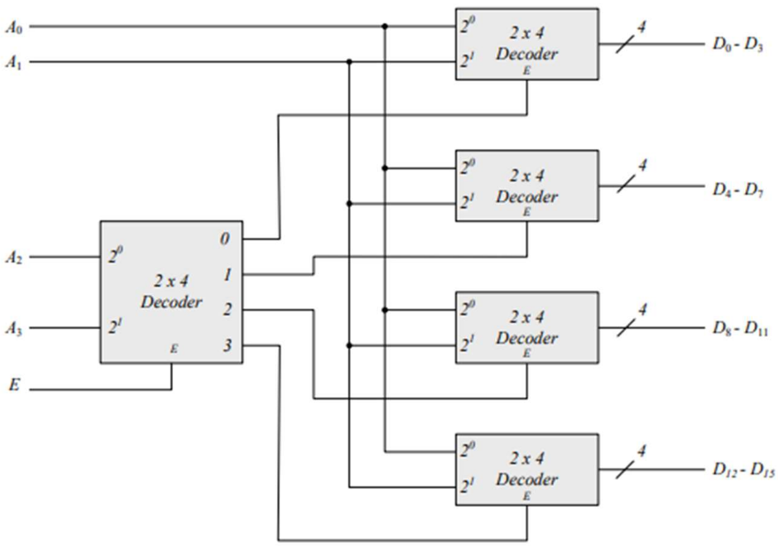
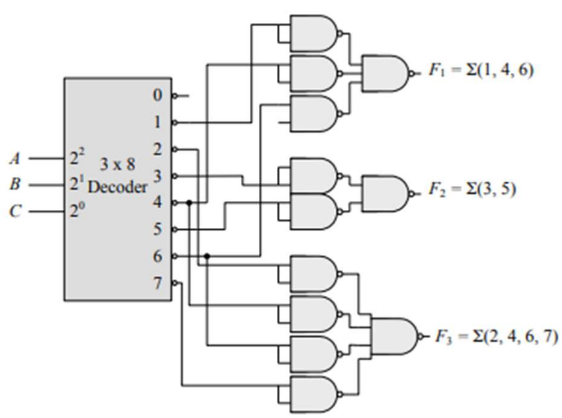
4.26

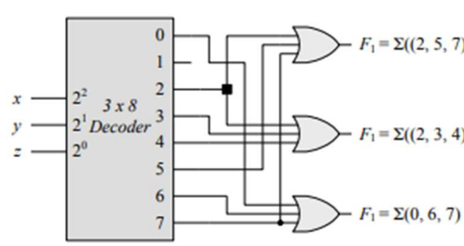


4.27



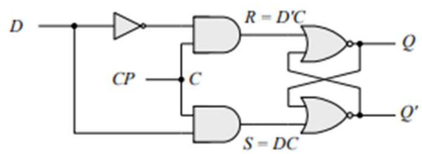
4.28 **(a)**

$F_1 = x(y + y')z + x'yz' = xyx + xy'z + x'yz' = \Sigma(2, 5, 7)$
$F_2 = xy'z' + x'y = xy'z' + x'yz + x'yz' = \Sigma(2, 3, 4)$
$F_3 = x'y'z' + xy(z + z') = x'y'z' + xyz + xyz' = \Sigma(0, 6, 7)$

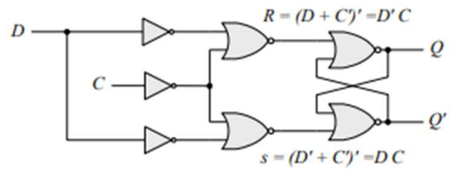


(b)

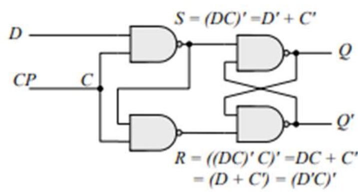
5.1 **(a)**



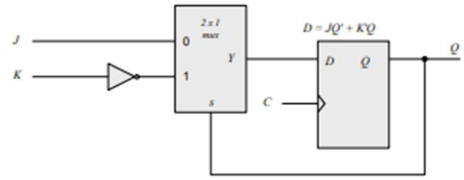
(b)



