P1. The next figure shows the state diagram of a logic circuit which has a unique one-bit external input x.

Even

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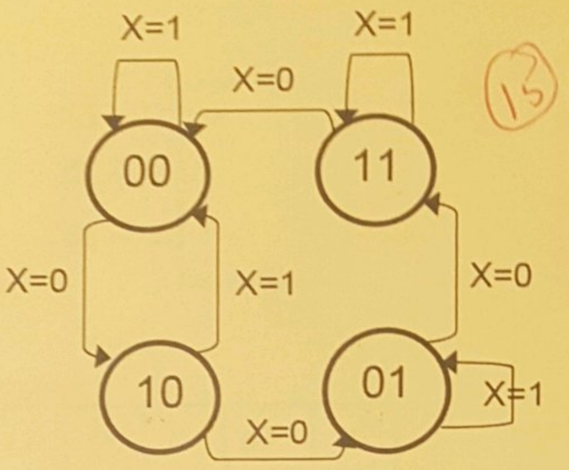
1. Assuming that two JK flip-flops (A and B) are used in the implementation, start off by deriving the state table of the circuit. Then, extend the state table with the excitation table of the circuit.
2. Find simplified expressions for each flip-flop inputs.



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$Q(t)$	$Q_2(t)$	x	$Q_1(t+1)$	$Q_2(t+1)$	J_1	K_1	J_2	K_2
0	0	0	1	0	1	x	0	x
0	0	1	0	0	0	x	0	x
0	1	0	1	1	1	x	x	0
0	1	1	0	1	0	x	x	0
1	0	0	0	1	x	1	1	x
1	0	1	0	0	x	1	0	x
1	1	0	0	0	x	1	x	1
1	1	1	1	1	x	0	x	0

2.

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J_1:

Q_1Q_2 \ x	0	1
00	1	0
01	1	0
11	x	x
10	x	x

$$J_1 = x' = \overline{x}$$

K_1:

Q_1Q_2 \ x	0	1
00	x	x
01	x	x
11	1	0
10	1	1

$$K_1 = x' + Q_2'(t) = \overline{x} + \overline{Q_2(t)}$$

J_2:

Q_1Q_2 \ x	0	1
00	0	0
01	x	x
11	x	x
10	1	0

$$J_2 = Q_1(t)\,x' = Q_1(t)\cdot\overline{x}$$

K_2:

Q_1Q_2 \ x	0	1
00	x	x
01	0	0
11	1	0
10	x	x

$$K_2 = Q_1(t)\,x' = Q_1(t)\cdot\overline{x}$$

P2. A sequential circuit has 3 data inputs D_2, D_1 and D_0 and a control input "LD" (load data). The operation of the sequential circuit is described in the functional Table 1. Design the sequential circuit using three T flip-flops $\{Q_i, i = [0, 1, 2]\}$.

(P2.1.) Provide the *equations for the next state variables* of the T flip-flops $\{Q_i^{n+1}, i = [0, 1, 2]\}$, either by filling out column Q_i^{n+1} of Table 2, or by writing directly its logic expression $Q_i^{n+1} = \delta(LD, Q_i^n, D_i^n)$.

(P2.2.) Find the excitation equations $\{T_i = f(LD, Q_i, D_i), i = [0, 1, 2]\}$ of the T flip-flops, by firstly filling out column T_i of Table 2.

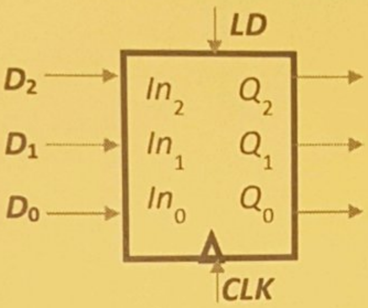

Table 1

LD	Q_i^{n+1} (next state)
0	Q_i^n (present state)
1	D_i^n (data input)

$i = \{0, 1, 2\}$

Table 2.

LD	Q_i^n	D_i^n	Q_i^{n+1} P2.1	T_i P2.2
0	0	0	0	0
0	0	1	0	0
0	1	0	1	0
0	1	1	1	0
1	0	0	0	0
1	0	1	1	1
1	1	0	0	1
1	1	1	1	0

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T_i:

LD/Q_i \ D_i^n	0	1
00	0	0
01	0	0
11	$\boxed{1}$	0
10	0	$\boxed{1}$

$$\Rightarrow T_i = LD \cdot Q_i^n \cdot D_i^{n'} + LD \cdot Q_i^{n'} \cdot D_i^n$$

$$= LD \cdot Q_i^n(t) \cdot \overline{D_i^n} + LD \cdot \overline{Q_i^n(t)} \cdot D_i^n$$

for $i = \{0, 1, 2\}$