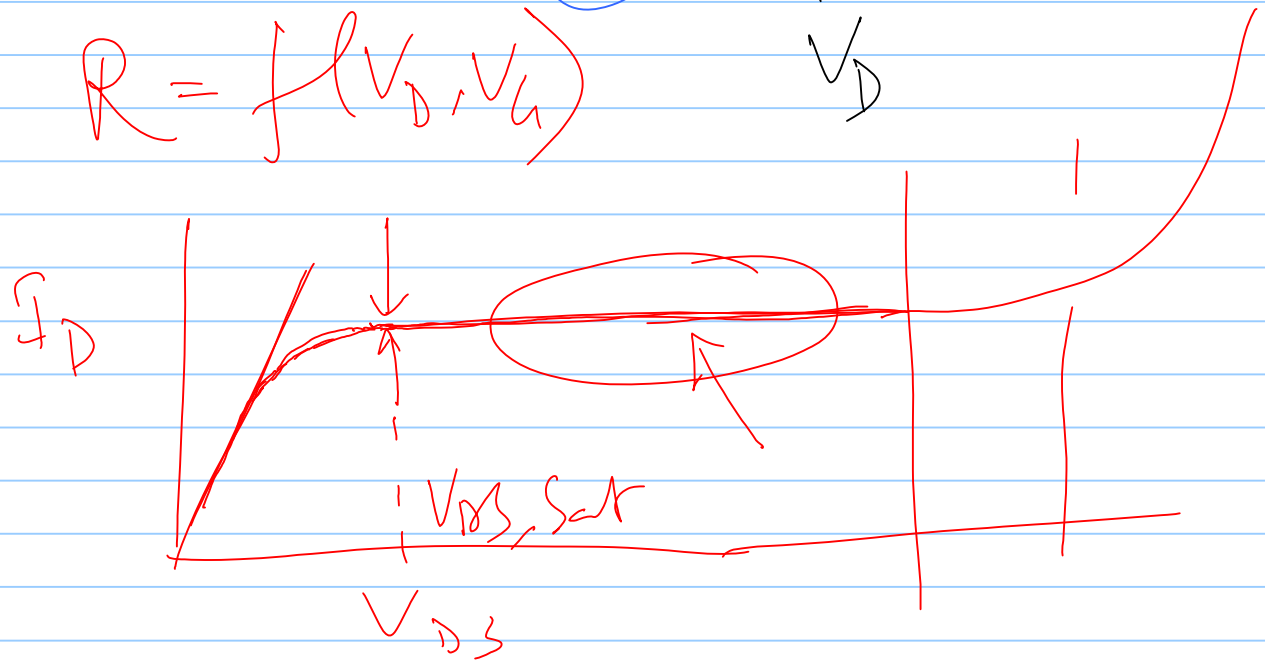
$V_{GC} = V_{GD}$ at $x=L$

C => Channel


E_C
E_i
ϕ_s
E_f
E_V
E_f
E_C
$\mathcal{E}$
E_{fn}
E_i
E_V
eV_b



$R = f(V_D, V_G)$



$$V_{GS} = V_{FB} + \phi_s - \frac{Q_s}{C_{ox}}$$

If $\phi_s = 2\phi_F$

$V_{GS} = V_{TH}$

$$= V_{FB} + \phi_s - \left(\frac{Q_{dep} + Q_{inv}}{C_{ox}} \right)$$

$$Q_{inv} = -C_{ox} \left[V_{GS} - V_{FB} - \phi_s + \frac{Q_{dep}}{C_{ox}} \right]$$

$$= -C_{ox} \left[V_{GS} - \left(V_{FB} + \phi_s - \frac{Q_{dep}}{C_{ox}} \right) \right]$$

