*(20 pts) Approx. 3 days*

This unit starts with a new application of the J/K Flip Flop. We certainly remember the J/K Flip Flop from the last unit where we used it to create asynchronous counters. In that unit, we used the inputs (Clock, J, K) in combination with the outputs ($Q, \bar{Q}$) to make a binary counter that went both up and down. The problem with asynchronous counters like those is that we had to wait for the least significant bit to count all the way up before then having to wait for the rising clock edge to trigger the 'carry over'. If our counter had more than 4 bits, this lag time resulting from the ripple of the counter would be problematic. That's where *synchronous counters* come in to play.
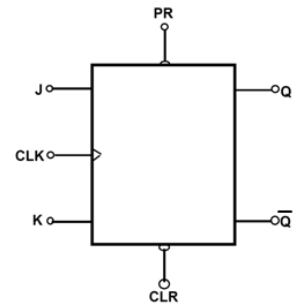
A J/K Flip-Flop with inputs on the left and outputs on the right

A **synchronous counter** is a counter where all the bits are updated simultaneously. This eliminates the lag time between the increment of the counter and the real-time update of the counter. What we need to do in this first part of the unit is use our J/K Flip Flops to create a synchronous counter.

1. **Synchronous Counter Notes:** Start by watching the four presentations on synchronous counters. These videos will share the big picture, the nitty-gritty details of how synchronous counters work, a comparison between asynchronous and synchronous counters, and a good example of a functioning counter. Take at least two (2) pages of good notes on the topic, and be sure to include details about how the J/K Flip Flops can be used to make a synchronous counters.

2. **Synchronous Counters Assignment:** Complete the *Synchronous Counters Assignment* by creating the proper simulations in Multisim. Pay particularly close attention to the connections between the inputs/outputs of the J/K Flip Flop to better understand how the system is working. As you continue, keep good notes on new or interesting ideas about these counters.

3. **Working Simulations:** The *Synchronous Counters Assignment* asks you to build your simulated synchronous counter in the standard (not PLD) mode. Complete this circuit and adapt it to count 0-4 as indicated. Have Mr. Benshoof confirm your working counter before moving on to the next part!

Part 1: Tasks	10-8 points	7-5 points	4-0 points
▢ Notes: Synchronous Counters	+ You took 2 full pages of notes on the various *Synchronous Counters* presentations + Your notes include details about using J/K Flip Flops in synchronous counters	- Your notes are missing some of the details about Flip Flops	- Very brief or no notes in your engineering notebook
	5 points	**4-2 points**	**1-0 points**
📄 *Synch. Counters Assignment*	+ You completed the *Synchronous Counters Assignment* + Your simulations are complete and you've documented interesting ideas in your notebook	- Your assignment is mostly complete	- Your assignment is missing important parts
⊕ Working Simulations	+ Your simulations of synchronous counters from the assignment work correctly. + Mr. Benshoof confirmed your working simulation	- Your simulation does not quite work as intended	- Your simulation is missing completely - Mr. Benshoof did not get to see it working