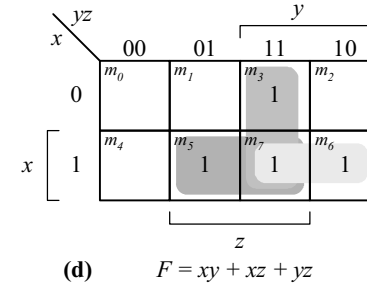
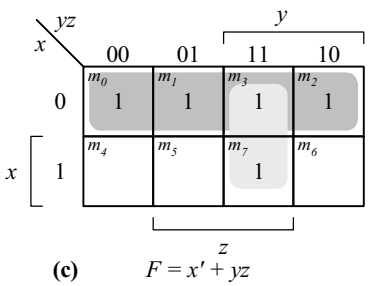
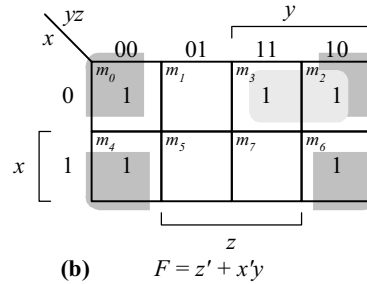
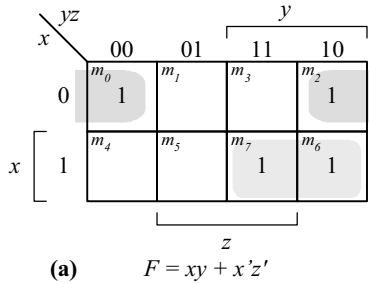
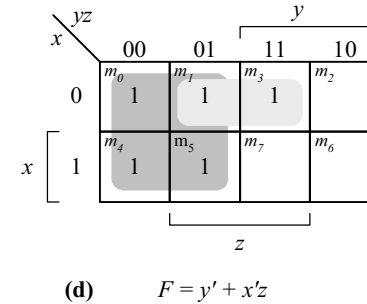
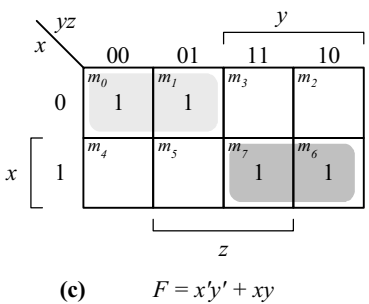
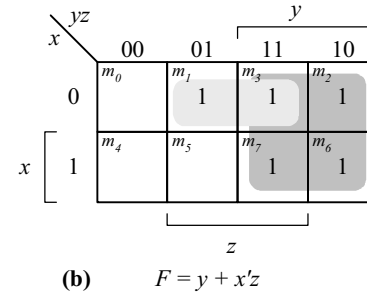
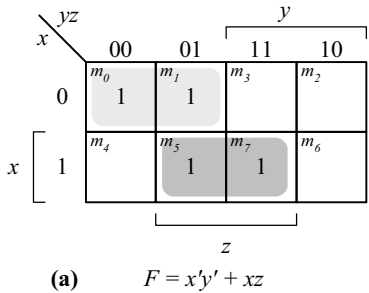


Chapter 3

3.1



3.2



		y			
		00	01	11	10
x	yz	00	01	11	10
	0	m_0	m_1	m_3	m_2
x	1	m_4	m_5	m_7	m_6
			z		

(e) $F = z$

		y			
		00	01	11	10
x	yz	00	01	11	10
	0	m_0	m_1	m_3	m_2
x	1	m_4	m_5	m_7	m_6
			z		

(f) $F = x + y'z$

3.3

		y			
		00	01	11	10
x	yz	00	01	11	10
	0	m_0	m_1	m_3	m_2
x	1	m_4	m_5	m_7	m_6
			z		

(a) $F = xy + x'y'z' + x'yz'$
 $F = xy + x'z'$

		y			
		00	01	11	10
x	yz	00	01	11	10
	0	m_0	m_1	m_3	m_2
x	1	m_4	m_5	m_7	m_6
			z		

(b) $F = x'y' + yz + x'yz'$
 $F = x' + yz$

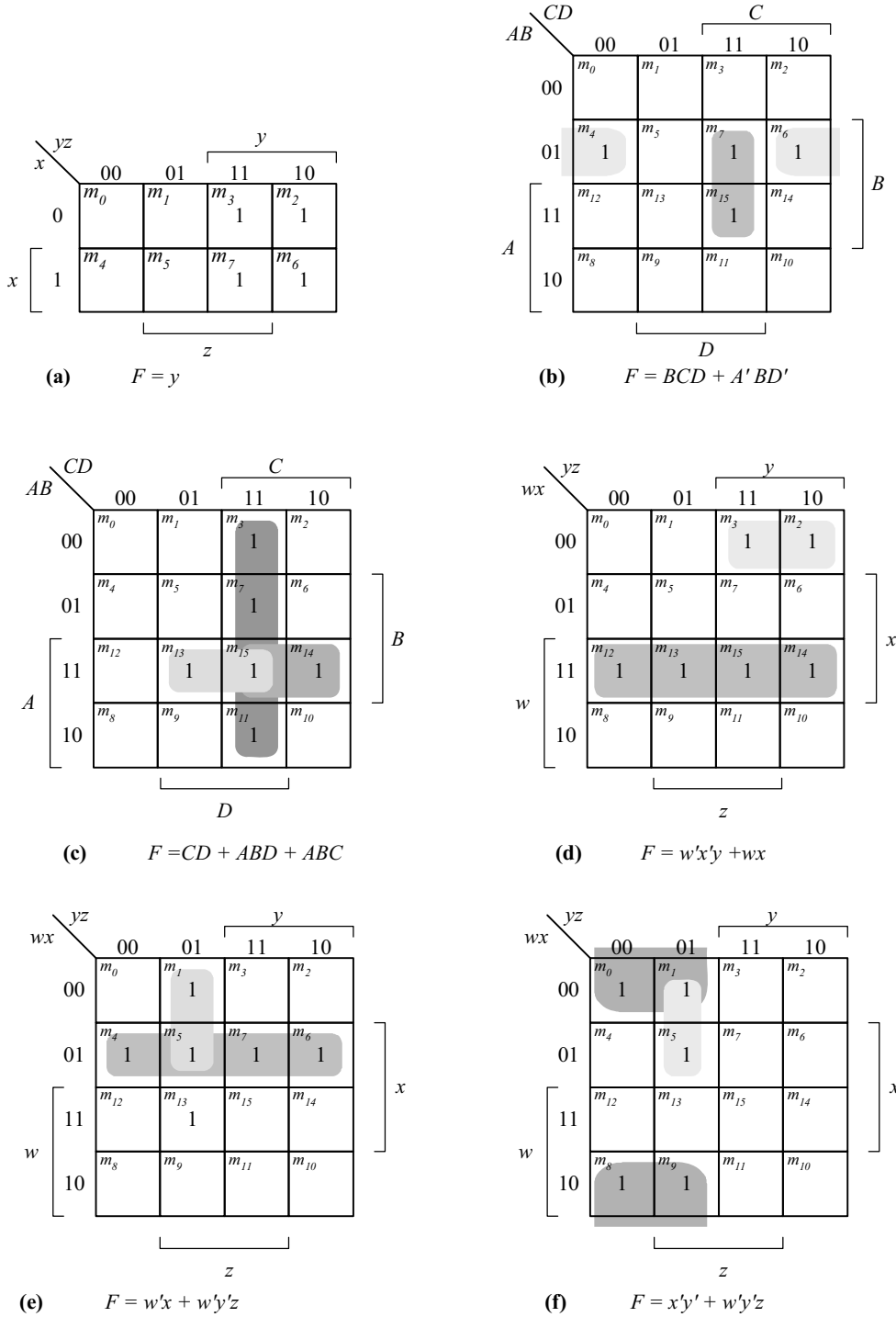
		y			
		00	01	11	10
x	yz	00	01	11	10
	0	m_0	m_1	m_3	m_2
x	1	m_4	m_5	m_7	m_6
			z		

