Tutorial - 4

1)

Q_A	Q_B	Q_C	$D_A = Q_B \cdot Q_C = Q_A^+$	$D_B = Q_A = Q_B^+$	$D_C = Q_C^+ = Q_B$
0	0	0	1	0	0
1	0	0	1	1	0
1	1	0	0	1	1
0	1	1	1	0	1

2) $D_0 = Q_2'$

$D_2 = Q_0 Q_1'$

$D_1 = Q_0'$

Q_0	Q_1	Q_2	$Q_0^+ = D_0 = Q_2'$	$Q_1^+ = D_1 = Q_0'$	$Q_2^+ = D_2 = Q_0 Q_1'$
0	1	0	1	1	0
1	1	0	1	0	0
1	0	0	1	0	1
1	0	1	0	0	1
0	0	1	0	1	0
0	1	0	1	1	0

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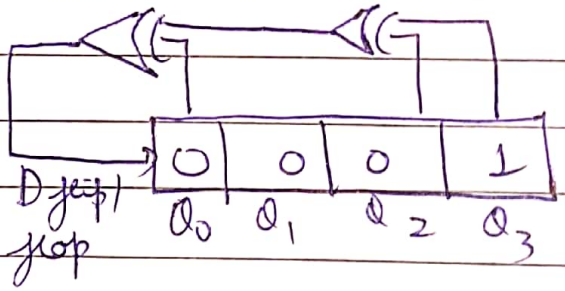
3) Prev State | Next State

Q_3	Q_2	Q_1	Q_0	Q_3^+	Q_2^+	Q_1^+	Q_0^+
0	1	1	0	1	0	1	1
1	0	1	1	0	1	0	1
0	1	0	1	1	0	1	0

→ XOR (1,0)
→ XOR (1,1)
→ XOR (0,1)

4) a) The above situation can be depicted as



$D = Q_0(n+1)$
$= (Q_2(n) \oplus Q_3(n)) \oplus Q_0(n)$

CP	Prev State Q_0	Q_1	Q_2	Q_3	Next State Q_0^+	Q_1^+	Q_2^+	Q_3^+
0	0	0	0	1	1	0	0	0
1	1	0	0	0	1	1	0	0
2	1	1	0	0	1	1	1	0
3	1	1	1	0	0	1	1	1
4	0	1	1	1	0	0	1	1
5	0	0	1	1	0	0	0	1
6								

→ So, After 6th pulse

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b)

Prev state				Next state			
Q_0	Q_1	Q_2	Q_3	Q_0^+	Q_1^+	Q_2^+	Q_3^+
0	0	1	–	1	0	0	1

For Next state to 1 0 0 1
prev state should be 0 0 1 –
we have to find this

Now,

$$Q_0^+ = D = (Q_2 \oplus Q_3) \oplus Q_0$$

$$1 = (1 \oplus Q_3) \oplus 0$$

$$\Downarrow$$

So, to get $(1 \oplus Q_3) \oplus 0 = 1$

$$(1 \oplus Q_3) = 1$$

$$\Downarrow$$

To get this $Q_3 = 0$

So,

0 0 1 0 $\Rightarrow$ Prev. State Required

5) Initially

$Q_1 = Q_2 = 1$

$Q_3 = 0$

$S = 0$, $C = 1$

	D_1	Q_1	D_2	Q_2	D_3	Q_3	S	C	C_{in}	SR
1st	1	1	1	1	1	1	1	1	1	101_ 001_
2nd	1	1	1	1	1	1	(1)	(1)	1	10__ 00__

