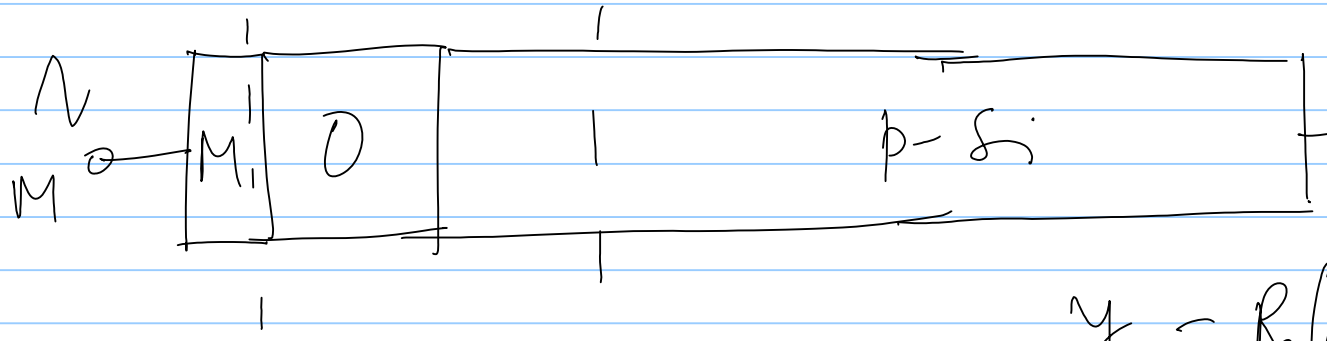
Capacitance - Voltage Characteristics of MOS