(c) $F = x'y + yz' + y'z'$
 $F = x'y + z'$

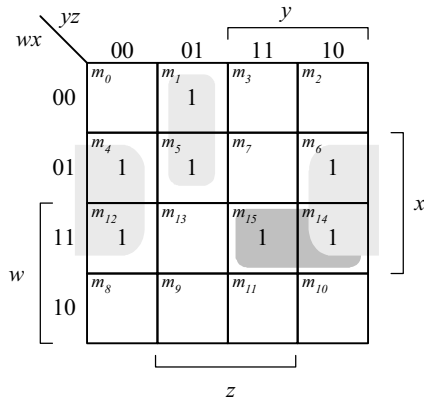
		y			
		00	01	11	10
x	yz	00	01	11	10
	0	m_0	m_1	m_3	m_2
x	1	m_4	m_5	m_7	m_6
			z		

(d) $F = xyz + x'y'z + xyz'$
 $F = x'y'z + xy$

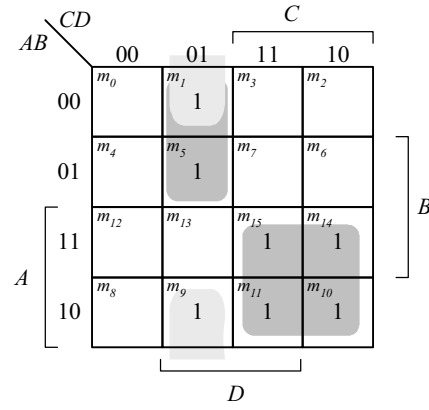
3.4



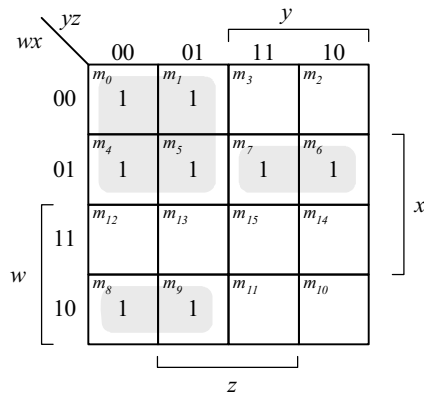
3.5



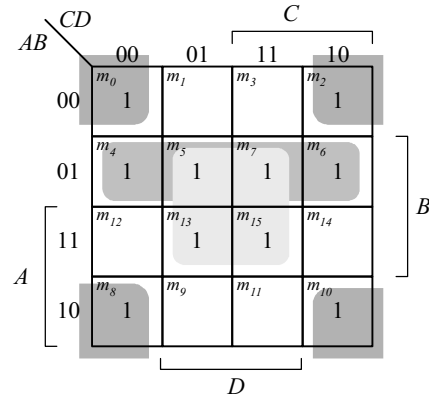
(a) $F = xz' + w'y'z + wxxy$



(b) $F = A'C + A'CD + B'C'D$

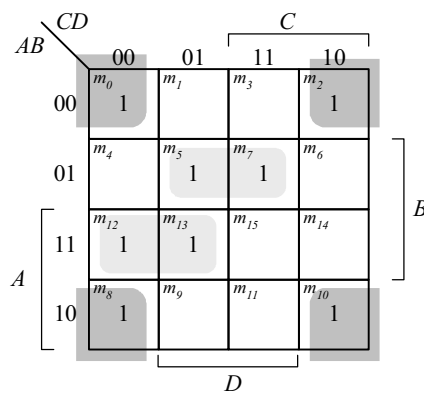


(c) $F = w'y' + wx'y' + w'xy$

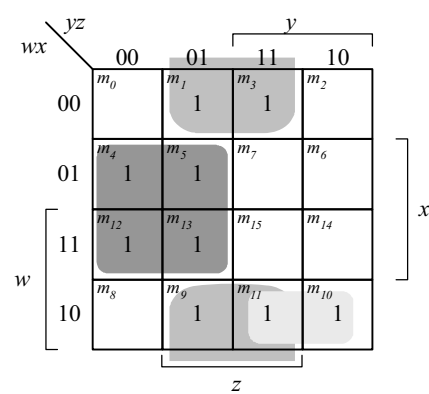


(d) $F = BD + A'B + B'D'$
or $F = BD + B'D' + A'D'$

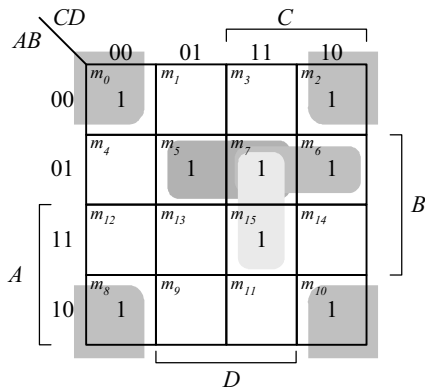
3.6



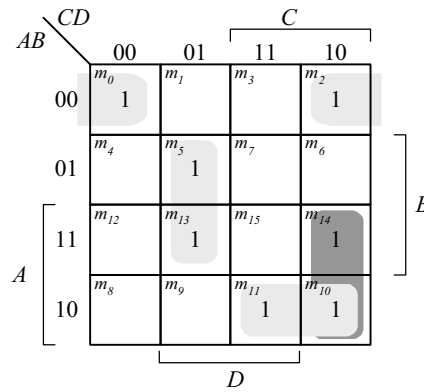
(a) $F = B'D' + A'BD + ABC'$



(b) $F = xy' + x'z + wx'y$

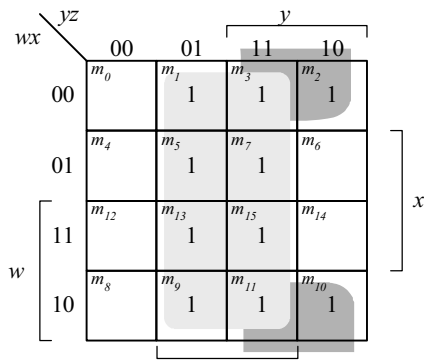


(c) $F = B'D' + BCD + A'BD + A'BC$

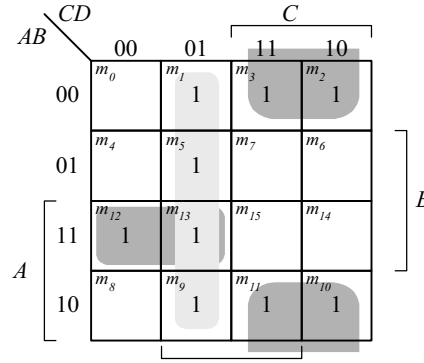


(d) $F = A'B'D' + BC'D + ACD' + ABC'$

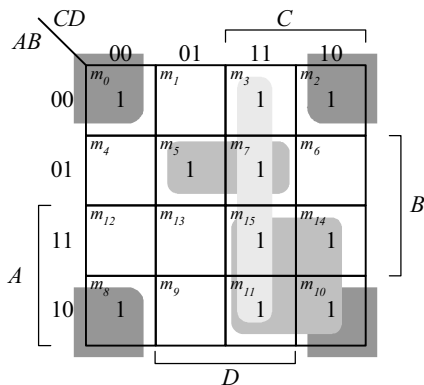
