Home Work Assignment #3

ELE 447

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Physical Constants:

$q = 1.6x10^{-19}C$ $\epsilon_o = 8.85x10^{-14}F/cm$

$\epsilon_{ox} = 3.9\epsilon_o = 3.45x10^{-13}F/cm$ $\epsilon_{Si} = 11.7\epsilon_o = 1.04x10^{-12}F/cm$

Parameters:

$\lambda = 0.6\mu m$ $t_{ox} = 20nm$

nMOS & pMOS

$C_{j-sw} = 0.2fF/\mu m$ $C_{j-sw} = 0.25fF/\mu m$

$C_{j-A} = 0.24fF/\mu m^2$ $C_{j-A} = 0.4fF/\mu m^2$

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1) Assume:

$$R_n = 12k\Omega \; for \; \left(\frac{W}{L}\right)_n = \left(\frac{2.4\mu m}{1.2\mu m}\right)$$

$$R_p = 12k\Omega \; for \; \left(\frac{W}{L}\right)_p = \left(\frac{6\mu m}{1.2\mu m}\right)$$

   a) Text Book Problem 1.14: ignore equation (1.21), use $(W/L)_n = (1.2\mu m/0.6\mu m)$, $(W/L)_p = (2.4\mu m/0.6\mu m)$ & $C_L = 50$ fF.

   b) Text Book Problem 1.15: use $L_p = L_n = 0.6\mu m$ (instead of $0.8\mu m$) & use the W_p's, W_n's from figure P1.15 (note the sizes in figure P1.15 are μm!!).

2) Text Book Problems

   a) 1.5

   b) 1.6

3) Provide a gate-level description and the logic function, V_o, of the circuit shown in figure 1.

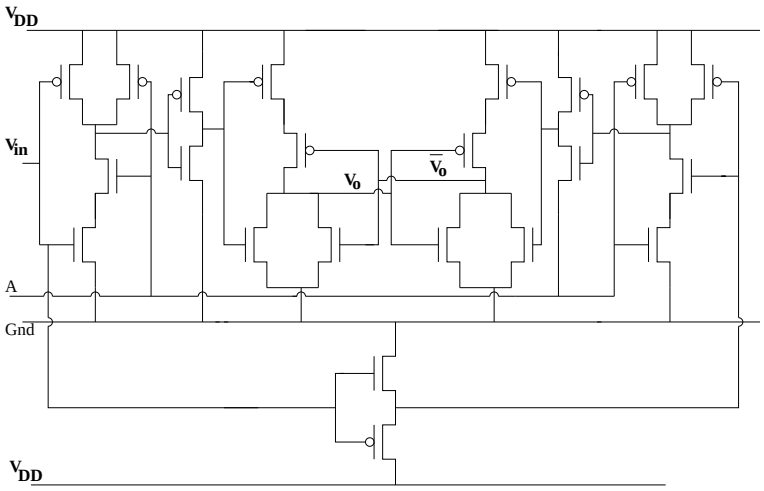

Figure 1. Circuit for Problem 3.

4) Find the capacitance of the parallel plate capacitor shown in figure 2 using dielectrics of air, SiO_2, Si and Si_3N_4 for each of the geometries provided:

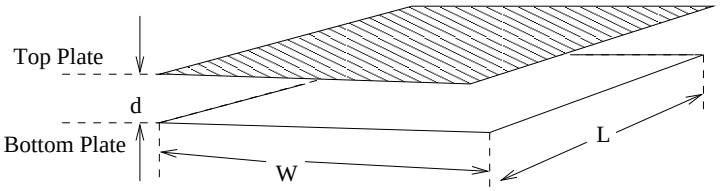

Figure 2. Circuit for Problem 4.

a) $d = 2mm$, $L = 40mm$ and $W = 30mm$

b) $d = 10^{-2}\mu m$, $L = 0.6mm$ and $W = 0.3mm$

c) $d = 20\mathring{A}$, $L = 3\mu m$ and $W = 8\mu m$

d) Find the capacitance of the parallel and series combination of a 850 fF, 30fF and a 130 fF capacitor.

5) Find the electric field between the top and bottom plates for the capacitor shown in figure 2 for distances given (assume that the voltage across the terminals is $5V$):

a) $d = 2mm$

b) $d = 10^{-2}\mu m$

c) $d = 20\mathring{A}$