LATHROP ENGINEERING

Name:

UNIT 8: FLIP FLOPS & COUNTERS

Digital Electronics Unit Due Date: **February 16, 2018**

Welcome to the eighth unit of Digital Electronics! This unit is all about new tools and new applications of digital circuits. We'll start by revisiting the job that Flip Flops can do for us in digital circuits. We'll make sure that we understand *how* they work before then extending that work to investigate how they can be applied in different contexts. We'll also start building more and more complex counters in Multisim by taking advantage of the Flip Flop as a circuit design tool. In the end, the expectation is that you learn the following elements of digital logic:

- How **D-Flip Flops** and **J/K-Flip Flops** work
- How to use Flip Flops in **event detecting** circuits
- What a **shift register** is, and how to use Flip Flops in **shift registers**
- How to create small scale **counters** in different ways

As we move through this unit, you are responsible for making adequate progress through the assignments, and for being done by the Unit Due Date (**February 16, 2018**). You are also responsible for completing each part before moving on to the next. Our unit is broken up into three main parts:

Part 1: **Flip Flops** *(20 pts) Approx. 3 days*		
The beginning of our unit is all about understanding the function of D-Flip Flops and J/K-Flip Flops. Here you'll see how these tools work and start to investigate applications of Flip Flops as a tool in developing digital circuits. One of those most basic tools is to store single bits of information, as well as in the creation of a "Transparent D Latch" for event detection. You'll do our first written assignment of the unit as well as you build some basic circuits in Multisim to understand Flip Flops further.		Notes on Flip Flops
		Notes on the Transparent Latch
		Flip Flop Assignment
		Check-off from Mr. Benshoof

Part 2: **Shift Registers** *(30 pts) Approx. 3 days*		
Here you'll look at two applications of flip flops. We'll start with shift registers and investigate the ways that flip flops can be used to pass information down a digital circuit. The second half will look at the first of many asynchronous counters. These circuits will use flip-flops to add and create a system that can 'carry over' as numbers add up. Our simulated counters will get more and more complex as this work continues!		Notes: Shift Registers
		Shift Register Assignment
		Notes: Asynchronous Counters
		First Asynchronous Counter
		Check-off from Mr. Benshoof

Part 3: **Asynchronous Counters** *(20 pts) Approx. 3 days*		
The last part of our unit asks you to build more complex asynchronous counters. You will design, Multisim, and breadboard two more asynchronous counters here. The first one is called a modulus counter that lets you set the starting and ending number of your counter. The last one lets you take advantage of the 'suspend' and 'reset' tools in a flip flop. Take good notes as you work through these, because the next unit will bring them all together in one giant circuit!		Multisim Asynch. Counter 2
		Breadboard Asynch. Counter 2
		Multisim Asynch. Counter 3
		Breadboard Asynch. Counter 3
		Check-off from Mr. Benshoof

(20 pts) Approx. 3 days

First up in this unit: the Flip Flop. Flip Flops are digital tools – often built into IC chips – that allow a digital engineer to hold onto a single bit of information for use later on. This tool can be used when making systems that need to count up, count down, or count with multiple place values. We'll also see examples of flip flops being used to change place values in large systems of numbers and detect events occuring. As you work through the first part of this unit, be sure to think about the function and application of flip flops!

1. **Flip Flop Notes:** Flip Flops are a tricky thing. The input signals (0's/1's) get stored in the flip flop until a new signal 'pushes it out the other end'. As you look through the digital signal diagrams it's essential that you slow down and take careful notes. Watch the two presentations: *Flip Flops* and *Flip Flop Explained*. Also look through the *Flip Flop Pin Diagram* image. Take a full page of good notes on how the flip flop works
2. **Flip Flop Applications:** Watch the presentation *Flip Flop Application: D-Latch* and take a full page of notes. This presentation is complex and talks about how the flip flop can be used as a tool in larger circuits. Read through the creation of the Transparent D-Latch and draw that circuit into your engineering notebook. As more ideas for flip flop applications come up, make note of them!
3. **Flip Flop Assignment:** Complete the Flip Flops Assignment. As you do this, add to your notes as you make observations about how things work. This assignment requires thinking about digital signals and how they change on the rising or falling edge of input signals. As you work through this assignment, consider the following:
    a. Many of the circuits are extremely simple. Consider building those small circuits in Multisim to confirm what you expect should be happening with the on/off signals.
    b. Remember that Multisim has a built-in oscilloscope that will create those on/off digital signal graphs so you can see what's happening.
    c. Watch the rising/falling edge of the input signal when investigating the function of a flip flop.

Part 1: Tasks	*5 points*	*4-2 points*	*1-0 points*
Notes on Flip Flops	+ You took a full page of notes on how Flip Flops work as you watched the presentations *Flip Flops* and *Flip Flop Explained* + Your notes include the details about how Flip Flops work	- Your notes are missing some of the details about Flip Flops	- Very brief or no notes in your engineering notebook
Notes on Flip Flop Applications & the Latch	+ You took a full page of notes on the application of Flip Flops + Your notes include details on the Transparent D-Latch and its application.	- Your notes are missing some of the details on Flip Flop applications	- Your notes are missing more than one element
	10-8 points	*7-4 points*	*3-0 points*
Flip Flop Assignment	+ You completed the Flip Flop Assignment including all the simple circuits required to investigate and understand Flip Flops better	- Your assignment is not totally completed	- Your assignment is missing - You did not Multisim your small circuits