

HW #3

1. T flip flop: input = CLK
output = Q

JK flip flop: receives clock; inputs: J, K
output = Q

T	Q	Q'
0	0	0
0	1	1
1	0	1
1	1	0

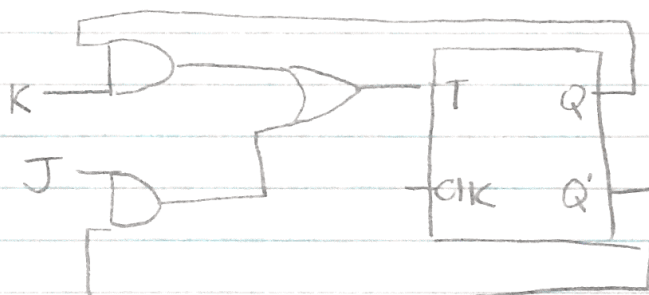
J	K	Q'
0	0	Q
0	1	0
1	0	1
1	1	\bar{Q}

J	K	Q	T
0	0	Q	0
0	1	Q	Q
1	0	Q	\bar{Q}
1	1	Q	1

JK

Q	00	01	11	10
0	0	0	1	1
1	0	1	1	0

$T = J\bar{Q} + KQ$

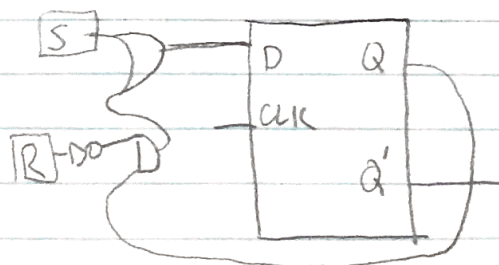


2.

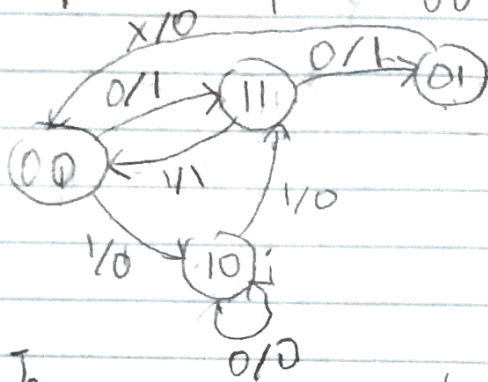
S	R	Q	Q'	D
0	0	0	0	0
0	0	1	1	1
0	1	0	0	0
0	1	1	0	0
1	0	0	1	1
1	0	1	1	1
1	1	0	X	X
1	1	1	X	X

S	RQ	00	01	11	10
0	0	0	1	0	0
1	0	1	1	X	X

$D = S + \bar{R}Q$



Current	Input	Next	Output
00	0	11	1
00	1	10	0
01	X	00	0
10	0	10	0
10	1	11	0
11	0	01	1
11	1	00	1



