Revision (2) 9/6/2019.

* Sequential system

4 flipflops:

D ff
SR ff
T ff
Jk ff

equation. (Characteristic equ. = Next state equ.
- Transition Table
- characteristic Table
- exitation Table
- State Diagram

equations

D ff Q^* (Q(t+1)) $= D$

SR ff

$$Q^* = S + R'Q$$

T ff

$$Q^* = T \oplus Q$$

Jk ff

$$Q^* = JQ' + K'Q$$

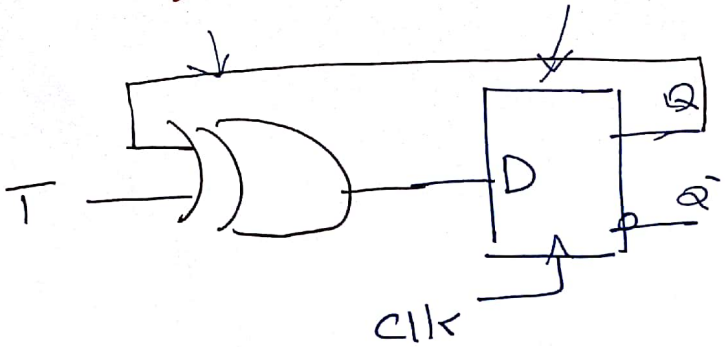
* Convert between 2 flip flops:.

Construct a ff using $\equiv$.

* Ex:

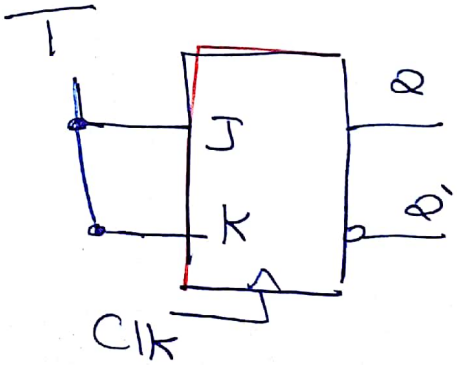
* Design a T ff using D ff?

equ. Design



* Design a T ff using JK ff?

equ. Design



(2)

equ. of T ff $\Rightarrow Q^* = T \oplus Q$

$= T'Q + TQ'$

equ of JK ff $\Rightarrow$

$Q^* = JQ' + K'Q$

$= KQ + JQ'$ (2)

$T' = K' \Rightarrow T = K$

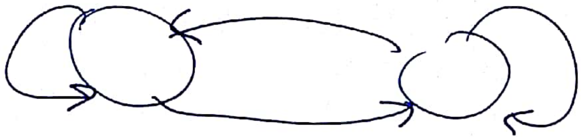
$T = J$

$\boxed{T = K = J}$

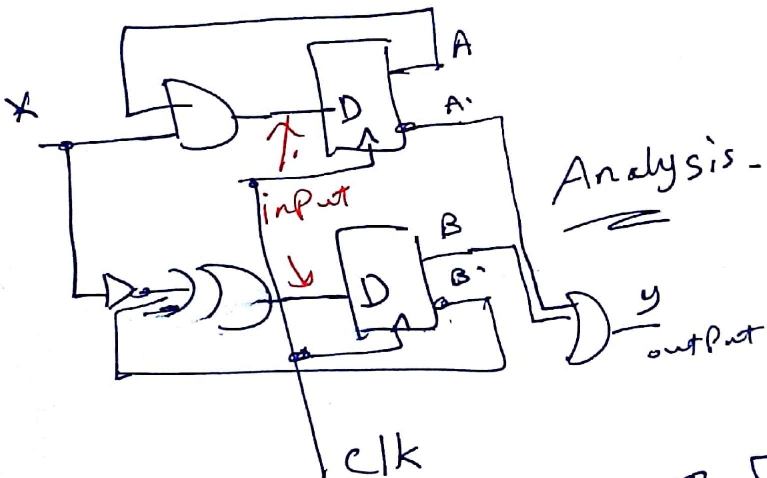
① ⇒ State Table

input	Current state		Next state		output
x	Q_1	Q_2	Q_1^*	Q_2^*	y

② ⇒ State Diagram

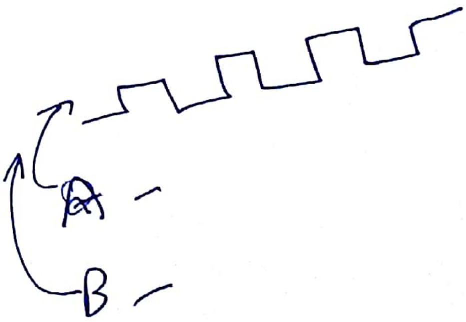


③ ⇒ Block diagram.



Analysis.

④ ⇒ equations
→ input equations
→ output equ.
→ Next state equations.

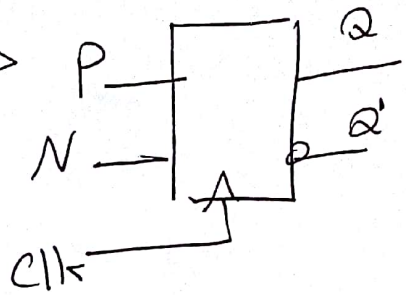


← المسائل بيعطي واحدة من المذكور ١..٤
ويطلب الباقي_

⇒ How to build new ff?

↳ from "Revision File" Q 29

A PN ff ⇒ 2 input



* Four operations:

	P	N
① clear to 0	0	0
② no change	0	1
③ complement	1	0
④ set to 1	1	1

a) Tabulate the Characteristic Table:.

P	N	Q^*
0	0	0
0	1	Q
1	0	$\bar{Q}$
1	1	1

b) Derive Characteristic equation:

$Q^* = Q\bar{P}N + \bar{Q}P\bar{N} + PN$

∵ K.map

(4)

After.

⇒ K-map.

$$Q^* = PQ' + NQ$$

c) Tabulate the excitation Table:

