CS & IT ENGINEERING

Digital Logic

Sequential Circuit

Lecture No. 11

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01 Synchronous counter

02 Designing

03 QUESTION PRACTICE

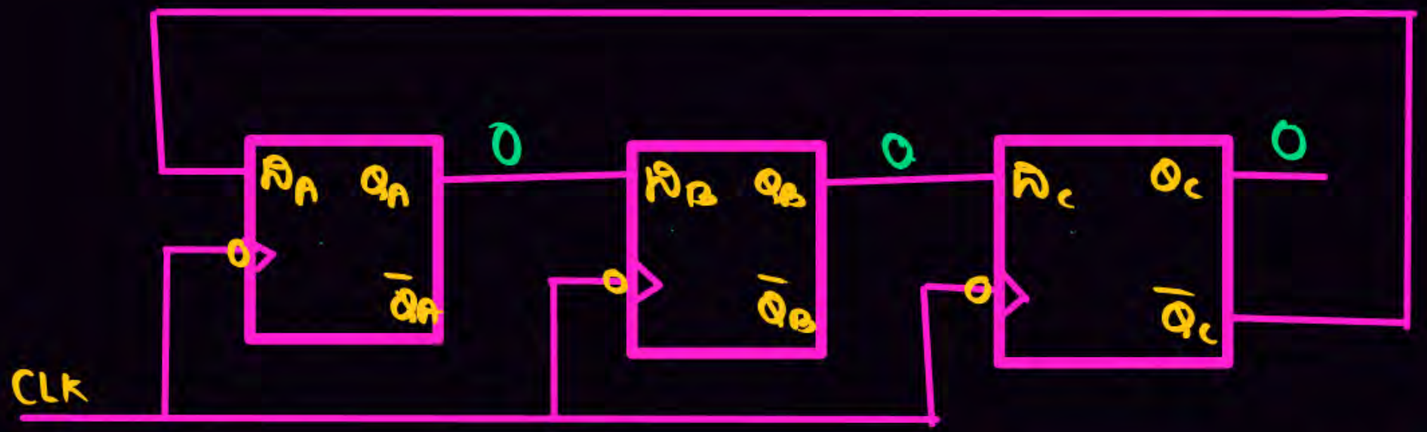
04 DUAL & SELF DUAL

05 DISCUSSION

t.me/CJSIR

JOHNSON COUNTER

- Twisted Ring counter
- Creeping counter
- Mobies counter
- Walking counter



MOD 6.

Clock	Q_A	Q_B	Q_C
0	0	0	0
1	1	0	0
2	1	1	0
3	1	1	1
4	0	1	1
5	0	0	1
6	0	0	0
7	1	0	0
8.	1	1	0

