Q1

(1)

J	K	Q^+	
0	0	Q	hold
0	1	0	reset
1	0	1	set
1	1	Q'	Invert

$N = K'$

J	N	Q^+	
0	0	0	reset
0	1	Q	hold
1	0	Q'	invert
1	1	1	set

JN Excitation

Q	Q^+	J	N
0	0	0	X
0	1	1	X
1	0	X	0
1	1	X	1

(2)

D	Q^+
0	0
1	1

when $J = N$.

JN	Q^+
00	0
11	1

Q	Q^+	D
0	0	0
0	1	1
1	0	0
1	1	1

Q	Q^+	JN
0	0	0
0	1	1
1	0	0
1	1	1

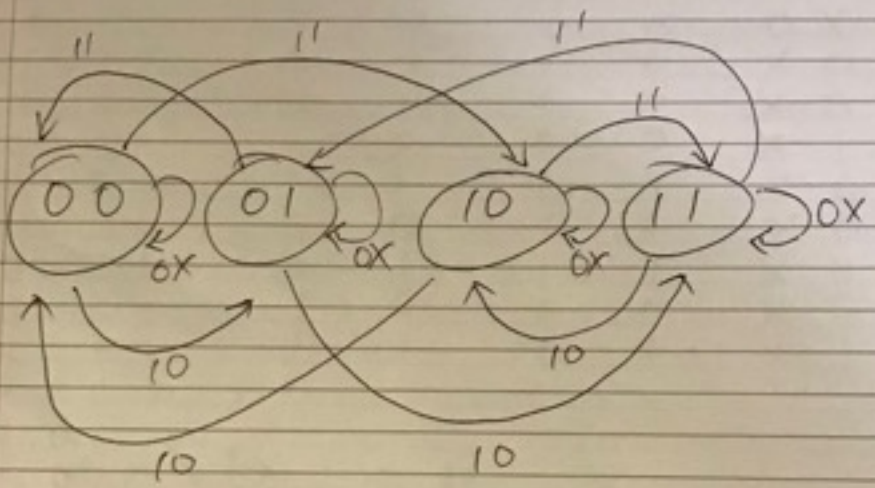
So. D flip-flop can be made by connecting JN together.

Q2

E=0 hold X

E=1 X=1 0, 2, 3, 1

E=1 X=0 0, 1, 3, 2



Q_0	Q_1	E	X	Q_0^+	Q_1^+	J_0	K_0	J_1	K_1
0	0	0	0	0	0	0	X	0	X
0	0	0	1	0	0	0	X	0	X
0	0	1	0	0	1	0	X	1	X
0	0	1	1	1	0	1	X	0	X
0	1	0	0	0	1	0	X	X	0
0	1	0	1	0	1	0	X	X	0
0	1	1	0	1	1	1	X	X	0
0	1	1	1	0	0	0	X	X	1
1	0	0	0	1	0	X	0	0	X
1	0	0	1	1	0	X	0	0	X
1	0	1	0	0	0	X	1	0	X
1	0	1	1	1	1	X	0	1	X
1	1	0	0	1	1	X	0	X	0
1	1	0	1	1	1	X	0	X	0
1	1	1	0	1	0	X	0	X	1
1	1	1	1	0	1	X	1	X	0

