

Lab 4

Ex(10) $F = \bar{A}(B+CD) + A\bar{B}C + AB\bar{C}\bar{D}$

$$F = \bar{A}B + \bar{A}CD + A\bar{B}C + AB\bar{C}\bar{D}$$

$$F_{Dual} = (\bar{A}+B)(\bar{A}+C+D)(A+B+C) \quad (A+B+\bar{C}+\bar{D})$$

$$F_{Comp} = \underset{1}{(A+B)} \underset{2}{(A+\bar{C}+\bar{D})} \underset{3}{(\bar{A}+B+\bar{C})} \underset{4}{(\bar{A}+\bar{B}+C+D)}$$

A	B	C	D	$\bar{A}B$	$\bar{A}CD$	$A\bar{B}C$	$AB\bar{C}\bar{D}$	F	1	2	3	4	\bar{F}
0	0	0	0	0	0	0	0	0	1	1	1	1	1
0	0	0	1	0	0	0	0	0	1	1	1	1	1
0	0	1	0	0	0	0	0	0	1	1	1	1	1
0	0	1	1	0	1	0	0	1	1	0	1	1	0
0	1	0	0	1	0	0	0	1	0	1	1	1	0
0	1	0	1	1	0	0	0	1	0	1	1	1	0
0	1	1	0	1	0	0	0	1	0	1	1	1	0
0	1	1	1	1	1	0	0	1	0	0	1	1	0
1	0	0	0	0	0	0	0	0	1	1	1	1	1
1	0	0	1	0	0	0	0	0	1	1	1	1	1
1	0	1	0	0	0	1	0	1	1	1	0	1	0
1	0	1	1	0	0	1	0	1	1	1	0	1	0
1	1	0	0	0	0	0	1	1	1	1	1	0	0
1	1	0	1	0	0	0	0	0	1	1	1	1	1
1	1	1	0	0	0	0	0	0	1	1	1	1	1
1	1	1	1	0	0	0	0	0	0	1	1	1	1

Homework 4

①

$$1. a + 0 = a$$

$$2. \bar{a} \cdot 0 = 0$$

$$3. a + \bar{a} = 1$$

$$4. a + a = a$$

$$5. a + ab = a$$

$$6. a + \bar{a}b = a + b$$

$$7. a(\bar{a} + b) \Rightarrow a\bar{a} + ab \Rightarrow 0 + ab = ab$$

$$8. ab + \bar{a}b \Rightarrow b(a + \bar{a}) \Rightarrow b(1) = b$$

$$9. (\bar{a} + b)(\bar{a} + b) \Rightarrow \bar{a}(1 + \bar{b})(1 + b) \Rightarrow \bar{a}(1)(1) = \bar{a}$$

$$10. a(a + b + c + \dots) \Rightarrow aa + ab + ac + \dots = a$$

$$11. a + b + ab = a + b$$

$$12. a + b + \bar{a}\bar{b} \Rightarrow a + \bar{a}\bar{b} \Rightarrow a + \bar{b} + b = a$$

$$13. a + b + \bar{a}b \Rightarrow a + b + \bar{a} + \bar{b} \Rightarrow \bar{a} + \bar{a} + b + \bar{b} = 1 + 1 = 1$$

$$14. y + y\bar{y} \Rightarrow y(1 + \bar{y}) \Rightarrow y + 1 = 1$$

$$15. xy + x\bar{y} \Rightarrow x(y + \bar{y}) \Rightarrow x(1) = x$$

$$16. \bar{x} + y\bar{x} = \bar{x}$$

$$17. (w + \bar{x} + y + \bar{z})y \Rightarrow wy + \bar{x}y + yy + \bar{z}y \Rightarrow wy + \bar{x}y + y + \bar{z}y \\ \Rightarrow y(w + \bar{x} + 1 + \bar{z}) \Rightarrow y(1) = 1$$

$$18. (x + \bar{y})(x + y) \Rightarrow xx + xy + x\bar{y} + y\bar{y} \Rightarrow x + xy + x\bar{y} + 0 \\ \Rightarrow x(1 + y + \bar{y}) \Rightarrow x(1 + 1) = x$$

