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Lab # 8

Lab Section - 1B

3/19/2020

Description -

For this lab, we were first tasked with measuring the propagation delay with the oscilloscope, across our inverters. For the second part of this lab, we needed to build an edge triggered flip-flop by combining our ICs on the breadboard. We also had to use LEDs to indicate the state of the D input, Q output, and ~Q output.

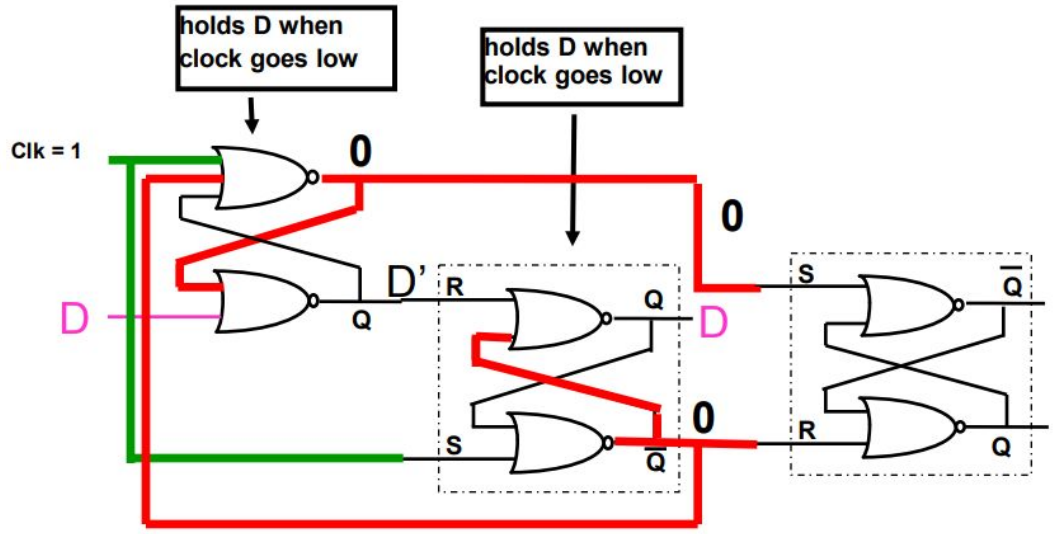
Method -

Part I -

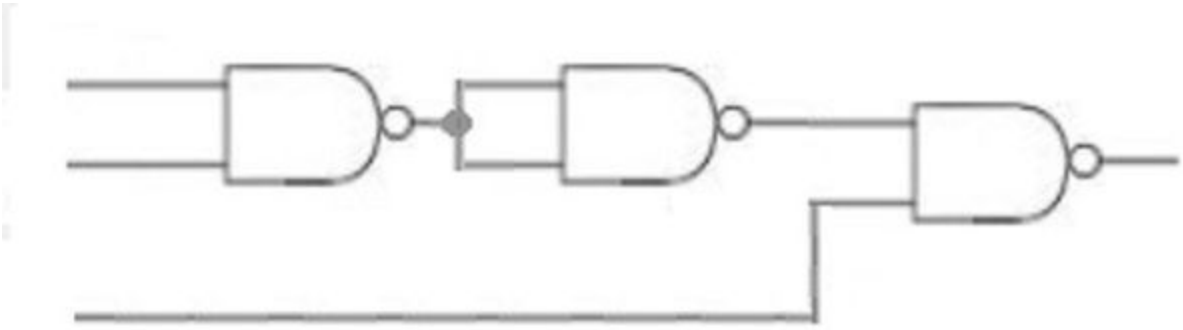
For the first part of this lab, the method was to connect three inverters together and connect the inverter IC to the positive and negative terminals. I then connected the positive and negative ends of the oscilloscope to opposing ends of the strung together inverters and measured the frequency. I then divided this by the number of inverters which gave me the frequency per inverter. By taking the inverse, this gave me the propagation delay in seconds. I forgot to take a picture of the board on how I did it, and I don't have it here so, oops.

Part II -

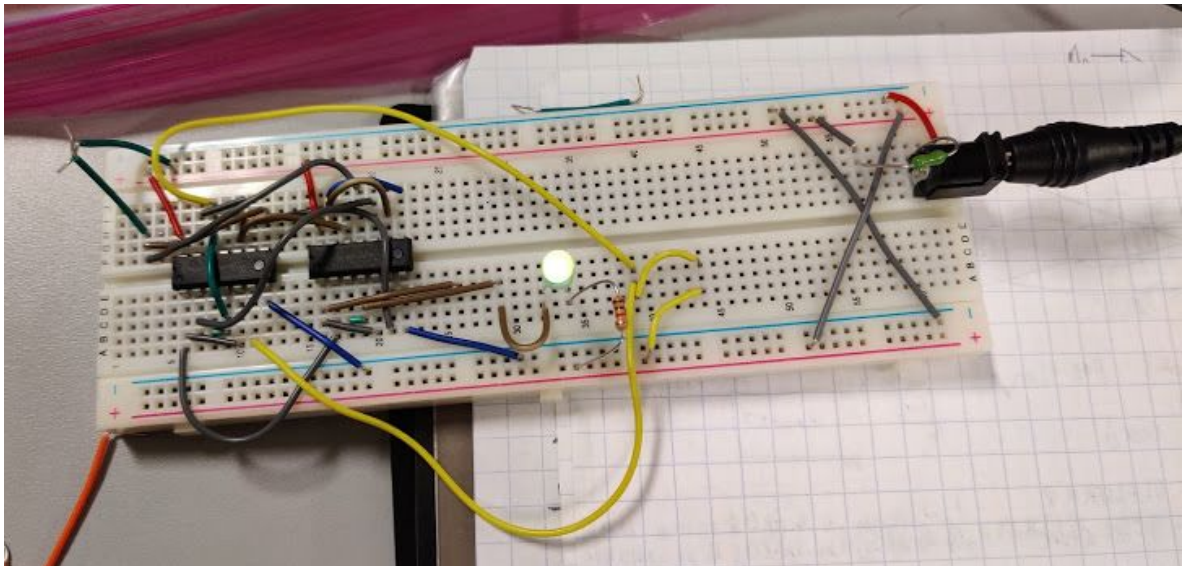
For the second part of this lab, we had to make an edge triggered flip flop. I decided to make a negative edge triggered flip-flop because I thought it would be easiest using just 6 NAND gates. I implemented the following design on my breadboard with the ICs.



This uses multiple RS latches to achieve a stable state. For the first NAND in the schematic where there is 3 inputs, I instead used this schematic:



This is a picture of my design implemented on the bread board, after I removed two of the LEDs.



I had the yellow wires acting as my D_{in} and the green wires for my clock signal. This LED was connected to the ~Q out.

Results -

For the first part of the lab, I measured a frequency of 23.3MHz across 9 inverters. Doing 23.3MHz/9inverters = 2.59MHz per inverter. The inverse of that, 1/2.59MHz = 38.61µS.

For the second part of the lab, I was able to get the LED/ Q_{out} to hold the D_{in} value when a negative clock edge was given. The Q and ~Q outs were also always the opposite.

Conclusion -

This lab was mostly easy. It was just a lot of making sure all the wires were going to the right places, and finding the schematics to build. For the first part, I kept wondering why my oscilloscope readings were purely haze. It took a TA to tell me that my power supply input was

not hooked up correctly. For the second part, it wasn't working at first because apparently I couldn't just use one NAND with three inputs, I needed to use three NANDS.

Appendix -

The RS latch is from Lecture#22

Lab Book :