3.7



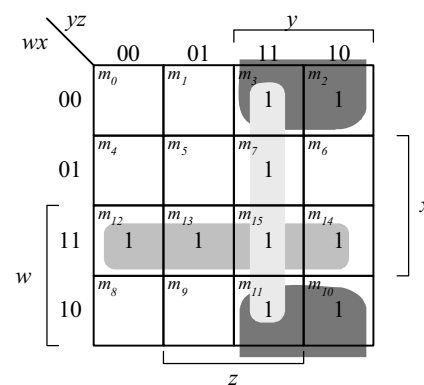
(a) $F = z + x'y$



(b) $F = C'D + B'C + ABC'$



(c) $F = B'D' + AC + A'BD + CD$ (or $B'C$)



(d) $F = wx + x'y + yz$

3.8

(a) $F(x, y, z) = \Sigma(3, 5, 6, 7)$

		y			
		00	01	11	10
x	0	m_0	m_1	1	m_2
	1	m_4	1	1	1
		z			

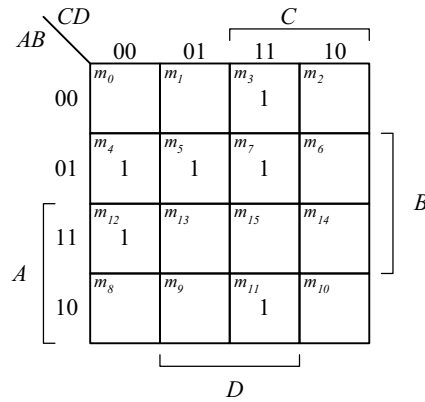
(b) $F = \Sigma(1, 3, 5, 9, 12, 13, 14)$

		C				
		00	01	11	10	
A	00	m_0	1	1	m_2	B
	01	m_4	1	m_6	m_7	
	11	1	1	1	m_{14}	
	10	m_8	1	m_{11}	m_{10}	
		D				

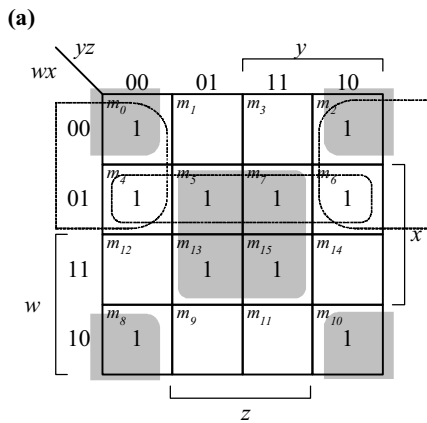
(c) $F = \Sigma(0, 1, 2, 3, 11, 12, 14, 15)$

		y				
		00	01	11	10	
w	00	1	1	1	1	x
	01	m_4	m_5	m_7	m_6	
	11	1	m_{13}	1	1	
	10	m_8	m_9	m_{11}	1	
		z				

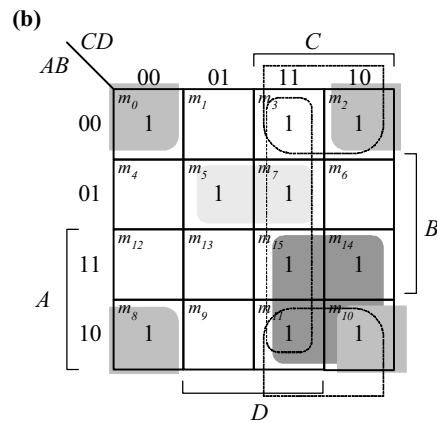
(d) $F = \Sigma(3, 4, 5, 7, 11, 12)$



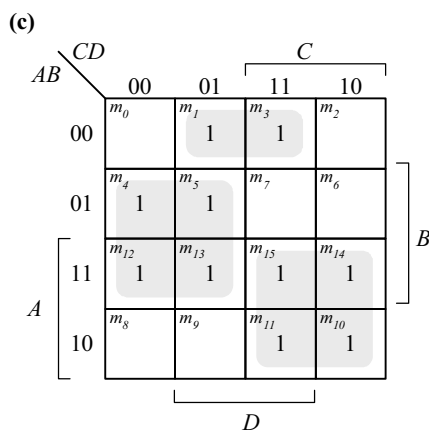
3.9



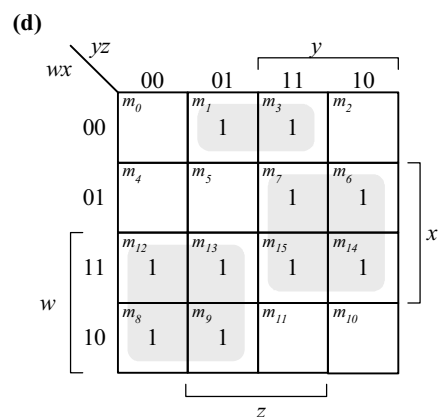
Essential: $xz, x'z'$
Non-essential: $w'x, w'z'$
 $F = xz + x'z' + (w'x \text{ or } w'z')$



