

Solutions for Homework # 6

12.9 (a)

$QQ'$	$MN$
00	00 01
01	10 11
10	10 00
11	01 11

12.9 (b)

$CBA$	$C^*B^*A^*$
000	001
001	011
011	111
111	101
101	100
100	000

$C^*$

B A	C	0	1
00	0	0	0
01	0	0	1
11	0	1	1
10	0	X	X

$M_C = B$

B A	C	0	1
00	0	0	X
01	0	0	X
11	0	1	X
10	0	X	X

$N_C = A$

B A	C	0	1
00	0	X	0
01	0	X	1
11	0	X	1
10	0	X	X

$B^*$

B A	C	0	1
00	0	0	0
01	0	1	0
11	0	1	0
10	0	X	X

$M_B = C'A$

B A	C	0	1
00	0	0	0
01	0	1	0
11	0	X	X
10	0	X	X

$N_B = C'$

B A	C	0	1
00	0	X	X
01	0	X	X
11	0	1	0
10	0	X	X

$A^*$

B A	C	0	1
00	0	1	0
01	0	1	0
11	0	1	1
10	0	X	X

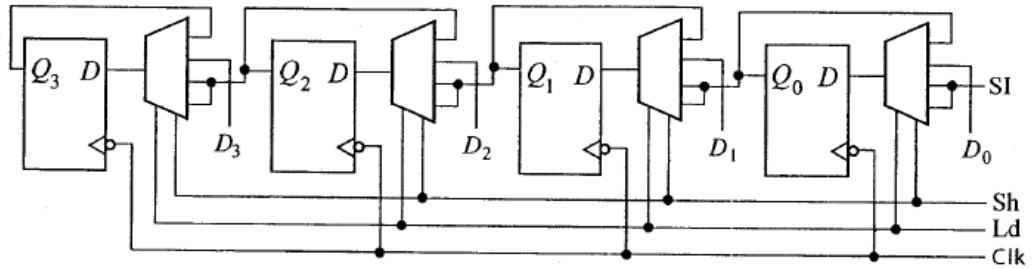
$M_A = C'$

B A	C	0	1
00	0	1	0
01	0	X	X
11	0	X	X
10	0	X	X

$N_A = C + B$

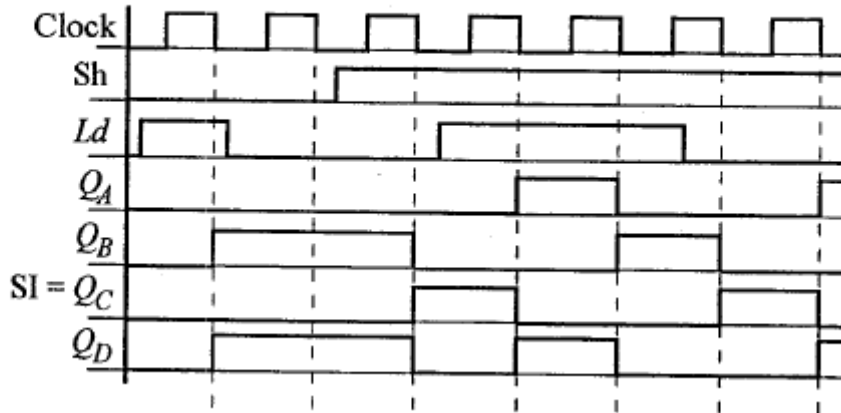
B A	C	0	1
00	0	X	X
01	0	1	0
11	0	1	1
10	0	X	X

- 12.12 (a) When  $ShLd = 00$ , the MUX for flip-flop  $i$  selects  $Q_i$  to hold its state  
 When  $ShLd = 01$ , the MUX for flip-flop  $i$  selects  $D_i$  to load.  
 When  $ShLd = 10$  or  $11$ , the MUX for flip-flop  $i$  selects  $Q_i$  to shift left.