Q	Q*	P	N	
Clear to 0 / No change 0	0	0	X	①
0	1	1	X	②
1	0	X	0	③
1	1	X	1	④

① Q Q* | P N
0 0 | 0 0 Clear to 0
0 1 | No change
0 X

② Q Q* | P N
0 1 | 1 1 set to 1
1 0 Complement
1 X

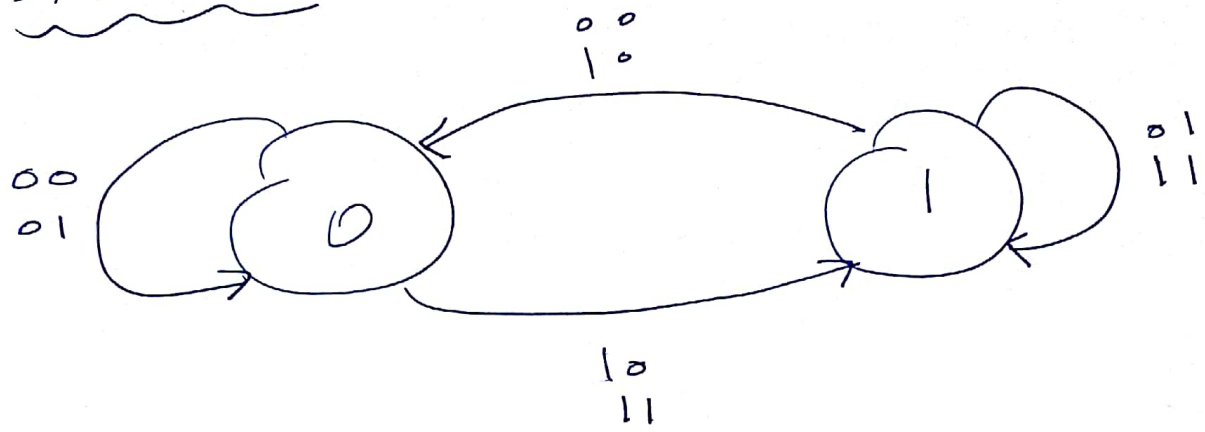
③ Q Q* | P N
1 0 | 0 0 Clear to 0
1 0 Complement
X 0

(4)

Q	Q*	P	N	
1	1	0	1	no change
		1	1	set to 1

X 1

* State Diagram



⇒ Counters with unused state ? ⇒ ex: [illegible]

Ex: Q 32 → in "Revision file"

↳ sequence 0 → 1 → 2 → 4 → 5 → 6 → 0

110 (3 bits) → 3ff → JK

Manipulate the unused state as don't care (X)

JK

Requirments ~~1) Draw~~

2) logic diagram.

3) State Diagram. to show the effect of unused state.

Counter ⟹ M S T T

Modified State Transition Table

① Modified state Transition Table (Mstt)

~~input~~	Current state			Next State			Flip flops inputs.					
	A	B	C	A*	B*	C*	J_A	K_A	J_B	K_B	J_C	K_C
	0	0	0	0	0	1	0	x	0	x	1	x
	0	0	1	0	1	0	0	x	1	x	x	1
	0	1	0	1	0	0	1	x	x	1	0	x
unused	0	1	1	x	x	x	x	x	x	x	x	x
	1	0	0	1	0	1	x	0	0	x	1	x
	1	0	1	1	1	0	x	0	1	x	x	1
	1	1	0	0	0	0	x	1	x	1	0	x
7 → unused	1	1	1	x	x	x	x	x	x	x	x	x

0 → 1 → 2 → 4 → 5 → 6 → 0

Excitation Table

Q	Q*	JK.
0	0	0 x
0	1	1 x
1	0	x 1
1	1	x 0

② equation

$J_A = \Sigma m(2) + \Sigma d(3,4,5,6,7)$

K_A ——

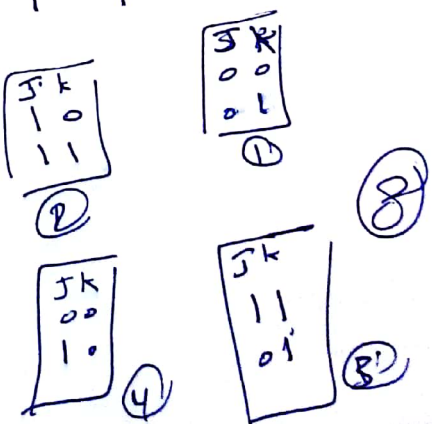
J_B ——

K_B ——

J_C ——

K_C —

③ on K-map.



After K-map

→ $J_A = K_A = B$

→ $J_b = C$

→ $K_b = 1$

→ $J_C = B'$

→ $K_C = 1$

(4) next state equ. $Q^*_{JK} = J\bar{Q} + \bar{K}Q$

$$A^* = J_A \bar{A} + \bar{K_A} A$$

$$= B\bar{A} + \bar{B}A$$

$$\boxed{A^* = B \oplus A}$$

$$B^* = J_B \bar{B} + \cancel{\bar{K_B} B}^{(1)}$$

$$C\bar{B} + 0$$

$$\boxed{B^* = C\bar{B}}$$

$$C^* = J_C \bar{C} + \cancel{\bar{K_C} C}^{(1)}$$

$$\bar{B}\bar{C} + 0$$

$$\boxed{C^* = \bar{B}\bar{C}}$$

$A^* = B \oplus A$

$B^* = CB'$

$C^* = B'C'$

2 unused state.

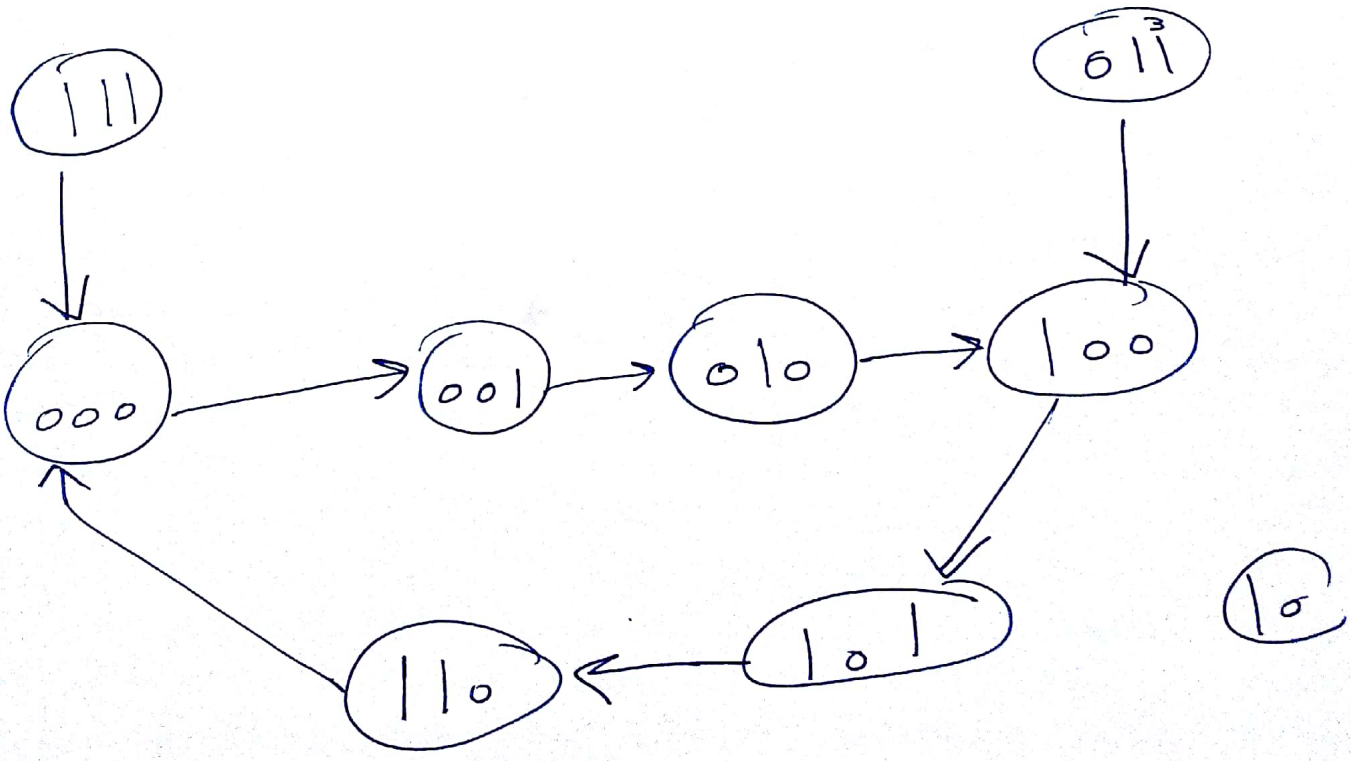
	A B C	A^*	B^*	C^*	
3 →	0 1 1	1	0	0	(4)
7 →	1 1 1	0	0	0	(0)