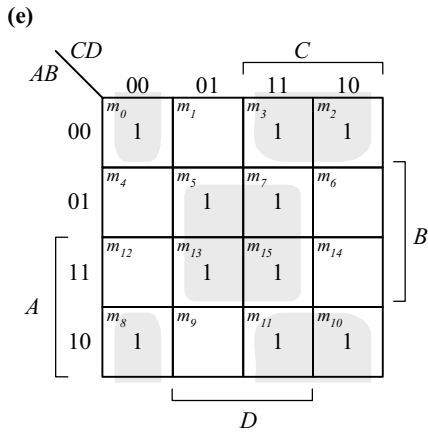
Essential: $B'D', AC, A'BD$
Non-essential: $CD, B'C$
 $F = B'D' + AC + A'BD + (CD \text{ OR } B'C)$



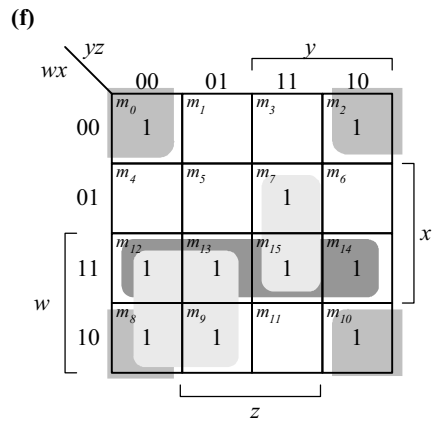
Essential: $BC', AC, A'B'D$
 $F = BC' + AC + A'B'D$



Essential: $wy', xy, w'x'z$
 $F = wy' + xy + w'x'z$

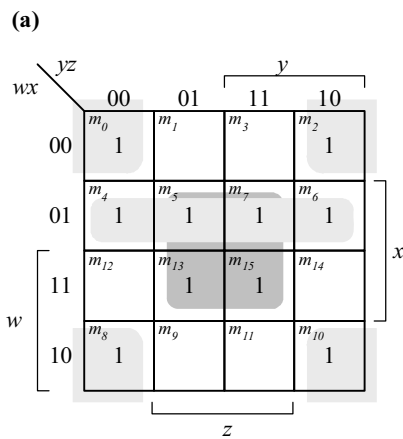


Essential: $BD, B'C, B'C'D'$
 $F = BD + B'C + B'C'D'$

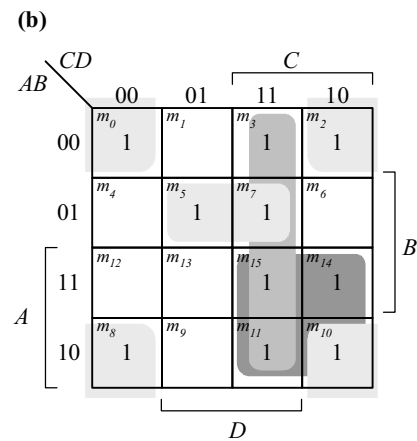


Essential: $wy', wx, x'z', xyz$
 $F = wy' + wx + x'z' + xyz$

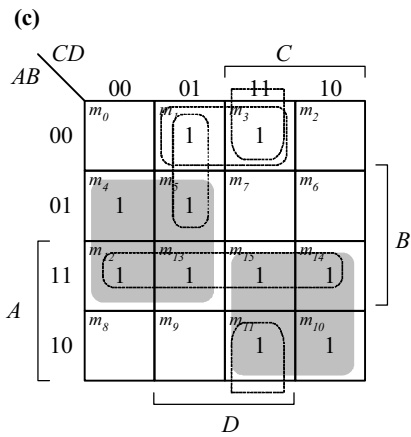
3.10



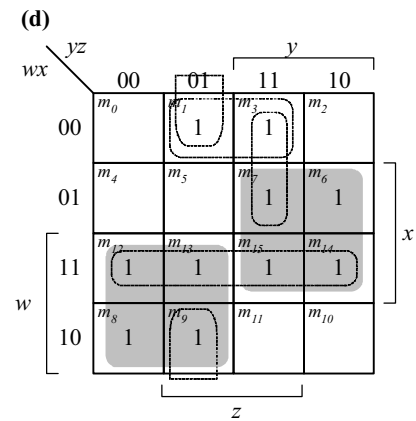
Essential: $xz, w'x, x'z'$
 $F = xz + w'x + x'z'$



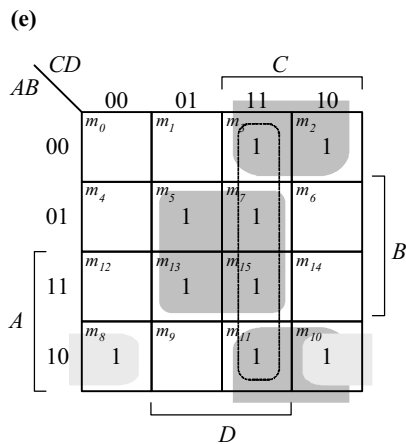
Essential: $AC, B'D', CD, A'BD$
 $F = AC + B'D' + CD + A'BD$



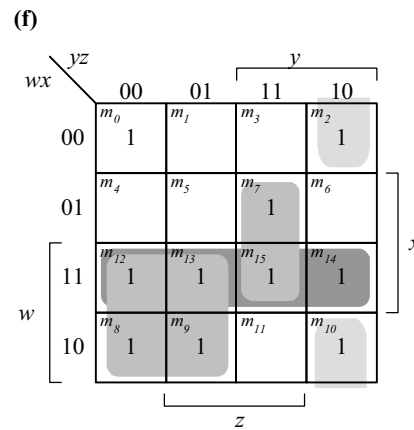
Essential: BC', AC
Non-essential: $AB, A'B'D, B'CD, A'C'D$
 $F = BC' + AC + A'B'D$



Essential: wy', xy
Non-essential: $wx, x'y'z, w'wz, w'x'z$
 $F = wy' + xy + w'x'z$



