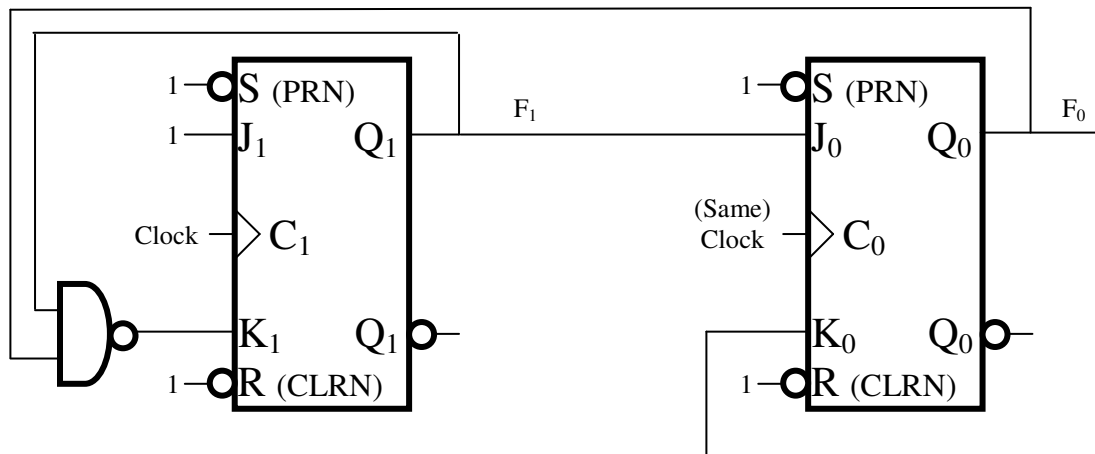


ECE 1315 - Lab #6: Flip-Flops

Determine by hand the state diagram that describes the operation of the circuit as shown below. Be sure to show all 4 states that the circuit may be in. **Before testing your circuit, obtain your lab instructor's signature indicating s/he saw your pre-testing state diagrams.**

Wire the circuit below in Quartus II using the 'jkff' component and appropriate gate (NAND first). You will need one input pin and two output pins. Also, make sure to connect the appropriate signals to V_{CC} . Again, it might again be useful to refer to the Quartus II Supplement PDF (<https://www.d.umn.edu/~pjweber/ece1315f07/umdonly/labs/QuartusIISupplement.pdf>).



Test the circuit with the Vector Waveform. Allow for at least 10 clock cycles of operations and **make sure that the frequency of your clock is slow enough that propagation delays have a negligible effect in the output.** Save a screenshot of the waveform for your report. Note that the initial state of the circuit is unpredictable, so you cannot control that. Does the repeating sequence of states you observe agree with what your state diagram shows?

Now remove the NAND gate and replace it with an AND gate without changing anything else. Repeat your hand generation of the state diagram, and repeat the test with the Quartus II. Save a screenshot of the waveform for your report. Do your test results agree with what your state diagram shows?

Lastly, remove the AND gate and replace it with an OR gate, without changing anything else. Repeat your hand generation of the state diagram, and repeat the test with the Quartus II. Save a screenshot of the waveform for your report. Do your test results agree with what your state diagram shows?

For your report, show the state diagrams you generated for each of the three cases above (with the NAND, AND, and OR gate) and show the repeating sequence of states you observed in the Vector Waveform file for each of the three cases. Also, *answer the questions in the above paragraphs.* Remember to get your lab instructor to check your result, and sign his/her sheet after you've answered the question(s).

Q#1: What do PRN and CLRN refer to? What could these be used for?

Q#2: Are all possible states shown on your timing outputs? Why/why not?