1) $N_a = 10^{18} \text{ acc/cm}^3$ $N_d = 10^{14} \text{ don/cm}^3$ $a = \frac{W}{2} = 1\mu m$ $\epsilon = 11.7 \times 8.85 \times 10^{-14}$
$= 10^{-4} cm$ $= 1.04 \times 10^{-12}$

$n_i = 1.5 \times 10^{10} cm^{-3}$

$V_p = \frac{qa^2 N_d}{2\epsilon} = \boxed{7.7 \text{ V}}$ $V_0 = \frac{kT}{q} \ln\left(\frac{N_a N_d}{n_i^2}\right) = \boxed{0.82 \text{ V}}$
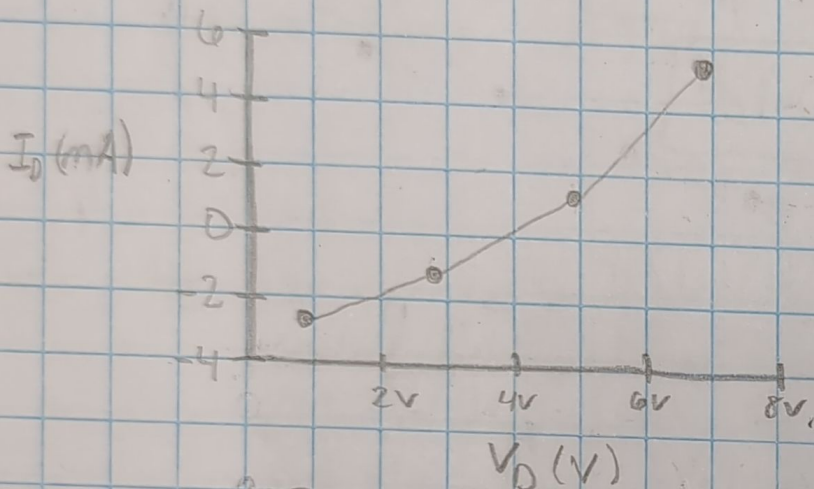
$V_T = -V_{GO} = V_p - V_0 = \boxed{6.8 \text{ V}}$ $V_{D(sat)} = V_T' + V_G = \boxed{3.8 \text{ V}}$

2) $Z/L = 10$ $\mu_n = 1000 \ cm^2/V\text{-}s$

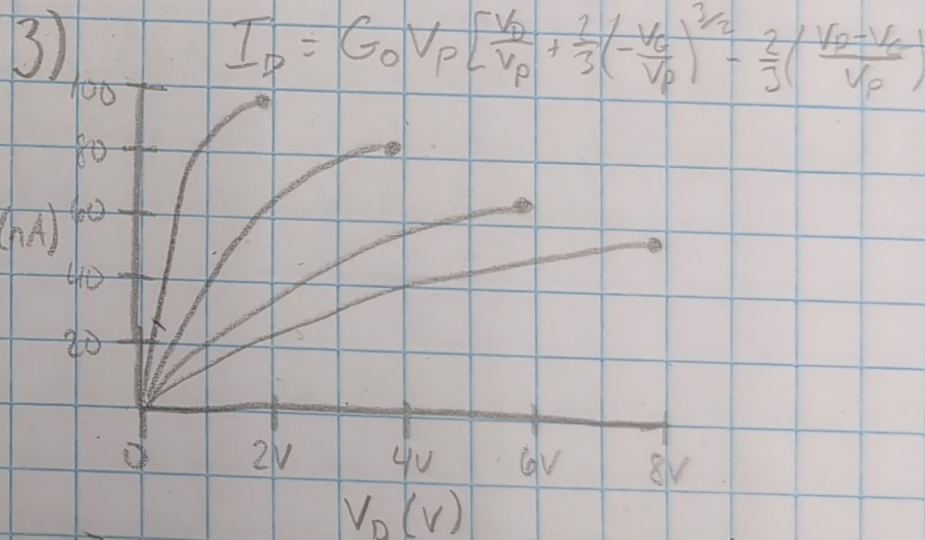$I_D(sat) = G_0 V_p \left[\frac{V_0}{V_p} + \frac{2}{3}\left(-\frac{V_G}{V_p}\right)^{3/2} - \frac{2}{3} \right]$

$V_D (V)$

V_G	$V_D(sat)$	$I_D(sat)$
0 V	6.8 V	5.42 mA
-2 V	4.8 V	1.2 mA
-4 V	2.8 V	-1.21 mA
-6 V	0.8 V	-2.45 mA

