Homework 7 - Solution

Problem 1

- Need state/output table and state diagrams

1) For JK flip-flop $Q^* = J Q' + K' Q$

A, B and C are the states of the circuit.

- $J_A = B + C$, $K_A = 1$ $\Rightarrow$ $A^* = J A' + K' A$

$$\boxed{A^* = (B + C) A'}$$

- $J_B = C$, $K_B = AC'$ $\Rightarrow$ $B^* = J B' + K' B$

$$= C B' + (A' + C) B$$

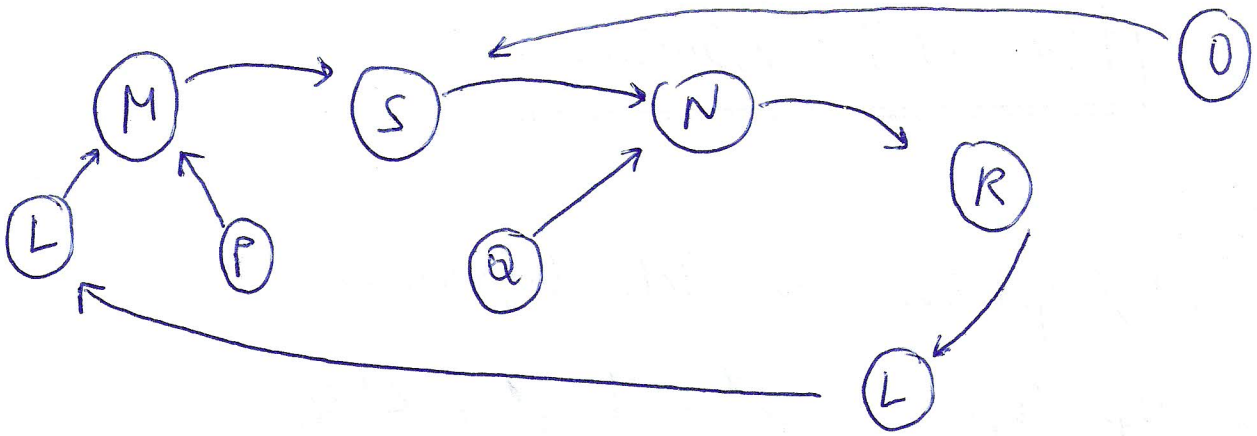
$$\boxed{B^* = C + A' B}$$

- $J_C = B'$, $K_C = A$ $\Rightarrow$ $C^* = J C' + K' C$

$$= B' C' + A' C$$

based on the equations that we just derived

Current State = ABC	$A^* B^* C^*$ = Next state
0 0 0 = L	0 0 1 = M
0 0 1 = M	1 1 1 = S
0 1 0 = N	1 1 0 = R
0 1 1 = O	1 1 1 = S
1 0 0 = P	0 0 1 = M
1 0 1 = Q	0 1 0 = N
1 1 0 = R	0 0 0 = L
1 1 1 = S	0 1 0 = N



2/ for D-flip flops $Q^* = D$.

- $D_A = 1 \cdot A' + 0 \cdot A = A' = D_A$

$$\boxed{A^* = A'}$$

- $D_B = (U'A' + UA) \oplus B$

$= (U'A' + UA) \oplus B \longrightarrow \boxed{B^* = D_B}$

- $D_C = (U'A'B' + UAB) \oplus C \longrightarrow \boxed{C^* = D_C}$

	A	B	C	U = 0			U = 1		
				A^*	B^*	C^*	A^*	B^*	C^*
S_0	0	0	0	1	1	1	1	0	0
S_1	0	0	1	1	1	0	1	0	1
S_2	0	1	0	1	0	0	1	1	0
S_3	0	1	1	1	0	1	1	1	1
S_4	1	0	0	0	0	0	0	1	0
S_5	1	0	1	0	0	1	0	1	1
S_6	1	1	0	0	1	0	0	0	1
S_7	1	1	1	0	1	1	0	0	0

$A^* B^* C^*$

State/output table

state	U = 0	U = 1
S_0	S_7	S_4
S_1	S_6	S_5
S_2	S_4	S_6
S_3	S_5	S_7
S_4	S_0	S_2
S_5	S_1	S_3
S_6	S_2	S_1
S_7	S_3	S_0

state*

do the ~~Circuit~~ State diagram (---)

Problem 2

{ input = X
  output = Y

Y = 1 if 1 0 1 1 1

+ moore design - D ffs.