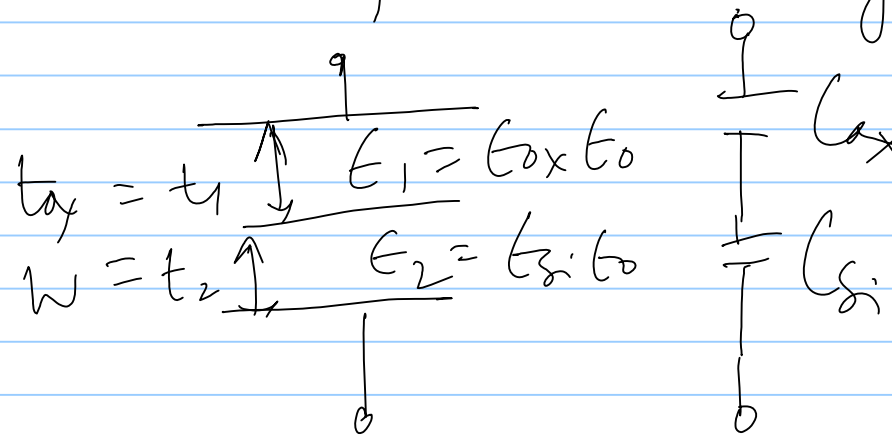
3/11/2014

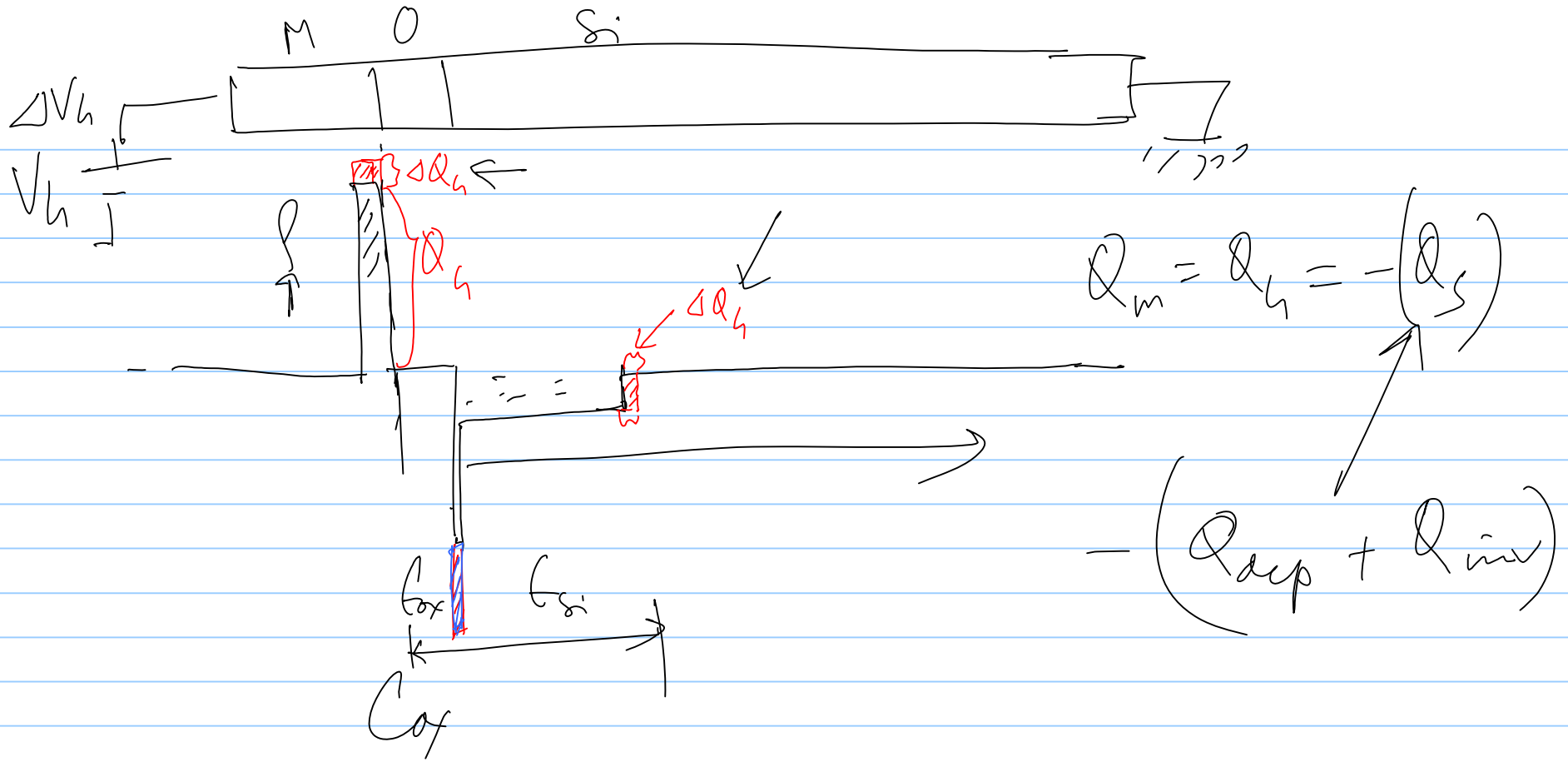


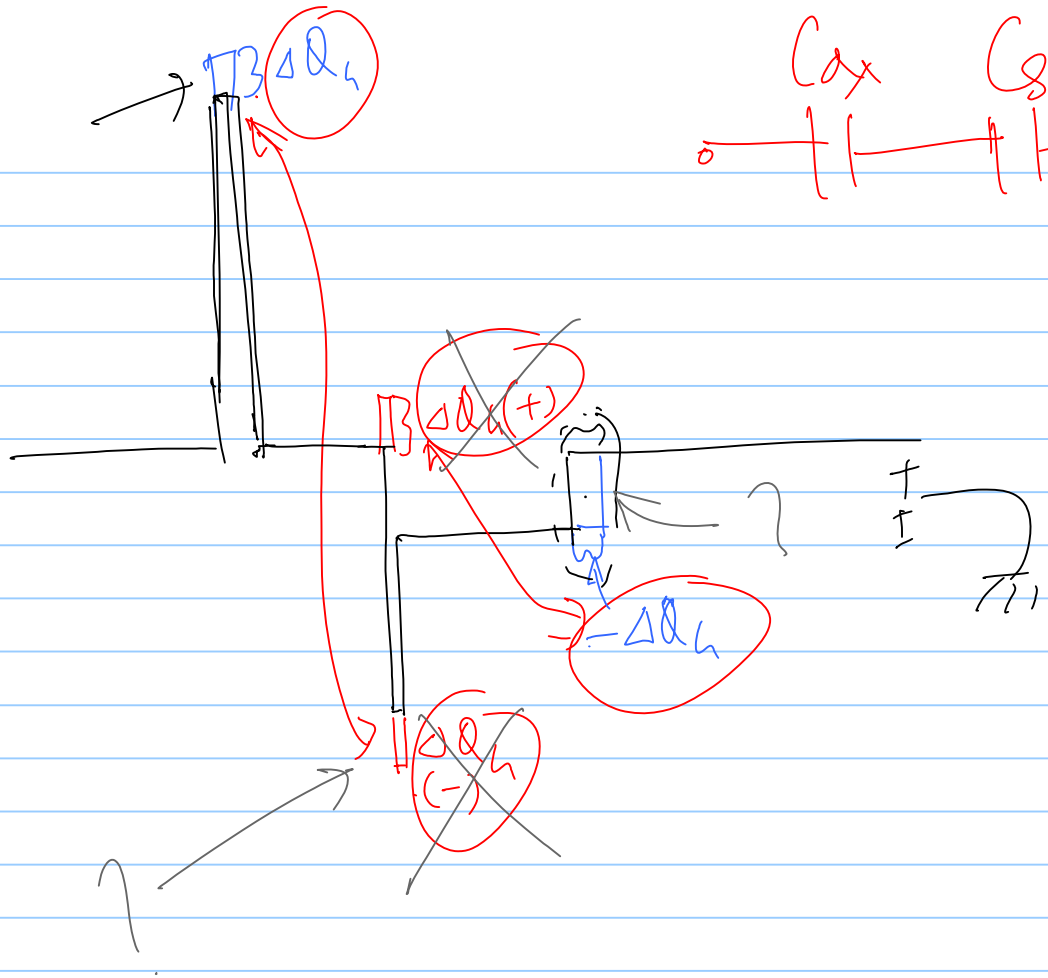
$$Y = R_e(M) + i\,I_m(Y)$$

$$R_e(M) = 0$$

