Digital Logic

2023 Fall Assignment 3

1. (10 points) Analyze the sequential circuit with two JK flip-flops A and B, two inputs x and y, and one output z. Write down the necessary steps for your analysis. The flip-flop input equations and circuit output equation are

$$JA = Bx + B'y' \qquad KA = B'xy'$$
$$JB = A'x \qquad KB = A + xy'$$
$$z = Ax'y' + Bx'y'$$

2. (10 points) Analyze the sequential circuit shown in the block diagram on right. Do write down all the necessary steps for your analysis.
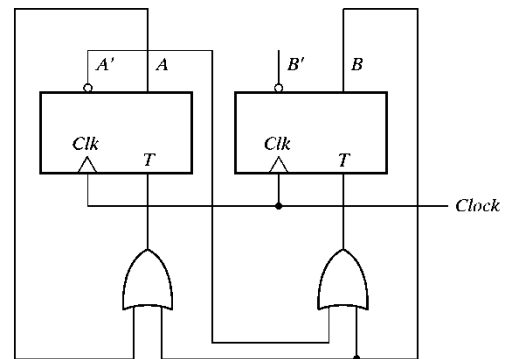
3. (15 points) For the block diagram on right
   a) Derive the state table and the state diagram of the sequential circuit. Do write down all the necessary steps.
   b) Is it a Mealy machine or a Moore machine? Why?
   c) Construct a timing diagram for the circuit for an input sequence X = 101100.(Assume that initially Q1 = Q2 = 0, X changes midway during the clock low level, and there's no gate delay), Complete the following waveform for Q1, Q2 and F
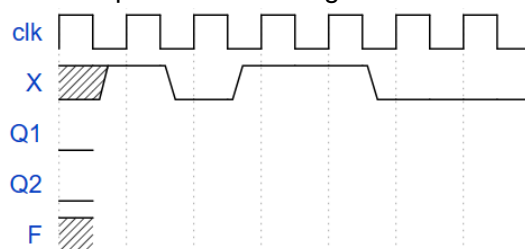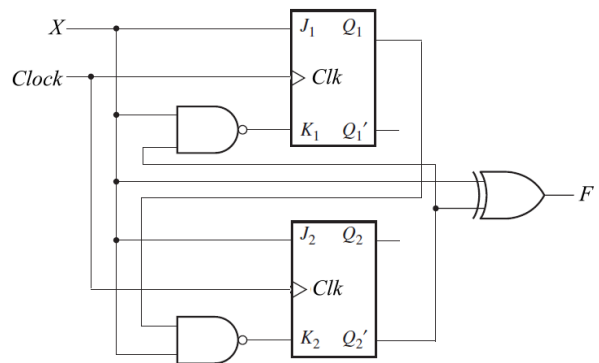
4. (10 points) Obtain the simplified input equations for a sequential circuit that **uses T flip-flops** and is specified by the state diagram below. Write down the necessary procedure.
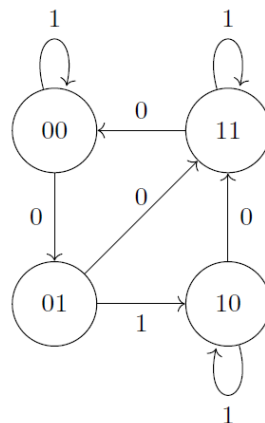
5. (10 points) Design a DFF with enable input whose function table is described on right. Write down necessary design procedure and then draw the block diagram. (Use DFF with extra logics).

Clk	En	D	Q	Q'
0	x	x	last Q	last Q'
1	x	x	last Q	last Q'
↯	1	0	0	1
↯	1	1	1	0
↯	0	x	last Q	last Q'

6. (15 points) A certain flip-flop has four operations: clear to 0, no change, complement, and set to 1, when inputs A and B are 00, 01, 10, and 11, respectively.
   a) Tabulate the characteristic table.
   b) Derive the simplified characteristic equation, write down the procedure.
   c) Tabulate the excitation table.
   d) Show how the new flip-flop can be converted to a JK flipflop. Write down the necessary procedure and draw the block diagram.

7. (15 points) For the following state table, simplify the state table and draw the state diagram corresponding to the reduced state table. Then design the sequential circuit **using JK flipflops**, write down the necessary procedure for your design (No need draw the block diagram).

Present State	Next State		Output	
	x = 0	x = 1	x = 0	x = 1
a	f	b	0	0
b	d	c	0	0
c	f	e	0	0
d	g	a	1	0
e	d	c	0	0
f	f	b	1	1
g	g	h	0	1
h	g	a	1	0

8. (15 points) Design a sequence detector **using DFFs** to recognize the occurrence of a particular sequence of bits (1101) (**using Moore machine, overlapping mode**), write down the necessary procedure for your design (No need to draw the block diagram)