State	0	1	Y
initial	initial	Got 1	0
Got 1	Got 10	Got 1	0
Got 10	initial	Got 101	0
Got 101	Got 10	Got 1011	0
Got 1011	Got 10	Got 10111	0
Got 10111	Got 10	Got 1	1

Next state

ABC	0	1	Y
0 0 0	0 0 0	0 0 1	0
0 0 1	0 1 0	0 0 1	0
0 1 0	0 0 0	0 1 1	0
0 1 1	0 1 0	1 0 0	0
1 0 0	0 1 0	1 0 1	0
1 0 1	0 1 0	0 0 1	1

Note: used minimum cost design

$A^* B^* C^*$

A^*: CX / AB

	00	01	11	10
0			d	
01			d	
11		1	d	1
10			d	

$A^* = AC'X + BCX.$

$B^* = AC'X + BC' + AC'$

$C^* = C'X + BC'$

B^+:

CX \ AB	00	01	11	10
00			d	1
01		1	d	
11			d	
10	1	1	d	1

$B^+ = CX' + AX' + BCX$

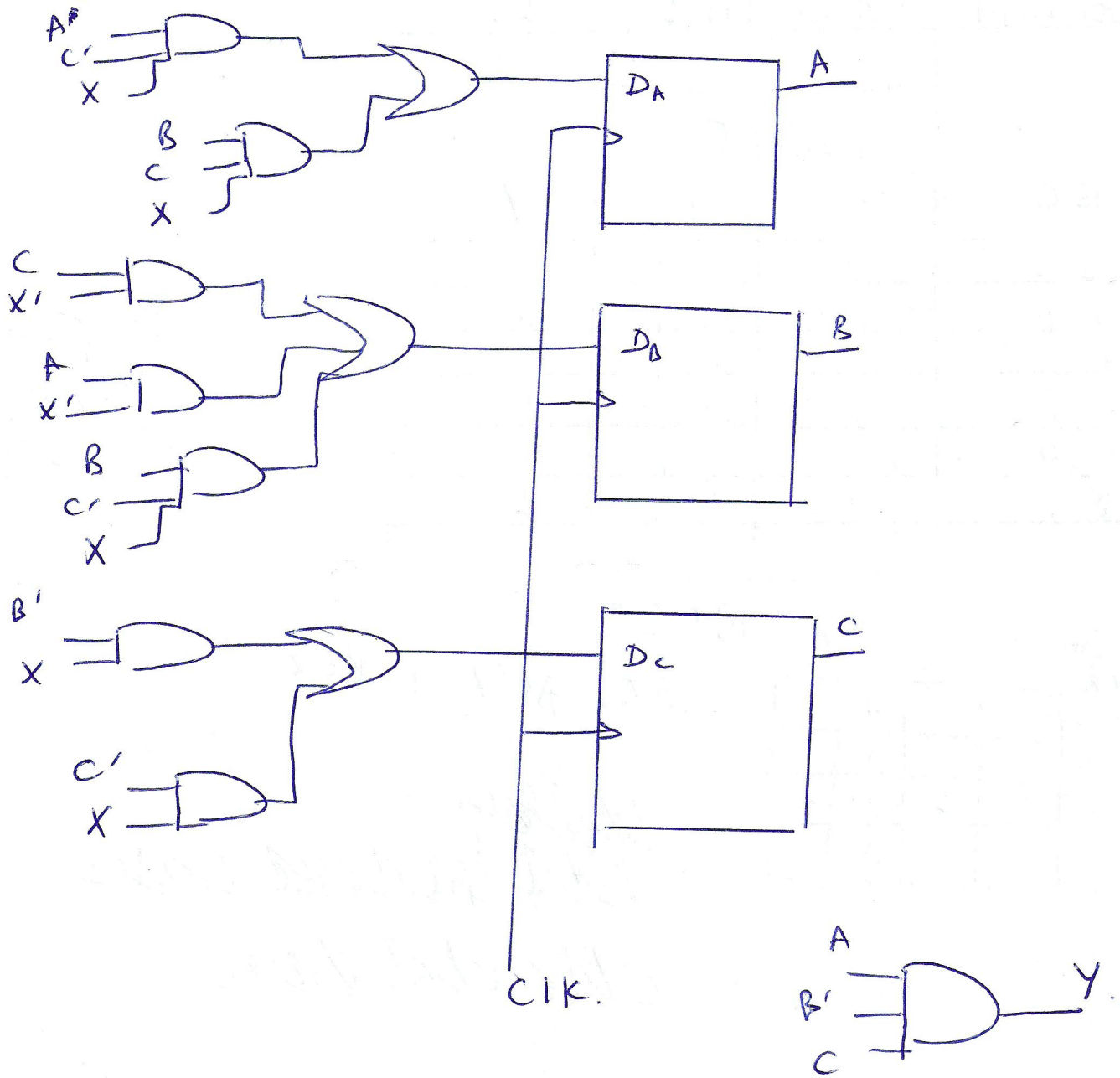
C^+

CX \ AB	00	01	11	10
00			d	
01	1	1	d	1
11	1		d	1
10			d	

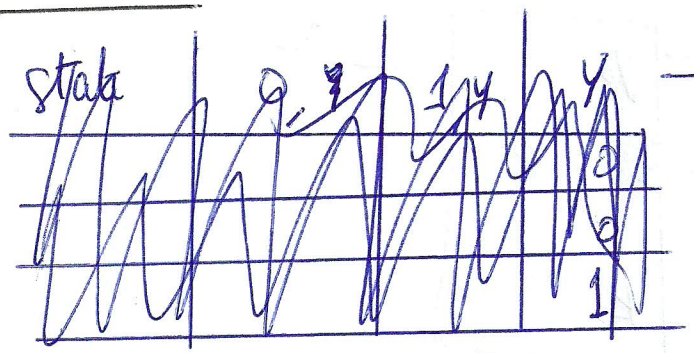