$G_0 = \frac{2a\bar{z}}{\rho L} = 3.2 \times 10^{-3}$

$\rho = \frac{1}{\mu_n q N_d} = 6.24$

3) $I_D = G_0 V_p \left[\frac{V_D}{V_p} + \frac{2}{3}\left(-\frac{V_G}{V_p}\right)^{3/2} - \frac{2}{3}\left(\frac{V_D - V_G}{V_p}\right) \right]$

$V_D (V)$

4) $T = 300 k$ $a = 1000 \text{ Å}$ $N_D = 7 \times 10^{7} cm^{-3}$ $Z = 100 \mu m = 0.01 cm$
$V_D = \{0, 5\}$ $V_G = \{0, -5\}$ $L = 5 \mu m = 5 \times 10^{-4} cm$

$I_D = G_0 V_p \left[\frac{V_D}{V_p} + \frac{2}{3}\left(-\frac{V_G}{V_p}\right)^{3/2} - \frac{2}{3}\left(\frac{V_D - V_G}{V_p}\right)^{3/2} \right]$

5) $t_{ox} = 10^{-8}$ m $N_a = 10^{22}$ m^{-3} $\varepsilon_s = 1.035 \times 10^{-12}$ F/m $\phi_s = 2\phi_F = 0.69$ V

$$W_{max} = \sqrt{\frac{2\varepsilon_s \phi_s}{qN_a}} = \boxed{298.6 \text{ nm}}$$

$$\phi_F = \frac{kT}{q}\ln\left(\frac{N_a}{n_i}\right) = 0.35 \text{ V}$$

$$\varepsilon_{ox} = 3.9 \times \varepsilon_0 = 3.45 \times 10^{-}$$

$$C_{dep} = \frac{\varepsilon_s}{W_{max}} = 3.47 \times 10^{-4} \text{ F/m}^2$$

$$C_{ox} = \frac{\varepsilon_{ox}}{t_{ox}} = 34.52 \times 10^{-4} \text{ F/m}^2$$

$$C_{min} = \left(\frac{C_{ox} \cdot C_{dep}}{C_{ox} + C_{dep}}\right) = \boxed{3.15 \times 10^{-4} \text{ F/m}^2}$$

$$V_T = \phi_s + \frac{\sqrt{4\varepsilon_s q N_A \phi_F}}{C_{ox}} = \boxed{0.096 \text{ V}}$$

6) $N_D = 5 \times 10^{17}$ cm^{-3} $t_{ox} = 10^{-6}$ cm $d = 10^{-6}$ cm $Q_i = 5 \times 10^{10}$ qC/cm^2

a)

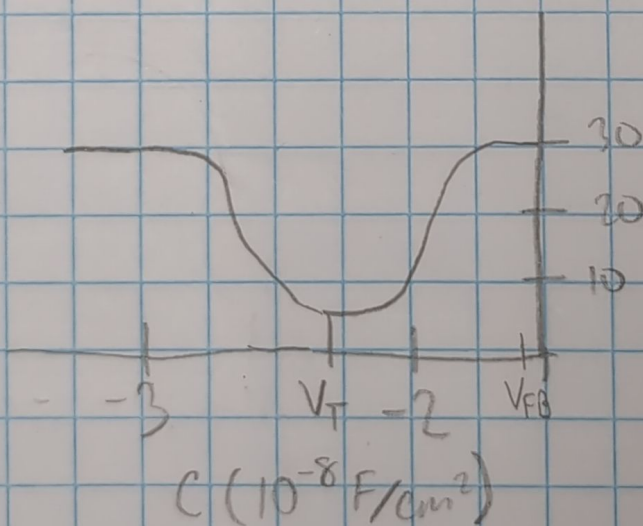$$W_{min} = \sqrt{\frac{2\varepsilon_s \phi_s}{qN_d}} = \boxed{4.84 \times 10^{-6} \text{ cm}}$$

