

1.

$$3.7. (a) f(x,y,z) = \sum m(0,2,4,5,7)$$

$$= \bar{x}\bar{y}\bar{z} + \bar{x}y\bar{z} + x\bar{y}\bar{z} + x\bar{y}z + xyz$$

x	y	z	f
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

$$(b) f(w,x,y,z) = \sum m(1,3,7,8,9,14,15)$$

$$= \bar{w}\bar{x}\bar{y}z + \bar{w}\bar{x}yz + \bar{w}xyz + w\bar{x}\bar{y}\bar{z} + w\bar{x}\bar{y}z + wxy\bar{z} + wxyz$$

w	x	y	z	f
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	1
1	1	1	1	1

2.

$$\begin{aligned}
 3.8. (a) f(x, y, z) &= (x + \bar{y} + z)(\bar{x} + y + z)(\bar{x} + \bar{y} + \bar{z}) \\
 &= M_2 M_4 M_7 \\
 &= \prod M(2, 4, 7)
 \end{aligned}$$

$$\begin{aligned}
 (b) f(w, x, y, z) &= (w + x + y + z)(w + x + \bar{y} + \bar{z})(w + \bar{x} + y + \bar{z})(\bar{w} + x + y + z) \\
 &\quad \cdot (\bar{w} + x + y + \bar{z})(\bar{w} + x + \bar{y} + z)(\bar{w} + \bar{x} + \bar{y} + z) \\
 &= M_0 M_3 M_5 M_8 M_9 M_{10} M_{14} \\
 &= \prod M(0, 3, 5, 8, 9, 10, 14)
 \end{aligned}$$

3

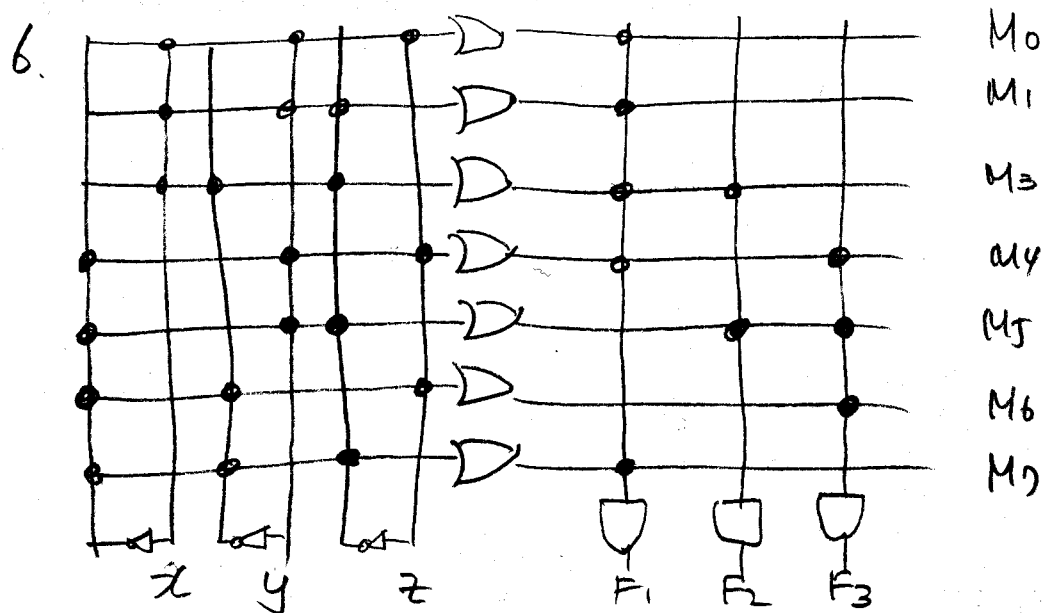
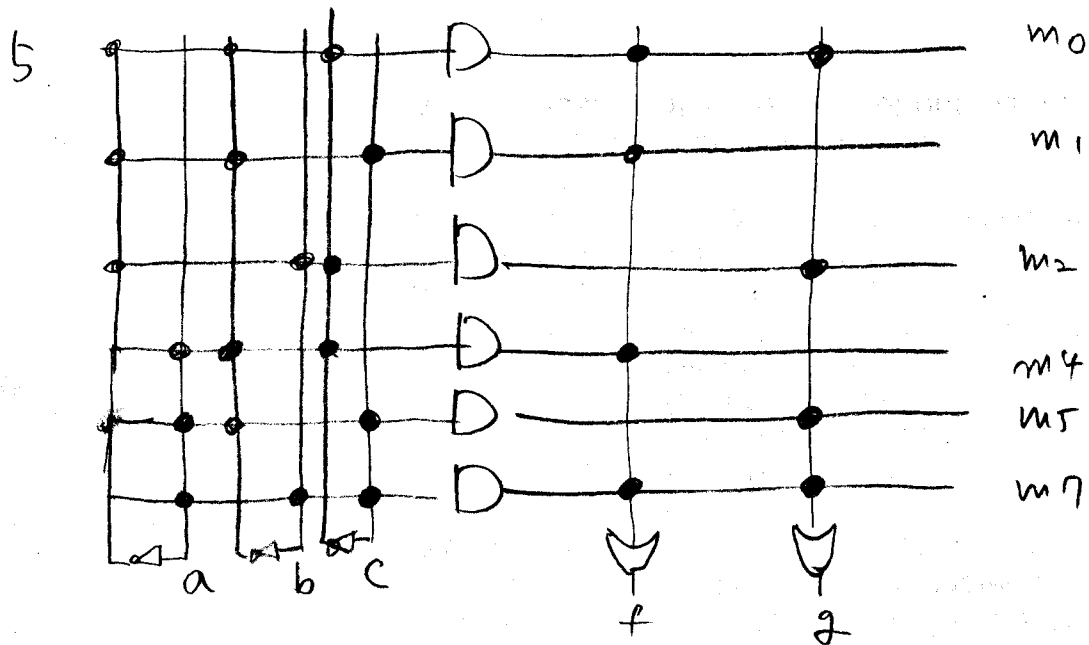
$$\begin{aligned}
 3.14. (a) f(x, y, z) &= \bar{x}(\bar{y} + z) + \bar{z} \\
 &= \bar{x}\bar{y} + \bar{x}z + \bar{z} \\
 &= \bar{x}\bar{y}(z + \bar{z}) + \bar{x}z(y + \bar{y}) + \bar{z}(x + \bar{x})(y + \bar{y}) \\
 &= \bar{x}\bar{y}z + \bar{x}\bar{y}\bar{z} + \bar{x}yz + x\bar{y}\bar{z} + x\bar{y}z + \bar{x}y\bar{z}
 \end{aligned}$$