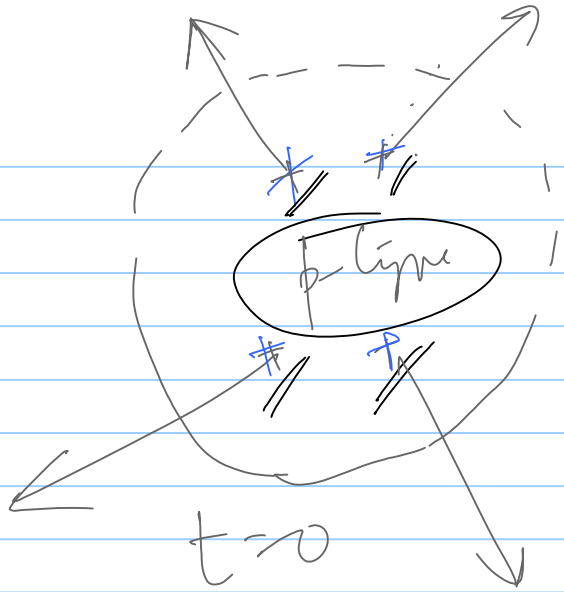
$$Y = i\,I_m(Y) = i\omega C$$

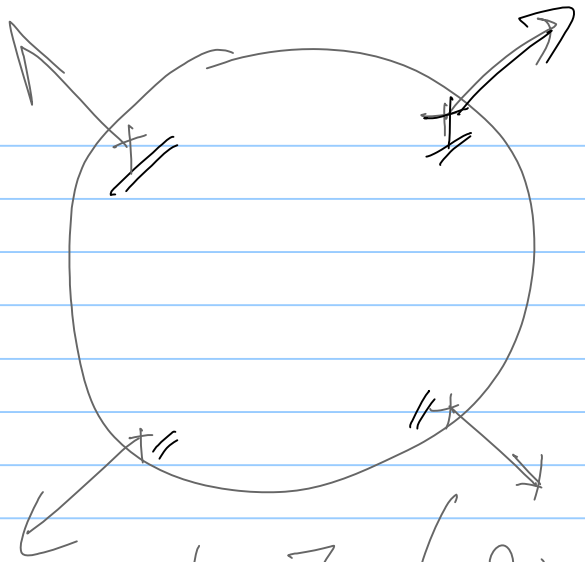



M
O
Si
ΔV_h
V_h
ΔQ_h
Q_h
ΔQ_h
C_{ox}
C_{si}
C_{ox}
$Q_m = Q_h = -(Q_s$
$-(Q_{dep} + Q_{inv})$



