2024 EE5250 VLSI Design Homework 1

Due date: 2024/10/3 (upload to eeclass)

Note

1. Please generate report with pdf format and name report as HWX_112XXXXXX_謝 OO.pdf. At first page please add your student ID and name.
2. Please hand in the 0.18um HSPICE simulation file & netlist (.sp, .spi).
3. Try to make the information "readable". (Don't use black color in background for your screen capture figures).
4. Discussion is encouraged, but the results and comments can't be shared

Report

Please write the report according to the following format:

1. Use the combination of CMOS to sketch the **transistor-level schematic** and **stick diagram** of the compound gate function **only** from inputs A, B, C and D. Simplify the function to minimize the number of MOS transistors, and provide clear comments. Please differentiate layers by using distinct colors or patterns, and include a legend to indicate which color corresponds to which layer. (32%)

   (a). $Y = \overline{(A \cdot B + C) \cdot D}$ (8%)

   (b). $Y = A \cdot B + C \cdot D$ (8%)

   (c). $Y = A + \bar{B} + C$ (8%)

   (d). $Y = \overline{A \oplus B}$ (8%)

2. Run HSPICE simulation to answer the following question. (40%)

   (a). Please design an INVERTER with $\left(\frac{W}{L}\right)_n = 1\mu m/0.25\mu m$ while $\left(\frac{W}{L}\right)_p$ is to be determined by your design. The inverter operates at $V_{DD} = 1.8V$, with the transition point $V_M = 0.5VDD$ ($V_{out} = 0.5V_{DD}@V_{in} = 0.5V_{DD}$) in the TT corner. Please print out the transfer curve waveforms. (12%)

   (b). Provide the schematic using **Composer**. (5%)

   (c). Using the MOS sizes from (b), print out the transfer curve waveforms for 4 other corners (SS, SF, FS, FF). (8%)

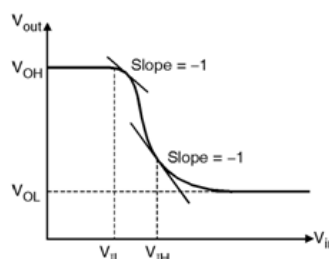   (d). Comment on the differences of the transfer curve across 5 corners. (15%)

Fig. 1

by CCHsieh

3. Using the transfer curve simulated in Q2, answer the following question. (28%)

    (a). Please calculate the value of V_{IL}, V_{IH}, V_{OL}, V_{OH} and NM_H and NM_L in 5 process corners. It is recommended to summarize the result in a table or graph after the calculation. (13%)

    (b). Please comment on the differences. (15%)