Essential: $BD, B'C, AB'C$
Non-essential: CD
 $F = BD + B'C + AB'C$

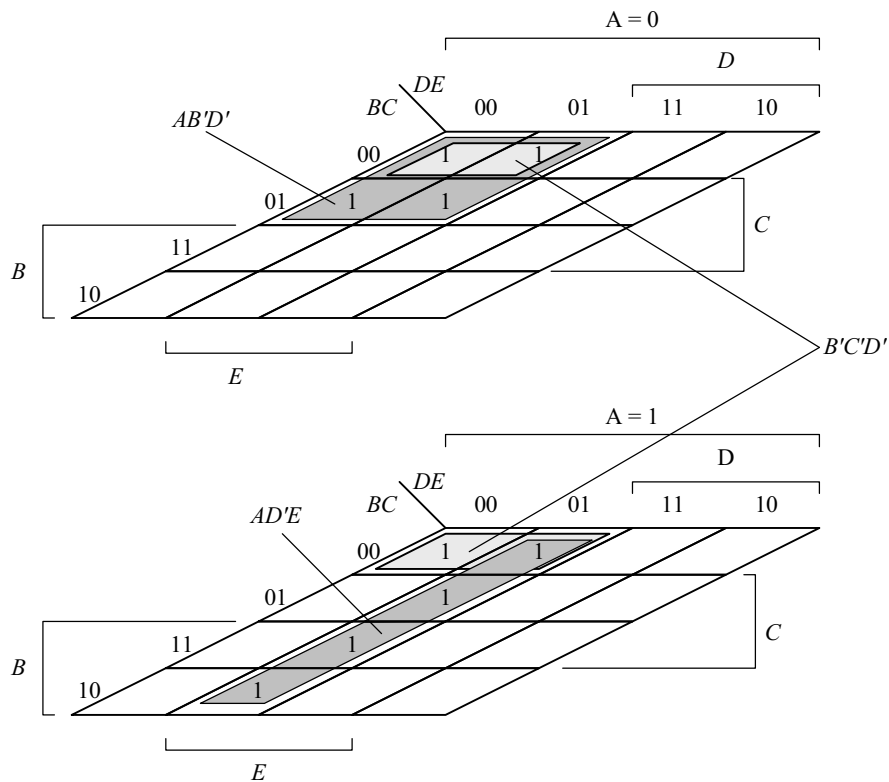


Essential: $wy', wx, xyz, x'yz'$
 $F = wy' + wx + xyz + x'yz'$

3.11 (a) $F(A, B, C, D, E) = \sum (0, 1, 4, 5, 16, 17, 21, 25, 29)$

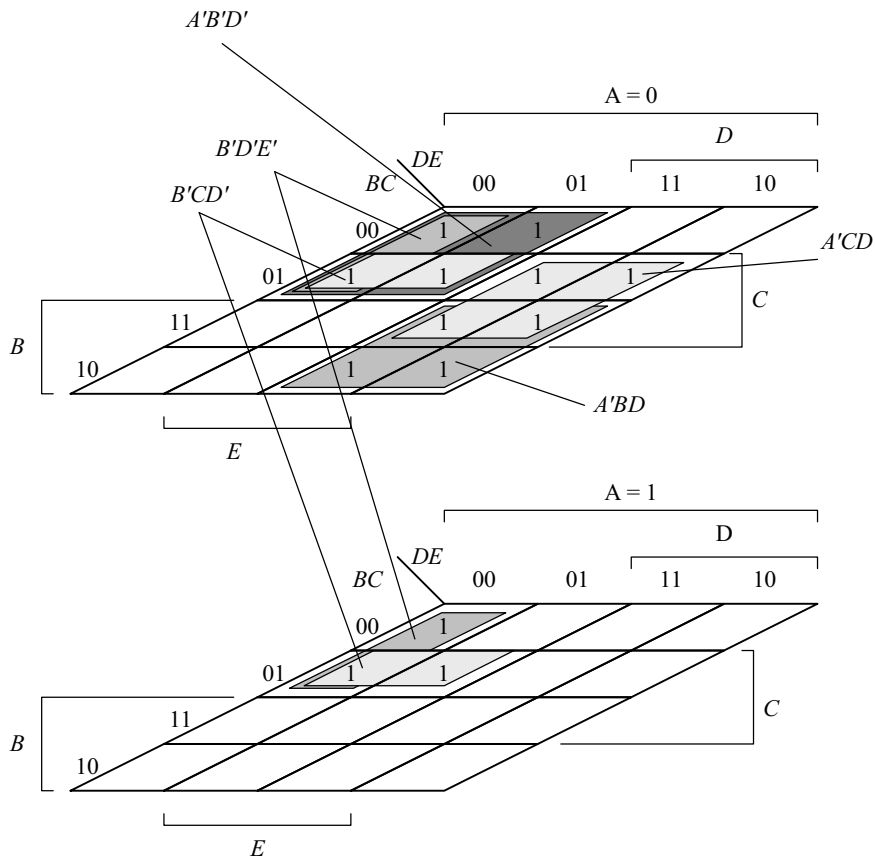
$$F = A'B'D' + AD'E + B'C'D'$$

m_0 :	$A'B'C'D'E'$	=	00000
m_1 :	$A'B'C'D'E$	=	00001
m_4 :	$A'B'CD'E'$	=	00100
m_5 :	$A'B'CD'E$	=	00101
m_{16} :	$AB'C'D'E'$	=	10000
m_{17} :	$AB'C'D'E$	=	10001
m_{21} :	$AB'CD'E$	=	10101
m_{25} :	$ABC'D'E$	=	11001
m_{29} :	$ABCDE$	=	11101



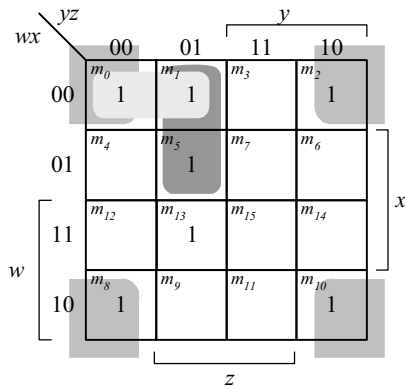
(b) $F(A, B, C, D, E) = A'B'CE' + B'C'D'E' + A'B'D' + B'CD' + A'CD + A'BD$
 $F(A, B, C, D, E) = A'B'D' + B'D'E' + B'CD' + A'CD + A'BD$

$A'B'CE'$: $AB'CDE' + A'B'CD'E'$
 $B'C'D'E'$: $AB'C'D'E' + A'B'CD'E'$
 $A'B'D'$: $A'B'CD'E + A'B'CD'E' + A'B'CD'E + A'B'CD'E'$
 $B'CD'$: $AB'CD'E + AB'CD'E' + A'B'CD'E + A'B'CD'E'$
 $A'CD$: $A'BCDE + A'BCDE' + A'B'CDE + A'B'CDE'$
 $A'BD$: $A'BCDE + A'BCDE' + A'BC'DE + A'BC'DE'$



