

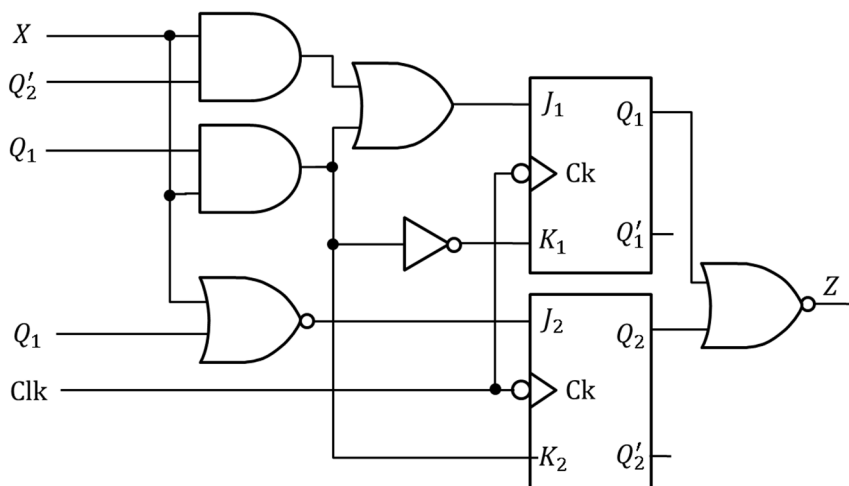
Logic design (2016 fall)

Quiz # 13

Name: _____ ID: _____

1. (100%) Consider the circuit shown below.

- (20%) Derive the flip-flop input equations (J_1, K_1, J_2, K_2). Note that each equation needs to be expressed in the minimum SOP form.
- (25%) Derive the next-state equation for each FF from its input equations and derive the equation for output Z . Note that each equation needs to be expressed in the minimum SOP form.
- (30%) Complete the transition table for the circuit.
- (15%) Construct the state graph for the circuit using the given state assignment.
- (5%) Does the circuit have any unused states?
- (5%) Is the circuit a Mealy or Moore machine?



Transition table

Present State $Q_1 Q_2$	Next State $Q_1^+ Q_2^+$		Z
	$X = 0$	$X = 1$	
00	01	10	1
01	01	01	0
11	01	10	0
10	00	10	0

State assignment

S_0	11
S_1	00
S_2	01
S_3	10

Ans:

$$J_1 = XQ_2' + XQ_1 \quad K_1 = (XQ_1)' = X' + Q_1'$$

$$J_2 = (X + Q_1)' = X'Q_1' \quad K_2 = XQ_1$$

$$\begin{aligned} Q_1^+ &= J_1Q_1' + K_1'Q_1 \\ &= (XQ_2' + XQ_1)Q_1' + (X' + Q_1')Q_1 \\ &= XQ_1'Q_2' + XQ_1 = XQ_2' + XQ_1 \end{aligned}$$

$$\begin{aligned} Q_2^+ &= J_2Q_2' + K_2'Q_2 \\ &= X'Q_1'Q_2' + (XQ_1)'Q_2 \\ &= X'Q_1'Q_2' + (X' + Q_1')Q_2 \\ &= X'Q_1'Q_2' + X'Q_2 + Q_1'Q_2 \\ &= X'Q_1' + X'Q_2 + Q_1'Q_2 \end{aligned}$$

$$Z = (Q_1 + Q_2)' = Q_1'Q_2'$$

(e) No

(f) The circuit is a Moore machine .