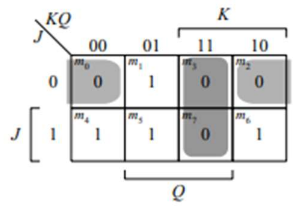
(c)



5.2



5.3 $Q'(t+1) = (JQ' + K'Q)' = (J' + Q)(K + Q') = J'Q' + KQ$



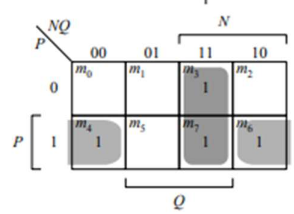
5.4

(a)

P	N	Q(t + 1)
0	0	0
0	1	$Q(t)$
1	0	$Q'(t)$
1	1	1

(b)

P	N	$Q(t)$	$Q(t+1)$
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1



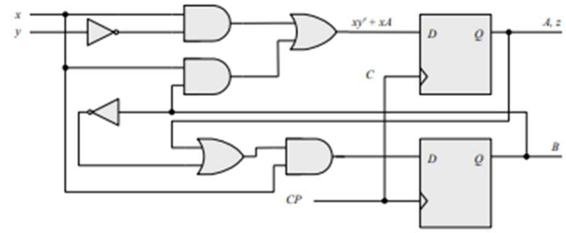
$Q(t+1) = PQ' + NQ$

(c)

$Q(t)$	$Q(t+1)$	P	N
0	0	0	x
0	1	1	x
1	0	x	0
1	1	x	1

(d) Connect P and N together.

5.6

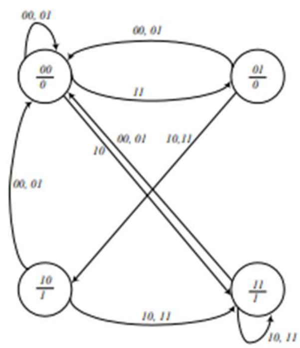


(b)

$A(t+1) = xy' + xB$
$B(t+1) = xA + xB'$
$z = A$

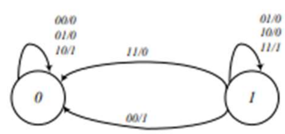
Present state		Inputs		Next state		Output
A	B	x	y	A	B	z
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	0	1	0	1	1	0
0	0	1	1	0	1	0
0	1	0	0	0	0	0
0	1	0	1	0	0	0
0	1	1	0	1	0	0
0	1	1	1	1	0	0
1	0	0	0	0	0	1
1	0	0	1	0	0	1
1	0	1	0	1	1	1
1	0	1	1	1	1	1
1	1	0	0	0	0	1
1	1	0	1	0	0	1
1	1	1	0	1	1	1
1	1	1	1	1	1	1

(c)



5.7

Present state	Inputs		Next state	Output
Q	x	y	Q	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1



$S = x \oplus y \oplus Q$
$Q(t + 1) = xy + xQ + yQ$

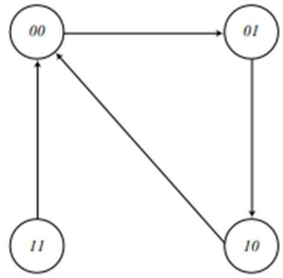
5.8 A counter with a repeated sequence of 00, 01, 10.