$$\begin{aligned}
 (b) f(x, y, z) &= (x + \bar{y})(x + z) \\
 &= x + \bar{y}z \\
 &= x(y + \bar{y})(z + \bar{z}) + (x + \bar{x})\bar{y}z \\
 &= xyz + x\bar{y}z + x\bar{y}\bar{z} + x\bar{y}\bar{z} + \bar{x}\bar{y}z
 \end{aligned}$$

4.

$$\begin{aligned}
 3.15. (a) f(x, y, z) &= (y + \bar{z})(x\bar{y} + z) \\
 &= (y + \bar{z})(x + z)(\bar{y} + z) \\
 &= (x\bar{x} + y + \bar{z})(y\bar{y} + x + z)(x\bar{x} + \bar{y} + z) \\
 &= (x + y + \bar{z})(\bar{x} + y + \bar{z})(x + y + z)(x + \bar{y} + z)(\bar{x} + \bar{y} + z)
 \end{aligned}$$

$$\begin{aligned}
 (b) f(x, y, z) &= x + \bar{x}\bar{z}(y + z) \\
 &= (x + \bar{x})(x + \bar{z})(x + y + z) \\
 &= (x + \bar{z})(x + y + z) \\
 &= (x + \bar{z} + y\bar{y})(x + y + z) \\
 &= (x + y + \bar{z})(x + \bar{y} + \bar{z})(x + y + z)
 \end{aligned}$$



7. a. 435 \Rightarrow 0100 0011 0101
 13 \Rightarrow 0001 0011
 2029 \Rightarrow 0010 0000 0010 1001

8.

Kmap for a.

		CD			
AB		00	01	11	10
	00	1	0	1	1
	01	0	1	1	1
	11	X	X	X	X
	10	1	1	X	X

⊗ note: X means "don't care"

so, we can assign 1s & 0s properly to make mSOP & mPOS simpler.

The main goal is to make the smallest # of groups while maximizing the # of 1s in each group (0s in case of mPOS).

If we assign 1s to Xs...

		CD			
AB		00	01	11	10
	00	1	0	1	1
	01	0	1	1	1
	11	1	1	1	1
	10	1	1	1	1

Groups identified: $\overline{B}\overline{D}$ (top-left), A (bottom), C (middle), BD (right).

so, $a = \overline{B}\overline{D} + A + C + BD$ in mSOP.

If we assign 0 for ABCD = 1100 & 1s for the other cells

		CD			
AB		00	01	11	10
	00	1	0	1	1
	01	0	1	1	1
	11	0	1	1	1
	10	1	1	1	1

Groups identified: $(\overline{B} + C + D)$ (left), $(A + B + C + \overline{D})$ (top-right).

so, $a = (\overline{B} + C + D) \cdot (A + B + C + \overline{D})$ in mSOP.

k-map for b.