0/1 1/0	0/1 1/1
A (00)	B (10, 01) C (11)
(00)	(10) (01) (11)
A	B C D

$S_0' J_0$

$X \backslash S_0$	00	01	11	10
0	1	X	X	0
1	0	X	X	1

$J_0 = \overline{S_1}X + S_1X$

$S_0' K_0$

$X \backslash S_0$	00	01	11	10
0	X	1	0	X
1	X	1	1	X

$K_0 = S_1 + X$

J_1

$X \backslash S_0$	00	01	11	10
0	1	0	X	X
1	1	0	X	X

$$J_1 = \overline{S_0}$$

K_1

$X \backslash S_0$	00	01	11	10
0	X	X	1	0
1	X	X	1	0

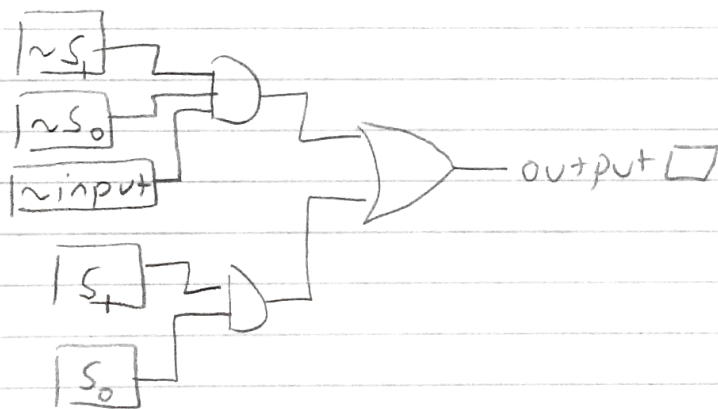
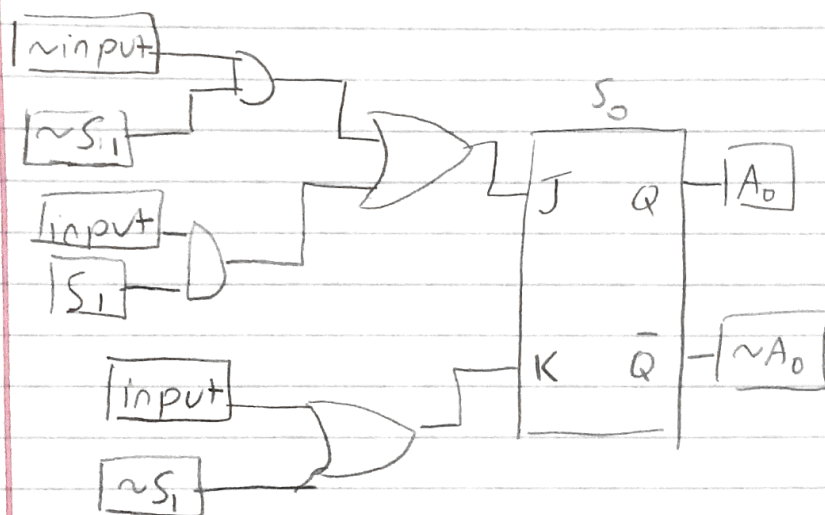
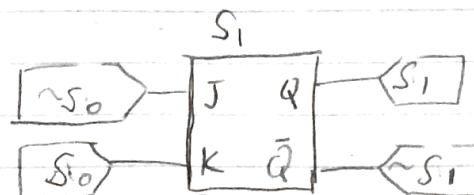
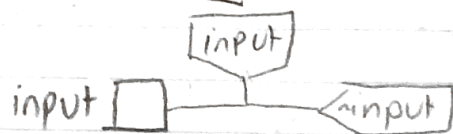
$K_1 = S_0$

output:

