Digital Systems Lab 1 Breakdown - READ

Everyone needs to read over the lab procedure (which can be found on the course web site at http://www.bioee.ee.columbia.edu/courses/ee3082/handouts.html) before coming to class. You may not have enough background knowledge to be able to fully understand all the tasks (and the corresponding questions to be answered in your lab report), so take a look at the quick summary of the key concepts on the next page.

Also, the last task in the lab is a design question, for which you need to come into the lab with a schematic - one of the Las or TAs will check over your schematic before you build your circuit. It is recommended that you use the schematic sheet (with some desing tips) uploaded on courseworks to draw the connections between different pins for your design. It's fine for it to be hand-drawn- you just need to represent all the important connections to/between all the chips.

You should look through the data sheets of the parts below (which can be found at the handout link above) to figure out how to incorporate each chip into your design and what the important pins are for each.

HCF4511B - converts from 4-bit binary to 7-segment display output
74AC161 - counter
74F04 - contains 6 inverters
NKR141 - 7-segment display
74F00 - contains 4 NAND gates
4116R - contains 8 resisistors - it is *essential* that you put resistors in series with the LEDs in your displays

It is also worth noting that the switch debouncer circuit you construct in Q4 of the lab will be needed for the design question, so you should keep that intact. Additionally, a portion of your design will be useful for the second lab, so once you are done with this lab, you'll probably want to just keep your entire circuit assembled for next time. The debouncer circuit uses a single-pole, double-throw switch button- its schematic symbol indicates that there are three terminals to the button, of which one should be tied to ground, while one of the other two will be connected to that ground terminal, depending on whether the button is depressed or not. This will be a lot clearer once you actually see the button in the lab and you can use one of the meters at your lab station to test it out.

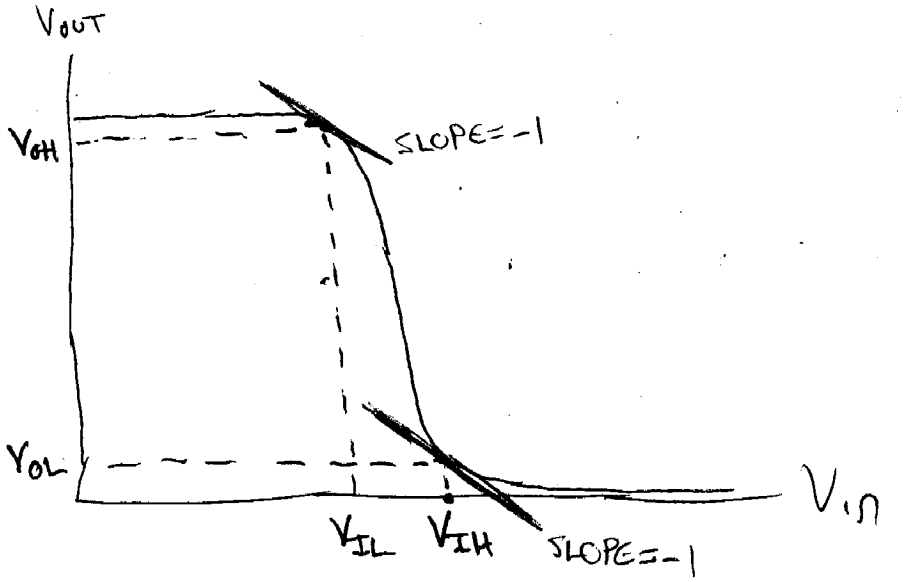
Be aware that all the chips you use, other than the 7-segment display (which is just a bunch of LEDs) and the resistor chip, must have the correct voltages applied to all of their power and ground pins- these may not be drawn on all the schematics in your lab handout, in which case you should consult the appropriate datasheets to find out what voltages to use.

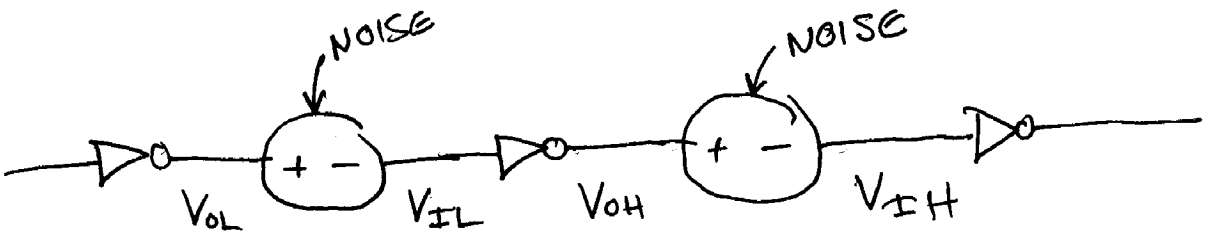
Finally, three minor updates to the handout: regarding Q2, you don't have a 67 pF capacitor in your lab kit, but you do have 33 pF ones, so just use 66 pF instead; in figure 3, the resistor values are not specified- they are not terribly important, but you should use 10k resistors there; and in figure 4, the 74F74 D flip flop diagram has two 'Q' pins, but the one on the left should be a 'D'.

Matt Carlberg
EE 3082
Lab 1

Noise Margins

→ voltage transfer characteristic of inverter





$NM_L = V_{IL} - V_{OL}$ $NM_H = V_{OH} - V_{IH}$

Delay