3 bit Johnson counter

MOD-6

0 0 0
1 0 0
1 1 0
1 1 1
0 1 1
0 0 1

4 bit Johnson counter

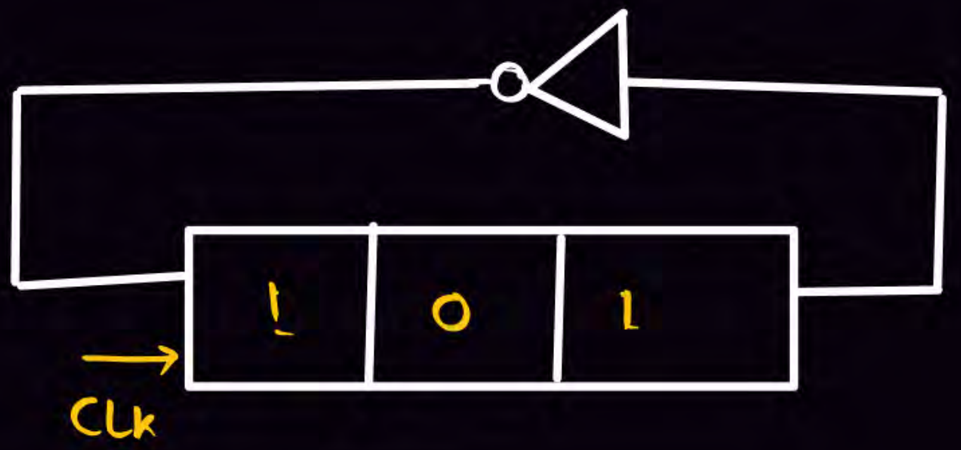
MOD-8

0 0 0 0
1 0 0 0
1 1 0 0
1 1 1 0
1 1 1 1
0 1 1 1
0 0 1 1
0 0 0 1

N bit Johnson counter $\Rightarrow$ MOD (used state) = $2N$

unused states = $2^N - 2N$

Symbolic Representation



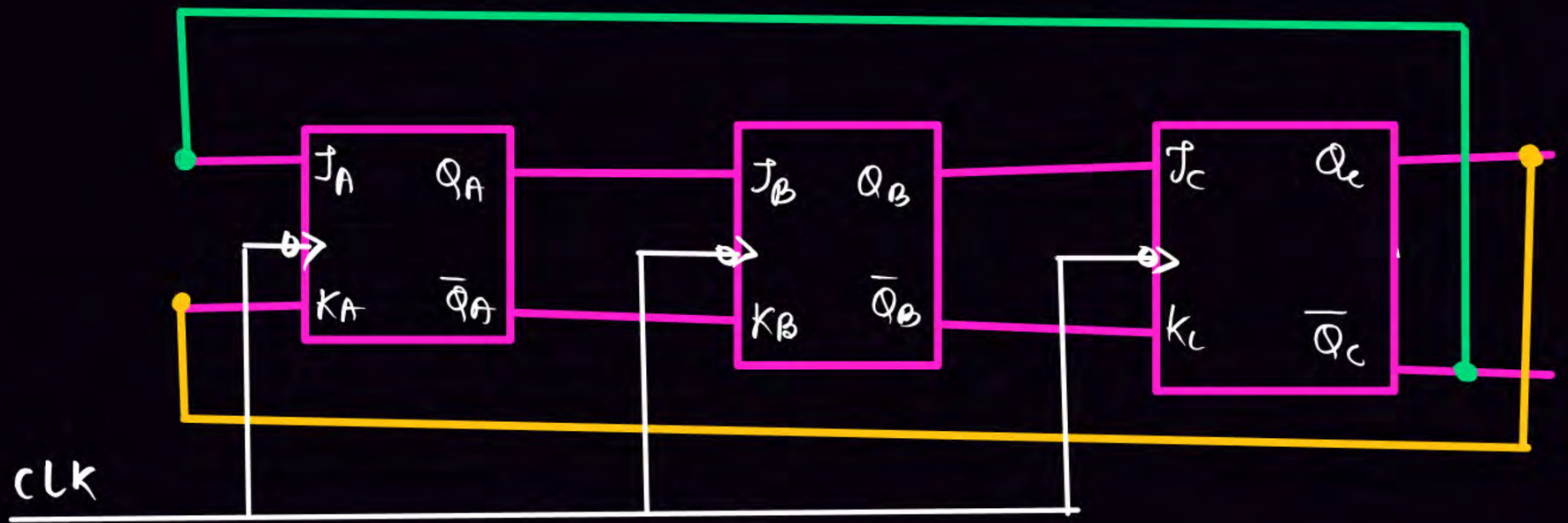
MOD-2

CLK	Q_1	Q_2	Q_3
0	1	0	1
1	0	1	0
2	1	0	1
3	0	1	0
4	1	0	1
5			

Lockout problem :→

↳ Whenever Johnson counter enters into its unused state, it will be trap or lock into unused state, are called Lockout problem

Johnson counter by JK FF.



SYNCHRONOUS COUNTER DESIGN :→

Step 1 :→ Write the Previous and Present state

Step 2 :→ Write the excitation Table of Flip-Flop.

