Digital Logic Theory Assignment 3

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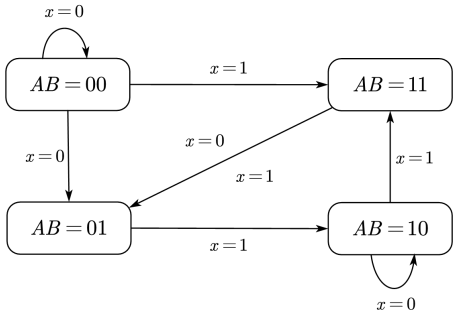
1. a) $A(t+1) = J_A A(t)' + K_A' A(t) = xA' + B'A$, $B(t+1) = J_B B(t)' + K_B' B(t) = xB' + AB$.

   b) State table:

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

   State diagram:



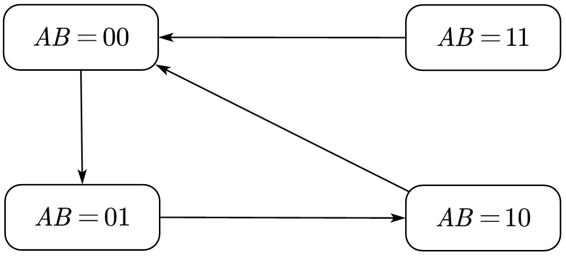
2. In the T Flip-Flop for A, $T_A = A + B$. In the T Flip-Flop for B, $T_B = A' + B$.

   $\therefore A(t+1) = T_A' A + TA' = A'B$, $B(t+1) = T_B' B + T_B B' = A'B'$.

   State table:

Clk	A	B	$A(t+1)$	$B(t+1)$
0	x	x	last A	last B
1	x	x	last A	last B
0→1	0	0	0	1
0→1	0	1	1	0
0→1	1	0	0	0
0→1	1	1	0	0

State diagram:



This circuit performs as a binary counter with $00 \rightarrow 01 \rightarrow 10 \rightarrow 00$.

3. a) $J_1 = J_2 = X$, $K_1 = (XQ_2')' = X' + Q_2$, $K_2 = (XQ_1)' = X' + Q_1'$, $F = X \oplus Q_2' = XQ_2 + X'Q_2'$.

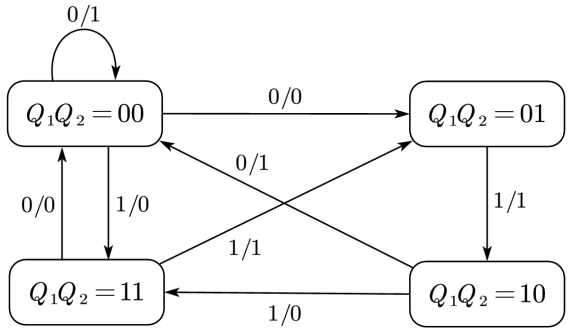
$\therefore Q_1(t+1) = J_1Q_1' + K_1'Q_1 = XQ_1' + XQ_1Q_2' = X(Q_1' + Q_2')$.

$Q_2(t+1) = J_2Q_2' + K_2'Q_2 = XQ_2' + XQ_1Q_2 = X(Q_1 + Q_2')$.

State table:

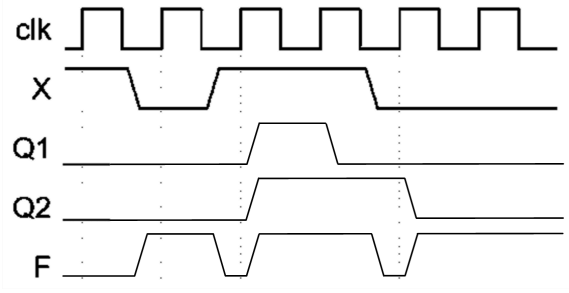
Clk	X	Q_1	Q_2	$Q_1(t+1)$	$Q_2(t+1)$	F
0→1	0	0	0	0	0	1
0→1	0	0	1	0	0	0
0→1	0	1	0	0	0	1
0→1	0	1	1	0	0	0
0→1	1	0	0	1	1	0
0→1	1	0	1	1	0	1
0→1	1	1	0	1	1	0
0→1	1	1	1	0	1	1

State diagram:

