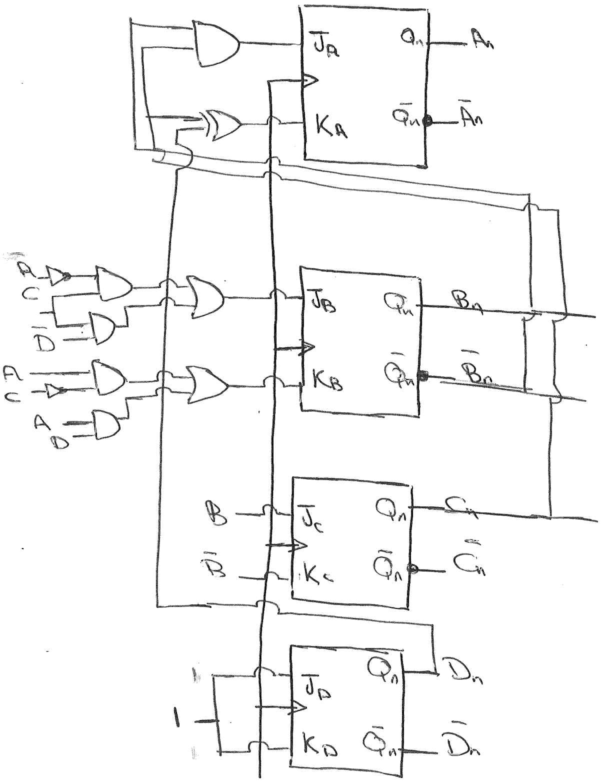
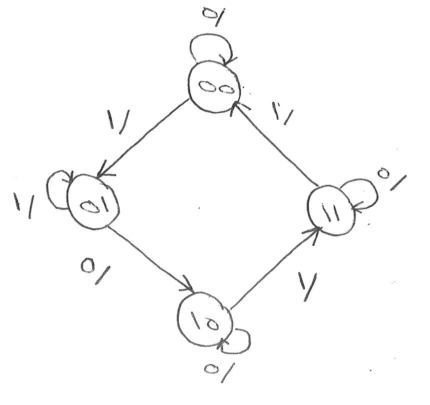


Example:- A sequential circuit has the following state diagram, design the circuit using J-K flip-flop:-



(state diagram)

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Solution:-

Present state A_n	Present state B_n	Input X	Next state A_{n+1}	Next state B_{n+1}	J_A	K_A	J_B	K_B
0	0	0	0	0	0	d	0	d
0	0	1	0	1	0	d	1	d
0	1	0	1	0	1	d	d	1
0	1	1	0	1	0	d	d	0
1	0	0	1	0	d	0	0	d
1	0	1	1	1	d	0	1	d
1	1	0	1	1	d	0	d	0
1	1	1	0	0	d	1	d	1

$X \backslash A_nB_n$	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{X}$	0	1	d	d
X	0	0	d	d

$J_A = B_n\bar{X}$

$X \backslash A_nB_n$	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{X}$	d	d	0	0
X	d	d	1	0

$K_A = B_n X$

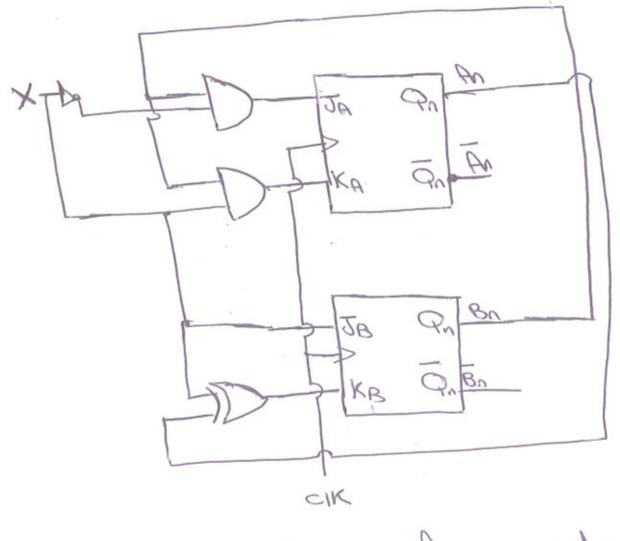
$X \backslash A_nB_n$	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{X}$	0	d	d	0
X	1	d	d	1