$$C = \frac{\Delta Q}{\Delta V}$$





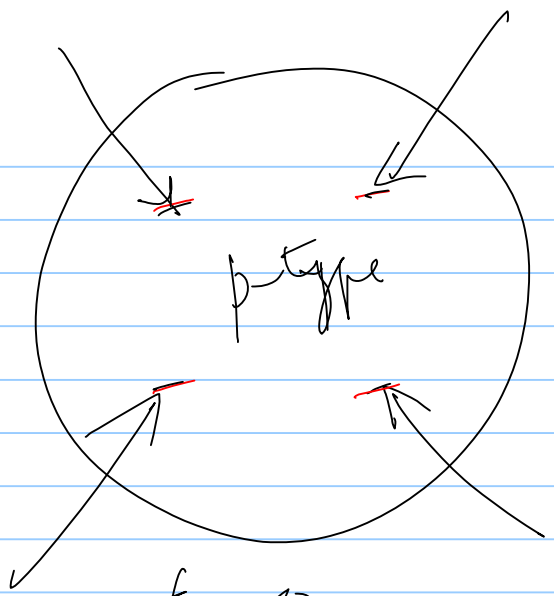
$t = \tau_d$ (dielectric time const)

$\sim 10^{-12}$ sec.

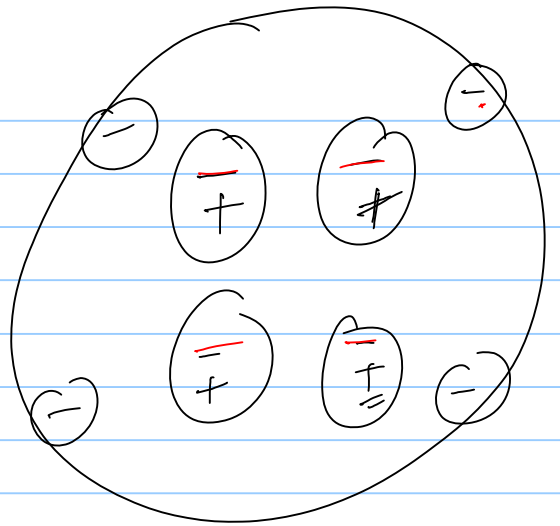
$\tau_d = \rho \cdot \epsilon_{Si} \epsilon_0$

$= 10\ \Omega\text{cm} \quad 11.8 \times 8.85 \times 10^{-14}\ \text{F/cm}$ (100)

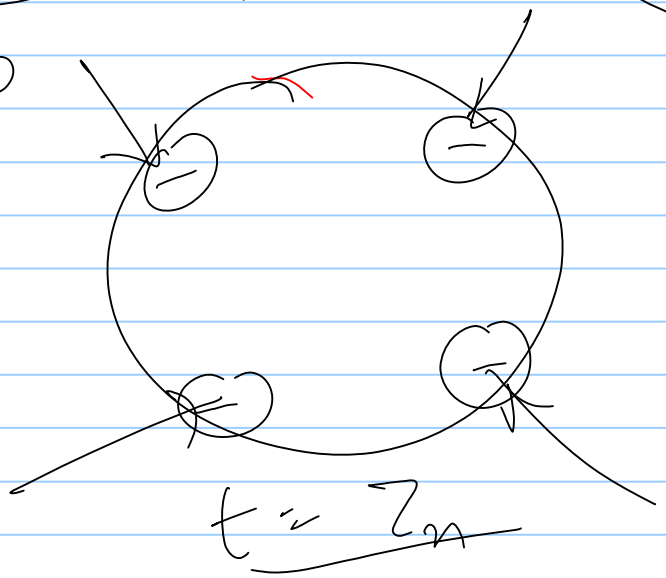
$= 10$ ps.