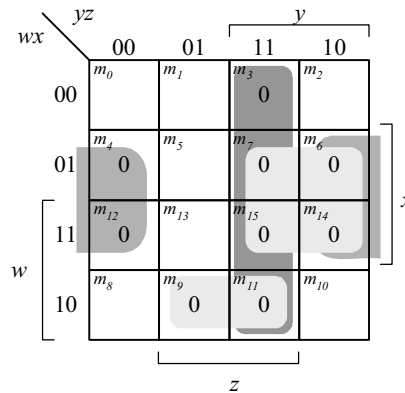
3.12

(a)



$$F = \Sigma(0, 1, 2, 5, 8, 10, 12, 13)$$

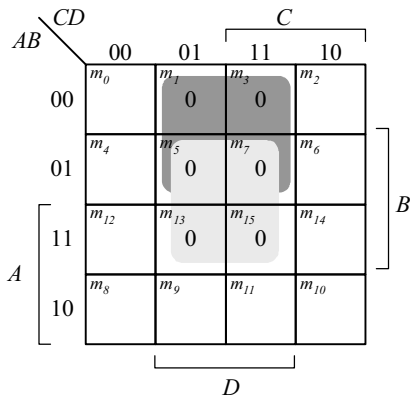
$$F = x'z' + w'x'y' + w'y'z$$



$$F' = yz + xz' + xy + wx'z$$

$$F = (y' + z')(x' + z)(x' + y')(w' + x + z')$$

(b)



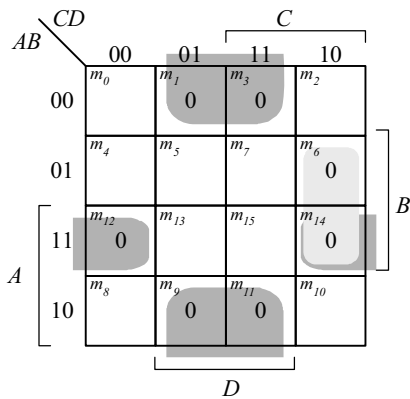
$$F = \Pi(1, 3, 5, 7, 13, 15)$$

$$F' = A'D + B'D$$

$$F = (A + D)(B' + D)$$

$$F = C'D' + AB' + CD'$$

(c)



$$F = \Pi(1, 3, 6, 9, 11, 12, 14)$$

$$F' = B'D + BCD' + ABD'$$

$$F = (B + D')(B' + C' + D)(A' + B' + D)$$

$$F = BD + B'D' + A'CD'$$

3.13 (a) $F = xy + z' = (x + z)(y + z)$

(b)

		CD					
		00	01	11	10		
A	AB	00	m_0 0	m_1 1	m_3 0	m_2 0	B
		01	m_4 0	m_5 1	m_7 0	m_6 0	
	11	m_{12} 1	m_{13} 1	m_{15} 1	m_{14} 0		
	10	m_8 1	m_9 1	m_{11} 1	m_{10} 1		
		D					

$$F = AC' + AD + C'D + AB'C$$

		CD					
		00	01	11	10		
A	AB	00	m_0 0	m_1 1	m_3 0	m_2 0	B
		01	m_4 0	m_5 1	m_7 0	m_6 0	
	11	m_{12} 1	m_{13} 1	m_{15} 1	m_{14} 0		
	10	m_8 1	m_9 1	m_{11} 1	m_{10} 1		
		D					

$$F' A'D' + A'C + BCD'$$

$$F = (A + D)(A + C')(B' + C' + D)$$

(c)

		CD					
		00	01	11	10		
A	AB	00	m_0	m_1	m_3 0	m_2	B
		01	m_4	m_5	m_7 0	m_6	
	11	m_{12}	m_{13} 0	m_{15} 0	m_{14}		
	10	m_8	m_9 0	m_{11} 0	m_{10} 0		
		D					

$$F = (A + C' + D')(A' + B' + D')(A' + B + D')(A' + B + C')$$

$$F' = A'CD + ABD + AB'D + AB'C$$

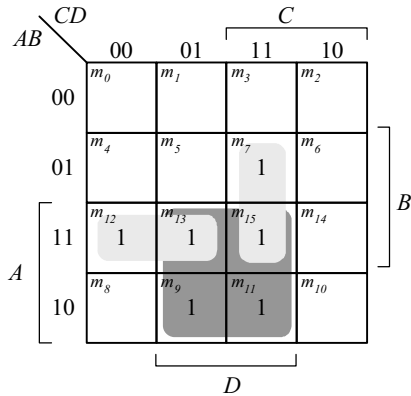
$$F = A'C + A'D' + BD' + C'D'$$

$$F' = AD + CD + AB'C$$

$$F = (A' + D')(C + D')(A' + B + C')$$

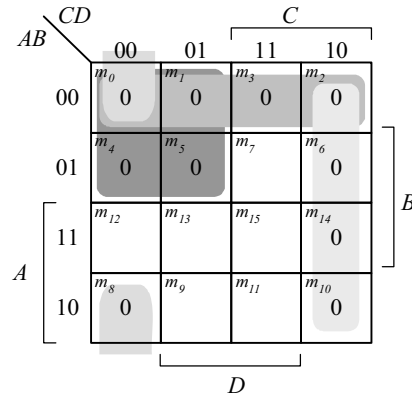
		CD					
		00	01	11	10		
A	AB	00	m_0 1	m_1 1	m_3	m_2 1	B
		01	m_4 1	m_5 1	m_7	m_6 1	
	11	m_{12} 1	m_{13}	m_{15}	m_{14} 1		
	10	m_8 1	m_9	m_{11}	m_{10}		
		D					

(d)



$$F = ABC' + AB'D + BCD$$

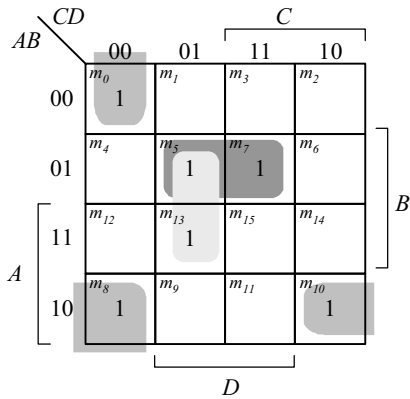
$$F = AD + ABC' + BCD$$



$$F' = A'C' + A'B' + CD' + B'C'D'$$

$$F = (A + C)(A + B)(C' + D)(B + C + D)$$

3.14



SOP form (using 1s): $F = B'C'D' + AB'D' + BC'D + A'BD$

$$F = B'D'(A + C) + BD(A' + C)$$

POS form (using 0s): $F' = BD' + B'D + A'CD' + ACD$

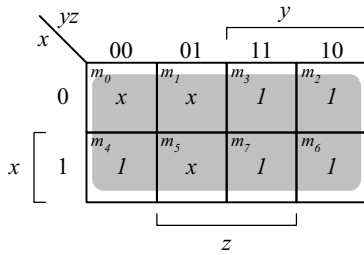
$$F = [(B' + D)(B + D)][(A + C' + D)(A' + C + D)']$$