$J_B = X$

$X \backslash A_nB_n$	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{X}$	d	1	0	d
X	d	0	1	d

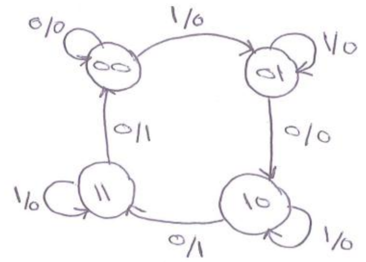
$K_B = \bar{A}_n\bar{X} + A_nX$

$K_B = A_n \odot X$



(logic diagram of seq. cct)

Example:- For the state diagram shown below, connect the cct, using T flip-flop:-



(state diagram)

present state		input	next state				output
A_n	B_n	X	A_{n+1}	B_{n+1}	T_A	T_B	y
0	0	0	0	0	0	0	0
0	0	1	0	1	0	1	0
0	1	0	1	0	1	1	0
0	1	1	0	1	0	0	0
1	0	0	1	1	0	1	1
1	0	1	1	0	0	0	0
1	1	0	0	0	1	1	1
1	1	1	1	1	0	0	0

$X \backslash A_nB_n$	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{X}$	0	1	1	0
X	0	0	0	0

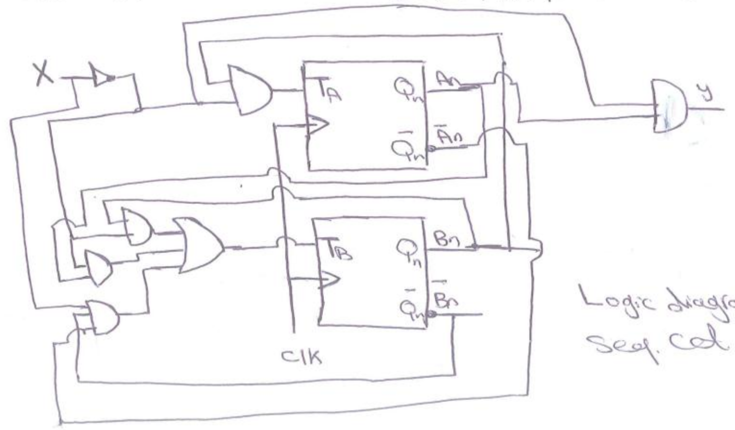
$T_A = B_n\bar{X}$

$X \backslash A_nB_n$	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{X}$	0	1	1	1
X	1	0	0	0

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

$X \backslash A_nB_n$	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{X}$	0	0	1	1
X	0	0	0	0

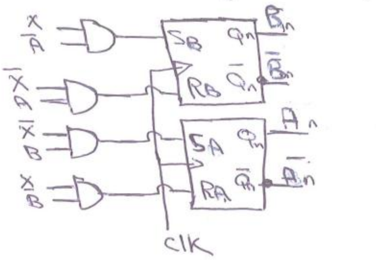
$y = A\bar{X}$



Logic diagram of Seq. cct

H.W:- Repeat the previose example by using JK flip_flop.

Example:- For the circuit shown below, design the circuit, using J-K flip flop (one input variable X & one output y).



Note: for SR f.f

$Q_{n+1} = S + \bar{R}Q_n$

$S_A = B_n\bar{X}$; $R_A = \bar{B}X$

$A_{n+1} = B_n\bar{X} + (\overline{\bar{B}X})A_n$

$S_B = \bar{A}_n X$; $R_B = A_n\bar{X}$

$B_{n+1} = \bar{A}_n X + (\overline{A_n\bar{X}})B_n$

Solution:-

Present state		input	next state						output
A_n	B_n	X	A_{n+1}	B_{n+1}	J_A	K_A	J_B	K_B	y
0	0	0	0	0	0	d	0	d	0
0	0	1	0	1	0	d	1	d	0
0	1	0	1	1	1	d	d	0	0
0	1	1	0	1	0	d	d	0	0
1	0	0	1	0	d	0	0	d	0
1	0	1	0	0	d	1	0	d	1
1	1	0	1	0	d	0	d	1	0
1	1	1	1	1	d	0	d	0	0

