

Analysis of Sequential Circuits

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Lecture Review

- Analysis of Clocked Sequential Circuits with D Flip Flops
 - State Equation?
 - State Table?
 - Alternative State Table?
 - State Diagram?

- Analysis of Clocked Sequential Circuits
 - Circuit with T or JK flop flops

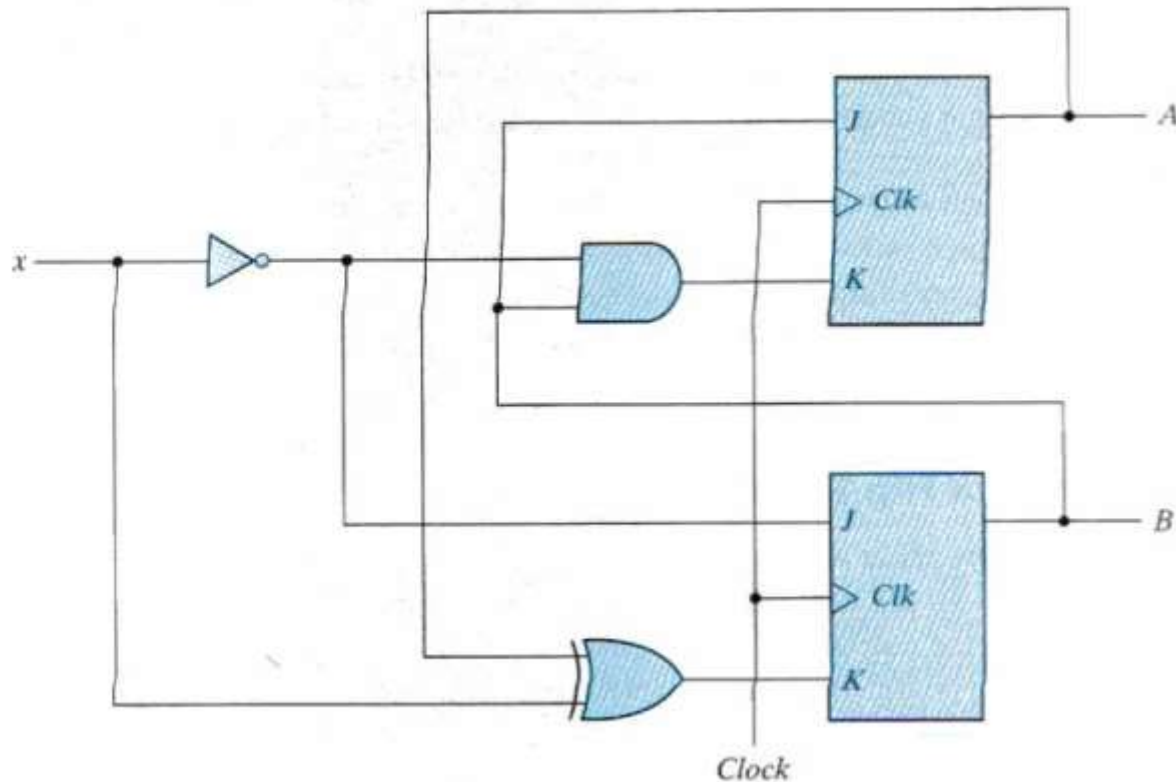
JK and T Flip Flop Analysis

- The next-state values of a sequential circuit that uses flip flops such as JK or T type can be derived using the following procedure:
 - Determine the flip flop input equations in terms of the present state and input variables
 - List the binary values of each input equation
 - Use the corresponding flip flop characteristic table to determine the next state values in the state table