$t = 0$

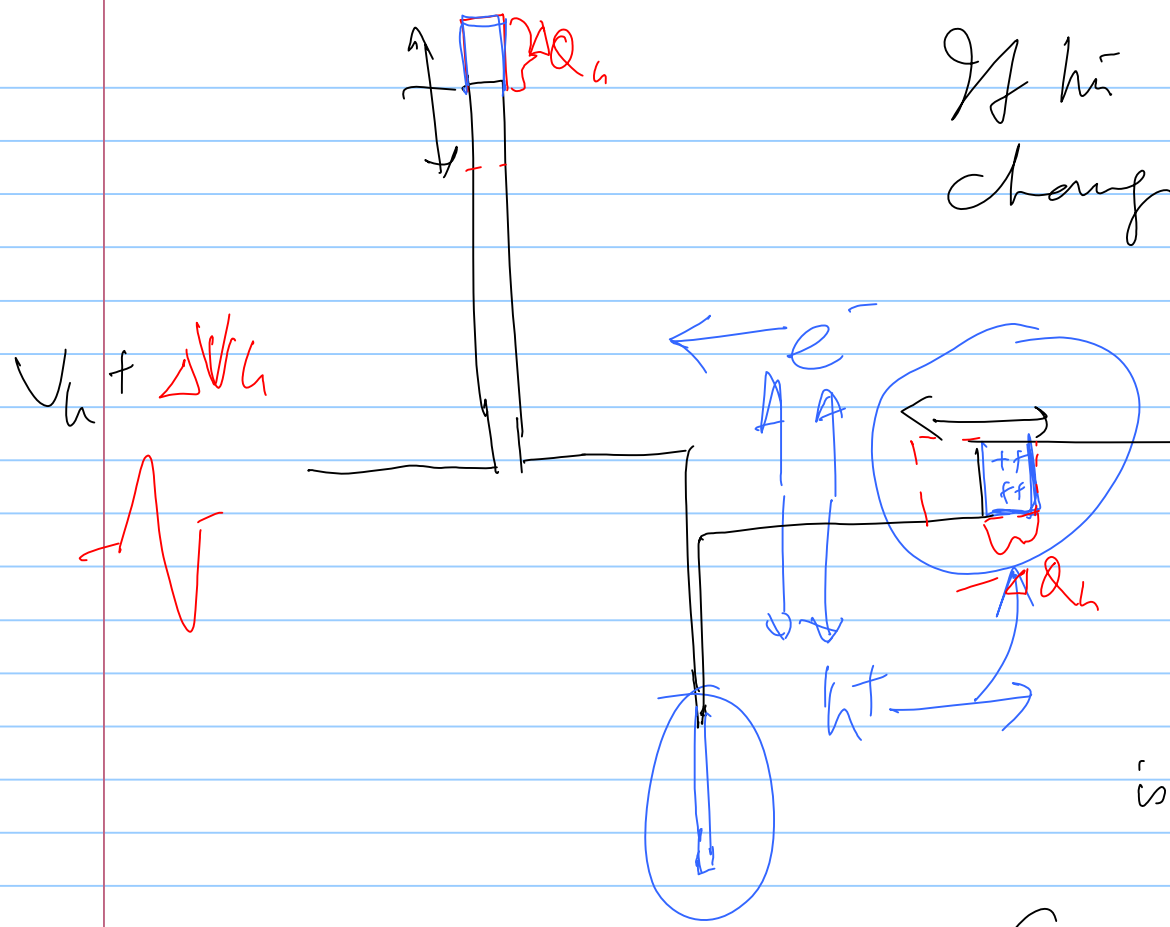


$t = \tau_d \sim \mu sec$



$t = \tau_n$

$\tau_n \sim \mu sec$

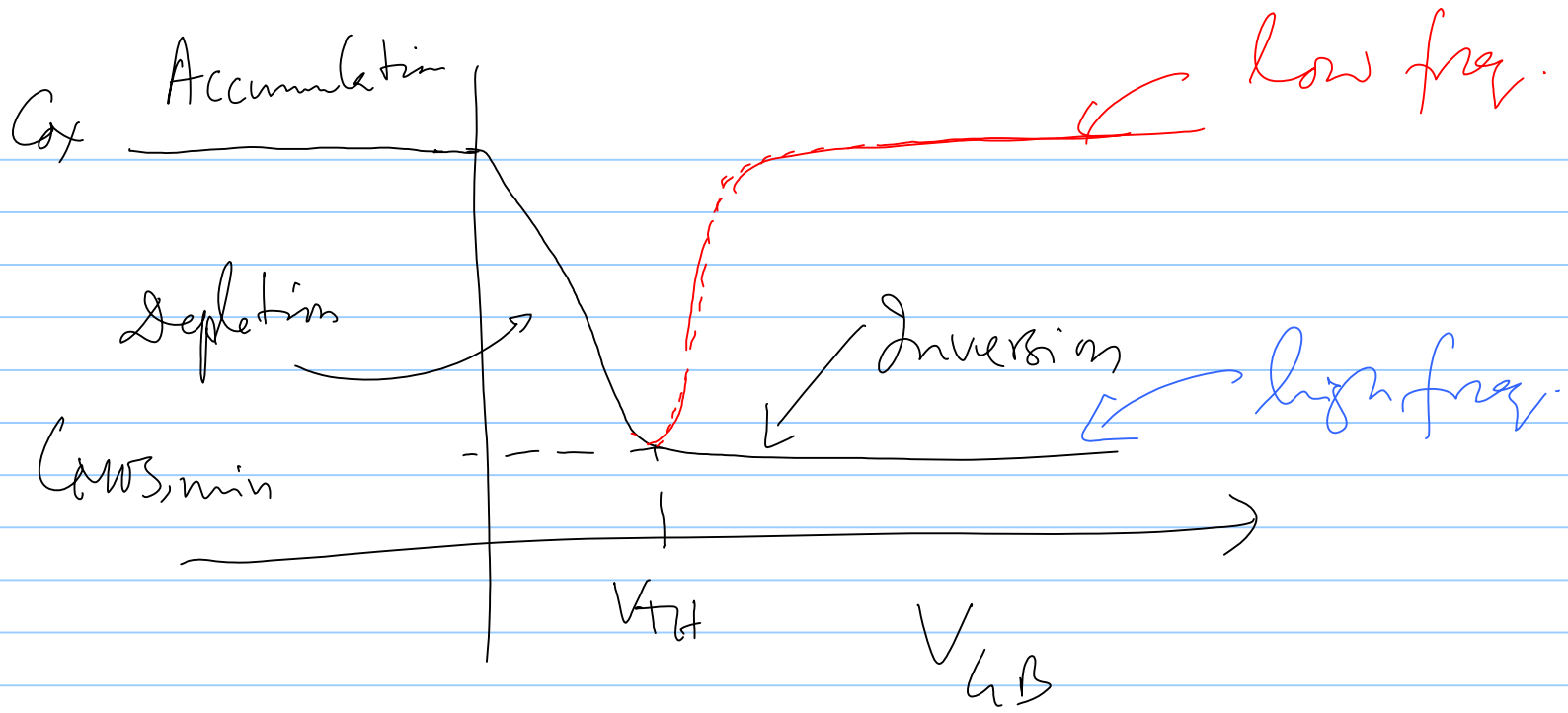


If the measuring ac signal is changing very fast (h.f. ac. signal)