Alternative POS: $F' = BD' + B'D + A'CD' + A'B'C$

$$F = [(B' + D)(B + D)][(A + C' + D)(A' + B + C)']$$

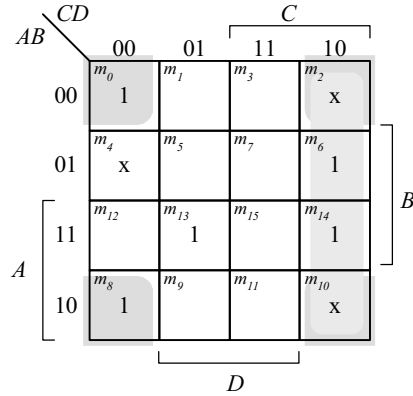
3.15

(a)



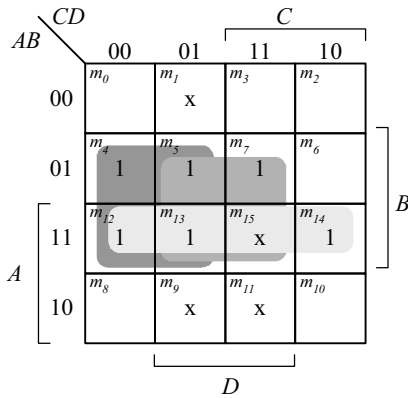
$F = 1$
 $F = \Sigma(0,1, 2, 3, 4, 5, 6, 7)$

(b)



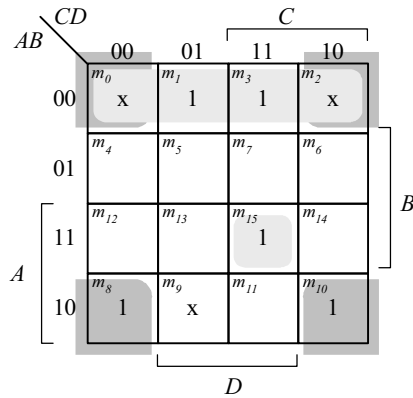
$F = B'D' + ABC'D$
 $F = \Sigma(0, 2, 6, 8, 10, 13, 14)$

(c)



$F = BC' + BD + AB$
 $F = \Sigma(4, 5, 7, 12, 13, 14, 15)$

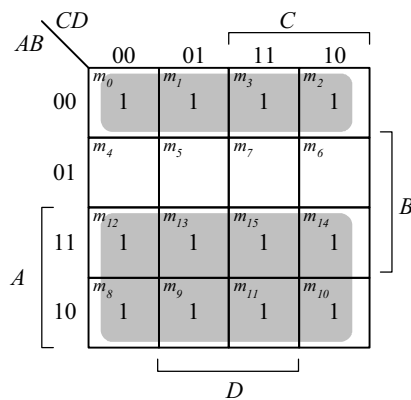
(d)



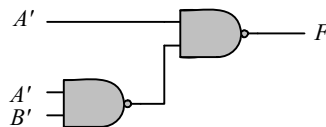
$F = B'D' + A'B' + ABCD$
 $F = \Sigma(0, 1, 2, 3, 8, 10, 15)$

3.16

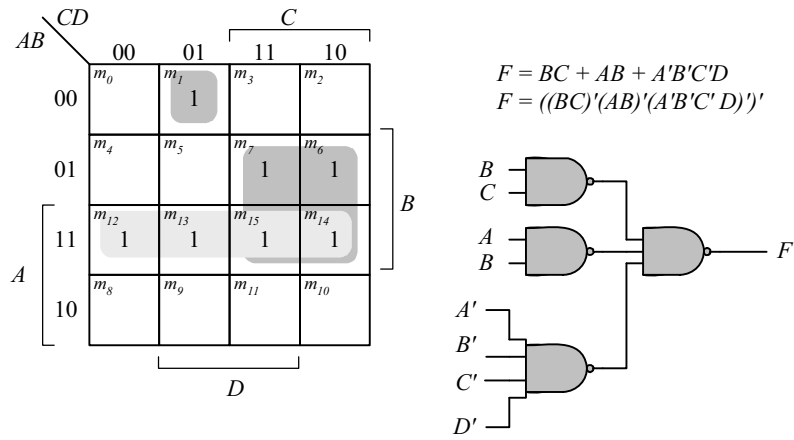
(a)



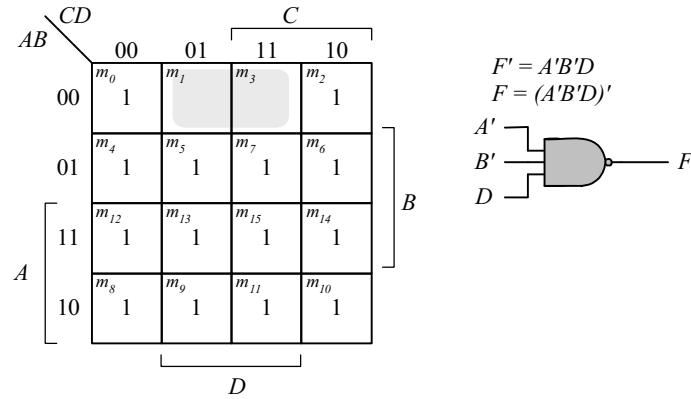
$F = A + A'B'$
 $F = (A'(A'B'))'$



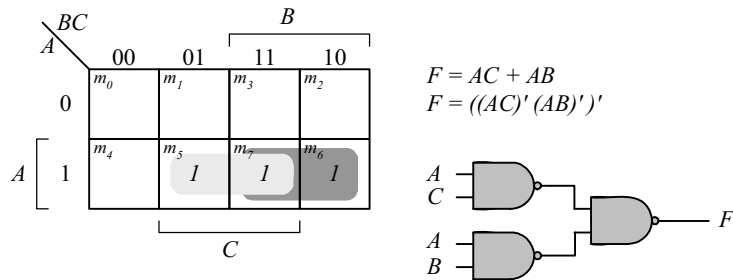
(b)