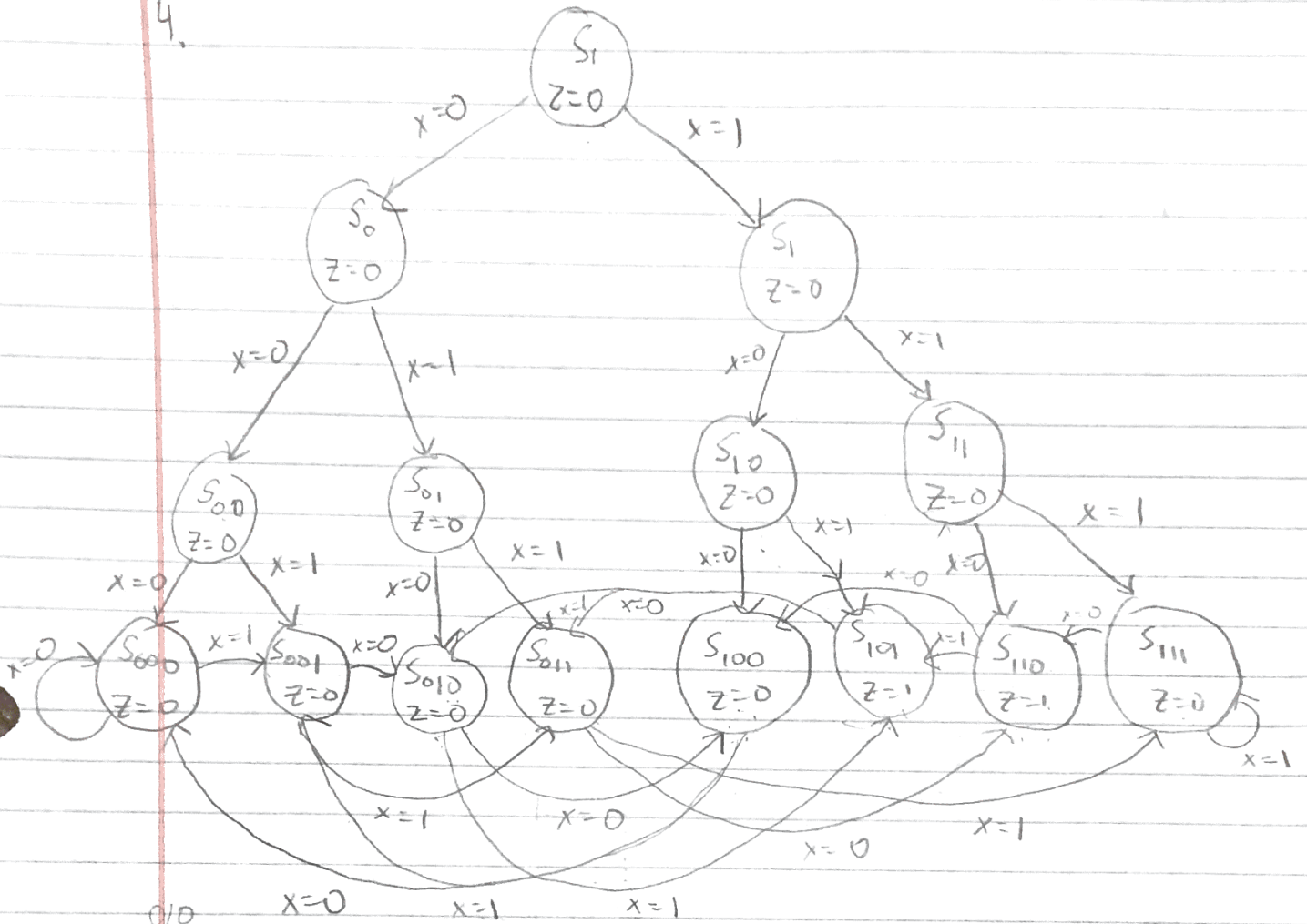
$X \backslash S_0$	00	01	11	10
0	1	0	1	0
1	0	0	1	0

$out = \overline{S_1}S_0X + S_1S_0$

3 circuit



4.



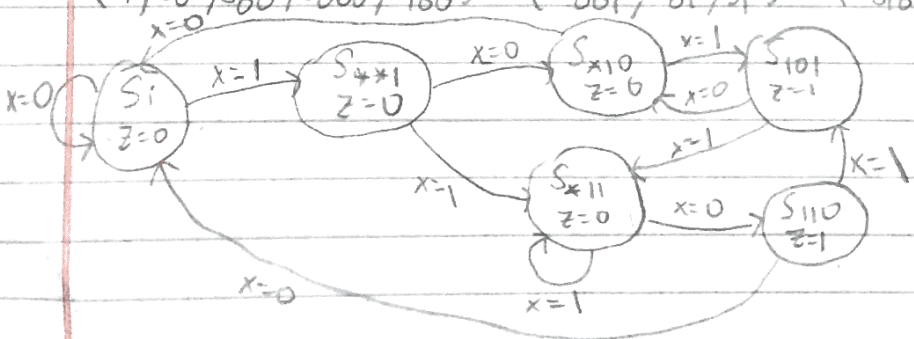
$$A \quad (S_1, S_0, S_{00}, S_{000}, S_{001}, S_{01}, S_{010}, S_{011}, S_{11}, S_{101}, S_{100}, S_{111}, S_{111}) \quad B \quad (S_{101}, S_{110})$$