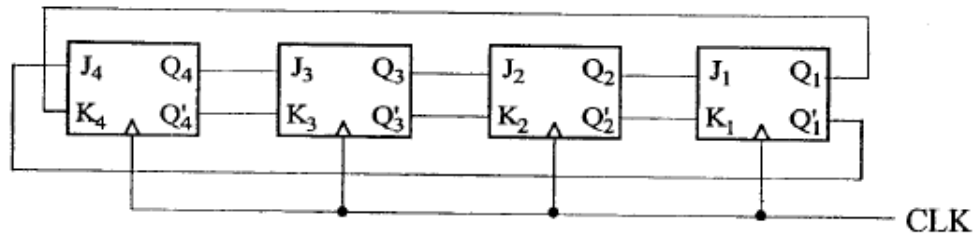


- 12.12 (b)  $Q_3^* = Ld'Sh'Q_3 + LdSh'D_3 + ShQ_2$ ;  $Q_2^* = Ld'Sh'Q_2 + LdSh'D_2 + ShQ_1$ ;  $Q_1^* = Ld'Sh'Q_1 + LdSh'D_1 + ShQ_0$   
 $Q_0^* = Ld'Sh'Q_0 + LdSh'D_0 + ShSI$

- 12.13 Notice that  $Sh$  overrides  $Ld$  when  $Sh = Ld = 1$



- 12.15 4-bit Johnson counter using J-K flip-flops:

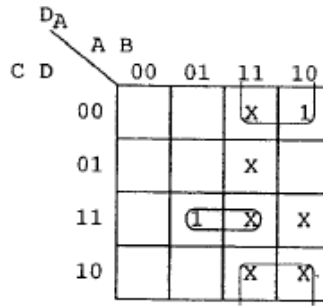


Starting in 0000: 0000, 1000, 1100, 1110, 1111, 0111, 0011, 0001, (repeat) 0000, ...

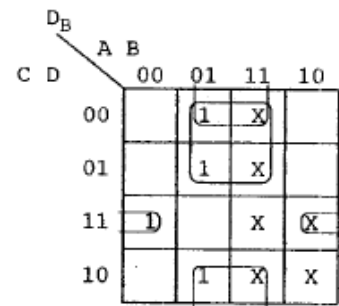
Starting in 0110: 0110, 1011, 0101, 0010, 1001, 0100, 1010, 1101, (repeat) 0110, ...

12.17 (a)

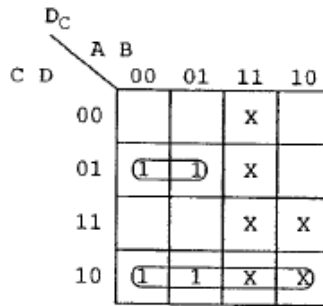
ABCD	A*B*C*D*
0000	0001
0001	0010
0010	0011
0011	0100
0100	0101
0101	0110
0110	0111
0111	1000
1000	1001
1001	0000
1010	XXXX
1011	XXXX
1100	XXXX
1101	XXXX
1110	XXXX
1111	XXXX



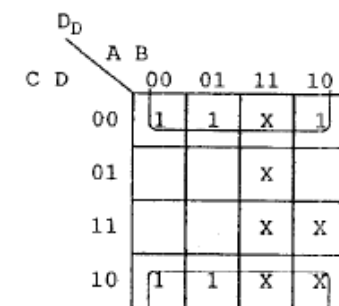
$$D_A = BCD + AD'$$



$$D_B = B'CD + BC' + BD'$$

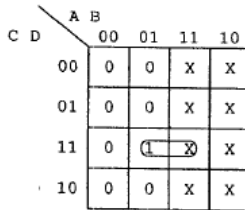


$$D_C = A'CD + CD'$$

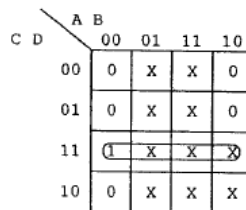


$$D_D = D'$$

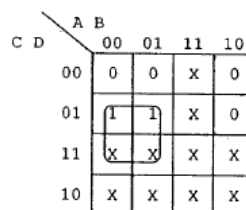
12.17 (b) See table 12-7 (c) on FLD p. 345.