Step 3 :→ Write the Logical expression

Step 4 :→ Minimization

Step 5 :→ Hardware Implementation.

Question → Design a synchronous counter by using "T" FF which count the sequence ⇒ $0 \to 3 \to 1 \to 2 \to 0 \to \ldots$

$\{00 \to 11 \to 01 \to 10 \to 00 \to \ldots\}$

↳ 2 FF's required.

Step 1.

& Step 2.

Q_1	Q_0	Q_1^+	Q_0^+	T_1	T_0
0	0	1	1	1	1
0	1	1	0	1	1
1	0	0	0	1	0
1	1	0	1	1	0

Step 3.

& Step 4

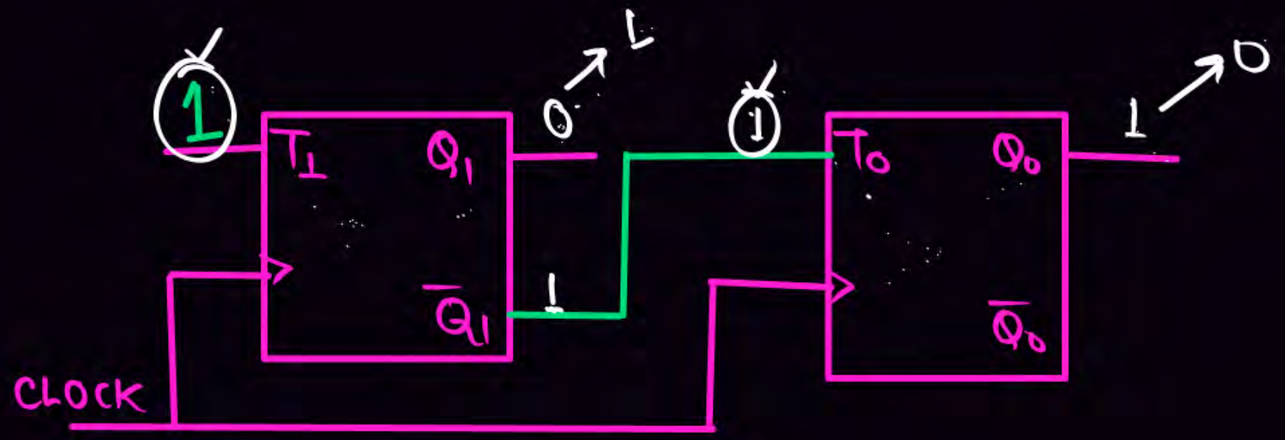
$T_1 = 1$

$T_0 = \bar{Q}_1 \bar{Q}_0 + \bar{Q}_1 Q_0$

$T_0 = \bar{Q}_1 [\bar{Q}_0 + Q_0]$

$T_0 = \bar{Q}_1$

Step 5 :



Justification

Clock	Q_1	Q_0
0	0	0
1	1	1
2	0	1
3	1	0
4	0	0

Q Design a Synchronous counter by using 'D' FF which count

$00 \rightarrow 11 \rightarrow 01 \rightarrow 00 \rightarrow \ldots$

Method (1)

step 1 & step 2.