$$AA \quad (1, S_0, S_{00}, S_{000}, S_{001}, S_{01}, S_{11}, S_{100}) \quad AB \quad (S_{010}, S_{10}) \quad BA \quad (S_{011}, S_{11}, S_{11}) \quad AA \quad (S_{101}) \quad AB \quad (S_{110})$$

$$A \quad (1, S_0, S_{00}, S_{000}, S_{001}, S_{01}, S_{11}, S_{100}) \quad B \quad (S_{010}, S_{10}) \quad C \quad (S_{011}, S_{11}, S_{11}) \quad D \quad (S_{101}) \quad E \quad (S_{110})$$

$$AA \quad (1, S_0, S_{00}, S_{000}, S_{100}) \quad BC \quad (S_{001}, S_{01}, S_{11}) \quad AD \quad (S_{010}, S_{10}) \quad EC \quad (S_{011}, S_{11}, S_{11}) \quad (S_{101}, S_{110})$$

$$AB \quad (S_1, S_0, S_{00}, S_{000}, S_{100}) \quad D \quad (S_{001}, S_{01}, S_{11}) \quad AE \quad (S_{010}, S_{10}) \quad FD \quad (S_{011}, S_{11}, S_{11}) \quad (S_{101}, S_{110})$$



$S_2 S_1$	00	01	11	10
0	S_i	S_{110}	S_{*11}	S_{101}
1	S_{*x1}	X	X	S_{*10}

$$S_i = 000$$

$$S_{110} = 010$$

