EGC220
Class Notes
4/21/2023

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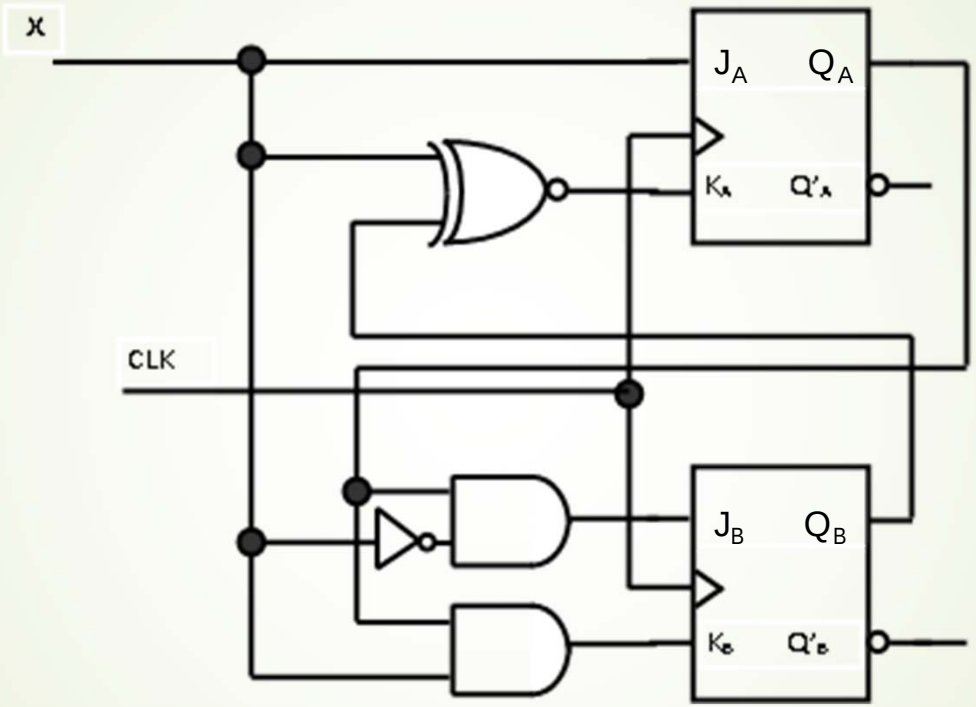
Test Result

	Test 1	Test 2
Average	70	69
Median	72	68
MAX	96	100
Minimum	0	0

Analysis Example:



Step 1: Flip-flop input equations and output equation

$J_A = X$

$K_A = \overline{Q_B \oplus X}$

$J_B = Q_A X'$

$K_B = Q_A X$

Step 2: Characteristic Table

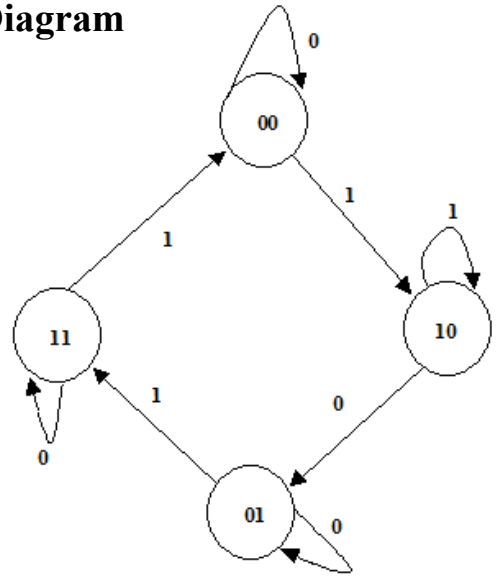
J K	Q(t+1)
0 0	Q(t)
0 1	0
1 0	1
1 1	Q'(t)