Q_1	Q_0	Q_1^+	Q_0^+	D_1	D_0
0	0	1	1	1	1
1	1	0	1	0	1
0	1	0	0	0	0

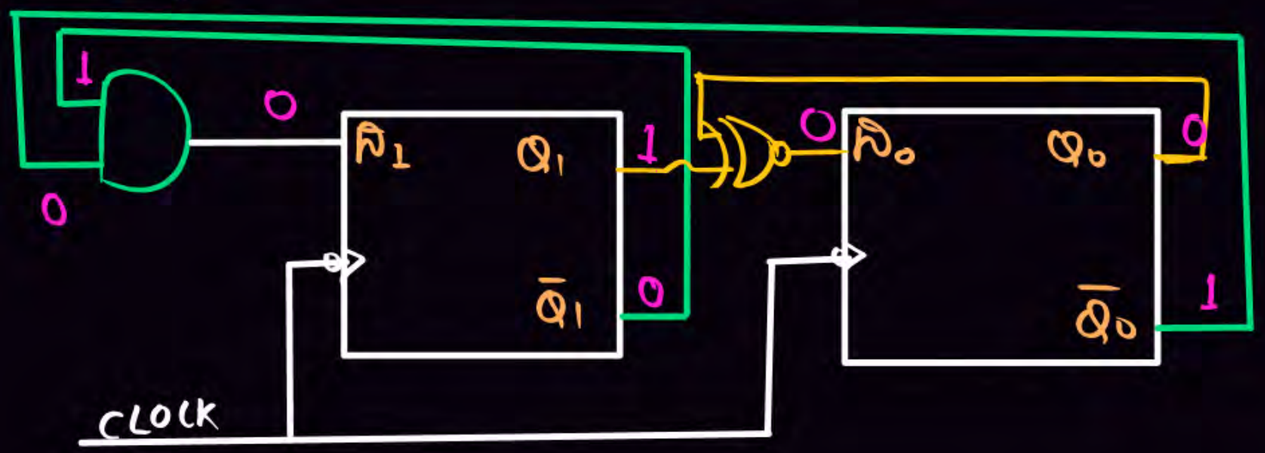
step 3 & step 4

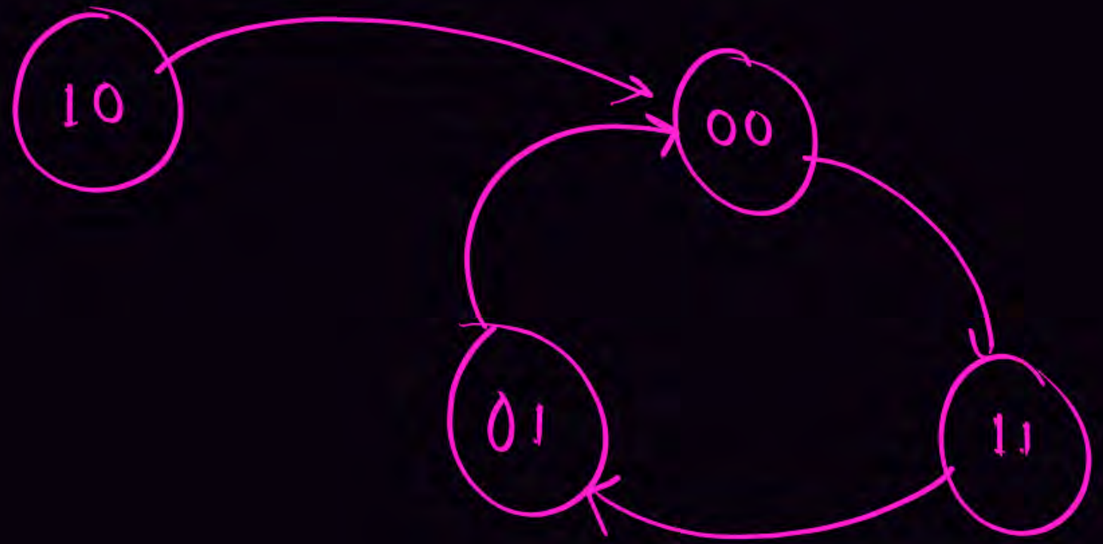
$D_1 = \bar{Q}_1 \bar{Q}_0$

$D_0 = \bar{Q}_1 \bar{Q}_0 + Q_1 Q_0$

$\boxed{D_0 = Q_1 \odot Q_0}$

Step 5.





