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

(a) (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.

(b) (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.

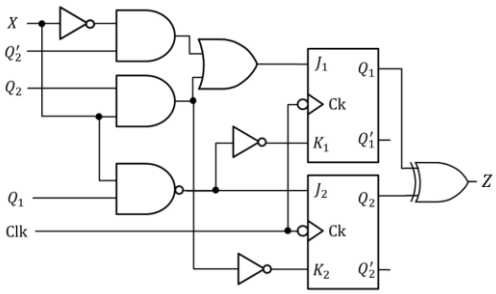
(c) (24%) Complete the transition table for the circuit.

(d) (12%) Complete the state table for the circuit after using the given state assignment.

(e) (5%) Does the circuit have any unused states?

(f) (9%) What is the definition of Mealy machine and Moore machine?

(g) (5%) Is the circuit a Mealy or Moore machine?



State assignment

S_0	11
S_1	00
S_2	01
S_3	10

ANS:

(a) $J_1 = X'Q_2'+XQ_2$ $K_1 = XQ_1$ $J_2 = X'+Q_1'$ $K_2 = X'+Q_2'$

(b) $Q_1^+ = J_1Q_1'+K_1'Q_1 = (X'Q_2'+XQ_2)Q_1'+(XQ_1)'Q_1 = X'Q_1'Q_2'+XQ_1'Q_2+X'Q_1$
$= X'Q_1+X'Q_2'+XQ_1'Q_2$

$Q_2^+ = J_2Q_2' + K_2'Q_2 = (X'+Q_1')Q_2'+(X'+Q_2')'Q_2$
$= X'Q_2'+Q_1'Q_2'+XQ_2$

$Z = Q_1Q_2'+Q_1'Q_2$

(c) Transition table

Q_1Q_2	$Q_1^+Q_2^+$		Z	
	X=0 (2 pt)	X=1 (2 pt)	X=0 (1 pt)	X=1 (1 pt)
00	11	01	0	0
01	00	11	1	1
11	10	01	0	0
10	11	00	1	1

(d)

Present State	Next State		Z	
(Q_1Q_2)	X=0 (1 pt)	X=1 (1 pt)	X=0 (0.5 pt)	X=1 (0.5 pt)
S_1	S_0	S_2	0	0
S_2	S_1	S_0	1	1
S_0	S_3	S_2	0	0
S_3	S_0	S_1	1	1

(e) No

(f) Moore machine: the output depends only on the present state
Mealy machine: the output depends on both the present state and on the inputs

(g) Moore machine

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

(a) (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.

(b) (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.

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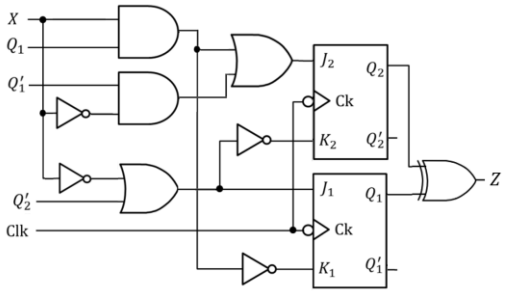

State assignment

S_0	11
S_1	00
S_2	01
S_3	10

ANS:

(a) $J_1 = X'+Q_2'$ $K_1 = X'+Q_1'$ $J_2 = X'Q_1'+XQ_1$ $K_2 = XQ_2$

(b) $Q_1^+ = J_1Q_1' + K_1'Q_1 = (X'+Q_2')Q_1'+(X'+Q_1')'Q_1$

$= X'Q_1'+Q_1'Q_2'+XQ_1$

$Q_2^+ = J_2Q_2'+K_2'Q_2 = (X'Q_1'+XQ_1)Q_2'+(XQ_2)'Q_2 = X'Q_1'Q_2'+XQ_1Q_2'+X'Q_2$

$= X'Q_2+X'Q_1'+XQ_1Q_2'$

$Z = Q_1Q_2'+Q_1'Q_2$

(c) Transition table

Q_1Q_2	$Q_1^+Q_2^+$		Z	
	X=0 (2 pt)	X=1 (2 pt)	X=0 (1 pt)	X=1 (1 pt)
00	11	10	0	0
01	11	00	1	1
11	01	10	0	0
10	00	11	1	1

(d)

Present State	Next State		Z	
(Q_1Q_2)	X=0 (1 pt)	X=1 (1 pt)	X=0 (0.5pt)	X=1 (0.5pt)
S_1	S_0	S_3	0	0
S_2	S_0	S_1	1	1
S_0	S_2	S_3	0	0
S_3	S_1	S_0	1	1

(e) No

(f) Moore machine: the output depends only on the present state

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(g) Moore machine