J_0 Q_0Q_1 \ EX

Q_0Q_1 \ EX	00	01	11	10
00	0	0	1	0
01	0	0	0	1
11	X	X	X	X
10	X	X	X	X

$J_0 = EXQ_1' + EX'Q_1$

$= E(X \text{ XOR } Q_1)$

K_0 Q_0Q_1 \ EX

Q_0Q_1 \ EX	00	01	11	10
00	X	X	X	X
01	X	X	X	X
11	0	0	1	0
10	0	0	0	1

$K_0 = EXQ_1 + EX'Q_1'$

$= E(X \text{ XOR } Q_1)'$

J_1

0	0	0	1
X	X	X	X
X	X	X	X
0	0	1	0

$J_1 = EX'Q0' + EXQ0$

$= E(X \text{ XOR } Q0)'$

K_1

X	X	X	X
0	0	1	0
X	X	0	1
X	X	X	X

$K_1 = EXQ0' + EX'Q0$

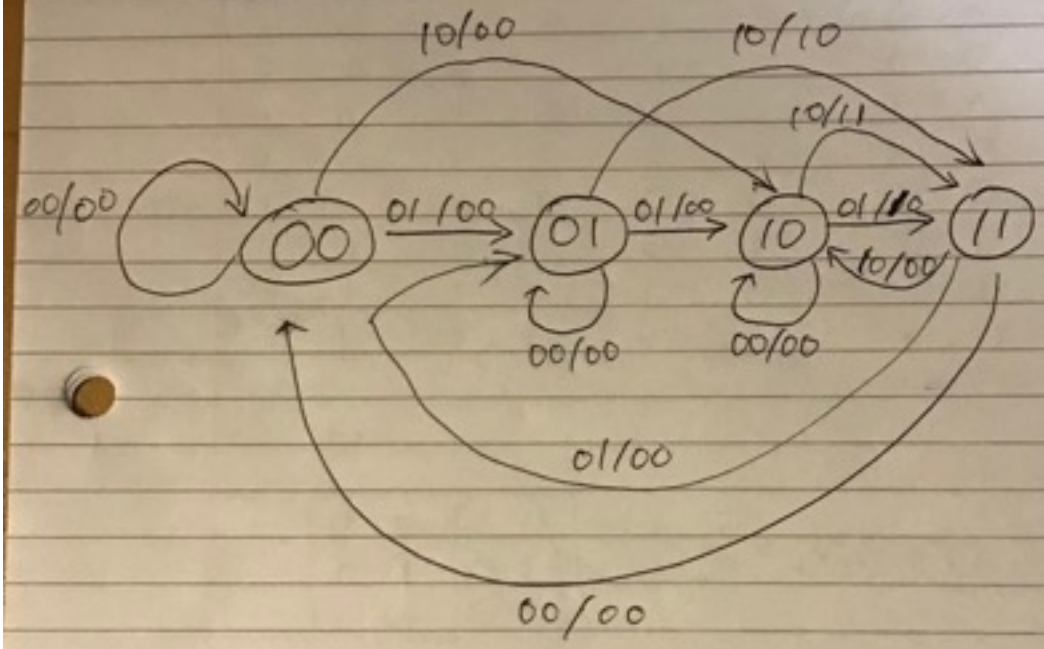
$= E(X \text{ XOR } Q0)$

Then Draw circuits.

Q3 Input D N
Output G C

(00) 0cent (01) 5cents

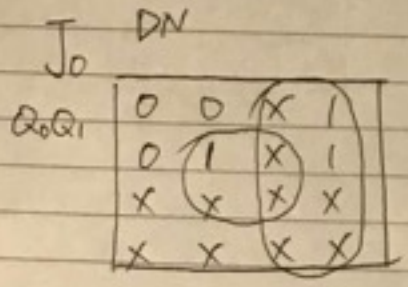
(10) 10 cents (11) 15 cents



S^t

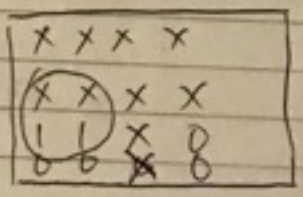
Q_0	Q_1	D	N	Q_0^+	Q_1^+	G	C	J_0	K_0	J_1	K_1
0	0	0	0	0	0	0	0	0	X	0	X
0	0	0	1	0	1	0	0	0	X	1	X
0	0	1	0	1	0	0	0	1	X	0	X
0	0	1	1	X	X	X	X	X	X	X	X
0	1	0	0	0	1	0	0	0	X	X	0
0	1	0	1	1	0	0	0	1	X	X	1
0	1	1	0	1	1	1	0	1	X	X	0
0	1	1	1	X	X	X	X	X	X	X	X
1	0	0	0	1	0	0	0	X	0	0	X
1	0	0	1	1	1	1	0	X	0	1	X
1	0	1	0	1	1	1	1	X	0	1	X
1	0	1	1	X	X	X	X	X	X	X	X
1	1	0	0	0	0	0	0	X	1	X	1
1	1	0	1	0	1	0	0	X	1	X	0
1	1	1	0	1	0	0	0	X	0	X	1
1	1	1	1	X	X	X	X	X	X	X	X

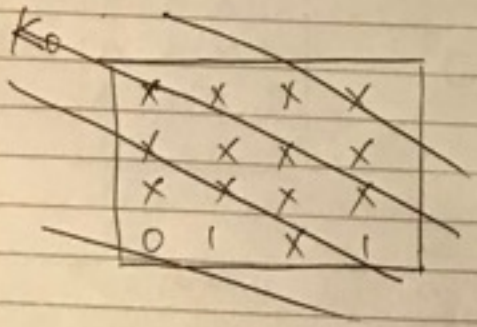
J_0



$J_0 = NQ_1 + D$

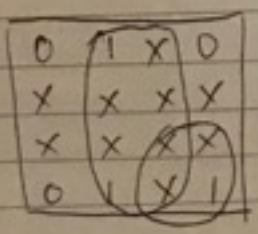
K_0





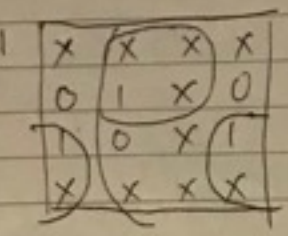
$K_0 = Q_1 D'$

J_1



$J_1 = Q_0 D + N$

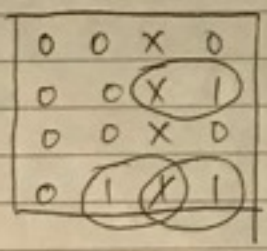
K_1



$K_1 = NQ_0' + N'Q_0$

$= N \text{ XOR } Q_0$

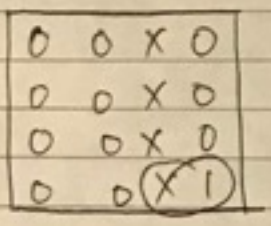
G



$G = DQ_0'Q_1 + NQ_0Q_1' + DQ_0Q_1'$

$= D(Q_0 \text{ XOR } Q_1) + NQ_0Q_1'$

C



$C = DQ_0Q_1'$

Then draw circuits.