CLK	Q_1	Q_0
0	0	0
1	1	1
2	0	1
3	1	0

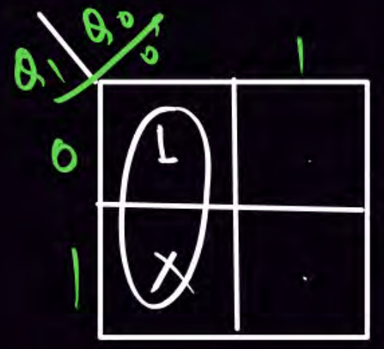
4. 1 1

5. 0 1

6. 0 0

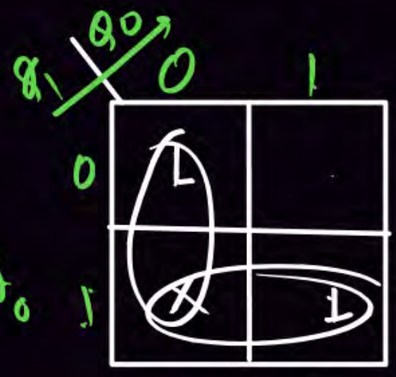
Method ②

	Q_1	Q_0	Q_1^+	Q_0^+	D_1	D_0
0	0	0	1	1	1	1
1	0	1	0	0	0	0
2	1	0	X	X	X	X
3	1	1	0	1	0	1



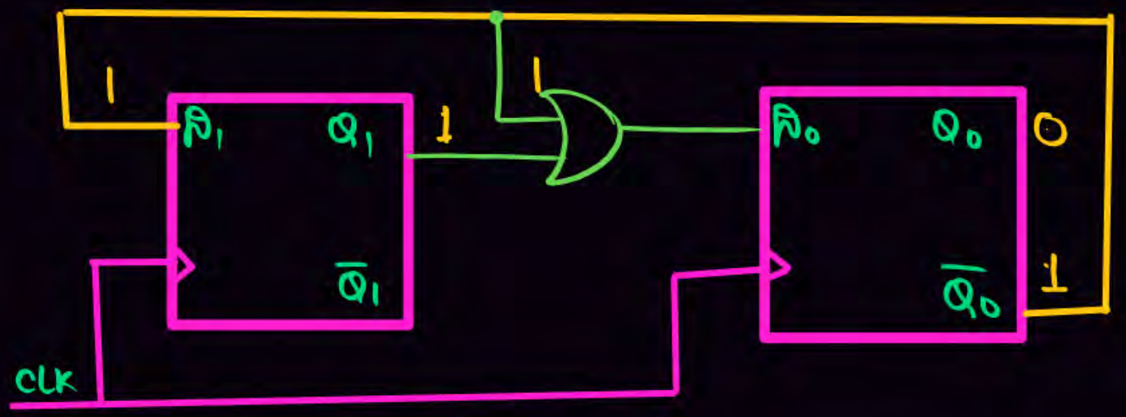
D_1

$D_1 = \bar{Q}_0$

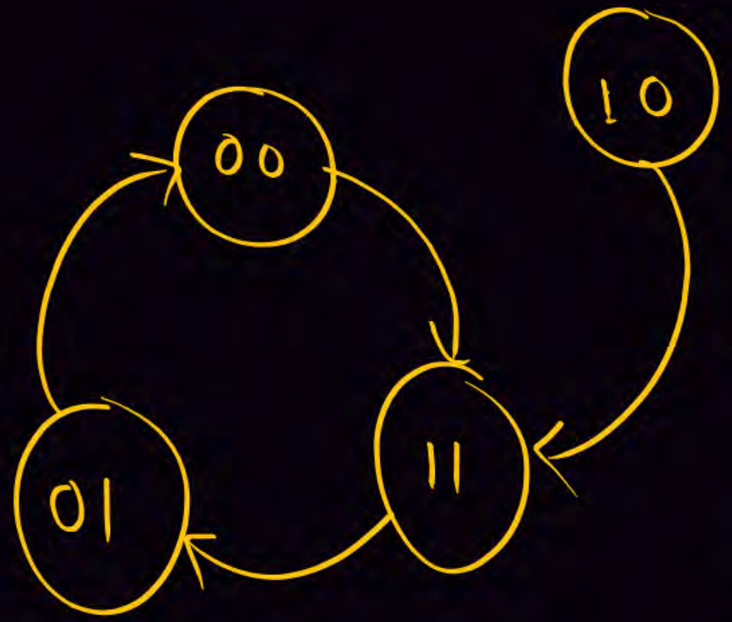


D_0

$D_0 = Q_1 + \bar{Q}_0$



Clock	Q_1	Q_0
0	0	0
1	1	1
2	0	1
3	0	0
4	1	1
5	0	1