next state of 3 → 4 self ✓

next state of 7 → 0 ✓

self correcting.

* State Diagram.



* logic Diagram. or Block diagram

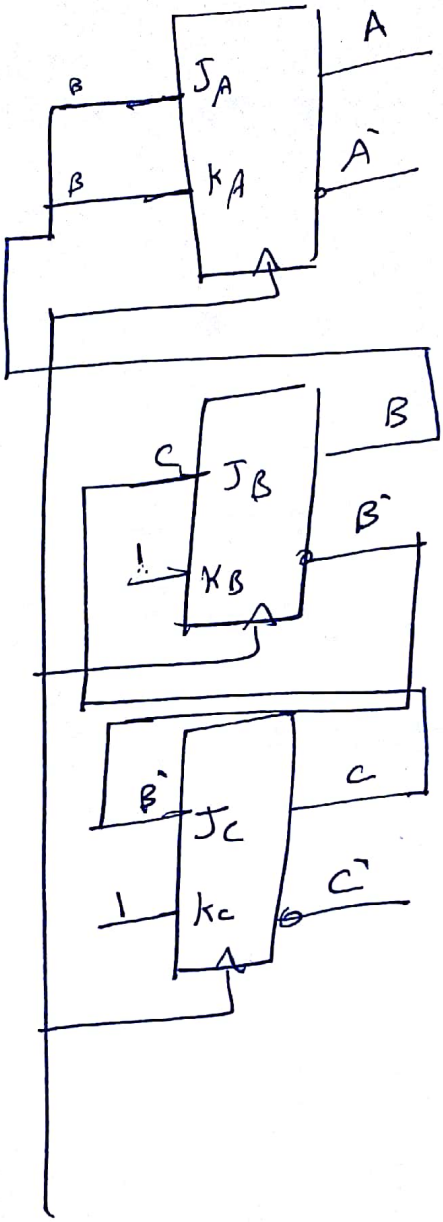
→ $J_A = K_A = B$

→ $J_b = C$

→ $K_b = 1$

→ $J_C = \bar{B}$

→ $K_C = 1$



Q33)

2 Tff A & B input X_{in}

① MSTT

input X_{in}	Current state A	B	Next state A*	B*	flip flops input T_A	T_B
0	0	0	0	0	0	0
0	0	1	0	1	0	0
0	1	0	1	0	0	0
0	1	1	1	1	0	0
1	0	0	0	1	0	1
1	0	1	1	0	1	0
1	1	0	1	1	1	0
1	1	1	1	0	0	1

the same

$00 \to 01 \to 11 \to 10 \to$

Excitation Table of T

Q	Q*	T
0	0	0
0	1	1
1	0	1
1	1	0

Change = 1

No change = 0

② equations.

$T_A = \Sigma m(\quad) = X(\bar{A}B + A\bar{B}) = X(A \oplus B)$

$= (X_{in}\bar{A}B) + (X_{in}A\bar{B})$

$T_B = \Sigma m(\quad) = X(\bar{A}\bar{B} + AB)$

$X(A \oplus B)'$

~~③ k-map~~ . X

④ Next state equ.

$A^* = T_A \oplus A$

⇒ Logic Diagram

⇒ State diagram

Q34)

input X — 3 ff Toggle (3 TFF) — output y

* State Diagram (Given)

① Sequence from state diagram.

1, 2, 3, 4,

X = 0

0 → 3 → 1 → 1 (y = 0)

4 → 2 → 2 (y = 0)

5, 6, 7 unused states.

X = 1

0 → 4 (y = 1) → 3 (y = 0) → 2 (y = 1) → 0

② MSTT ⇑ excitation Table.

input	current			next			input of ff			output
X	A	B	C	A*	B*	C*	T_1	T_2	T_3	y

T_1 T_2 T_3

Em Em Em

↳ K.map.

* From k.map:

$T_A = A + XB'$

$T_B = A + X'B'C + XBC + XBC'$

$T_C = A + X'B'C' + XC$

$A^* = T_A \oplus A$

$(A + XB') \oplus A$

$B^* = T_B \oplus B$

$= (A + X'B'C + XBC + XBC') \oplus B$

$C^* = T_C \oplus C$

$= (A + X'B'C' + XC) \oplus C$

⇒ the effect of unused states. (5, 6, 7)

unused state				next state.					
				X = 0			X = 1		
	A	B	C	A*	B*	C*	A*	B*	C*
5 →	1	0	1	0	0	0	0	1	0
6 →	1	1	0	0	0	1	0	0	1
7 →	1	1	1	0	0	0	0	0	0

5 → 2 ✓

6 → 1 ✓ self correcting.

