Lab #13 Name: _____ Per: _____

Title: RIPPLE COUNTERS

Materials:
[1] 7400
[2] 7476 dual J-K flip-flop
[1] 7447
[1] clock (single pulse)

Procedure:

1. **Draw** a logic diagram of the 4-bit ripple up counter as drawn in class. Use 4 J-K flip-flops and four output LED's.
2. Insert 2 7476 ICs into the breadboard.
3. Connect power and ground (**they are not located at pins 7 and 14 – check your pinout diagram or you'll burn them out!**)
4. Wire the circuit you drew in step 1. Use **staples** for all J, K, PR, and CLR connections.
5. Operate the 4-bit counter and record the results in Table 13. **Get Instructor's Signature.**
6. **Draw** a logic diagram of the 4-bit ripple down counter as drawn in class. Notice the addition of a PS input for setting the output of the counter to 1111.
7. Rewire the 7476 J-K flip-flops to get the down counter you drew in step 6.
8. Preset (PS to 0 and then back to 1) the outputs to 1111.
9. Operate the counter and record the results in Table 13. **Get Instructor's Signature.**
10. **Draw** a logic diagram of a mod-10 ripple up counter as drawn in class. Use 4 J-K flip flops (2 7476's) and 1 7400.
11. Attach the 7447 BCD-to-seven-segment decoder with the 7-segment display (these should still be in your board from lab 9) to your mod-10 counter. The outputs (Q_D, Q_C, Q_B, and Q_A) should be hooked to the LED's (D, C, B, A) that you were using in lab 9.
12. Operate the mod-10 counter and record the results in Table 13. **Get Instructor's Signature.**

Questions (answer on a separate piece of paper – **"Draw" means you must use a template**)**:**

1. **Draw** the logic symbol for a 2-bit ripple up counter. Use two J-K flip-flops. Label the input CLK; label the output indicators B and A.
2. List the counting sequence of the 2-bit counter you drew in question 1. (start with 00_2 and list the next 4 in the sequence)
3. **Draw** a 3-bit ripple down counter that will count from binary 111 to 000. Use 3 J-K flip-flops. Label the input CLK; include and label a PS input. Label the output indicators C, B, and A.
4. List the counting sequence of the 3-bit down counter you drew in question 3. (start with 000_2 and list the next 8 in the sequence)
5. **Draw** a modulo-6 ripple up counter. Use 3 J-K flip-flops and one 2-input NAND gate. You must use the CLR inputs of the J-K flip-flops. Label the clock input as CLK; label the output indicators C, B, and A.
6. List the counting sequence of the mod-6 counter you drew in question 5 (start with 000_2 and list the next 6 in the sequence)
7. The modulo-10 counter is more commonly known as the _____ (decade, cascaded, century) counter.

Input	**Output**								
Pulse Number	4-bit ripple up counter				4-bit ripple down counter				Decade Counter with digital readout
	D	C	B	A	D	C	B	A	
0	0	0	0	0	1	1	1	1	
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									

Table 13 TT for 3 counters