$$S_{101} = 100$$

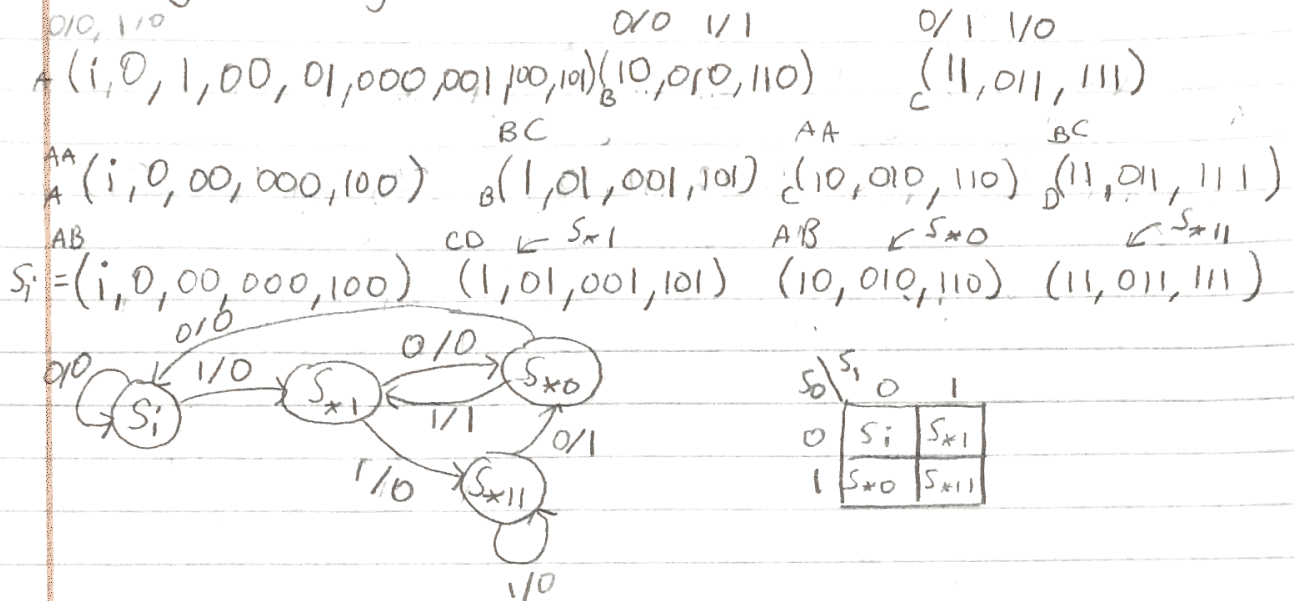
$$S_{*x1} = 001$$

$$S_{*11} = 110$$

$$S_{*10} = 101$$

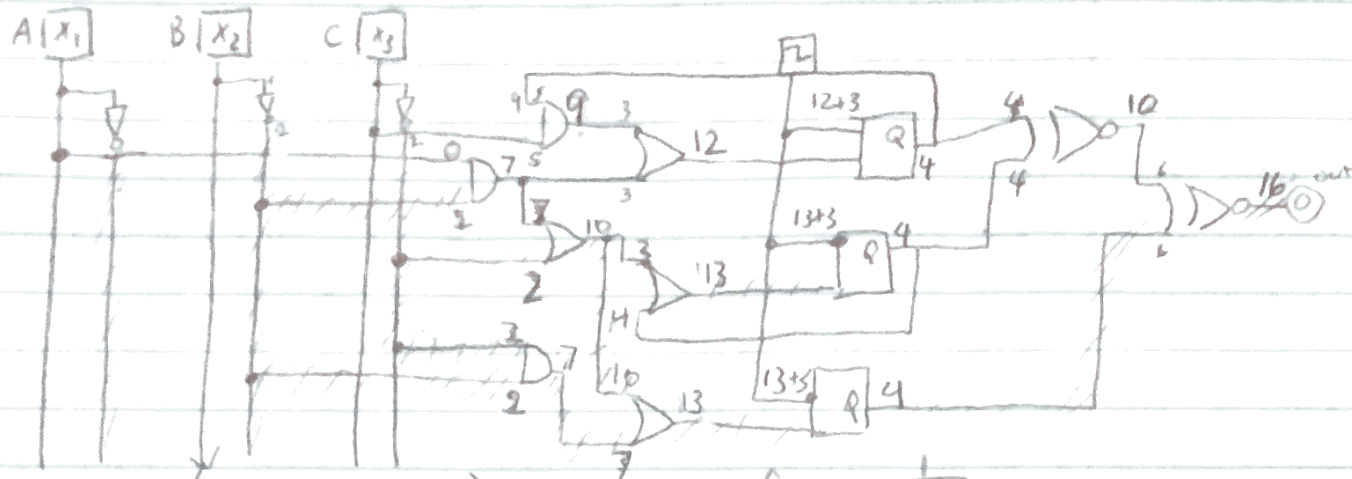
current	encod	X	next state	encoding	current output
S_i	000	0	S_i	000	0
S_i	000	1	S_{*x1}	001	0
S_{*x1}	001	0	S_{*10}	101	0
S_{*x1}	001	1	S_{*11}	110	0
S_{110}	010	0	S_i	000	1
S_{110}	010	1	S_{101}	100	1
S_{101}	100	0	S_{*10}	101	1
S_{101}	100	1	S_{*11}	110	1
S_{*10}	101	0	S_i	000	0
S_{*10}	101	1	S_{101}	100	0
S_{*11}	110	0	S_{110}	010	0
S_{*11}	110	1	S_{*11}	110	0

5. Using same diagram as #4



Current	encod	X	next state	encoding	output
S_i	00	0	S_i	00	0
S_i	00	1	S_{*1}	10	0
S_{*0}	01	0	S_i	00	0
S_{*0}	01	1	S_{*1}	10	1
S_{*1}	10	0	S_{*0}	01	0
S_{*1}	10	1	S_{*11}	11	0
S_{*11}	11	0	S_{*0}	01	0
S_{*11}	11	1	S_{*11}	11	0

6.



$$\max(13, 13, 12, 16) = 16 \text{ ns} \quad \text{freq} = \frac{1}{16}$$