$S = 1$ & $C = 1$

||

After two clock pulse

6) 2×1 Mux $\Rightarrow A'X_0 + AX_1$

$D = Y = A'X_0 + AX_1$

For D flip flop

$D = Q(n+1) = A'X_0 + AX_1$

Here $X_0 = Q'$ & $X_1 = Q$

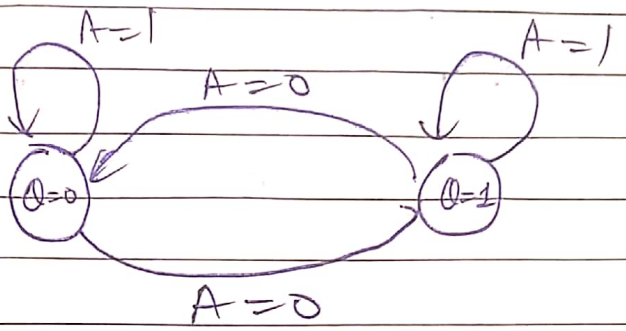
So,

$$Q_{n+1} = A'Q_n' + AQ_n$$

If $A=0 \Rightarrow Q(n+1) = Q_n'$

If $A=1 \Rightarrow Q(n+1) = Q(n)$

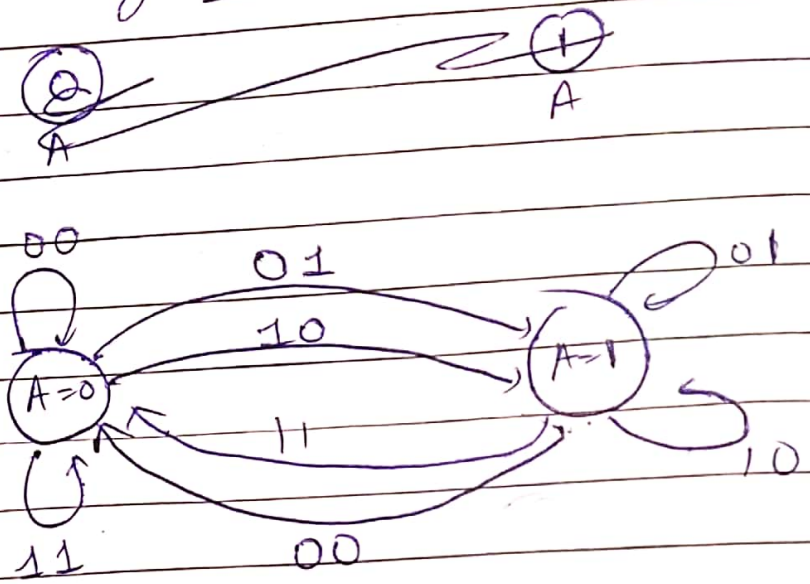
So,



7) State Table

Present State	I/P	Next state
A	X Y	A^+
0	0 0	0
0	0 1	1
0	1 0	1
0	1 1	0
1	0 0	1
1	0 1	0
1	1 0	0
1	1 1	1

State Diagram —



8)

Here

$$D_2 = A \oplus S = Q_1 \oplus S$$

$$= Q_1' S + Q_1 S' \quad \text{--- (1)}$$

Now,

XOR gate is replaced by XNOR

So,

$$D_2 = \overline{A \oplus S} = \bar{A} S + A S' \quad \text{--- (2)}$$

Comparing (1) & (2)

$$A = Q_1'$$

So, Input A should be connected to Q_1'

9) Mod ⇒ 6

b) No of T flip flop required = 3

M	Present State Q_A	Q_B	Q_C	Next State Q_{A^+}	Q_{B^+}	Q_{C^+}	T_A	T_B	T_C
0	0	0	0	0	0	1	0	0	1
0	0	0	1	0	1	0	0	1	1
0	0	1	0	0	1	1	0	0	1
0	0	1	1	1	0	0	1	1	1
0	1	0	0	1	0	1	0	0	1
0	1	0	1	0	0	0	1	0	1
1	0	0	0	1	0	1	1	0	1
1	1	0	1	1	0	0	0	0	1
1	1	0	0	0	1	1	1	1	1
1	0	1	1	0	1	0	0	0	1
1	0	1	0	0	0	1	0	1	1
1	0	0	1	0	0	0	0	0	1

Excitation Table of T flip flop

Q(n)	Q(n+1)	T
0	0	0
0	1	1
1	0	1
1	1	0

MQ_A \ Q_BQ_C	00	01	11	10
00	0		1	0
01	0	1	X	X
11	1	0	X	X
10	1	0	0	0

$$T_A = MQ_B'Q_C' + M'Q_AQ_C + M'Q_BQ_C$$

MQ_A \ Q_BQ_C	00	01	11	10
00	0	1	1	0
01	0	0	X	X
11	1	0	X	X
10	0	0	0	1

$$T_B = M'Q_A'Q_C + MQ_AQ_C' + MQ_BQ_C'$$

MQ_A \ Q_BQ_C	00	01	11	10
00	1	1	1	1
01	1	1	X	X
11	1	1	X	X
10	1	1	1	1

$$T_C = 1$$