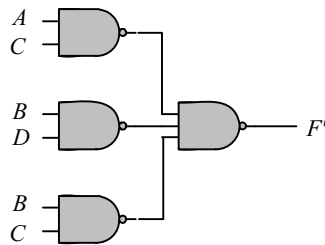
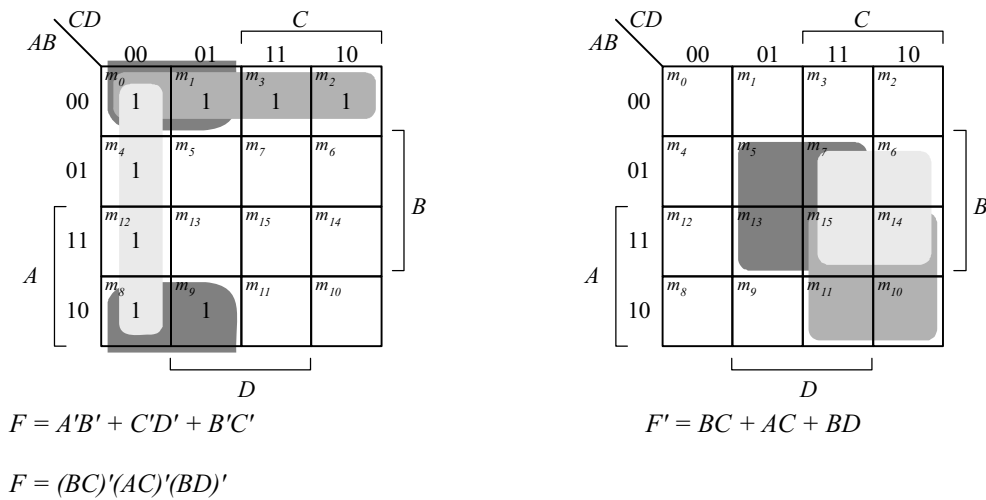
(c)



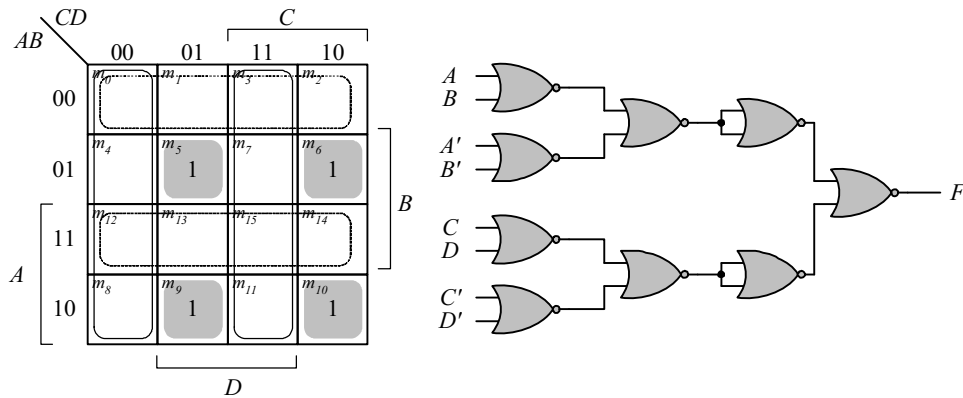
(d)



3.17

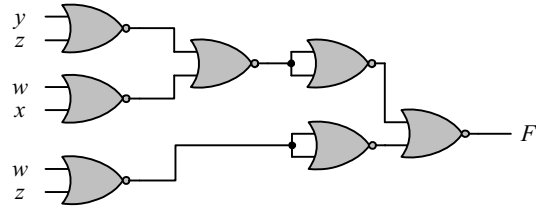
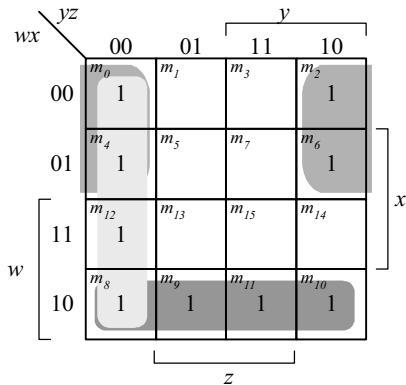


3.18 $F = (A \oplus B)'(C \oplus D) = (A'B' + A'B)(C'D' + C'D) = AB'CD' + AB'C'D + A'BCD' + A'BC'D$



$F = AB'CD' + AB'C'D + A'BCD' + A'BC'D$ and $F' = A'B' + AB + C'D' + CD$
 $F = (A'B')(AB)'(C'D)')(CD)' = (A + B)(A' + B') (C' + D')(C + D)$
 $F' = [(A + B)(A' + B')] + [(C' + D')(C + D)]'$
 $F = ([(A + B)(A' + B')] + [(C' + D')(C + D)])'$
 $F = ([(A + B)' + (A' + B)'] + [(C' + D)'] + (C + D)']'$

3.19 (a) $F = (w + z')(x' + z')(w' + x' + y')$

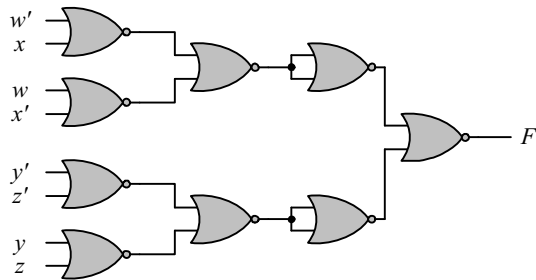
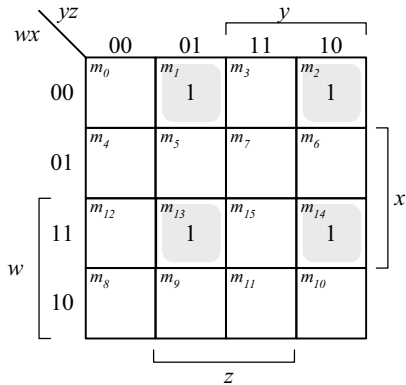


$$F = y'z' + wx' + w'z'$$

$$F = [(y + z)' + (w' + x)' + (w + z)']$$

$$F' = [(y + z)' + (w' + x)' + (w + z)']'$$

(b)

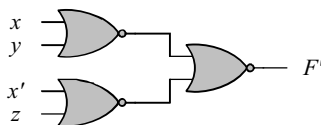


$$F = \Sigma(1, 2, 13, 14)$$

$$F' = w'x + wx' + y'z' + yz = [(w + x')(w' + x)(y + z)(y' + z)']'$$

$$F = (w + x')' + (w' + x)' + (y + z)' + (y' + z)'$$

(c) $F = [(x + y)(x' + z)]' = (x + y)' + (x' + z)'$
 $F' = [(x + y)' + (x' + z)']'$



3.20

Multi-level NOR:

$$F = (AB' + CD'E) + BC(A + B)$$

$$F' = [(AB' + CD'E) + BC(A + B)]'$$

$$F' = [[(AB' + CD'E)' + E]'] + [(BC)' + (A + B)']']'$$

$$F' = [([(A' + B)' + (C' + D)')' + E]'] + [(B' + C)' + (A + B)']']'$$