Present state		Next state		FF Inputs	
A	B	A	B	T_A	T_B
0	0	0	0	0	1
0	1	1	0	1	1
1	0	0	0	1	0
1	1	0	0	1	1

$$T_A = A + B$$
$$T_B = A' + B$$

Repeated sequence:

$\rightarrow 00 \rightarrow 01 \rightarrow 10 \rightarrow$



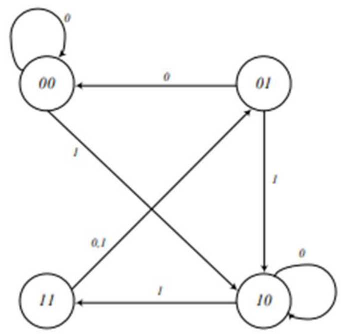
5.9

$J_A = x$ $\quad K_A = B$

$J_B = x$ $\quad K_B = A'$

$$A(t+1) = J_AA' + K_A'A = xA' + B'A$$
$$B(t+1) = J_BB' + K_B'B = xB' + AB$$

x	A	B	$xA' + B'A$	$xB' + AB$
0	0	0	0	0
0	0	1	0	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	1
1	0	1	1	0
1	1	0	1	1
1	1	1	0	1



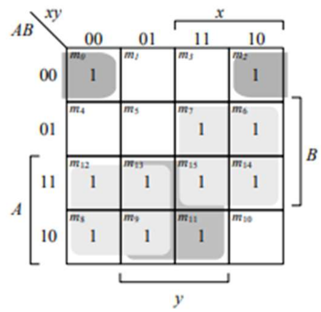
5.10 **(a)** $J_A = Bx + B'y'$ $\quad J_B = A'x$

$K_A = B'xy'$ $\quad K_B = A + xy'$ $\quad z = Axy + Bx'y'$

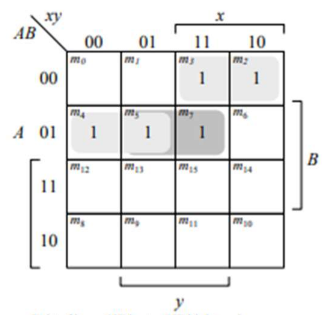
(b)

Present state A	B	Inputs x	y	Next state A	B	Output z	FF Inputs J_A	K_A	J_A	J_B
0	0	0	0	1	0	0	1	0	0	0
0	0	0	1	0	0	0	0	0	0	0
0	0	1	0	1	1	0	1	1	1	1
0	0	1	1	0	1	0	0	0	1	0
0	1	0	0	0	1	1	0	0	0	0
0	1	0	1	0	1	0	0	0	0	0
0	1	1	0	1	0	0	1	0	1	0
0	1	1	1	1	1	0	1	0	1	0
1	0	0	0	1	0	0	1	0	0	1
1	0	0	1	1	0	0	0	0	0	1
1	0	1	0	0	0	0	1	1	0	1
1	0	1	1	1	0	0	0	0	0	1
1	1	0	0	1	0	1	0	0	0	1
1	1	0	1	1	0	0	0	0	0	1
1	1	1	0	1	0	0	1	0	0	1
1	1	1	1	1	0	1	1	0	0	1

(c)



$A(t+1) = Ax' + Bx + Ay + A'B'y'$

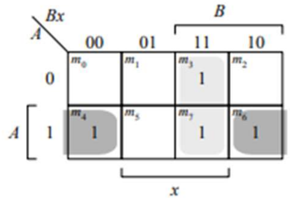


$B(t+1) = A'B'x + A'B'(x' + y)$

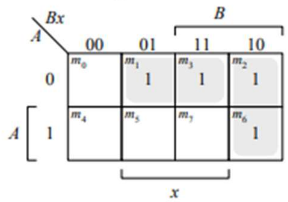
5.16 **(a)** $D_A = Ax' + Bx$

$D_B = A'x + Bx'$

Present state A B	Input x	Next state A B
0 0	0	0 0
0 0	1	0 1
0 1	0	0 1
0 1	1	1 1
1 0	0	1 0
1 0	1	0 0
1 1	0	1 1
1 1	1	1 0



$D_A = Ax' + Bx$

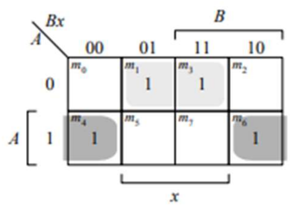


$D_B = A'x + Bx'$

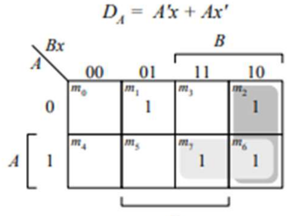
(b) $D_A = A'x + Ax'$

$D_B = AB + Bx'$

Present state A B	Input x	Next state A B
0 0	0	0 0
0 0	1	1 1
0 1	0	0 1
0 1	1	1 0
1 0	0	1 0
1 0	1	0 0
1 1	0	1 1
1 1	1	0 1