$$19. w + (w + (wx)) \Rightarrow w + (w) = w$$

$$20. x(x + (xy)) \Rightarrow x(x) = x$$

$$21. \overline{(x + x)} \Rightarrow \overline{\overline{x}} \Rightarrow \bar{\bar{x}} = x$$

$$22. \overline{(x + x)} \Rightarrow \overline{(1)} = 0 \quad \text{all this go to 1 b/c or } \Rightarrow$$

$$23. w + (w\bar{x}yz) \Rightarrow w(1 + (\bar{x}yz)) \Rightarrow w(1) = w$$

$$24. \bar{w} \cdot \overline{(wx\bar{y}z)} \Rightarrow \bar{w}(\bar{w} + \bar{x} + \bar{y} + \bar{z}) \Rightarrow \bar{w}(1(1 + \bar{x} + \bar{y} + \bar{z})) \\ \Rightarrow \bar{w}(1) = \bar{w}$$

$$25. xz + \bar{x}y + zy \Rightarrow xz + zy + \bar{x}y \Rightarrow z + xy + \bar{x}y$$

$$\Rightarrow z + y(x + \bar{x}) \Rightarrow z + y(1) = z + y$$

$$26. (x+z)(\bar{x}+y)(z+y) \Rightarrow (\bar{x}x + xy + z\bar{x} + zy)(z+y)$$

$$\Rightarrow (0 + xy + z\bar{x} + zy)(z+y) \Rightarrow (xy + z + \bar{x}y)(z+y)$$

$$\Rightarrow xyz + zz + \bar{x}yz + xy + \underline{zy} + \bar{x}yy$$

$$\Rightarrow xyz + z + \bar{x}yz + xy + \underline{\bar{x}y} + z$$

$$\Rightarrow xyz + \bar{x}yz + \underline{xy} + \underline{\bar{x}y} + z$$

$$\Rightarrow \underline{xyz} + \underline{\bar{x}yz} + y + z \Rightarrow yz(x + \bar{x}) + y + z$$

$$\Rightarrow \underline{yz(y + z)} = y + z$$

$$27. \bar{x} + \bar{y} + xy\bar{z} = (\bar{x}\bar{y}) + xy\bar{z}$$

(2) 26. $y = \overline{(AB)(B+C)} \Rightarrow \overline{(AB)} + \overline{(B+C)} \Rightarrow \bar{A} + \bar{B} + \overline{B}\bar{C}$

$$Y_{Simp} = \bar{A} + \bar{B} + \bar{C}$$

A	B	C	$\bar{A}\bar{B}$	$\bar{B}C$	$(\bar{A}\bar{B})(\bar{B}C)$	\bar{Y}	\bar{A}	\bar{B}	$\bar{A} + \bar{B}$
0	0	0	0	0	0	0	1	1	1
0	0	1	0	1	0	1	1	1	1
0	1	0	0	0	0	1	1	0	1
0	1	1	0	1	0	0	1	1	1
1	0	0	0	0	0	0	0	1	1
1	0	1	0	1	0	0	1	1	1
1	1	0	1	0	0	0	0	0	0
1	1	1	1	1	1	0	0	0	0

circuit is on HOMEWORK 4. Circ

$$\begin{aligned}
 2. F &= \overline{(\bar{A}\bar{B} + CD)} + \overline{AC\bar{D}} \\
 &= (\overline{\bar{A}\bar{B}} \cdot \overline{CD}) + \bar{A} + \bar{C} + \bar{D} \\
 &= (\bar{A} + \bar{B})(\bar{C} + \bar{D}) + \bar{A} + \bar{C} + D \\
 &= \bar{A}\bar{B}(\bar{C} + \bar{D}) + \bar{A} + \bar{C} + D \\
 &= AB(\bar{C} + \bar{D}) + \bar{A} + \bar{C} + D \\
 &= \underbrace{AB\bar{C}}_{= F_simp} + AB\bar{D} + \bar{A} + \underbrace{\bar{C} + D}_{= F_simp} \\
 &= \bar{C}(1 + AB) + AB\bar{D} + \bar{A} + D \\
 F_{simp} &= \bar{C} + AB\bar{D} + \bar{A} + D
 \end{aligned}$$