Step 3: State Table

PS $Q_A Q_B$ X	J_A	K_A	J_B	K_B	NS Q_A Q_B
000	0	1	0	0	0 0
001	1	0	0	0	1 0
010	0	0	0	0	0 1
011	1	1	0	0	1 1
100	0	1	1	0	0 1
101	1	0	0	1	1 0
110	0	0	1	0	1 1
111	1	1	0	1	0 0

unknown

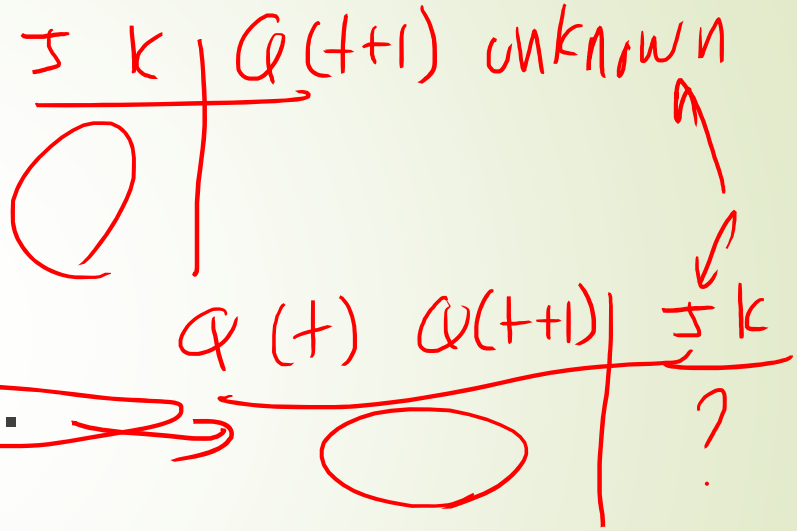
Step 4: State Diagram



Design of Sequential Circuits

- Design Procedure:

1. Word description.
2. State diagram.
3. Assign binary values.
4. Decide on type of flip flops.
5. Excitation table for the flip flop.
6. State table.
7. Generate simplified logic equations for flip flop inputs and system outputs.
8. Draw logic diagram.



Flip-Flop Excitation Tables

PRESENT STATE	NEXT STATE	S	R
Q(t)	Q(t+1)		
0	0	0	X
0	1	1	0
1	0	0	1
1	1	X	0

PRESENT STATE	NEXT STATE	J	K
Q(t)	Q(t+1)		
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