At $V_{CS} = V_{TH}$, $\phi_s = 2\phi_F + V_R$

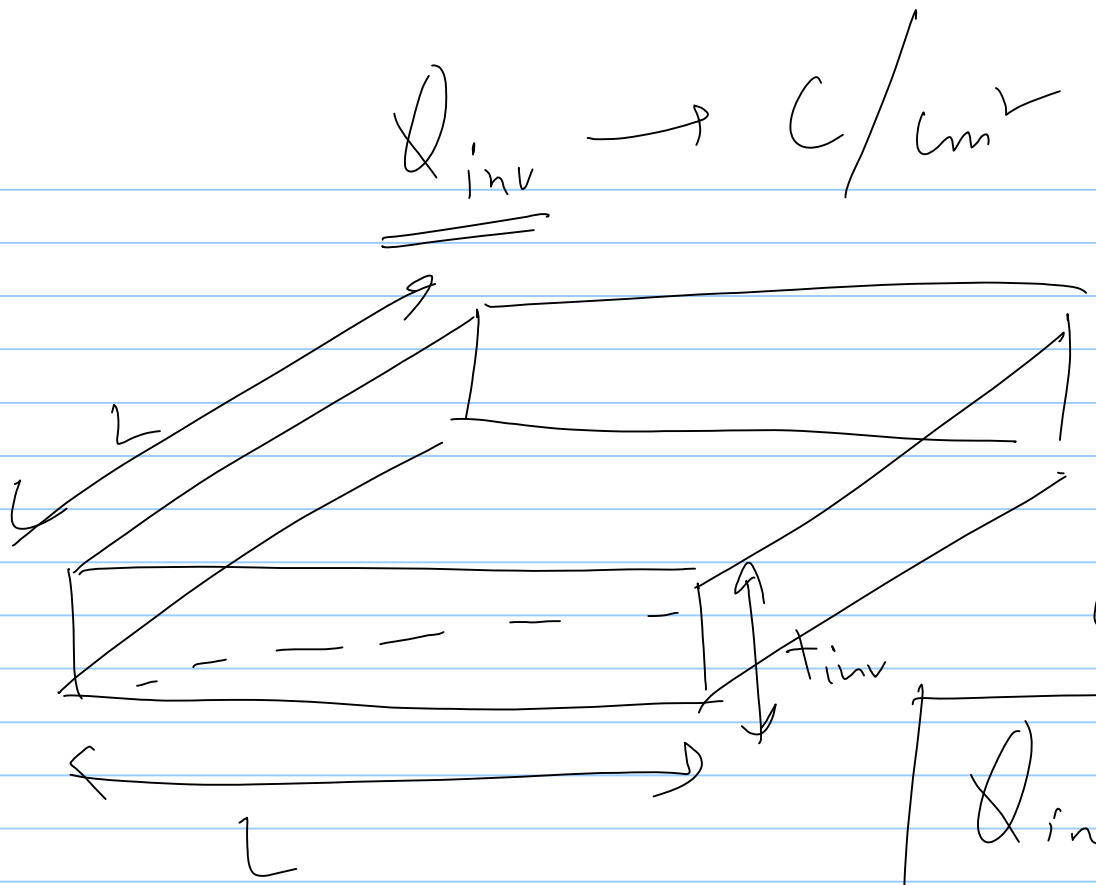
$$Q_{dep} = -\sqrt{2qN_A\varepsilon_{Si}(2\phi_F + V_R)}$$

$$Q_{inv} = -C_{ox}\left[V_{GS} - \left(V_{FB} + 2\phi_F + V_R - \frac{Q_{dep}}{C_{ox}}\right)\right]$$

$$= -C_{ox}\left[V_{GS} - \left(V_{FB} + 2\phi_F + V_R + \frac{\sqrt{2qN_A\varepsilon_{Si}(2\phi_F + V_R)}}{C_{ox}}\right)\right]$$

$$\boxed{Q_{inv} = -C_{ox}\left[V_{GS} - V_{TH} - V_R\right]}$$

$Q_{inv} \rightarrow C/cm^2$



$$q_n W L \cdot t_{inv} = Q_{inv}^{Total}$$

$$Q_{inv} = Q_{inv}^{Total} / WL.$$

$$\boxed{Q_{inv} = q_n t_{inv}}$$