$D_A = A'x + Ax'$



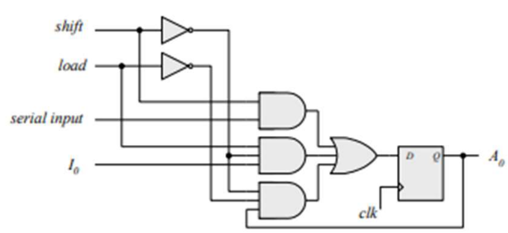
$D_B = AB + Bx'$

5.18 Binary up-down counter with enable *E*.

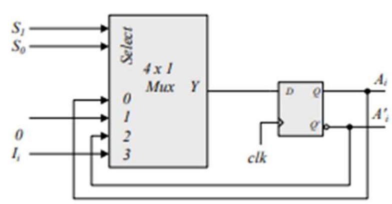
Present state *A B*	*Input* *x*	*Next state* *A B*	*Flip-flop inputs* J_A	K_A	J_B	K_B
0 0	0 1	0 0	0	x	0	x
0 0	0 1	0 0	0	x	0	x
0 0	1 0	1 1	1	x	1	x
0 0	1 1	0 1	0	x	1	x
0 1	0 0	0 1	0	x	x	0
0 1	0 1	0 1	0	x	x	0
0 1	1 0	0 1	0	x	x	1
0 1	1 1	1 0	1	x	x	1
1 0	0 0	1 0	x	0	1	0
1 0	0 1	1 0	x	0	1	0
1 0	1 0	0 1	x	1	x	1
1 0	1 1	1 1	x	0	x	1
1 1	0 0	1 1	x	0	x	0
1 1	0 1	1 1	x	0	x	0
1 1	1 0	1 1	1	0	x	1
1 1	1 1	1 1	x	1	x	1

6.4 0110 => 0011, 0001, 1000, 1100, 1110, 0111, 1011

6.6 First stage of register:



6.7 First stage of register:



6.11 **(a)** A count down counter.

(b) A count up counter.

6.12 Similar to diagram of Fig. 6.8.

(a) With the bubbles in *C* removed (positive-edge).

(b) With complemented flip-flops connected to *C*.

6.19 **(b)** From the state table in Table 6.5:

$D_{Q1} = Q'_1$
$D_{Q2} = \sum (1, 2, 5, 6)$
$D_{Q4} = \sum (3, 4, 5, 6)$
$D_{Q8} = \sum (7, 8)$
Don't care: $d = \sum (10, 11, 12, 13, 14, 15)$

Simplifying with maps:
$D_{Q2} = Q_2Q'_1 + Q'_8Q'_2Q_1$
$D_{Q4} = Q_4Q'_1 + Q4Q'2 + Q'_4Q_2Q_1$
$D_{Q8} = Q_8Q'_1 + Q_4Q_2Q_1$

6.21 **(a)**

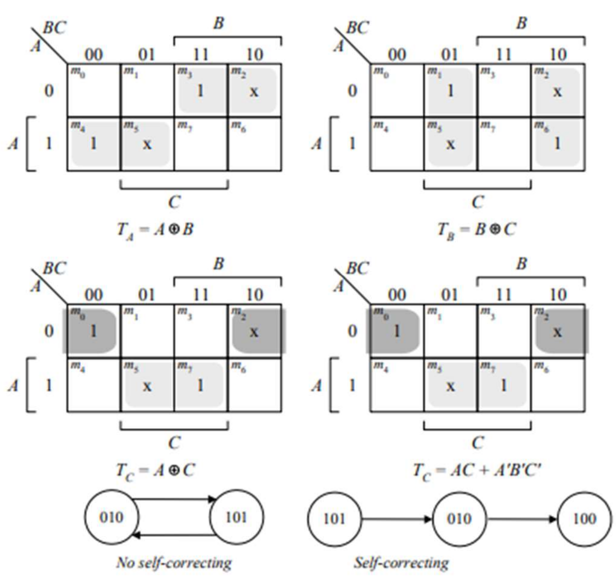
$J_{A0} = LI_0 + L'C \qquad KA_0 = LI'_0 + L'C$