$\phi_{ms} = -0.13$

$C_i = 3.45 \times 10^{17}$

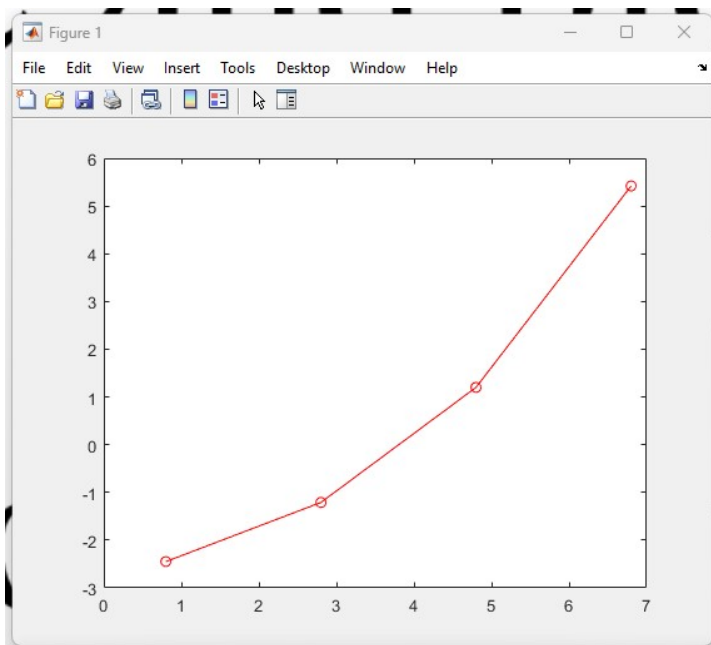$$V_{FB} = \phi_{ms} - \frac{Q_i}{C_i} = \boxed{-0.173 \text{ V}}$$

$$V_T = V_{FB} + 2\phi_F + \frac{-Q_d}{C_i} = \boxed{-2.2 \text{ V}}$$
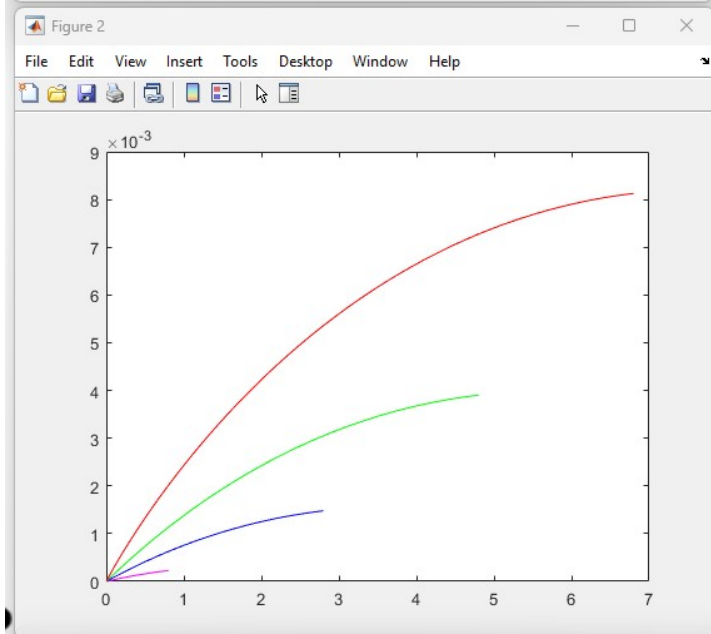
b)

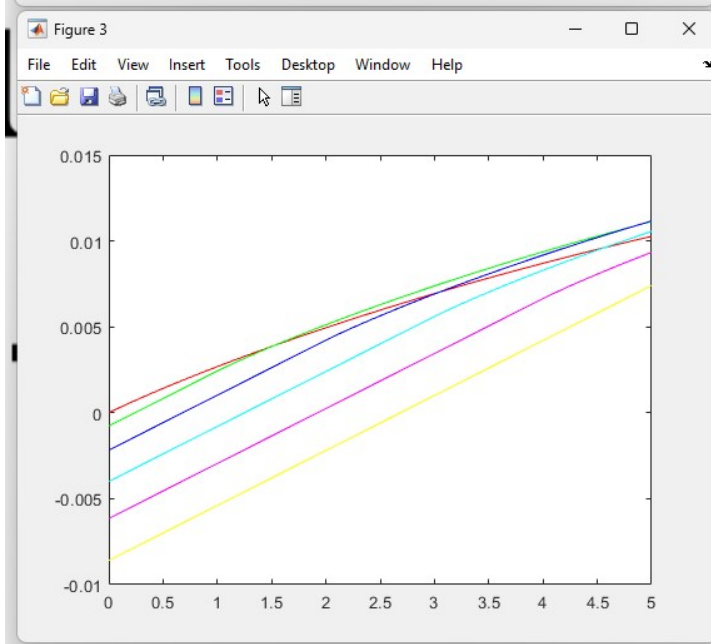$$C_d = \frac{\varepsilon_s}{W_{min}} = 2.13 \times 10^{-7}$$

$$C_{min} = \left(\frac{1}{C_i} + \frac{1}{C_d}\right)^{-1} = 1.32 \times 10^{-7} \text{ F/cm}$$

C (10^{-8} F/cm^2)

Question 2

Question 3

Question 4