C_{MOS} = C_{ox} in series with C_{Si}

If the measuring ac signal is too slow (l.f. ac. signal) (~ 100 Hz)

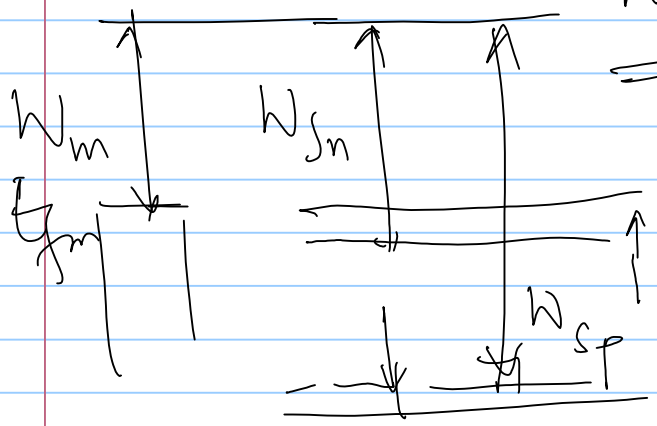
$C_{MOS} = C_{ox}$


Accumulation
C_{ox}
low freq.
Depletion
Inversion
high freq.
C_{min}
V_{TH}
V_{GB}