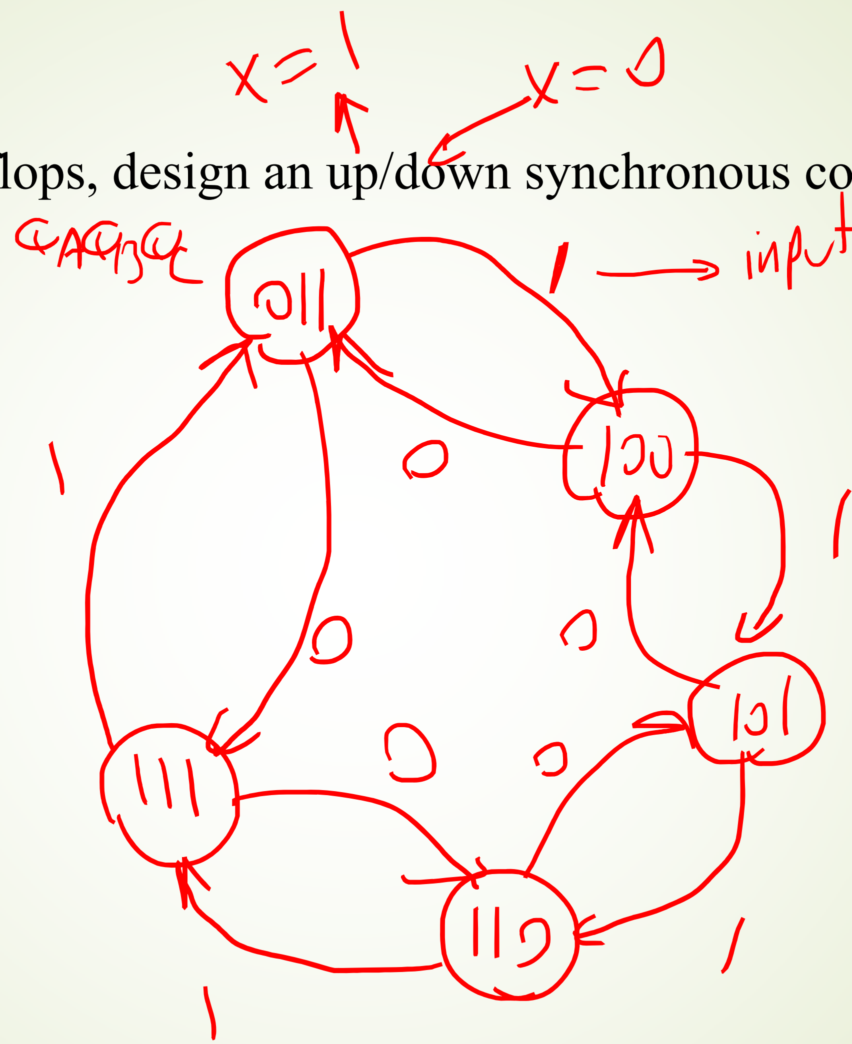
Q(t)	Q(t+1)	T
0	0	0
0	1	1
1	0	1
1	1	0

Q(t)	Q(t+1)	D
0	0	0
0	1	1
1	0	0
1	1	1

Problem 1