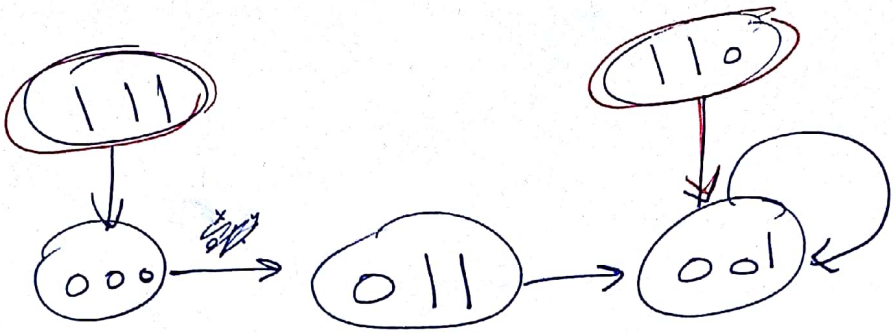
7 → 0 ✓

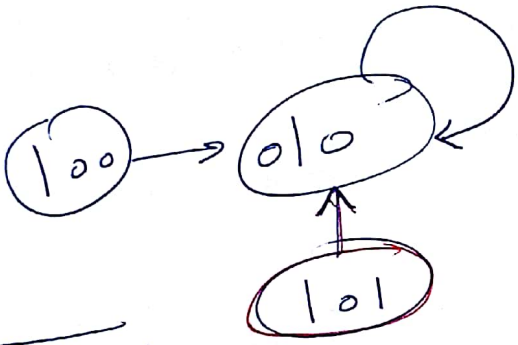
* State Diagram

Mealy State & input A, B, C & X

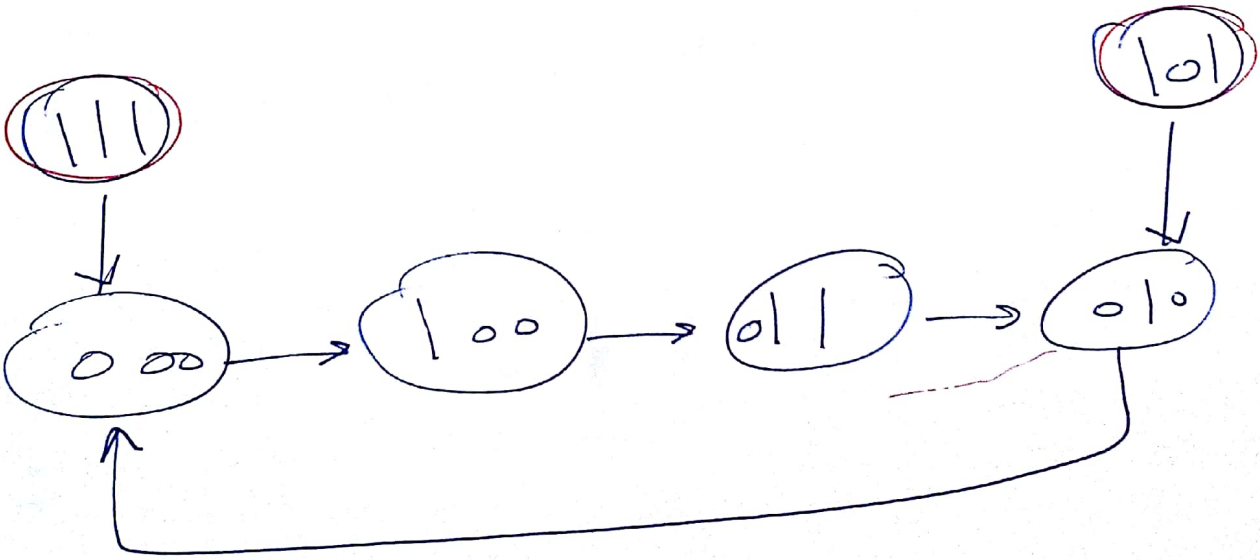
Moore only on State A, B, C

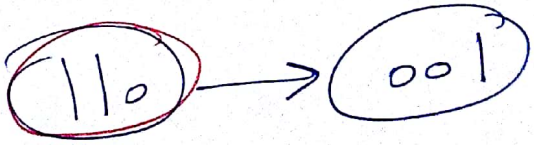
X = 0





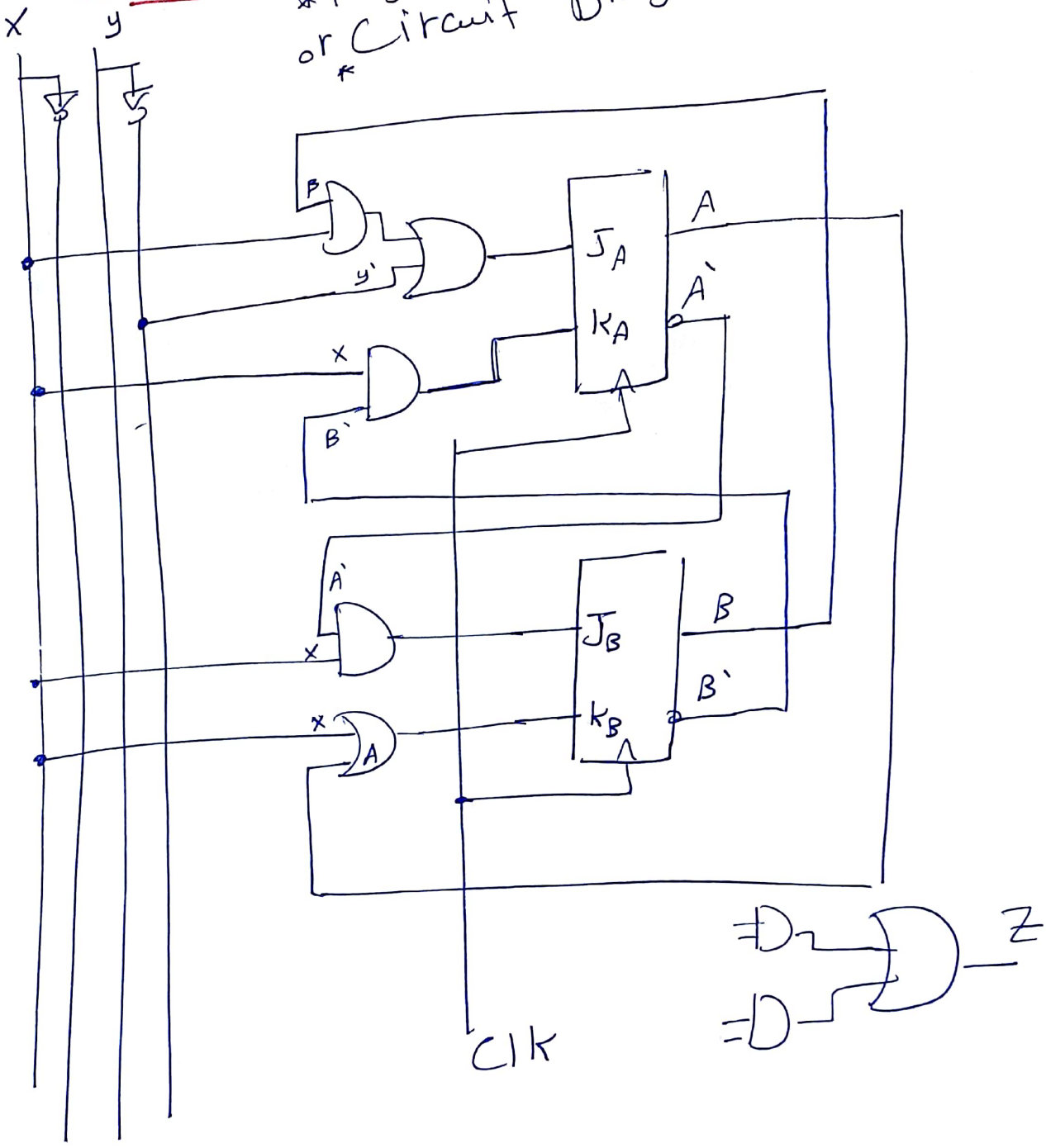
X = 1





Q35)

① *logic Diagram or Circuit Diagram / *Block Diagram



② State Table

$$A^* = J_A A' + K_A' A$$

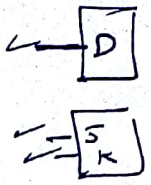
$$A^* = (BX + y')A' + (B'X)' \cdot A$$

B^* =

The solution in "Revision File" Q 35.