X \ A_nB_n	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{X}$	0	1	d	d
X	0	0	d	d

$J_A = B_n\bar{X}$

X \ A_nB_n	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{X}$	d	d	0	0
X	d	d	0	1

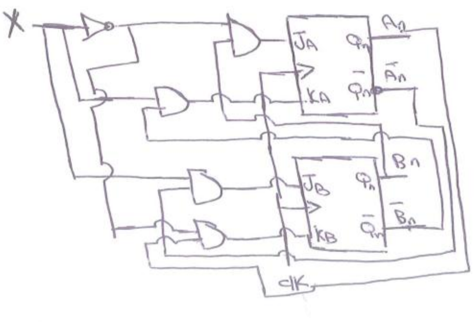
$K_A = \bar{B}_n X$

X \ A_nB_n	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{X}$	0	d	d	0
X	1	d	d	0

$J_B = \bar{A}_n X$

X \ A_nB_n	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{X}$	d	0	1	d
X	d	0	0	d

$K_B = A_n\bar{X}$



Logic diagram of seq. cct

Example :- Use (SR) Flip-Flop as a Comparator (or: Design a Comparator using SR flip-Flop).

Solution :- Available F.F = SR
Req. device = comp.

Note :- A or B can be chosen as Q_n in the design

A	B (Q_n)	G ($A>B$) Q_{n+1}	L ($A<B$) Q_{n+1}	E ($A=B$) Q_{n+1}	S_G	R_G	S_L	R_L	S_E	R_E
0	0	0	0	1	0	d	0	d	1	0
0	1	0	1	0	0	1	d	0	0	1
1	0	1	0	0	1	0	0	d	0	d
1	1	0	D	ϕ	0	1	0	1	d	0

B \ A	$\bar{A}$	A
$\bar{B}$	0	1
B	0	0

$S_G = A\bar{B}$

B \ A	$\bar{A}$	A
$\bar{B}$	d	0
B	1	1

$R_G = B$

B \ A	$\bar{A}$	A
$\bar{B}$	0	0
B	d	0

$S_L = 0$

B \ A	$\bar{A}$	A
$\bar{B}$	d	d
B	0	1

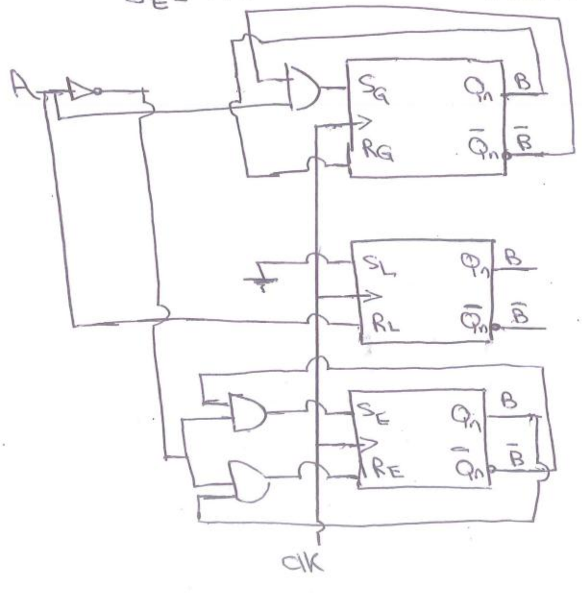
$R_L = A$

B \ A	$\bar{A}$	A
$\bar{B}$	1	0
B	0	d

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

B \ A	$\bar{A}$	A
$\bar{B}$	0	d
B	1	0

$R_E = \bar{A}B$



H.W:- Repeat the Example using J.K Flip-Flop.

Example:- Use JK Flip-Flop as Half Adder:-

solution:- Available F.F = JK
Required Device = H.A.