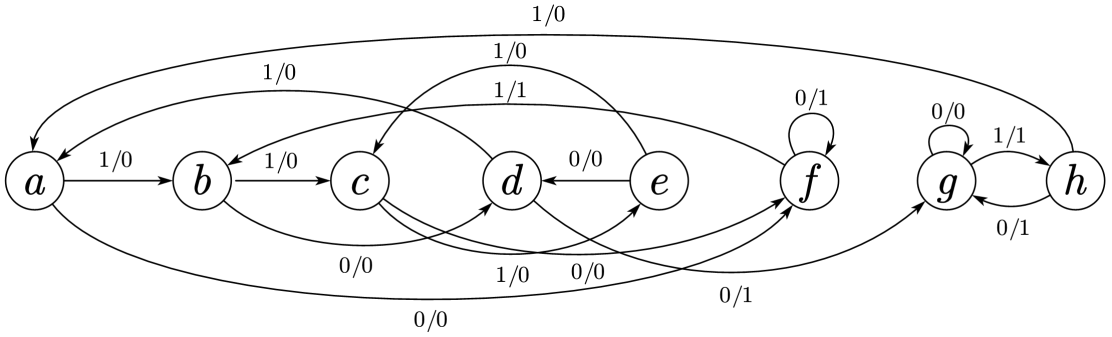


b) It is a mealy machine, because the output F depends on the current state Q_2' and the input X.

c)



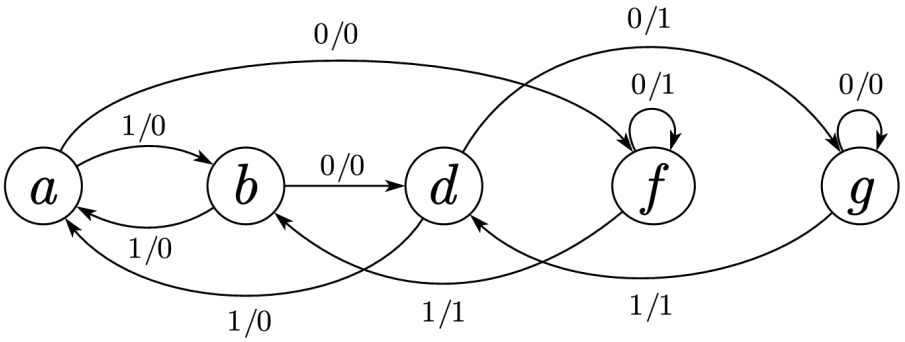
4. a)



b) Reduced table:

Present State	Next State		Output	
	x = 0	x = 1	x = 0	x = 1
a	f	b	0	0
b	d	a	0	0
d	g	a	1	0
f	f	b	1	1
g	g	d	0	1

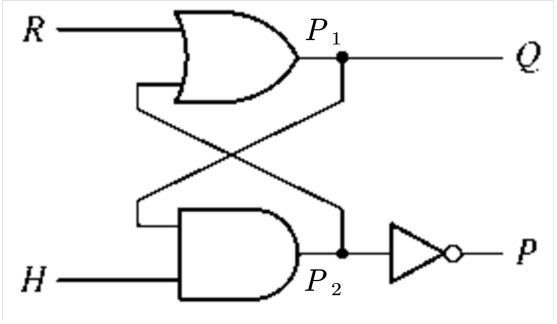
State diagram:



c)

Original Table											
t	0	1	2	3	4	5	6	7	8	9	10
s	a	f	b	d	a	f	f	b	d	a	b
x	0	1	0	1	0	0	1	0	1	1	1
y	0	1	0	0	0	1	1	0	0	0	0
Reduced Table											
t	0	1	2	3	4	5	6	7	8	9	10
s	a	f	b	d	a	f	f	b	d	a	b
x	0	1	0	1	0	0	1	0	1	1	1
y	0	1	0	0	0	1	1	0	0	0	0

5. a)



$\therefore$ When $R = 0$, $Q = P_2$; $R = 1$, $Q = P_1 = 1$. When $H = 0$, $Q = P_2 = 0$; $H = 1$, $Q = P_1$.

∴ Function Table:

R	H	Q	P	**Function**
0	0	0	1	Reset State
0	1	last Q	last P	No Change
1	0	1	1	Forbidden
1	1	1	0	Set State

b)