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JK Analysis Example



- $J_A = B$
- $K_A = Bx$
- $J_B = x'$
- $K_B = A'x + Ax' = A \oplus x$

JK Analysis State Table

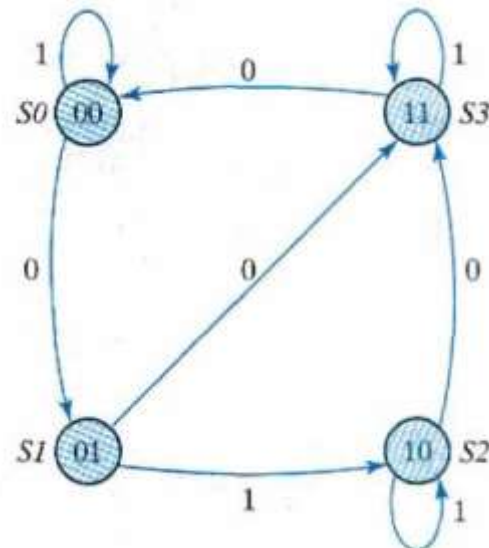
- $J_A = B$
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JK Flip Flop			
J	K	Q(t+1)	
0	0	Q(t)	No change
0	1	0	Reset
1	0	1	Set
1	1	Q'(t)	Complement

Present State		Input		Next State		Output			
A	B		x	A	B	J_A	K_A	J_B	K_B
0	0		0	0	1	0	0	1	0
0	0		1	0	0	0	0	0	1
0	1		0	1	1	1	1	1	0
0	1		1	1	0	1	0	0	1
1	0		0	1	1	0	0	1	1
1	0		1	1	0	0	0	0	0
1	1		0	0	0	1	1	1	1
1	1		1	1	1	1	0	0	0

JK Analysis State Diagram

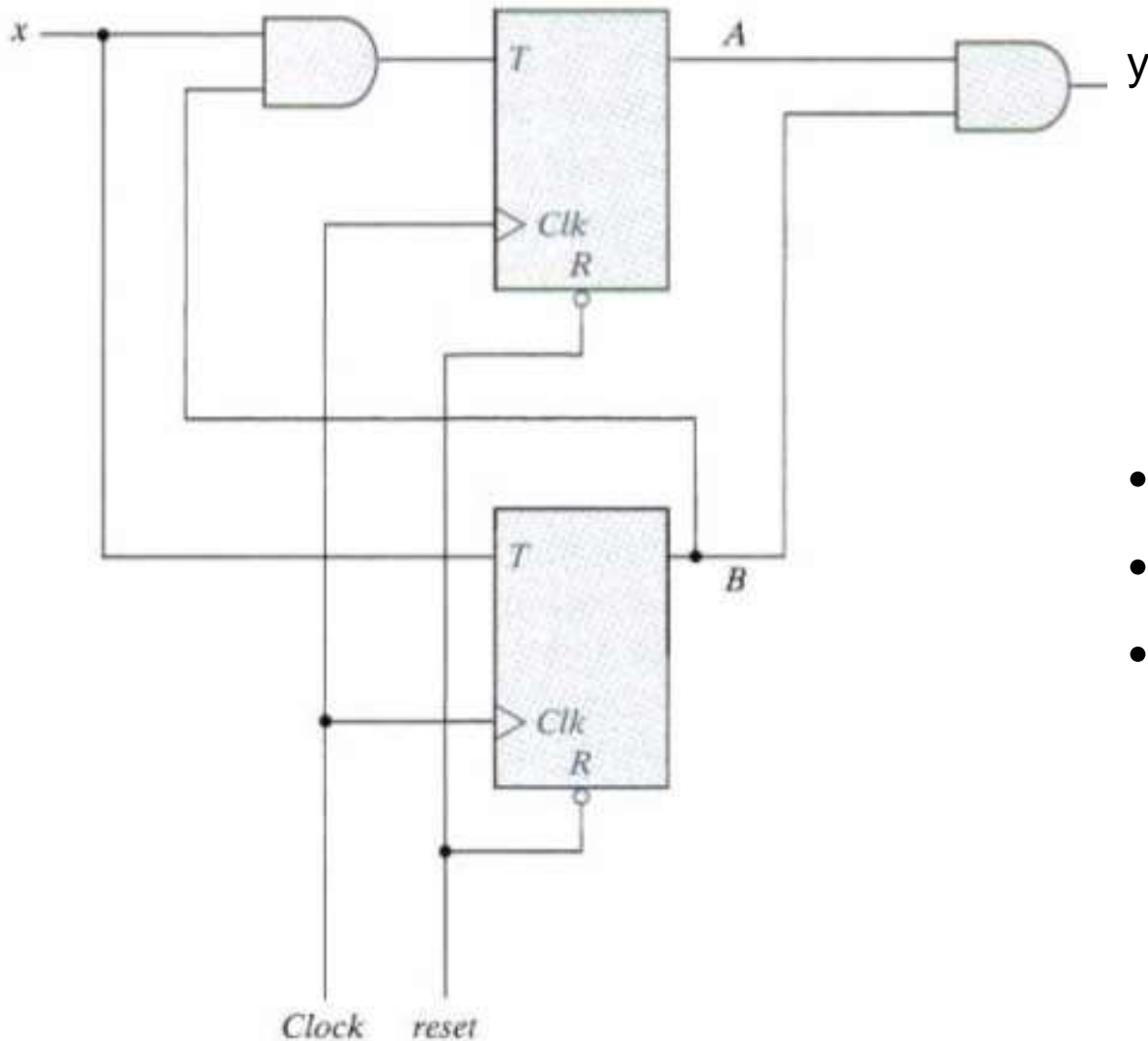
Present State		Input	Next State		Output			
A	B				J _A	K _A	J _B	K _B
0	0	0	0 1		0	0	1	0
0	0	1	0 0		0	0	0	1
0	1	0	1 1		1	1	1	0
0	1	1	1 0		1	0	0	1
1	0	0	1 1		0	0	1	1
1	0	1	1 0		0	0	0	0
1	1	0	0 0		1	1	1	1
1	1	1	1 1		1	0	0	0