AB \ CD	00	01	11	10
00	1	1	1	1
01	1	0	1	0
11	X	X	X	X
10	1	1	X	X

Assigning 1s & 0s to Xs.

AB \ CD	00	01	11	10
00	1	1	1	1
01	1	0	1	0
11	1	0	1	0
10	1	1	1	1

Groupings: $\bar{C}\bar{D}$, CD , \bar{B}

$$b = \bar{B} + \bar{C}\bar{D} + CD \text{ in mSOP.}$$

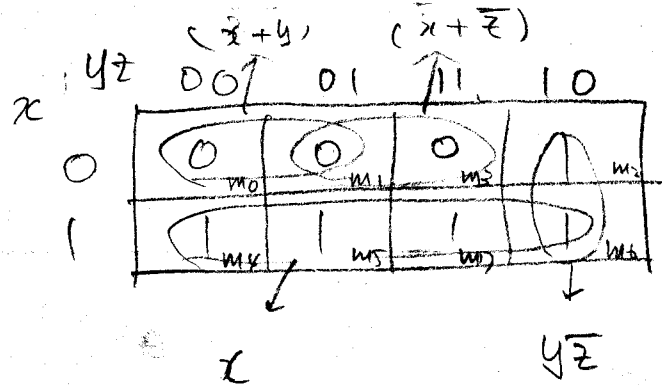
AB \ CD	00	01	11	10
00	1	1	1	1
01	1	0	1	0
11	1	0	1	0
10	1	1	1	1

Groupings: $(\bar{B} + C + \bar{D})$, $(\bar{B} + \bar{C} + D)$

$$b = (\bar{B} + C + \bar{D}) \cdot (\bar{B} + \bar{C} + D) \text{ in mPOS.}$$

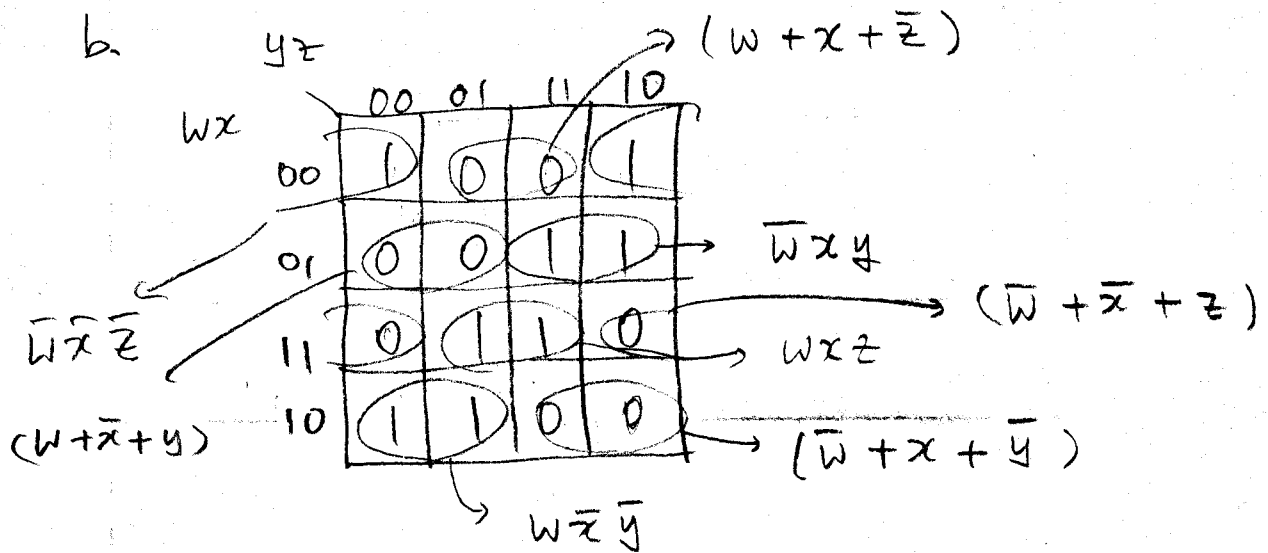
⊛ note: The optimal allocation of 1s & 0s in Xs is sometimes very complex task so, software tools are usually used in practice.
 ⇒ Suboptimal solutions will be considered as correct in this course.

9 a.



$$f = x + y\bar{z} \quad \text{in mSOP}$$

$$f = (x+y) \cdot (x+\bar{z}) \quad \text{in mPOS.}$$



$$f = \bar{w}\bar{x}\bar{z} + \bar{w}x\bar{y} + wxz + w\bar{x}\bar{y} \quad \text{in mSOP}$$

$$f = (w+x+\bar{z}) \cdot (w+\bar{z}+y) \cdot (\bar{w}+\bar{x}+z) \cdot (\bar{w}+x+\bar{y}) \quad \text{in mPOS.}$$