A	B	C	D	$\bar{A}\bar{B}$	CD	$\bar{A}\bar{B} + CD$	$AC\bar{D}$	F	$\bar{A} + \bar{C} + AB\bar{D}$	F_{simp}
0	0	0	0	1	0	0	0	0	1	0
0	0	0	1	1	0	1	0	0	1	0
0	0	1	0	1	0	1	0	1	0	0
0	0	1	1	1	1	0	0	0	1	0
0	1	0	0	0	0	0	0	0	1	0
0	1	0	1	0	0	0	0	1	1	0
0	1	1	0	0	1	1	0	0	1	1
0	1	1	1	1	1	1	0	0	1	1
1	0	0	0	1	0	0	0	0	1	0
1	0	0	1	0	0	0	0	1	0	1
1	0	1	0	1	0	1	0	0	0	0
1	0	1	1	1	1	0	0	0	0	0
1	1	0	0	0	1	1	0	1	1	1
1	1	0	1	0	1	1	1	0	1	1
1	1	1	0	1	0	1	0	1	0	0
1	1	1	1	1	1	1	1	1	1	1

I do not know where I went wrong.
but

My circuit does work correctly though

3. $\begin{array}{c} \text{W} \\ \text{A} \\ \text{B} \\ \text{C} \\ \text{D} \end{array}$

$\begin{array}{c} \text{AB} \\ \text{B+C} \\ \text{B+C} \\ \text{D} \end{array}$

$\begin{array}{c} \text{AB} + \text{A(B+C)} \\ \text{A(B+C)} \\ \text{B(B+C)} \end{array}$

X

$$X = (\overline{AB} + A(B+C)) + B(B+C)$$

A	B	C	\overline{AB}	$B+C$	$A(B+C)$	\downarrow	$B(B+C)$	X
0	0	0	1	0	0	0	0	0
0	0	1	1	1	0	1	0	1
0	1	0	0	1	0	1	1	1
0	1	1	0	1	0	1	1	1
1	0	0	1	0	0	0	0	0
1	0	1	1	1	1	1	0	1
1	1	0	0	1	1	1	1	1
1	1	1	1	1	1	1	1	1

$$\begin{aligned} X &= (\overline{AB} + A(B+C)) + B(B+C) \\ &= (\overline{AB} + AB + AC) + BB + BC \\ &= (A + B\overline{B} + AC) + \underline{B + BC} \\ &= (A + AC) + B \end{aligned}$$

$$X_{\text{simp}} = A + B$$

A	B	$A+B$
0	0	0
0	1	1
1	0	1
1	1	1

$$\begin{aligned}
 (3) \quad A) \quad & \bar{x}\bar{y} + \bar{x}y + xy \\
 &= \bar{x}\bar{y} + y(\bar{x} + x) \\
 &= \bar{x}\bar{y} + y \\
 &= \bar{x} + y \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 B) \quad & \bar{A}B + \bar{B}\bar{C} + AB + \bar{B}C \\
 &= \bar{A}B + AB + \bar{B}\bar{C} + \bar{B}C \\
 &= B(\bar{A} + A) + \bar{B}(\bar{C} + C) \\
 &= B + \bar{B} \\
 &= 1 \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 C) \quad & \bar{y} + \bar{x}z + x\bar{y} \\
 &= y + x + \bar{x}z \\
 &= y + x + z \quad \checkmark
 \end{aligned}$$

$$\begin{aligned}
 D) \quad & \bar{x}\bar{y} + \bar{y}z + xz + xy + y\bar{z} \\
 &= \bar{x}\bar{y} + z + \underbrace{\bar{y}\bar{y}}_{0} + \underbrace{xy}_{x\bar{y}} + y\bar{z} \\
 &= \bar{x}\bar{y} + z + x + y\bar{z} \Rightarrow x + \bar{y} + z + y
 \end{aligned}$$

$$\begin{aligned}
 E) \quad & \bar{A}\bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}\bar{B}D + \bar{A}\bar{B}C\bar{D} \\
 &= \bar{A}\bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}\bar{B}(D + C\bar{D}) \\
 &= \bar{A}\bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}\bar{B}(C + D) \\
 &= \bar{A}\bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}\bar{B}C + \bar{A}\bar{B}D \\
 &= \bar{A}\bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}(BC + BD) \\
 &= \bar{A}\bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}(\bar{B} + CD) \\
 &= \bar{A}\bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}\bar{B} + \bar{A}CD \\
 &= \bar{A}\bar{B} + \bar{A}\bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}CD \\
 &= \bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}CD \\
 &= \bar{B} + \bar{A}\bar{C}\bar{D} + \bar{A}CD
 \end{aligned}$$

