

Class: CECS 201, Section 7

Lab: 9

Title: Decade Ripple Counter

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Due Date: 11:59:59 P.M., 15, April 2015

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**Introduction.** In this lab we use T Flip-Flops to create a counter that counts modulo ten. That is, a counter that starts from 0, then increments on each clock edge by 1, and resets back to 0 upon reaching 10.

**Project Description.** Since we want the counter to reset at the decimal number 10, our output will require 4 bits; thus we shall connect four T Flip-Flops in sequence, wherein the inverted output of a T Flip-Flop is connected to the clock input of the Flip-Flop to its right. Label the Flip-Flops, from left to right, *A*, *B*, *C*, and *D*. The output of *A* represents the low bit of the counter, and the output of *B* represents the next bit, and so on. The T inputs of all Flip-Flops shall be high. Notice that the *A* toggles its value on every clock edge, *B* on every 2 clock edges, *C* on every 4 clock edges, and *D* on every 8 clock edges. Since we want the counter to reset at the binary value 1010, we shall clear the Flip-Flops by using inverters (on the outputs of *A* and *C*) and a 4-nand gate.

**Schematic.**