(16)

Q6 in final 2015:



* State Table is given:.

a) find the input equations when using a D ff for A , JK ff for B.

b) find system output equ. (Z)

c) implement Design.
↳ Block diagram

Ans.

a) MSTT (Modified state Transition Table)

input	Current state		Next state		ff-input			output
					$Q^*=D_A$			
x	A	B	A*	B*	$=A^*$	J_B	K_B	Z
0	0	0	1	0	1	0	X	0
0	0	1	0	0	0	X	1	1
0	1	0	0	1	0	1	X	1
0	1	1	1	0	1	X	1	1
1	0	0	0	0	0	0	X	0
1	0	1	1	1	1	X	0	1
1	1	0	1	1	1	1	X	1
1	1	1	0	1	0	X	0	1

(17)

↑ from excitation Table.

* excitation Table for JK:

Q	Q*	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

equations

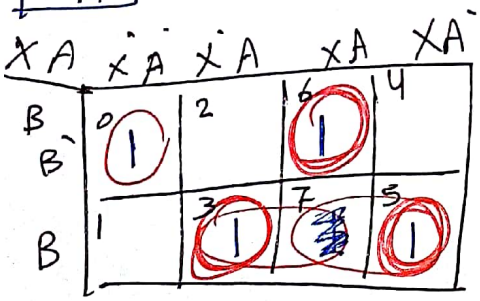
$$D_A = \Sigma m(0, 3, 5, 6)$$

$$J_B = \Sigma m(2, 6) + \Sigma d(1, 3, 5, 7)$$

$$K_B = \Sigma m(1, 3) + \Sigma d(0, 2, 4, 6)$$

$$Z = \Sigma m(1, 2, 3, 5, 6, 7)$$

D_A

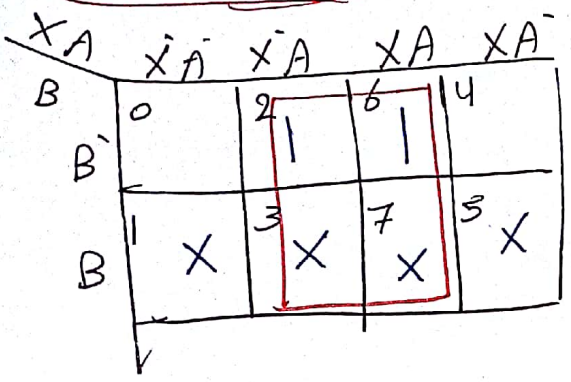


$$D_A = X'A'B' + X'AB + XAB' + XA'B$$

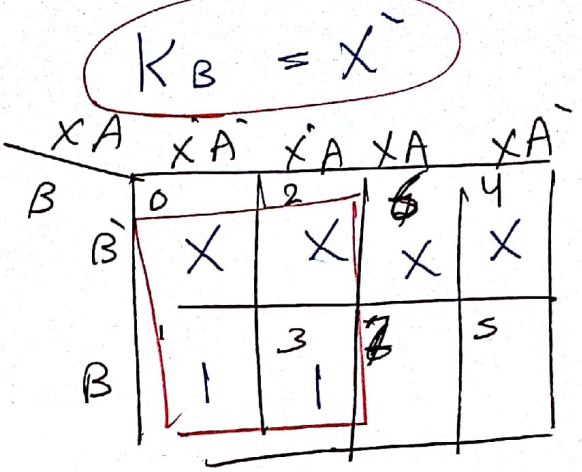
$$= X'(A \oplus B)' + X(A \oplus B)$$

$$= (X \oplus A \oplus B)$$

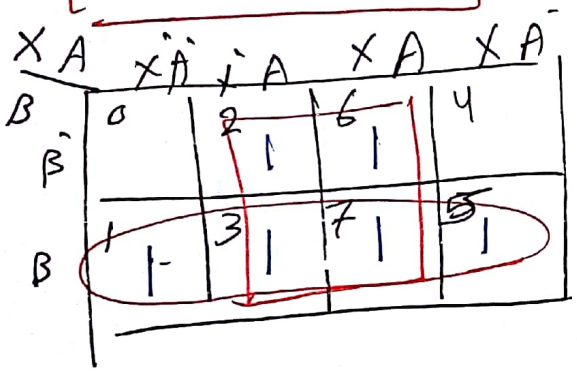
$J_B = A$



$K_B = X'$



$Z = B + A$



* input equations.