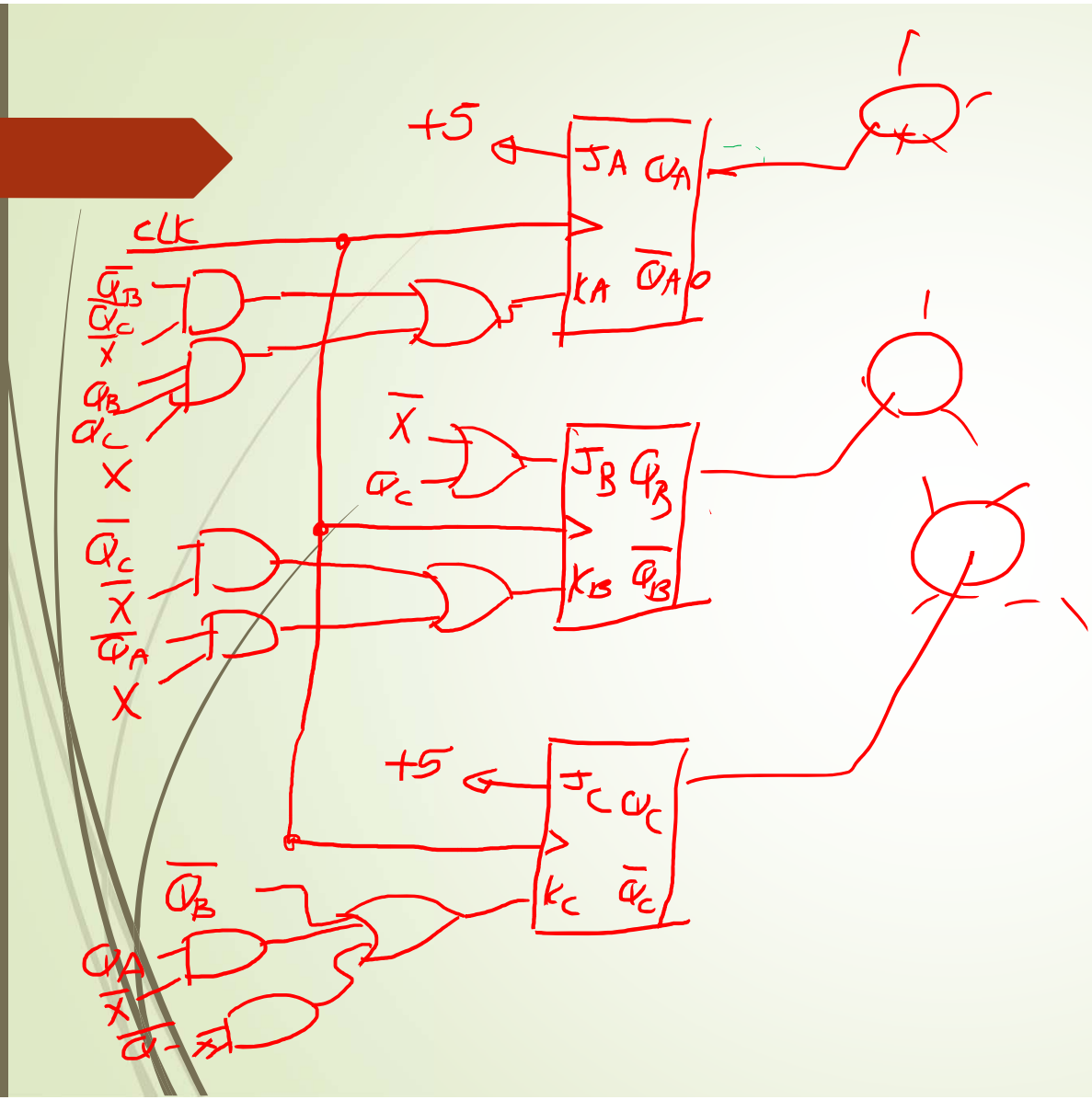
Using JK flip flops, design an up/down synchronous counter that counts from 3 to 7.

