ECE255 – Introduction to Digital Logic Design
Homework Assignment 5
Due November 13

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1. Show how to use a **T FF** to *implement* a **D FF**.

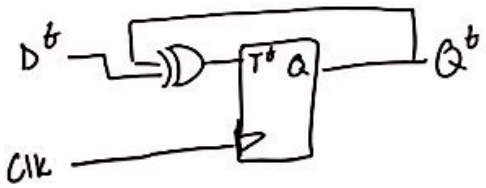
   (a) First fill in the truth table below for next state Q^{t+1} for the D FF, then fill in the table for input T^t such that the T FF yields the correct next state (Q^{t+1}) for each row in the table.

D^t	Q^t	Q^{t+1}	T^t	
0	0	0	0	→ toggle off
0	1	0	1	
1	0	1	1	→ toggle on.
1	1	1	0	

   (b) T^t in the table you just completed is a function of D^t (the input) and Q^t (present state). This is a small state machine. Write the MSOP form for T^t. You may minimize to MSOP format any way you see fit.

MSOP $T(D^t, Q^t) = Q^{t+1} = D^t \Rightarrow Q^{t+1} = T^t \oplus Q^t \Rightarrow \boxed{T^t = D^t \oplus Q^t}$

   (c) Sketch a schematic for this state machine showing the combinational logic for T^t and also the T FF with Q output. Draw by hand or use Logisim to sketch your circuit schematic.



2. Show how to use a **JK FF** to *implement* a **T FF**.

   (a) First fill in the truth table below for next state Q^{t+1} for the JK FF, then fill in the table for inputs J^t and K^t such that the JK FF yields the correct next state (Q^{t+1}) for each row in the table.

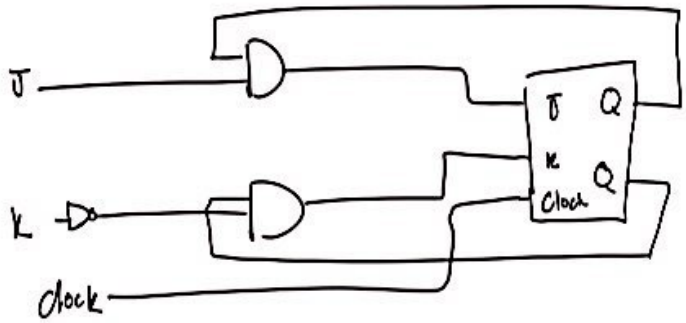
T^t	Q^t	Q^{t+1}	J^t	K^t	
0	0	0	0	X	JK = hold present state.
0	1	1	X	1	J=0, K=1 reset state
1	0	1	1	X	J=1, K=0 set next state
1	1	0	X	0	

(b) J^t and K^t in the table you just completed are functions of T^t (the input) and Q^t (present state). This is a small state machine. Write the MSOP forms for J^t and K^t. You may minimize to MSOP format any way you see fit.

MSOP $J(T^t, Q^t) = \bar{T}^t Q^t (m_2)$

MSOP $K(T^t, Q^t) = \bar{T}^t Q^t (m_1)$

(c) Sketch a schematic for this state machine showing the combinational logic for inputs J^t, K^t and also the JK FF with Q output. Draw by hand or use Logisim to sketch your circuit schematic.

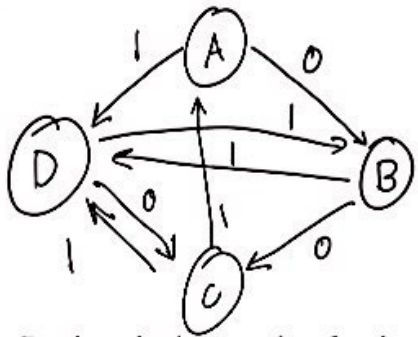


3. You are provided the following state table (assume 1-bit output z; state assignments in parentheses):

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

(a) Construct a state diagram for the state table shown.

represent Z



(b) What is the Boolean logic equation for the output variable z?

$Z = \bar{X}$