$DA = X \oplus A \oplus B$

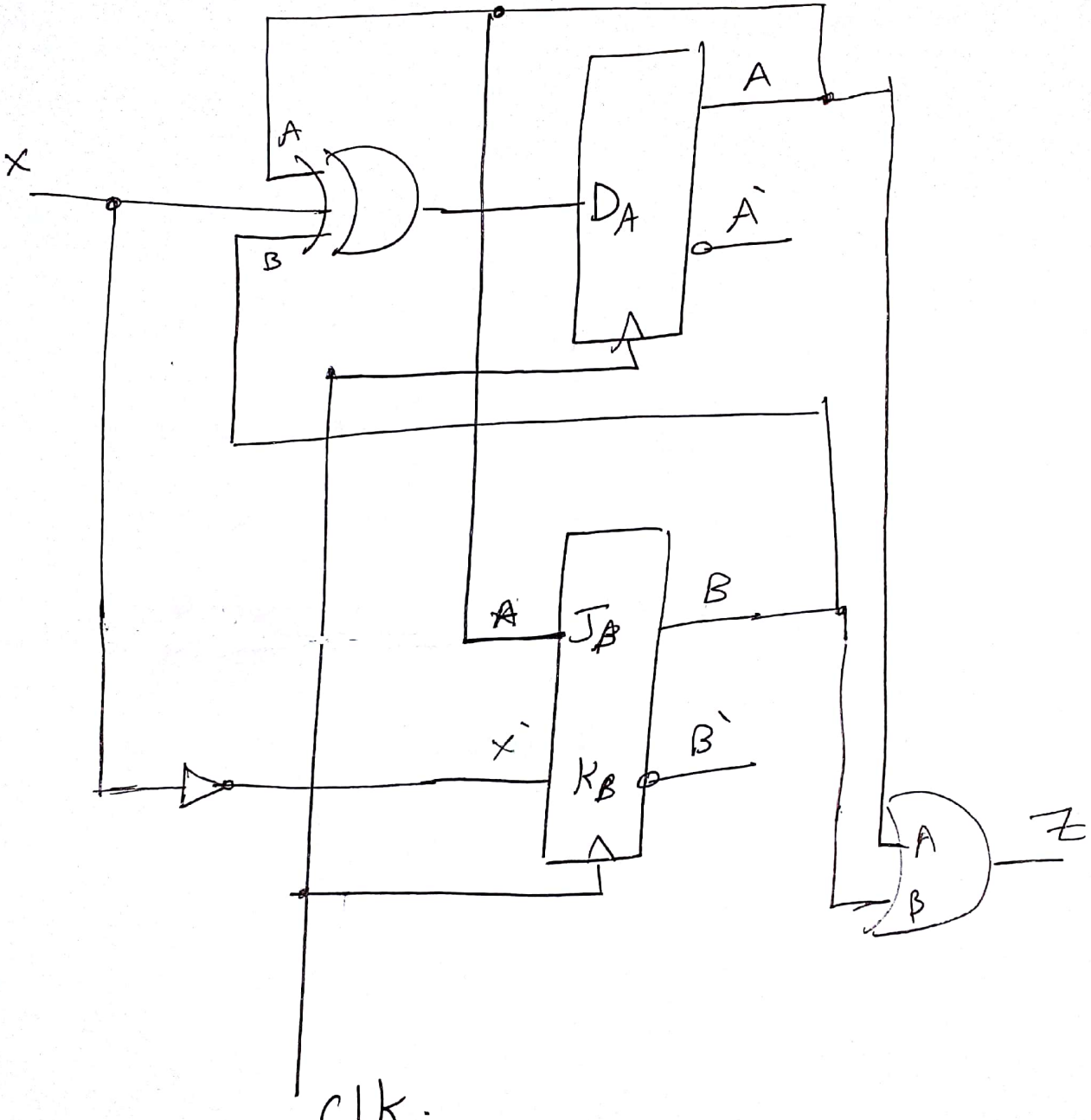
$K_B = X'$

$J_B = A$

* out put equations.

$Z = B + A$

* Block diagram:



Q6) 2016 Final.

الرسمة معفتة

CLR\` هذه الـ signal مش هنستخدمها لأنها ملغية

a) Build state Table.

2) Complete The Timing diagram.. (A & B are Initially Zero)

① State Table.

$J_A = X' A'$, $K_A = B'$

$J_B = A$, $K_B = (A' \oplus X)'$

$A^* = J_A A' + K_A' A$

$= X'A' + BA$

$B^* = J_B B' + K_B' B$

$= AB' + (A' \oplus X)'' B$

X = 0

$A^* = A' + BA$

$= \boxed{A' + B}$

$B^* = AB' + A'B$

$= \boxed{A \oplus B}$

X = 1

$A^* = \boxed{AB}$

$B^* = AB' + A''B$

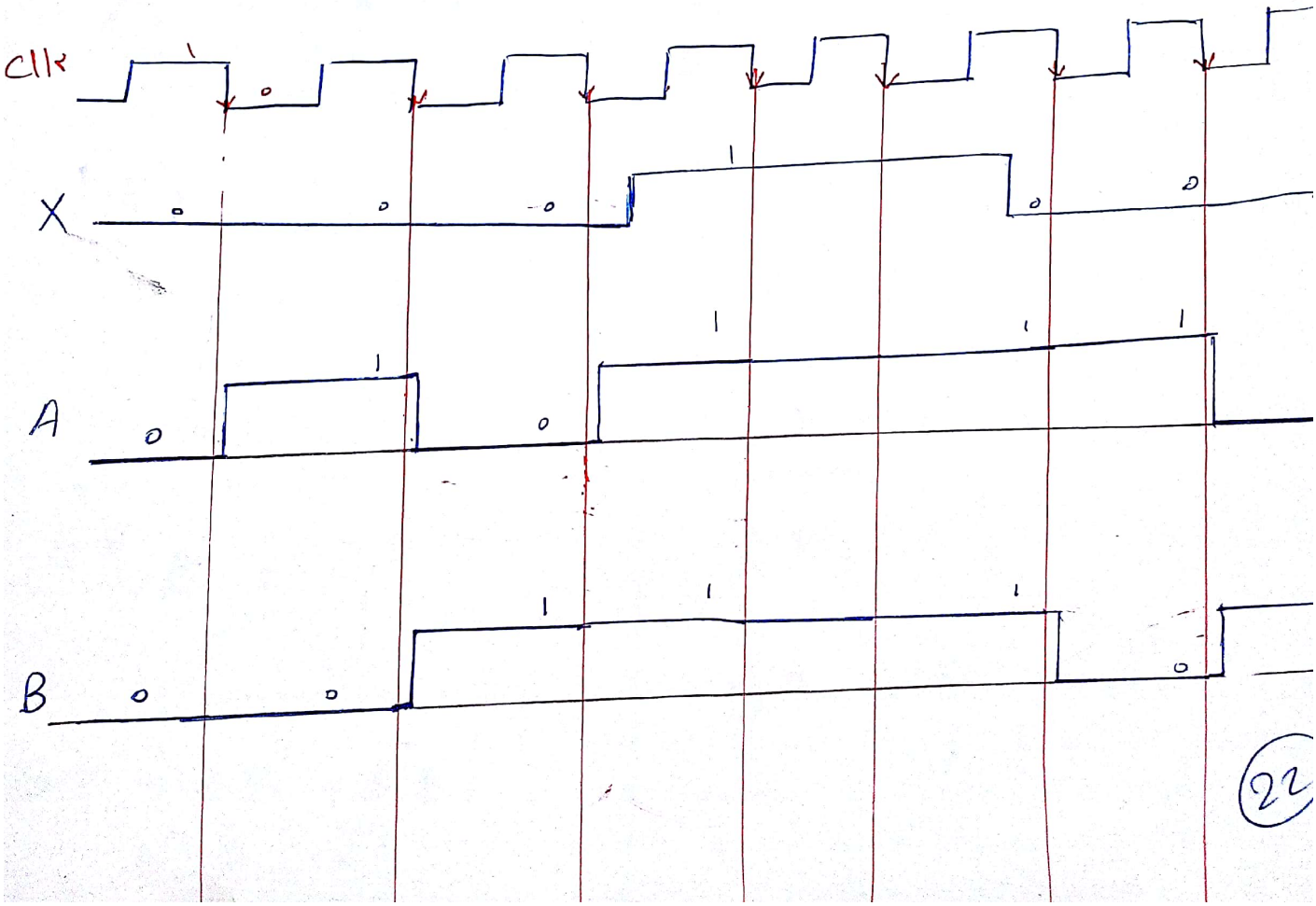
$= A(B' + B)$

$= \boxed{A}$

* State Table

Input X	Current state A	Current state B	Next state A*	Next state B*
0	0	0	0	1
0	0	1	1	0
0	1	0	1	1
0	1	1	0	0
1	0	0	0	1
1	0	1	1	0
1	1	0	0	1
1	1	1	1	0

