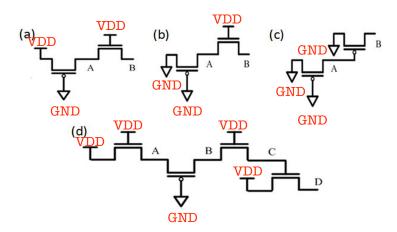
IC Design

Homework #1

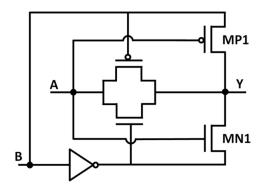
Due on 10/12/2018, 1:20PM in class, 10% penalty for each day of delay

- 1. (20%) Please answer the following questions. Your answer should contain pictures and texts for better explanation. A single page of A4 is recommended.
 - (a) In 2015, Micron Technology and Intel Corporation unveiled the 3D NAND technology. Explain briefly, what is 3D NAND, how does it work, as well as the main features and benefits of it. (學號尾數為單號者回答此題)
 - (b) Silicon-on-insulator (SOI) is a semiconductor process structure consisting of a layer of single crystalline silicon separated from the bulk substrate by a thin layer of insulator. Explain the SOI structure and how it works. What are the benefits of SOI structures? What are the applications of it in the IC technology? (學號尾數為雙號者回答此題)
- (20%) Please give an expression for all the node voltages in the pass transistor networks shown below (neglect the body effect).
 (You can use VDD, GND, |Vtp|, Vtn to express your answer.)
 (Assume that every NMOS has the same threshold voltage, and so does the PMOS.)

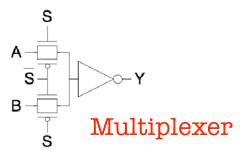


- 3. (20%) For the following transmission-gate circuit,
 - (a) (10%) Please show the function of this circuit.

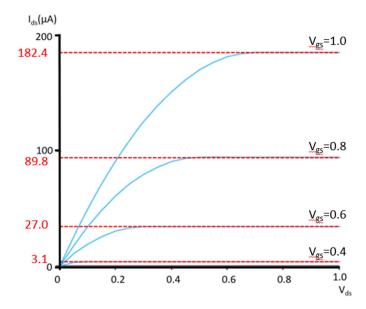
Hint: You can use the truth table method to find the function of Y. (b) (10%) Is there any bad-zero or bad-one problem in this circuit? **Explain** why. (Bad-one means the voltage of logic-1 is only VDD-V_{tn}; bad-zero means the voltage of logic-0 is $|V_{tp}|$)



- 4. (20%) For the following transmission-gate circuit (see p. 3 for explanation of transmission gate)
 - (a) If you want to compute $Y = \overline{E}F$, how do you set A, B, and S? **Explain why.**
 - (b) If you want to compute $Y = E \oplus \overline{F}$, how do you set A, B, and S? **Explain why.**



5. (20%) For the following I-V curves of an NMOS transistor, given the Isat of all four curves, estimate a precise value of Vt (小數點以下兩位). Explain how you find this value from four Isat.



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HW1 Office hours: 10/08 19:00-21:00 @ 博理 214 室 Office hours: 10/11 19:00-21:00 @ 博理 214 室

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

Transmission Gate

Input Output
$$g \qquad g = 0, gb = 1 \qquad g = 1, gb = 0$$

$$a \xrightarrow{-} b \qquad g = 1, gb = 0$$

$$g = 1, gb = 0 \qquad g = 1, gb = 0$$

$$gb \qquad a \xrightarrow{-} b \qquad 1 \xrightarrow{-} strong 1$$
(a) (b) (c)