No Lockout

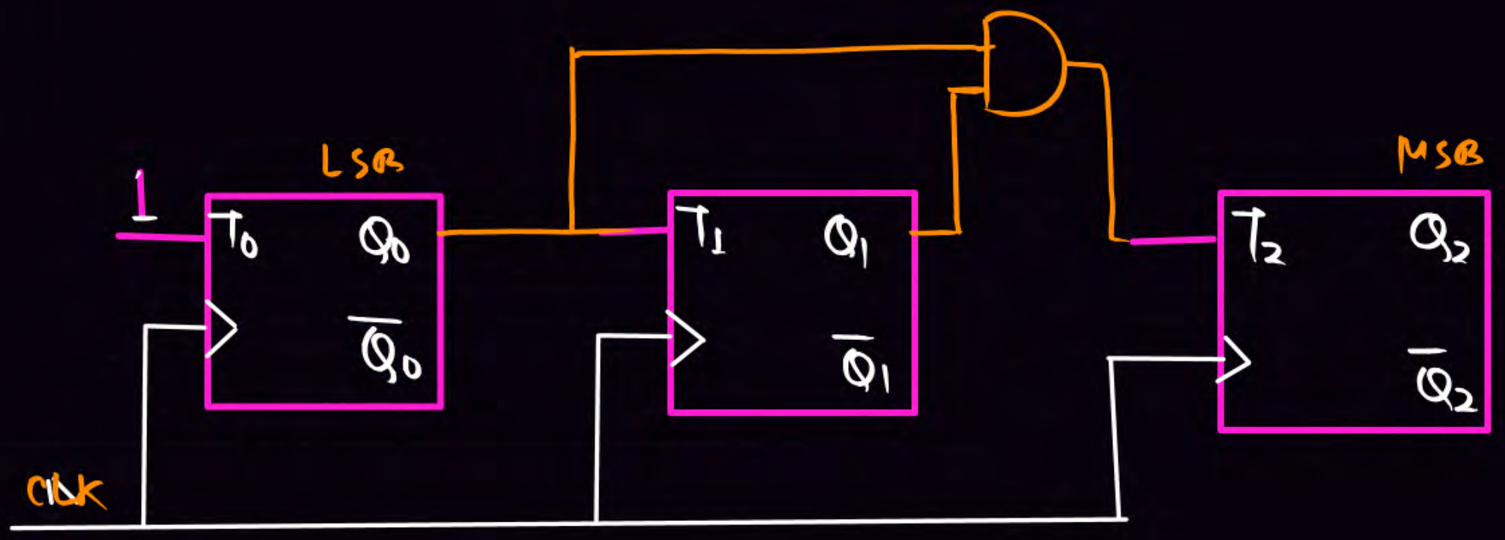
Q Design a synchronous counter by using T-FF which count -

$000 \rightarrow 001 \rightarrow 010 \rightarrow 011 \rightarrow 100 \rightarrow 101 \rightarrow 110 \rightarrow 111 \rightarrow 000 \rightarrow \ldots\ldots$

$T_0 = 1$

$T_1 = Q_0$

$T_2 = Q_1 Q_0$


LSB
MSB
1
T_0
Q_0
$\overline{Q}_0$
T_1
Q_1
$\overline{Q}_1$
T_2
Q_2
$\overline{Q}_2$
CLK


THANK YOU GW
SOLDIERS !