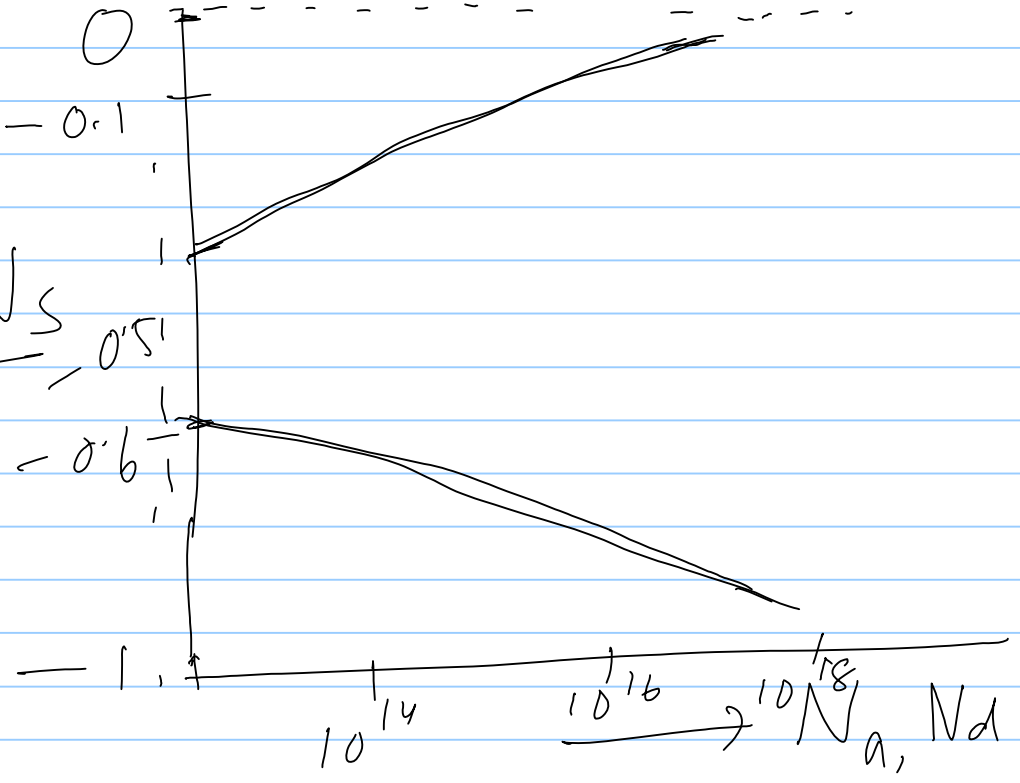
Real MOS Structure

Metal Work fn. ≠ Semiconductor Work fn.

