

Digital Design Assignment4

PART 1: DIGITAL DESIGN THEORY

Question1

Write A sequential circuit has two JKflip-flops A and B and one input x. The circuit is described by the following flip-flop input equations:

$$\begin{aligned}J_A &= xK_A = B \\J_B &= xK_B = A'\end{aligned}$$

(a) Derive the state equations $A(t+1)$ and $B(t+1)$ by substituting the input equations for the J and K variables.

(b) Draw the state diagram of the circuit.

(a)

$$\begin{aligned}A(t+1) &= J_A A + K_A A' = J_A (xK_B)' + K_A (xK_B) \\B(t+1) &= J_B B + K_B B' = J_B (xK_A) + K_B (xK_A)\end{aligned}$$

(b) We can draw the state table

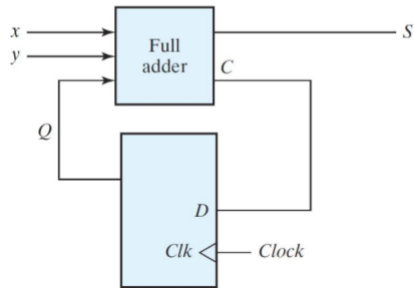
x	K_A	K_B	J_A	J_B	$A(t)$	$B(t)$	$A(t+1)$	$B(t+1)$
0	0	0	0	0	1	0	0	0
0	0	1	0	0	1	0		
0	1	0	0	0	1	0		
0	1	1	0	0	1	0		
1	0	0	0	0	1	0		
1	0	1	0	1	0	0		
1	1	0	1	0	1	1		
1	1	1	1	1	0	1		

Question2

Design a counter with T flip-flops that goes through the following binary repeated sequence: 0, 1, 3, 7, 6, 4. Show that when binary states 010 and 101 are considered as don't care conditions, the counter may not operate properly. Find a way to correct the design.

Question3

A sequential circuit has one flip-flop Q , two inputs x and y , and one output S . It consists of a full-adder circuit connected to a D flip-flop, as shown in figure. Derive the state table and state diagram of the sequential circuit.



Question4

Design a serial 2's complementer with a shift register and a flip-flop. The binary number is shifted out from one side and its 2's complement shifted into the other side of the shift register.