111



Q(t)	Q(t+1)	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0


PS input
NS
$Q_A Q_B Q_C$ X
$Q_A^+ Q_B^+ Q_C^+$
$J_A K_A$ $J_B K_B$ $J_C K_C$
$K_A = \bar{Q}_B \bar{Q}_C \bar{X} + Q_B Q_C X$
$J_A = 1$
$J_C = 1$
$J_B = \bar{X} + Q_C$



$K_B = \overline{Q_C}\,\overline{X} + \overline{Q_A}X$

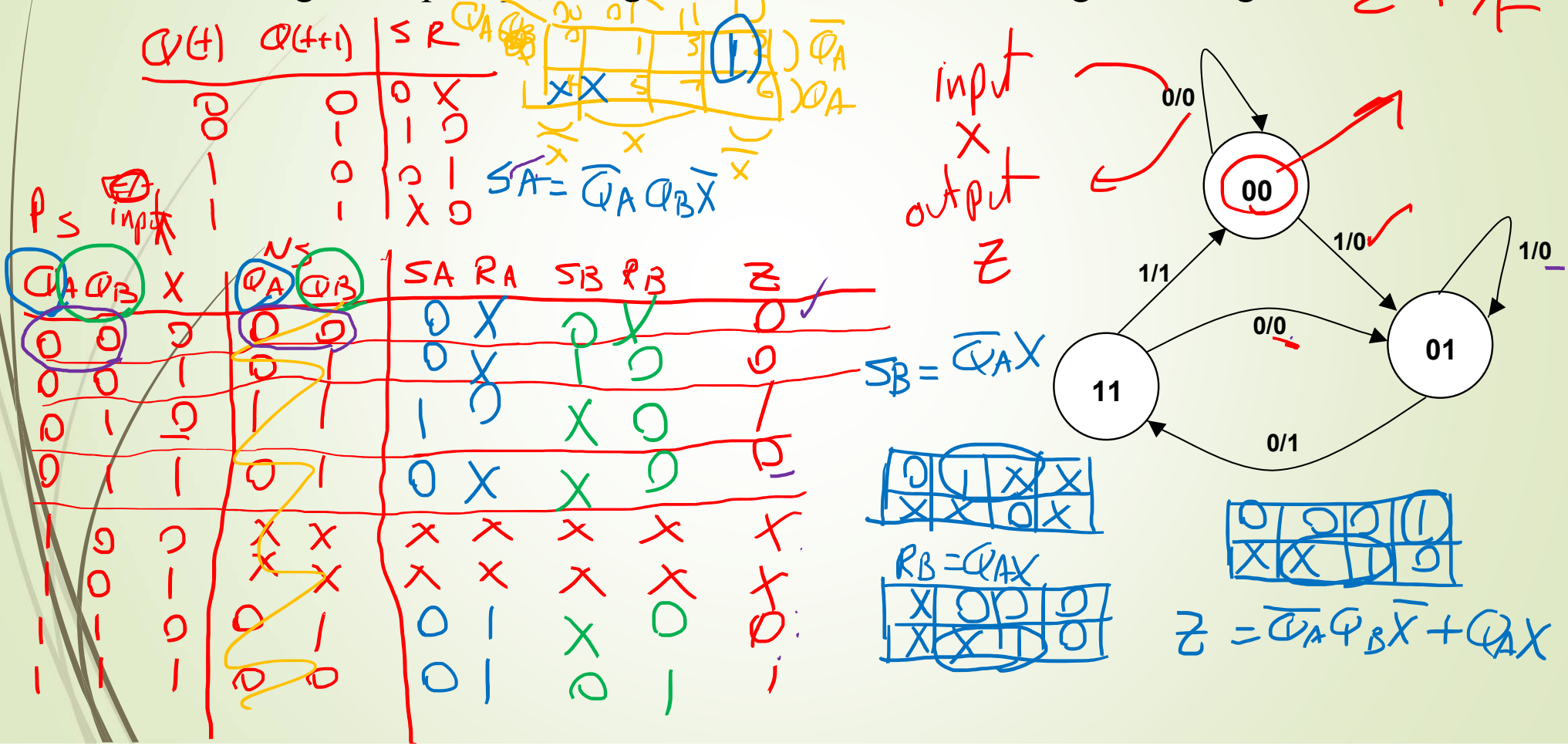
X	X	X	X
X	X	1	0
1	0	0	0
X	X	X	X

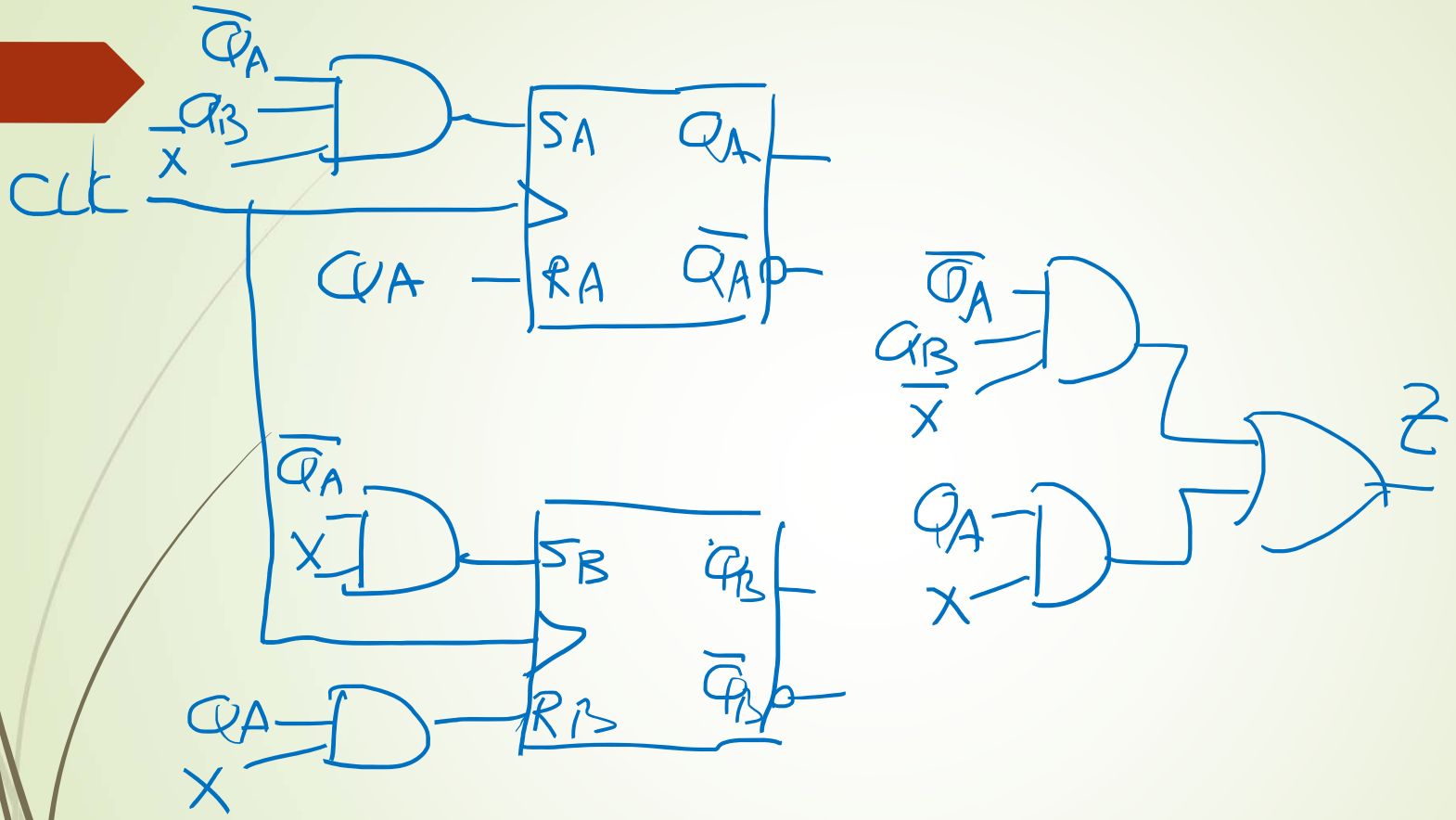
X	X	X	X
X	X	1	0
X	X	0	1
X	1	1	X

$K_C = \overline{Q_B} + Q_A\overline{X} + \overline{Q_A}X$

Problem