T Flip Flop Analysis

- Analysis of a sequential circuit with T flip flops follows the same procedure outlined for JK flip flops.
- The next state values in the state table can be obtained wither by using the characteristic table or the characteristic equation
 - $Q(t + 1) = T \oplus Q = T'Q + TQ'$

T Flip Flop Analysis Example



- $T_A = Bx$
- $T_B = x$
- $Y = AB$

T Flip Flop Analysis State Table

- $T_A = Bx$
- $T_B = x$
- $Y = AB$

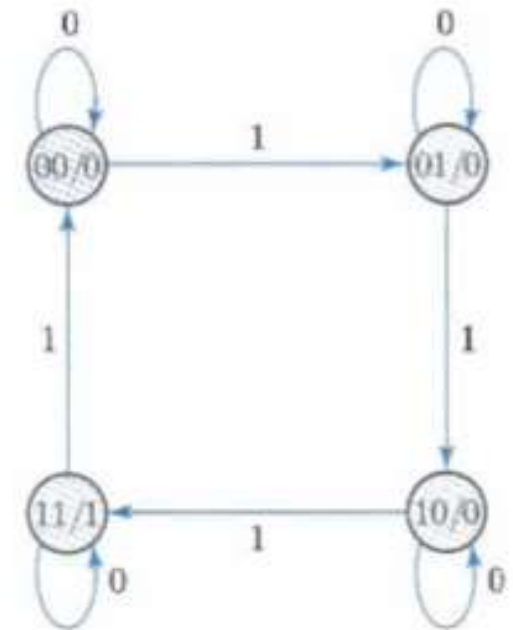
T Flip Flop		
T	Q(t + 1)	
0	Q(t)	No change
1	Q'(t)	Complement

- $A(t + 1) = T_A \oplus A = Bx \oplus A$
- $B(t + 1) = T_B \oplus B = x \oplus B$

Present State		Input		Next State		Output
A	B	x		A	B	y
0	0	0		0	0	0
0	0	1		0	1	0
0	1	0		0	1	0
0	1	1		1	0	0
1	0	0		1	0	0
1	0	1		1	1	0
1	1	0		1	1	1
1	1	1		0	0	1

T Flip Flop Analysis State Diagram

Present State		Input	Next State		Output
A	B		A	B	
0	0	0	0	0	0
0	0	1	0	1	0
0	1	0	0	1	0
0	1	1	1	0	0
1	0	0	1	0	0
1	0	1	1	1	0
1	1	0	1	1	1
1	1	1	0	0	1



End of Lecture