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Experiment 8

**Procedure 1:**

We designed the T flip flop by making an internal signal named carry to act as Q. We encountered a problem because we didn’t initialize carry as 0 initially. After we initialized carry, it worked.

**Procedure 2:**

We used our T flip flop as a component in this application. We had to make a counter, and we realized that the output of one T flip flop switches at half the speed as the clock does. We used CLK as the LSB and then used T flip flops to make the other bits. The output of one T flip flop would be the clock of the next flip flop.

**Procedure 3:**

We encountered a problem when implementing the program file for the first time because I had forgotten to change the clock value to a JTAG clock. Other than that it was just simply using our previous labs to create a better counter using the built-in clock.

**Questions:**

1. Use the output of the D flip flop and XOR it with the input to create a T flip flop.
2. Same thing as 1, use the output of the T flip flop and XOR it with the input to create a D Flip Flop
3. We used T flip flops to slow down the clock in a way, the output of a T flip flop with the clock as an input will switch from 1 to 0 and 0 to 1 half as often as the clock. We expected the counter to look like a truth table. The enable and the clock determined when the outputs would change. Since each flip flop was half as fast as the clock, and they were chained together, it came out looking like a perfect truth table.
4. We could have used the rising\_edge(CLK) function to slow down the clock using actual math instead of large components.
5. A more generic version could have outputs for many more signals, so it would be able to be mapped to different displays with more signals in them.
6. We had it display no output, for simplicity. It would have taken lot more work to allow the 2nd 7 segment display to light up correctly. We had it display 0-9, and anything else will make the display go blank. This is a problem for accuracy.
7. Idealy, the LED display should show the number that the code would display. The internal clock controls the speed at which the outputs change. The switch determines wheather to start or stop the display.
8. It can store the information forever, and be reprogrammed an infinite number of times.

**Summary:**

Tyler: In this lab I learned how to create a T flip flop. This is useful because it is very close to a memory device, and I can see it being useful later on. I used the T flip flop to create a counter based on the internal clock of the Nexys board. After that was done I used the BCD to 7 segment display code from experiment 6 to create a counting program for the Nexys board that will display the current number on the 7 Segment display.

Suzie: In today’s lab we used a t flip-flop to create a counter. I enjoyed taking the flip flop, which seemed of little importance and using it to create something that could be quite useful. This was the first lab we used sequential circuits and it seems to alow for a lot more possiblities when using VHDL. It was nice to implement the BCD to 7 segement display we created in a previous experiment to display our 4 bit counter.