Using SR flip-flops, design a circuit for the following state diagram.

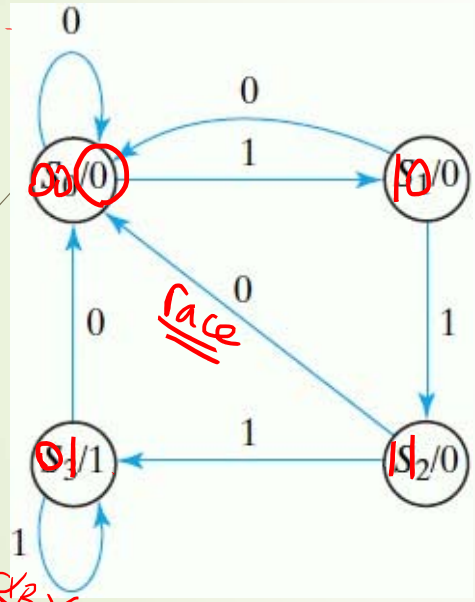



$\overline{Q_A}$
Q_B
X
CLK
SA
Q_A
Q_A
RA
$\overline{Q_A}$
$\overline{Q_A}$
X
SB
Q_B
$\overline{Q_B}$
Q_A
X
RB
$\overline{Q_B}$
$\overline{Q_A}$
Q_B
X
Q_A
X
Z

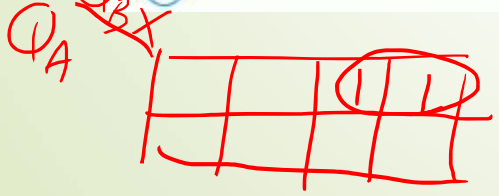
Problem 3

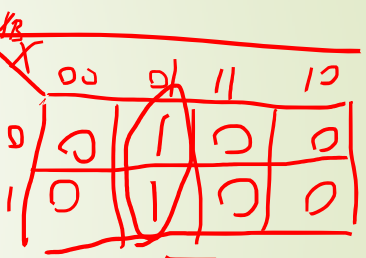
Using D flip-flops, design a circuit for the following state diagram. You may make the following state assignments: S0 = 00, S1 = 10, S2 = 11, S3 = 01

