

IC Design

Homework # 2

Due on 11/11/2016, 13:20 in class

Plagiarism is not allowed. 10% penalty for each day of delay.

In this homework, you will learn the following:

- Hspice
- nWave

Three of the following cells are assigned to each of you. Everyone must do cells **(10)**, and **(11)**. Those whose student ID end with 'k' must also do **cell k**. (Ex. If your ID is B01901123, you need to do (3)EO3, (10)FD2 and (11)FA1)

- (0) EN
- (1) NR2
- (2) OR2
- (3) EO3
- (4) AN3
- (5) ND2
- (6) AN2
- (7) EO
- (8) DRIVER
- (9) IV
- (10) FD2
- (11) FA1

For each cell,

- Base on the layout view, draw **transistor-level** and **gate-level circuit** diagrams (using Visio or 小畫家 or 手畫)
- Identify all **inputs** and **outputs**
- List **truth table**
- Revise the given netlist file to assemble your cells. All PMOS transistors have width 0.5um and length 0.1um. All NMOS transistors have width 0.25um and length 0.1um. Parameters of 90nm model file (90nm_bulk.l) must be included during the simulation. The substrate of PMOS is connected to VDD and the substrate of NMOS is connected to VSS.

- e. Run *Hspice* simulation on **all possible input** combinations. Assume $V_{DD}=1.0V$ and $V_{SS}=0V$. Use *nWave* to verify the truth table. Copy the **I/O waveform** to your report. State what you have observed.
- f. Please discuss problems you have encountered.

Files that you will need (available on the class website)

HW2_2016.rar includes the following files

- HW2.pdf (this document)
- HW2_tutorial.pdf
- example.sp
- 90nm_bulk.l
- Pictures of layout (in "pic" folder)

Files that you need to submit

- Hard copy of your report (in class)
 - List the names of the cells you did in homework in front of the report.
 - No need to attach HSpice code (only waveform is required)

References

[1] "SPICE," CIC handout, 2001

[2] "鳥哥的 Linux 私房菜," <http://linux.vbird.org/>

If there's any workstation account/password problem, please directly contact workstation administrator, 邱茂菱, d01943010@ntu.edu.tw

TA: 藍浩佑, EE2-329

TA email: r04943028@ntu.edu.tw

HW2 Office hours: 11/08 19:00-21:00 @ 博理 211

11/10 19:00-21:00 @ 博理 211

If you have no time at office hours, you can email TA to discuss another time for appointment.