(b)

$J = [L(LI)']'(L + C) = (L' + LI)(L + C)$
$LI + L'C + LIC = LI + L'C$ *(use a map)*
$K = (LI)'(L + C) = (L' + I')(L + C) = LI' + L'C$

6.24

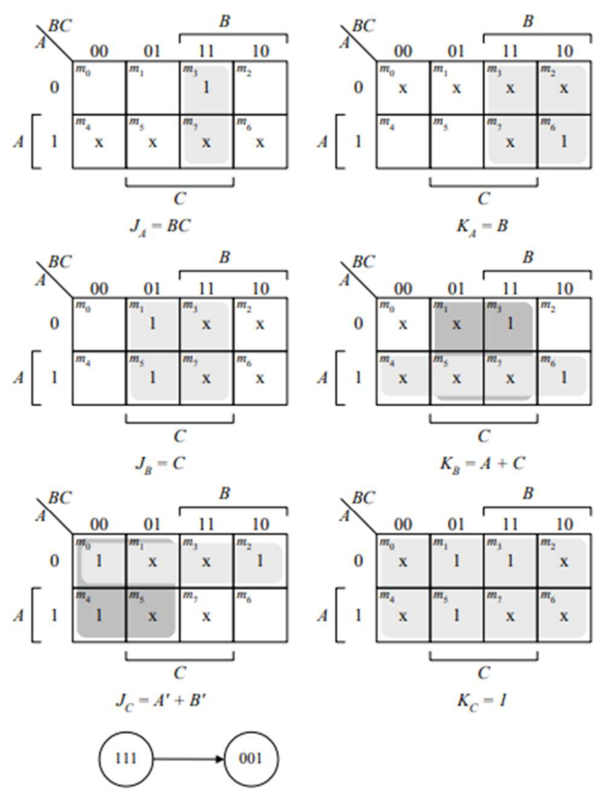
Present state ABC	Next state ABC	T_A	T_B	T_C
000	001	0	0	1
001	011	0	1	0
010	xxx	x	x	x
011	111	1	1	0
100	000	1	1	0
101	xxx	x	x	x
110	100	0	1	0
111	110	0	0	1



6.27

Present state ABC	Next state ABC	J_A	K_A	J_B	K_B	J_C	K_C
000	001	0	x	0	x	1	x
001	010	0	x	1	x	x	1
010	011	0	x	x	0	1	x
011	100	1	x	x	1	x	1
100	100	x	x	0	0	1	x
101	110	x	x	1	x	x	1
110	000	x	x	x	1	0	x
111	xxx	x	x	x	x	x	x

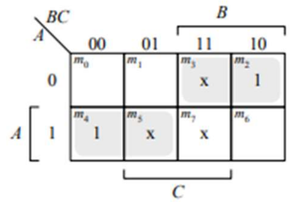
(Flip-flop inputs)



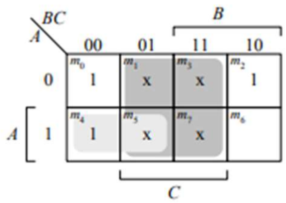
Self-correcting

6.28

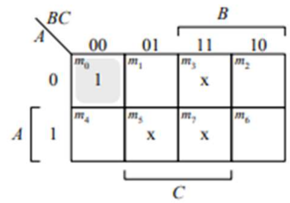
Present state ABC	Next state ABC
000	001
001	010
010	100
011	xxx
100	110
101	xxx
110	000
111	xxx



$D_A = A \oplus B$



$D_B = AB' + C$



$D_C = A'B'C'$

Self-correcting