A	B (Q_n)	S	C_{out}	J_s	K_s	J_{cout}	K_{cout}
0	0	0	0	0	X	0	X
0	1	1	0	X	0	X	1
1	0	1	0	1	X	0	X
1	1	0	1	X	1	X	0

B \ A	$\bar{A}$	A
$\bar{B}$	0	1
B	X	X

$J_s = A$

B \ A	$\bar{A}$	A
$\bar{B}$	X	X
B	0	1

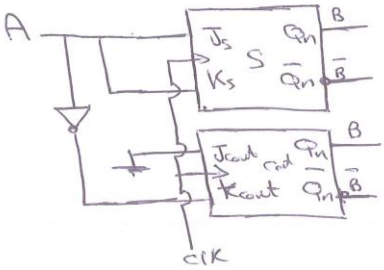
$K_s = A$

B \ A	$\bar{A}$	A
$\bar{B}$	0	0
B	X	X

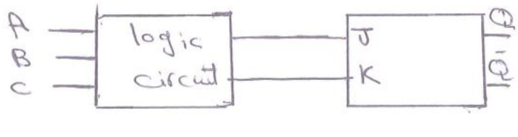
$J_{cout} = 0$

B \ A	$\bar{A}$	A
$\bar{B}$	X	X
B	1	0

$K_{cout} = \bar{A}$



Example:- Design a logic circuit shown below. The circuit will set the JK Flip-Flop if the binary number ABC is odd. & will reset it otherwise.



Solution:-

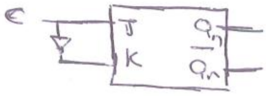
A	B	C	J	K
0	0	0	0	1
0	0	1	1	0
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	0	1
1	1	1	1	0

C \ AB	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}$	0	0	0	0
C	1	1	1	1

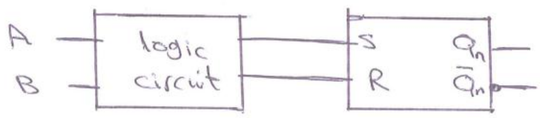
$J = C$

C \ AB	$\bar{A}\bar{B}$	$\bar{A}B$	AB	$A\bar{B}$
$\bar{C}$	1	1	1	1
C	0	0	0	0

$K = \bar{C}$



Example:- The logic circuit shown below, Design the logic circuit that make the F/F set if A=B & reset otherwise.



Solution:-

A	B	S	R
0	0	1	0
0	1	0	1
1	0	0	1
1	1	1	0

B \ A	$\bar{A}$	A
$\bar{B}$	1	0
B	0	1

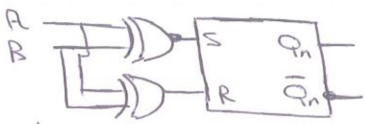
$S = \bar{A}\bar{B} + AB$

$S = A \odot B$

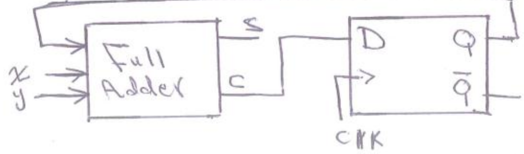
B \ A	$\bar{A}$	A
$\bar{B}$	0	1
B	1	0

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

$R = A \oplus B$



Example:- A sequential circuit has one Flip-Flop (Q_n), two inputs (X and Y) and one output S, It consists of a F.A connected to a D F/F as shown below. Derive the state table and state diagram of the sequential cct.



Solution

present state Q_n	input xy	next state Q_{n+1}	output S
0	0 0	0	0
0	0 1	0	1
0	1 0	0	1
0	1 1	1	0
1	0 0	0	1
1	0 1	1	0
1	1 0	1	0
1	1 1	1	1

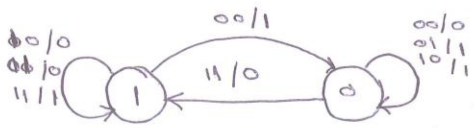
Note:-
For D Flip Flop
$Q_{n+1} = D$

For D flip Flop the c/cs equiton (Q_{n+1}) is

$Q_{n+1} = D$

$Q_{n+1} = xy + Q_n(x+y)$ D = Cout of F.A ← From block diagram.

$S = x \oplus y \oplus y$ ← sum of F.A ← From block diagram.



H.w:- ① Use JK as F.A.

② Design the sequential circuit of state diagram shown below using JK Flip_Flop