⇒ Timing Diagram



Q6) Final 2017

Block diagram is given

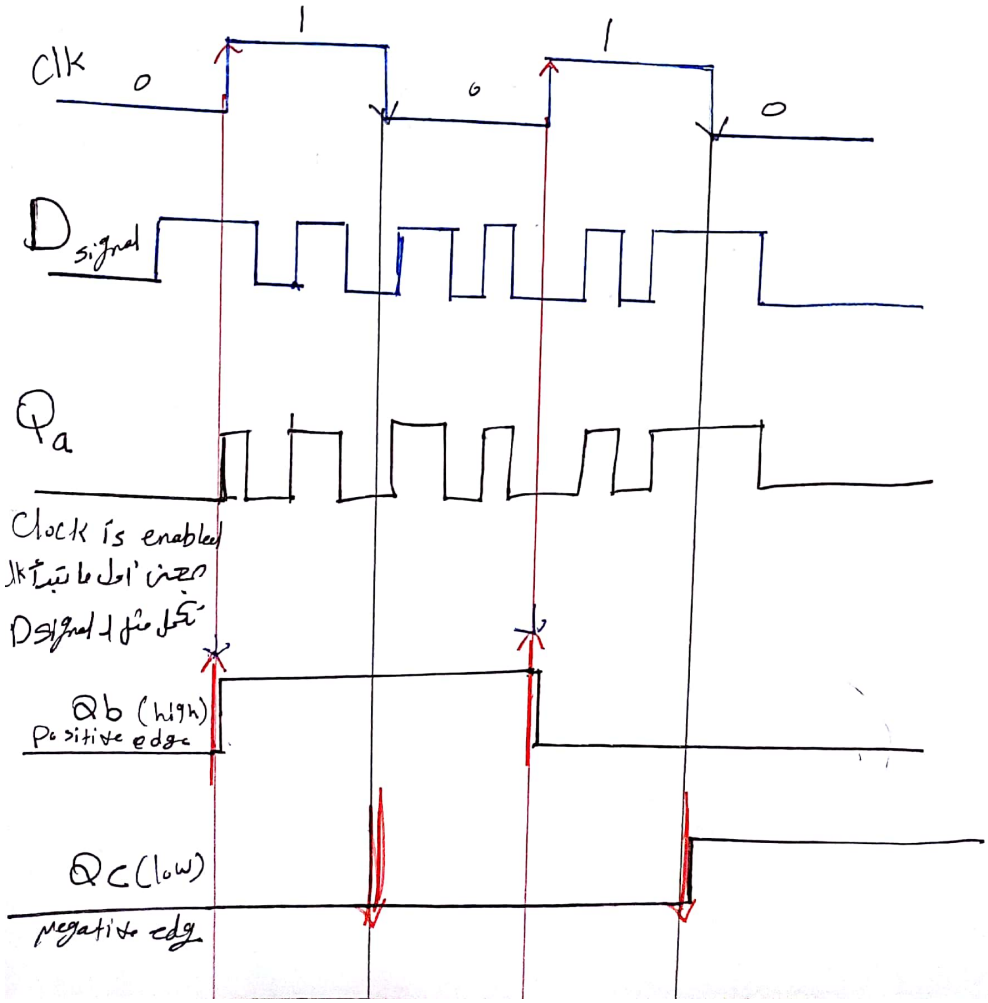
⇒ Complete timing Diagram

Qa → (enabled), Qb → edge trigger high. (Positive edge)

Qc → edge trigger low (Negative edge)

$$Q^* = D$$

* Timing Diagram



Q5) 2017)

→ the sequence 2 → 6 → 1 → 7 → 5 & Repeat

using T ff

7 ⇒ 111

3 bits

3 T ff

① is it self-started?

M S T T (inputs of ff)

Current A	Current B	Current C	next A*	next B*	next C*	Flip flop inputs T_A	T_B	T_C
0	0	0	X	X	X	X	X	X
0	0	1	1	1	1	1	1	0
0	1	0	1	1	0	1	0	0
0	1	1	X	X	X	X	X	X
1	0	0	X	X	X	X	X	X
1	0	1	0	1	0	1	1	1
1	1	0	0	0	1	1	1	1
1	1	1	1	0	1	0	1	0

(24)

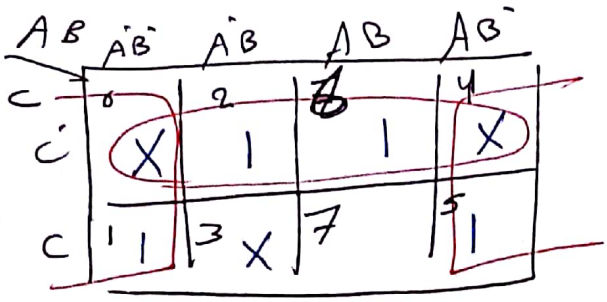
$T_A = \Sigma m(1,2,5,6) + \Sigma d(0,3,4)$

$T_B = \Sigma m(1,5,6,7) + \Sigma d(0,3,4)$

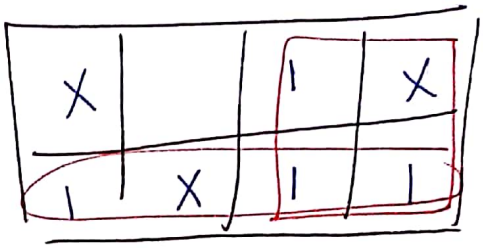
$T_C = \Sigma m(5,6,7) + \Sigma d(0,3,4)$

on k.m.

$T_A = B' + C'$



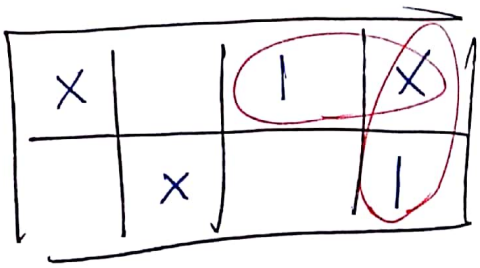
$T_B = C + A$



$A^* = T_A \oplus A$

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

$T_C = AC' + AB'$



$B^* = T_B \oplus B$

$= (C + A) \oplus B$

$C^* = T_C \oplus C$

$= (AC' + AB') \oplus C$

$= [A(C' + B')] \oplus C$

(B)

* un used state

A	B	C	A*	B*	C*
0	0	0	1	0	0 →
0 →	0	0	0	0	1
3 →	0	1	0	1	1
4 →	1	0	0		

$0 \rightarrow 4$ ✗

$3 \rightarrow 1$ ✓

$4 \rightarrow 3$ ✗

isn't self state

A)

⇒ Design a synchronous Counter

(Q5 2017)

