Answer key

1. a) $x' + y'z'$

   b) y

   c) $x' + yz'$

   d) $a + b + c + d \ldots$

   e) $\cancel{xz + yz}$ $\boxed{Z}$

2. a) $x + yz + \cancel{x' + y'z + z}$ $\bar{z}\bar{y}z$

   b) $x'(y+z) + y'(x+z) + z'(x+y)$

   c) $wxy'(y+z) + \bar{x}(y+z')$

3. a) 3 (B, C, D)

   b) E

   c) ABCD, ABCE, ACD, BCD, BCDE, CDE, ACE, ACDE

4. a) $f_1 = x' + w'z'$

   b) $f_2 = wx'z' + wxy + w'xz + w'x'y'$

   c) $f_3 = y'z' + w'z' + x'z' + w'xy'$

5. a) $T = z + w'y$

   b) $T = (w'+z)(y+z)$

6. yz, $w'x'$, $x'y'$, $w'z'$

   essential PI - yz, $x'y'$, $w'z'$

7. a) $f = (\bar{w}+\bar{x})(\bar{x}+\bar{z})$ $(\bar{w}+\bar{x}+y)(\bar{w}+x+\bar{z})$

   b) $f = (w+x+\bar{y})(w+\bar{x}+z)$

   c) $f = (\bar{y}+\bar{z})(\bar{w}+\bar{z})(x+\bar{z})(\bar{w}+\bar{x}+\bar{y})$

   d) $f = (w+\bar{z})(\bar{x}+y+\bar{z})(\bar{x}+y+z)(\bar{w}+x+\bar{y})(\bar{w}+x+z)$

   e) $f = (y+z)(\bar{w}+\bar{y})$

(8) $F = CD + \bar{B}\bar{D}$

(9) a) yz, $\bar{w}\bar{z}$, $\bar{x}\bar{y}$, $\bar{w}\bar{x}$

Essential PI - yz, $\bar{w}\bar{z}$, $\bar{x}\bar{y}$

b) $\bar{w}\bar{y}z$, $\bar{w}xz$, $\bar{w}x\bar{y}$, xyz, wxy, wyz, $w\bar{x}z$, $w\bar{x}\bar{y}$

Essential PI - $\bar{w}\bar{y}z$, $w\bar{x}\bar{y}$

(10) a) $f = (\bar{w}+\bar{x})(\bar{x}+\bar{z})$

b) $f = (w+x+\bar{y})(w+\bar{x}+z)(\bar{w}+\bar{x}+y)(\bar{w}+x+\bar{z})$

c) $f = (\bar{y}+\bar{z})(x+\bar{z})(\bar{w}+z)(\bar{w}+\bar{x}+\bar{y})$

d) $f = (\bar{w}+x)(x+\bar{z})(y+\bar{z})(\bar{x}+\bar{y}+\bar{z})$

(12) b) $AB(C+D)$

(14) a) $f(A,B,C) = ABC + ABC' + A'B'C' + AB'C' + ABC' + AB'C'$

b) $\bar{f} = \Sigma m(1,2,3) = \Pi_M(0,4,5,6,7)$

$(\bar{A}+B+C)(\bar{A}+B+\bar{C})(\bar{A}+\bar{B}+C)(\bar{A}+\bar{B}+\bar{C})$

$\bar{f} = (A+B+C)(\bar{A}+B+C)$

(15)

S	i_1	i_0	O_1	O_0
0	0	0	0	0
0	0	1	0	1
0	1	0	1	0
0	1	1	1	1
1	0	0	0	0
1	0	1	1	0
1	1	0	0	0
1	1	1	1	0

(16) a) $f_d = [A\cdot(B+C+D)'][(A+D)'\cdot B + (C'A)]$

b) $f_d = (A+B'+C)\cdot A'BD + (A+B+D')\cdot B'$

(17) a) $w(A,B,C) = A'B + AB' = A \oplus B$

b) $x(A,B,C) = B'C' + BC = B \odot C$

c) $Y(A,B,C,D) = \cancel{AC \odot (B+D)}\ B'D'(A'+C') + AC(B+D)$

$= AC \odot (B+D)$

19) Binary code ($b_3\ b_2\ b_1\ b_0$)

$b_0 = 2^n - 1$

$b_1 = 8 = \frac{2^n}{2} - 1$

$b_2 = 4 = \frac{2^n}{4} - 1$

$b_3 = \frac{2^n}{8} - 1$

Gray code

Total no of flips $= 15 = 2^n - 1$

20) $p = 1$, switching functions $= 4$

$p = 2$, switching functions $= 16$

$\underline{\underline{4^p}}$