Al – SiO_2 – Si



$W_M - W_S$



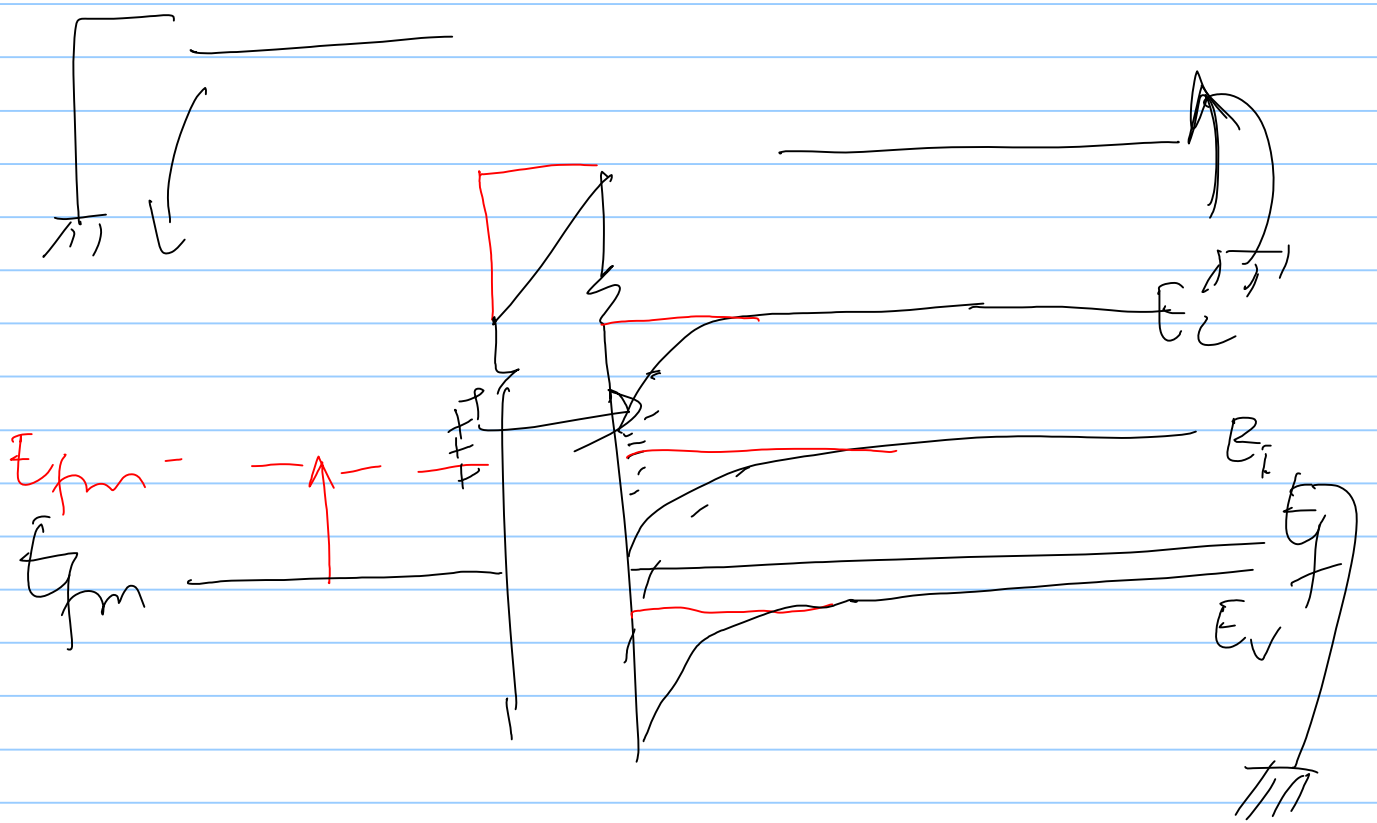
$W_M < W_S$

To Obtain

Flat Band

$V_G = V_{FB} = \frac{W_M - W_S}{q}$

$V_{FB} < 0$

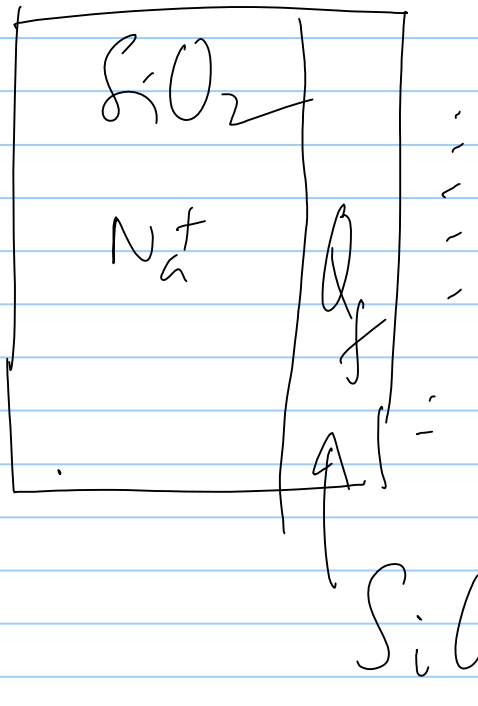


→ Surface of semicond. is dirty

Q_{it}

{100}

10^{10} q/C/cm²



(+ve) Q_{ox} ← Oxide Interface Charge

SiO_x

$$V_{FB} = -\frac{Q_{ox}}{C_{ox}}$$