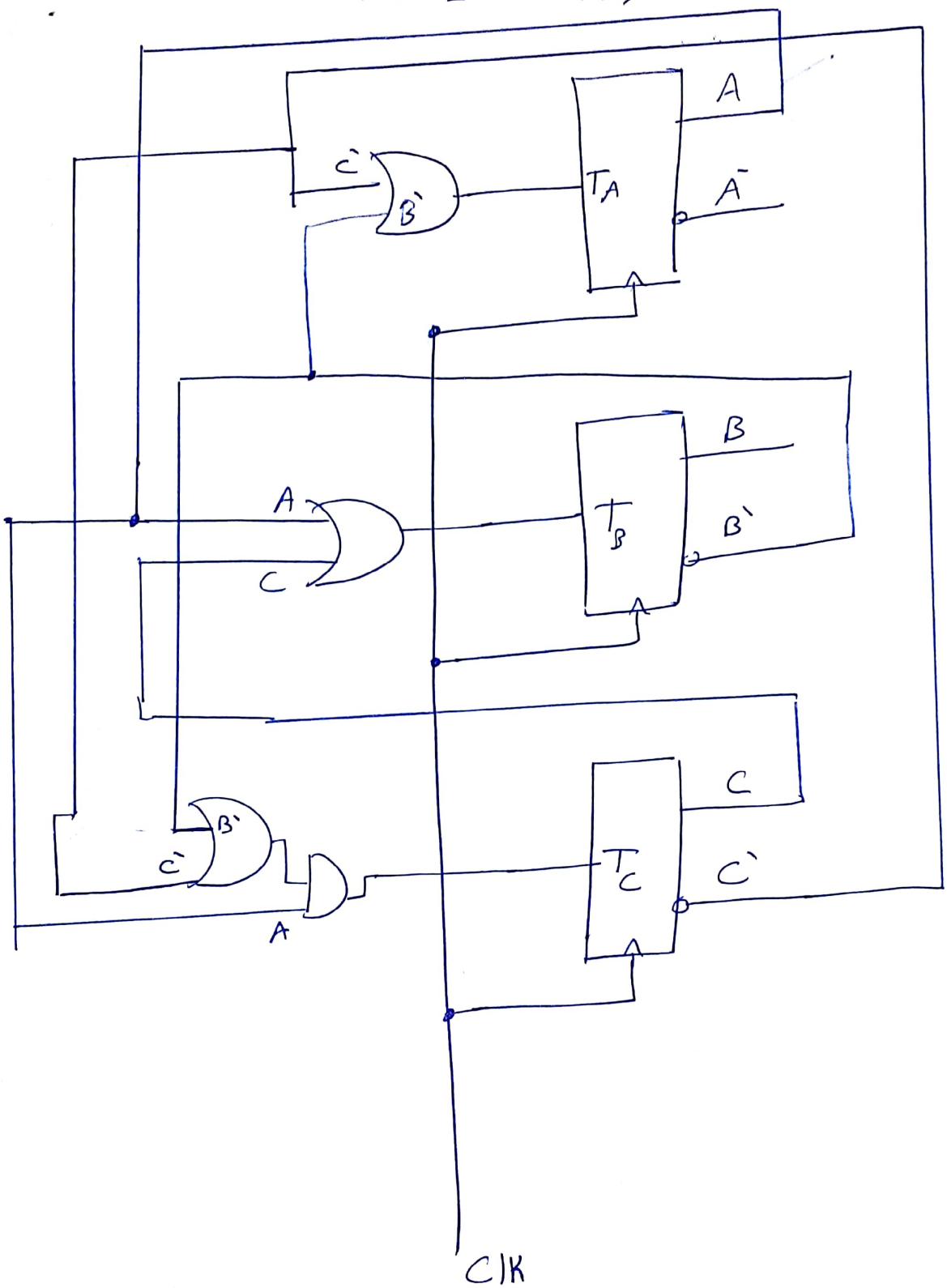
2 6 1 7 5

~~$A^* = (B'+C'$~~

$T_A = B' + C'$

$T_B = C + A$

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



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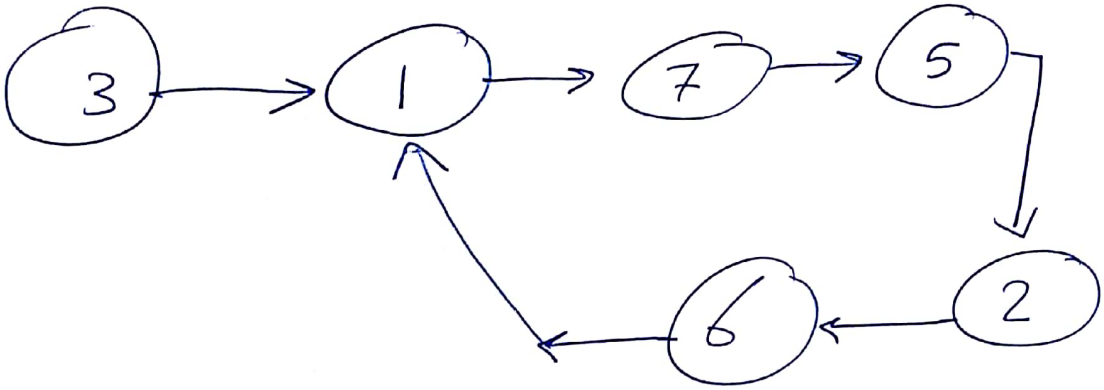

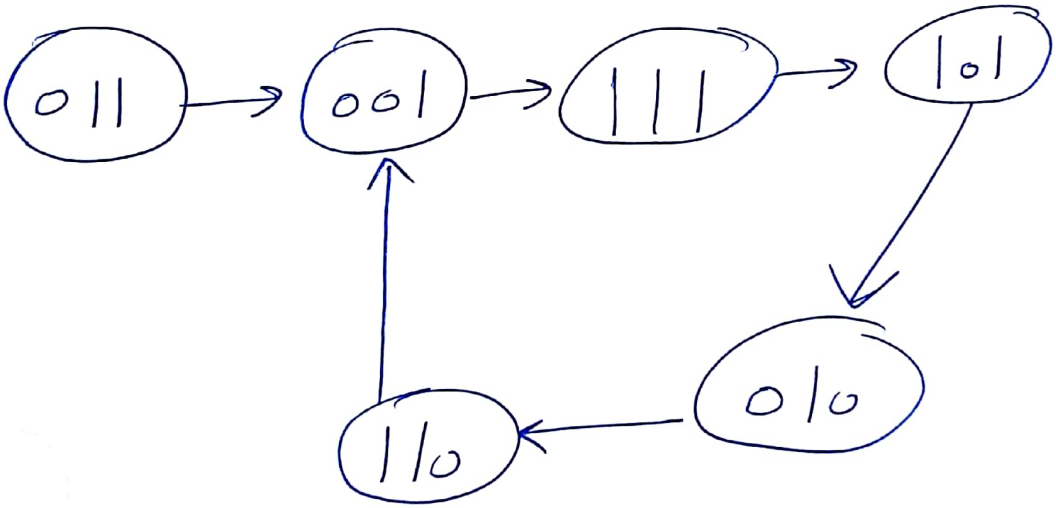

c) State Diagram