Digital Logic Design HW Answer

【Unit 3 & Unit 4】

3.8

$A' + BD' + B'D$

3.10

(a) $WYZ' + WY'Z + XW'$

(c) $(A' + C' + D')(B + C' + D)(A + C + D)$

3.17

(f)

$(x \equiv y) \equiv z = (xy + x'y') \equiv z = (xy + x'y')z + (xy' + x'y)z'$

$= xyz + x'y'z + xy'z' + x'yz' = x(yz + y'z') + x'(y'z + yz')$

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

$= x \equiv (yz + y'z')$

$= x \equiv (y \equiv z)$

(g)

$(x \equiv y)' = (xy + x'y')' = (x' + y')(x + y) = x'y + xy'$

$= x' \equiv y = xy' + x'y = x \equiv y'$

3.18

(f)

$(x \oplus y) \oplus z = (xy' + x'y) \oplus z = (xy' + x'y)z' + (xy' + x'y)'z$

$= xy'z' + x'yz' + xyz + x'y'z = x(yz + y'z') + x'(yz' + y'z)$

$= x(yz' + yz')' + x'(yz' + y'z) = x \oplus (yz + y'z') = x \oplus (y \oplus z)$

(g)

$(x \oplus y)' = (xy' + x'y)' = (x' + y)(x + y') = x'y' + xy$

$= x' \oplus y = xy + x'y' = x \oplus y'$

3.20

(a)

$xy \oplus xz = xy(x' + z') + (x' + y')xz = xyz' + x\,y'z = x(yz' + y'z) = x(y \oplus z)$

(b)

For y = 1, the left hand side is x + z' but the right hand side is x'z' which are not equal.

(c)

For $y = 0$, the left hand side is xz' but the right hand side is x' + z' which are not equal.

(d)

$(x + y) \equiv (x + z) = (x + y)(x + z) + (x + y)'(x + z)' = x + yz + (x'y')(x'z')$
$= x + yz + x'y'z' = x + yz + y'z' = x + (y \equiv z)$

3.25

(f)

A'BD + B'EF + CDE'G

(g)

abd + b'd' + c'd

3.31

(a)

VALID:
$LHS = (X' + Y') (X \oplus Z) + (X + Y) (X \oplus Z)$

$= (X' + Y') (X'Z' + XZ) + (X + Y) (X'Z + XZ')$
$= X'Z' + X'YZ' + XY'Z + X'YZ + XZ' + XYZ'$
$= X'Z' + (XY' + X'Y)Z + XZ'$
$= Z' + Z(X \oplus Y) = Z' + (X \oplus Y) = RHS$

(b)

VALID:
$LHS = (W' + X + Y') (W + X' + Y) (W + Y' + Z)$

$= (W' + X + Y') (W + (X' + Y) (Y' + Z))$
$= (W' + X + Y') (W + (X'Y' + YZ + X'Z))$
$= W'X'Y' + W'X'Z + W'YZ + WX + WY' + XYZ + Y'W + X'Y' + X'Y'Z$
$= W'YZ + XYZ + WX + X'Y' = RHS$

(c)

VALID:
$RHS = (A' + C)(A + D')(B + C' + D)$
$= (A'D' + AC + CD')(B + C' + D)$

$= A'BD' + A'C'D' + ABC + ACD + BCD$
$= ABC + A'C'D' + A'BD' + ACD = LHS$

3.38

(a)

x(y + a′) = x(y + b′) implies that
0 = x(y + a′) ⊕ x(y + b′)

= x(y + a′)(x′ + y′b) + (x′ + y′a)x(y + b′)
= xy′b(y + a′) + xy′a(y + b′)
= xy′a′b + xy′ab′ = xy′(a′b + ab′)
= xy′(a ⊕ b)

which implies that x=1 or y=0 or
a=b.

(b)

a′b + ab′ = a′c + ac′ implies that
0 = (a′b + ab′) ⊕ (a′c + ac′)

= (a′b + ab′)(ac + a′c′) + (ab + a′b′)(a′c + ac′)
= a′bc′ + ab′c + abc′ + a′b′c
= a′(bc′ + b′c) + a(bc′ + b′c) = bc′ + b′c = b ⊕ c

which implies that b =c.

4.3

$F_1 = \sum m(0, 4, 5, 6)$; $F_2 = \sum m(0, 3, 4, 6, 7)$; $F_1 + F_2 = \sum m(0, 3, 4, 5, 6, 7)$

General rule: $F_1 + F_2$ is the sum of all minterms that are present in either F_1 or F_2.

Proof: Let $F_1 = \sum_{i=0}^{2^n-1} a_i m_i$; $F_2 = \sum_{j=0}^{2^n-1} b_j m_j$; $F_1 + F_2 = \sum_{i=0}^{2^n-1} a_i m_i + \sum_{j=0}^{2^n-1} b_j m_j = a_0 m_0 + a_1 m_1 + a_2 m_2 + \dots$

$+ b_0 m_0 + b_1 m_1 + b_2 m_2 + \dots = (a_0 + b_0)\, m_0 + (a_1 + b_1)\, m_1 + (a_2 + b_2)\, m_2 + \dots = \sum_{i=0}^{2^n-1} (a_i + b_i)\, m_i$

4.4

(a) 16

(b)

$x\ y$	z_0	z_1	z_2	z_3	z_4	z_5	z_6	z_7	z_8	z_9	z_{10}	z_{11}	z_{12}	z_{13}	z_{14}	z_{15}
0 0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
0 1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
1 0	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
1 1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	0	$x'y'$	$x'y$	x'	xy'	y'	$x'y+xy'$	$x'+y'$	xy	$x'y'+xy$	y	$x'+y$	x	$x+y'$	$x+y$	1

4.6

(a) set don't care d1 =1 and d5 =0 , F = A'B' + AB

(b) set all don't care to 0 , G = C

4.9

(a)

$$\sum m(0, 1, 4, 5, 6)$$

(b)

$$\prod M(2, 3, 7)$$

(c)

$$\sum m(2, 3, 7)$$

(d)

$$\prod M(0, 1, 4, 5, 6)$$

4.25

(a)

$$\sum m(5, 6, 7, 10, 11, 13, 14, 15) = \prod M(0, 1, 2, 3, 4, 8, 9, 12)$$

(b)

$$\sum m(0, 2, 4, 6) = \prod M(1, 3, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15)$$

(c)

$$\sum m(7, 11, 13, 14, 15) = \prod M(0, 1, 2, 3, 4, 5, 6, 8, 9, 10, 12)$$

(d)

$$\sum m(4, 8, 12, 13, 14) = \prod M(0, 1, 2, 3, 5, 6, 7, 9, 10, 11, 15)$$

4.45

(a)

E_1	E_0	s_i	c_{i+1}
0	0	$s_i = a_i \oplus b_i \oplus c_i$	$c_{i+1} = a_ib_i + a_ic_i + b_ic_i$
0	1	$s_i = a_i \oplus b_i \oplus c_i$	$c_{i+1} = a_i'b_i + a_i'c_i + b_ic_i$
1	0	$s_i = a_i \oplus b_i$	$c_{i+1} = a_ib_i + a_ic_i + b_ic_i$
1	1	$s_i = a_i \oplus b_i \oplus a_ib_i$	$c_{i+1} = a_i'b_i + a_i'c_i + b_ic_i$

(b)

E_1	E_0	Function
0	0	Add (A , B)
0	1	Subt (A , B)
1	0	XOR (A , B)
1	1	OR (A , B)

(hint: ignore the carry out's function in E_1=1, E_0 =0 and E_1 =1 , E_0 = 1)