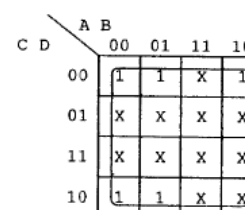
$$J_A = BCD$$



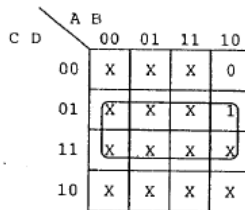
$$J_B = CD$$



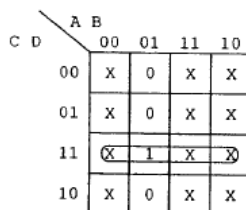
$$J_C = A'D$$



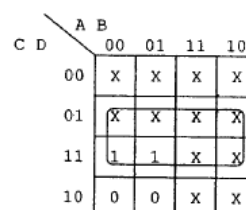
$$J_D = 1$$



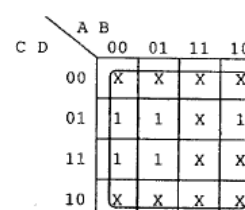
$$K_A = D$$



$$K_B = CD$$

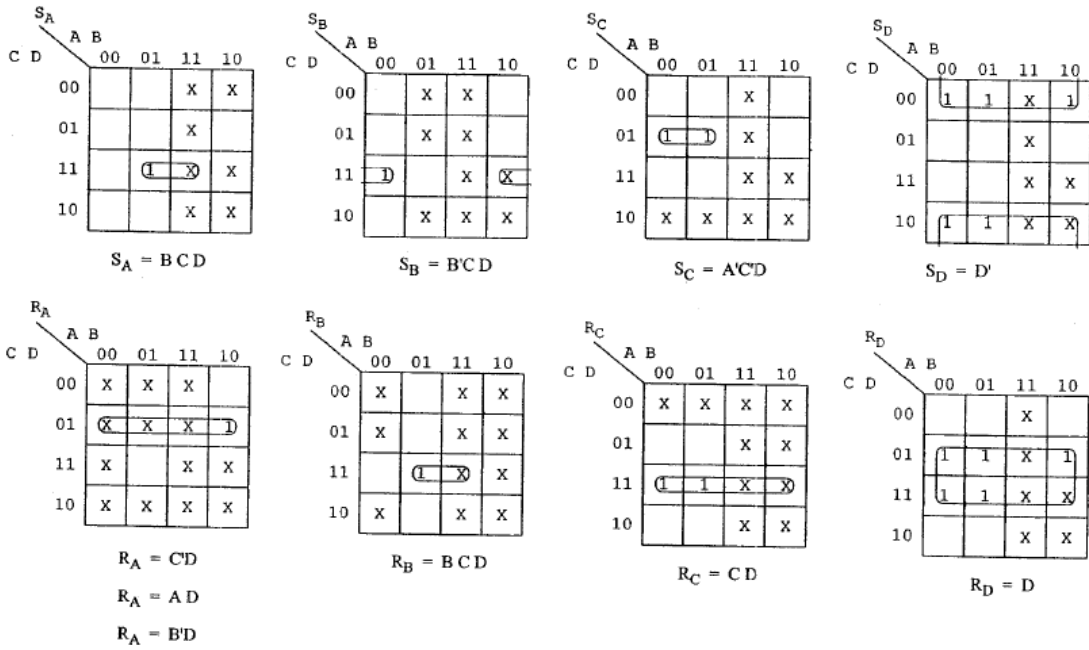


$$K_C = D$$

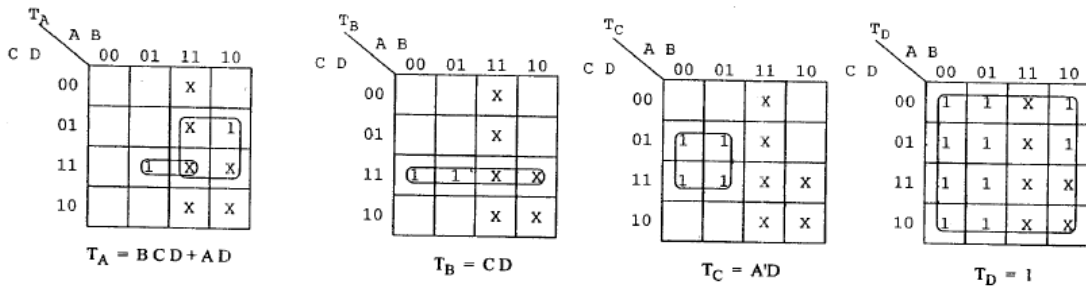


$$K_D = 1$$

12.17 (e) See table 12-5 (c) on FLD p. 342.



12.17 (d) See table 12-4 on FLD p. 339.



12.17 (e) Use equations to find next states for unused states.

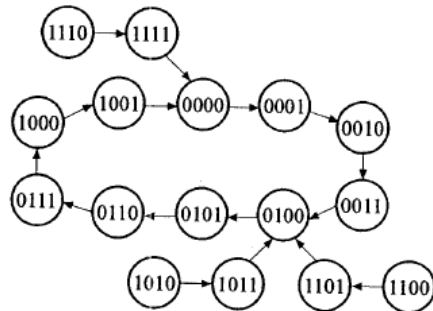
State 1101:  $J_A = BCD = 0, K_A = D = 1, A^* = 0$

$J_B = CD = 0, K_B = CD = 0, B^* = B = 1$

$J_C = A'D = 0, K_C = D = 1, C^* = 0$

$J_D = 1, K_D = 1, D^* = D' = 0$

So the next state is 0100. Other next states can be found in a similar way.



12.20 (a)

$QQ^+$	$LM$
00	$\left. \begin{matrix} 01 \\ 11 \end{matrix} \right\} X1$