$C^+ = C'X + B'X.$

Since $Q^+ = D$

$Y = AB'C.$



Problem 3



state/output table

state	0	1
S_0	S_0, 0	S_1, 0
S_1	S_2, 0	S_0, 0
S_2	S_1, 1	S_0, 1

state*, Y

transition/output table

Q_1 Q_0	0	1
0 0	00, 0	01, 0
0 1	10, 0	00, 0
1 0	01, 1	00, 1

$Q_1^* Q_0^*$, Y

Q Q^*	J K
0 0	0 d
0 1	1 d
1 0	d 1
1 1	d 0

excitation table

Q_1 Q_0	0	1
0 0	0d 0d, 0	0d, 1d, 0
0 1	1d, d1, 0	0d, d1, 0
1 0	d1, 1d, 1	d1, 0d, 1

$J_1^* K_1^*$, $J_0^* K_0^*$, Y

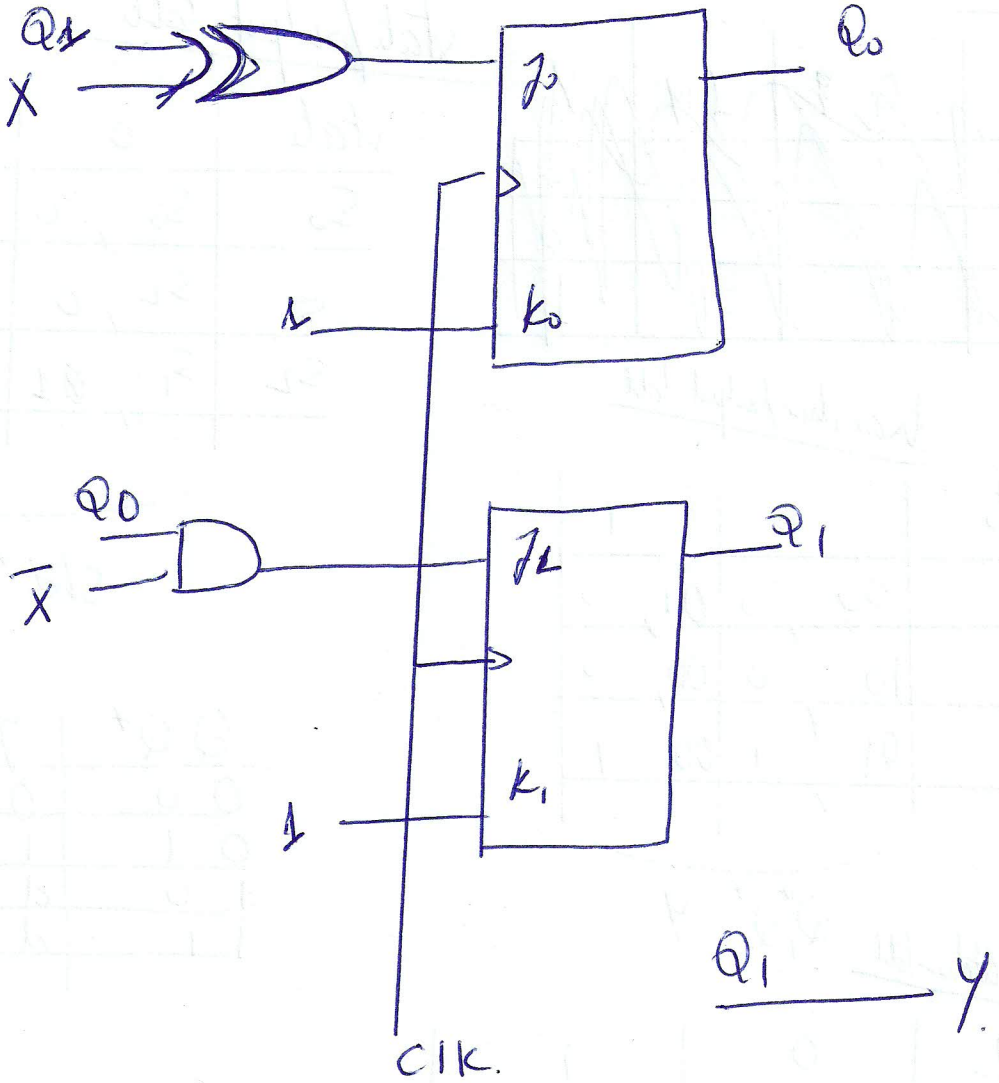
Need to find the expression for $J_1^*, K_1^*, J_0^*, K_0^*$ and Y.

$K_1^* = K_0^* = 1$

using K-maps ⟶ $J_1 = Q_0 x'$

$J_0 = x \oplus Q_1$

$Y = Q_1$


Q1
X
J0
Q0
1
K0
Q0
X̄
J1
Q1
K1
1
Q1
Y
CLK.