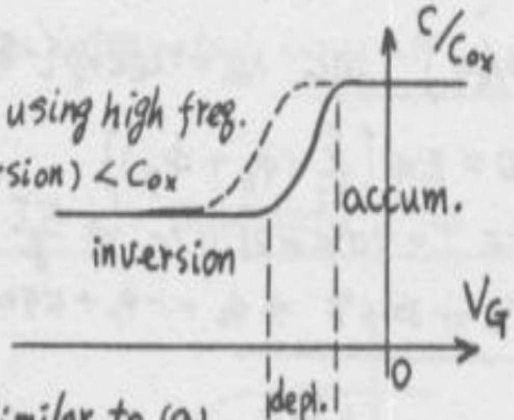
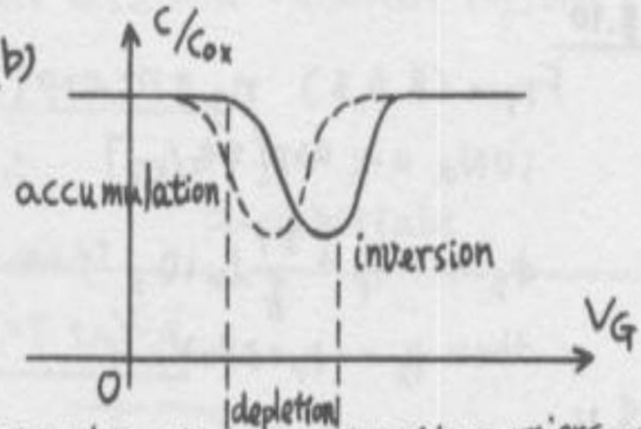
8.7

(a)

Because using high freq.
C (at inversion) $< C_{ox}$



(b)

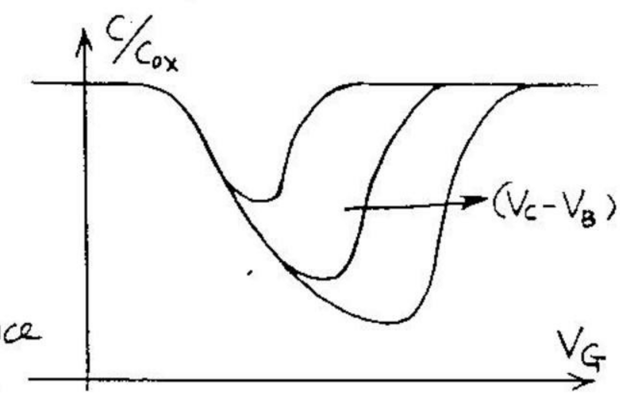


(C) Similar to (a)
but the n^+ type will make depletion and inversion at lower voltages than in part (a)

The n^+ supplies the minority carriers at inversion to make them follow the measuring signal even at high freq.

8.11

As $(V_C - V_B)$ is increased, the turn-on voltage is increased. The capacitance follows the deep-depletion $C-V_G$ curve until $V_G = V_T$ and then rapidly increases to the oxide capacitance as the surface becomes strongly inverted.



a) $C_{ox} = \frac{\epsilon_0 \epsilon_{ox}}{X_{ox}} \rightarrow X_{ox} = \frac{\epsilon_0 \epsilon_{ox}}{C_{ox}}$

$$X_{ox} = \frac{1.04\times10^{-10}}{3\times7\times10^{-4}} = \frac{1.04}{21}\, 10^{-6}\ m$$

$$\boxed{X_{ox} = 5\times10^{-6}\ cm.}$$

b) AT THRESHOLD: $C_{min} = \frac{C_{ox}\, C_{dmax}}{C_{ox} + C_{dmax}}$

$$C_{ox}C_{min} = (C_{ox} - C_{min})\, C_{dmax}$$

$$C_{dmax} = \frac{C_{ox}\, C_{min}}{C_{ox} - C_{min}} = \frac{\epsilon_0 \epsilon_s}{x_{dmax}}$$

$$x_{dmax} = \frac{C_{ox} - C_{min}}{C_{ox}\, C_{min}}\, \epsilon_0\epsilon_s = \left(\frac{1}{C_{min}} - \frac{1}{C_{ox}}\right)\epsilon_0\epsilon_s$$

$$= \left(1 - \frac{1}{7}\right)10^{4}\times 1.04\times10^{-10}\ m$$

$$= \frac{6}{7}\times 1.04\times10^{-6}\ m \approx \boxed{0.9\ \sout{\times10}\ \mu m}$$

c) $V_T = V_{FB} + 2|\phi_p| + \frac{1}{C_{ox}}\sqrt{2\epsilon_0\epsilon_s qN_a(2|\phi_p|)}$ $\qquad 2|\phi_p| = \frac{qN_a x_{dmax}}{2\, C_{dmax}}$

$$= V_{FB} + 2|\phi_p| + \frac{1}{C_{ox}}\sqrt{2\epsilon_0\epsilon_s qN_a \frac{qN_a x_d^2}{2\epsilon_0\epsilon_s}}$$

$$= V_{FB} + 2|\phi_p| + \frac{1}{C_{ox}}\, qN_a x_d$$

$$= V_{FB} + qN_a x_d\left[\frac{1}{2C_{dmax}} + \frac{1}{C_{ox}}\right]$$

~~$qN_a x_d = 1.6\times10^{-19}\times10^{15}\times0.9\times10^{-4}$~~

~~$qN_a x_d = 1.5\times10^{-8}\ C/cm^2$~~

$$V_{FB} = V_T - qN_a x_d\left[\frac{1}{2C_{dmax}} + \frac{1}{C_{ox}}\right]$$

$$= 1.1 - qN_a\,\epsilon_0\epsilon_s\left(\frac{1}{C_{min}} - \frac{1}{C_{ox}}\right)\left(\frac{1}{2C_{dmax}} + \frac{1}{C_{ox}}\right)$$

$$= 1.1 - 1.6\times10^{2}\times1.04\times10^{-10}\left(1 - \frac{1}{7}\right)\left(\frac{1}{2}\left(1 - \frac{1}{7}\right) + \frac{1}{7}\right)10^{-8}$$

$$= \left(1.1 - 1.6\times1.04\ \frac{6}{7}\cdot\frac{4}{7}\right)V = \left(1.1 - 1.6\times1.04\ \frac{24}{49}\right)V = (1.1 - 0.83)\,V = \boxed{0.27\,V}$$