01	$\left. \begin{matrix} 00 \\ 10 \end{matrix} \right\} X0$
10	$\left. \begin{matrix} 10 \\ 11 \end{matrix} \right\} 1X$
11	$\left. \begin{matrix} 00 \\ 01 \end{matrix} \right\} 0X$

12.20 (b)

$ABC$	$A^+B^+C^+$
000	100
001	000
010	XXX
011	001
100	101
101	111
110	XXX
111	011

$A^+$

		A	1
B	C	00	1 1
	01	0 1	
	11	0 0	
	10	X X	

$B^+$

		A	1
B	C	00	0 0
	01	0 1	
	11	0 1	
	10	X X	

$C^+$

		A	1
B	C	00	0 1
	01	0 1	
	11	1 1	
	10	X X	

12.20 (b)  $L_A = B$ ,  $M_A = C$ ;  $L_B = A'$ ,  $M_B = A' + C'$ ;  $L_C = A'B'$ ,  
 (contd)  $M_C = A'$

$L_A = B$

		A	1
B	C	00	X 0
	01	X 0	
	11	X 1	
	10	X X	

$M_A = C$

		A	1
B	C	00	0 X
	01	1 X	
	11	1 X	
	10	X X	

$L_B = A'$

		A	1
B	C	00	X X
	01	X X	
	11	1 0	
	10	X X	

$M_B = A' + C'$

		A	1
B	C	00	1 1
	01	1 0	
	11	X X	
	10	X X	

$L_C = A'B'$

		A	1
B	C	00	X X
	01	1 0	
	11	0 0	
	10	X X	

$M_C = A'$

		A	1
B	C	00	1 0
	01	X X	
	11	X X	
	10	X X	