Moore

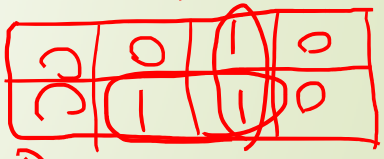


Q_A	Q_B	X	D_A	D_B	Z
0	0	0	0	0	0
0	0	1	1	0	0
→ 0	1	0	0	0	1
→ 0	1	1	0	1	1
1	0	0	0	0	0
1	0	1	1	1	0
1	1	0	0	0	0
1	1	1	0	1	0



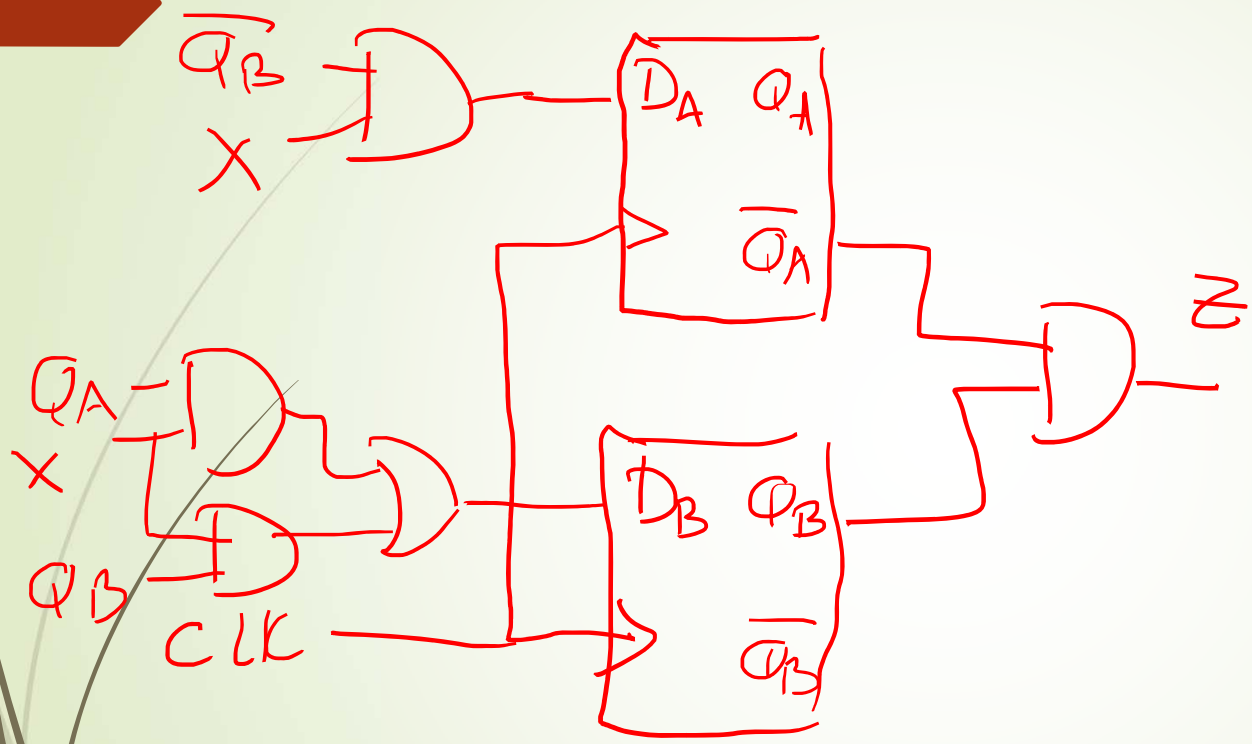


$D_A = \overline{Q}_B X$



$D_B = Q_A X + Q_B X$

$Z = \overline{Q}_A Q_B$


$\overline{Q_B}$
X
D_A
Q_A
$\overline{Q_A}$
Z
Q_A
X
Q_B
CLK
D_B
Q_B
$\overline{Q_B}$