

**DIGITAL LOGIC – Ph.D. Qualifying Exam Fall 2008**

1. Design the following synchronous sequential system using T Flip Flops and other necessary gates. The system has one bit input  $x$ . The system counts 0,1,2,3,0,1,2,3,..... (increasing order) when  $x = 0$  and the reverse order when  $x = 1$ . For example when  $x=0$  then the system counts 0,1,2 and if  $x$  suddenly becomes 1 then the system counts 2,1,0,3,2,1,0...

(10 Points)

2. Minimize the following boolean function w.r.t. number of literals

$$F(wxyz) = w'x'y'z + wxyz' + wxy'z + w'x'yz' + wx'y'z'$$

Don't care =  $wxy'z'$  and  $w'xyz$

(5 Points)

3. Answer the following briefly:

a) What is the difference between a prime implicant and an essential prime implicant?  
(3 Points)

b) Is Nand gate universal? Why/Why not  
(2 Points)