$$\begin{aligned}
 f) & xz + w\bar{y}\bar{z} + \bar{w}y\bar{z} + w\bar{x}\bar{z} \\
 & xz + \bar{z} + w\bar{w}\bar{y}y + w\bar{x}\bar{z} \\
 & xz + \bar{z} + w\bar{x}\bar{z} \\
 & = \bar{z} + w\bar{x}\bar{z}
 \end{aligned}$$

$$\begin{aligned}
 g) & = (\bar{A} + \bar{B} + C + \bar{D})(A + B + \bar{C} + D) \\
 & = \bar{A}\bar{A} + \bar{A}B + \bar{A}\bar{C} + \bar{A}D + \bar{B}A + \bar{B}\bar{B} + \bar{B}\bar{C} + \bar{B}D \\
 & \quad + CA + CB + C\bar{C} + CD + \bar{D}A + \bar{D}B + \bar{D}\bar{C} + \bar{D}D \\
 & = (\bar{A}B + \bar{A}\bar{C} + \bar{A}D + \bar{B}A + \bar{B}\bar{C} + \bar{B}D) + CA + CB + CD \\
 & \quad + (\bar{D}A + \bar{D}B + \bar{D}\bar{C}) \\
 & = \text{circled terms cancel} \\
 & = \bar{A}\bar{C} + \bar{B}\bar{C} + CA + CB + CD + \bar{D}\bar{C} \quad \checkmark
 \end{aligned}$$

(4)

$$\begin{aligned}
 a) & ABC + ABC + \bar{A}B \\
 & B(ACT + A\bar{C} + \bar{A}) \\
 & B(A + C\bar{C} + \bar{A}) \\
 & B(A + \bar{A}) = B
 \end{aligned}$$

$$\begin{aligned}
 b) & (\bar{A} + \bar{B})(\bar{A} + B) \\
 & \bar{A}\bar{B}(\bar{A} + B) \\
 & \bar{A}B(\bar{A} + B) \\
 & \bar{A}\bar{A}B + \bar{A}BB \\
 & \bar{A}B + \bar{A}B = \bar{A}(B + B) = \bar{A}B
 \end{aligned}$$

$$\begin{aligned}
 c) & \bar{A}BC + AC \\
 & C(\bar{A}B + A) \\
 & C(A) = AC
 \end{aligned}$$

$$\begin{aligned}
 D) & BC + B(AD + A\bar{D}) \\
 & BC + B(A(D + \bar{D})) \\
 & BC + AB = B + AC
 \end{aligned}$$

$$\begin{aligned}
 E) & (A + \bar{B} + A\bar{B})(AB + \bar{A}C + BC) \\
 & (A + \bar{B})(AB + C + \bar{A}B) \\
 & (A + \bar{B})(B + C) \\
 & AB + AC + \bar{B}B + \bar{B}C \\
 & AB + BC + \bar{B}C \\
 & A + C(B + \bar{B}) = A + C
 \end{aligned}$$

$$\begin{aligned}
 5) A) & \bar{x}\bar{y} + xy\bar{z} + \bar{x}y \\
 & \bar{x}(\bar{y} + y) + xy\bar{z} \\
 & \bar{x} + x(y\bar{z}) \\
 & \bar{x} + y\bar{z}
 \end{aligned}$$

$$\begin{aligned}
 B) & x + y(z + (x + z)) \\
 & x + \cancel{zy} + xy + \cancel{zy} \\
 & x + \cancel{zy} + xy \\
 & x + y + zx \\
 & x + y
 \end{aligned}$$

$$\begin{aligned}
 C) & \bar{w}x(\bar{z} + \bar{yz}) + x(w + \bar{w}yz) \\
 & \bar{w}\bar{x}(\bar{z}) + x(w) \\
 & x(\bar{w}\bar{z} + w) \\
 & x(w) = xw
 \end{aligned}$$

$$\begin{aligned}
 D) ((A+B) + \bar{A}\bar{B})(\bar{C}\bar{D} + CD) + \bar{A}\bar{C} \\
 ((A+B) + \bar{A}\bar{B})(1) + \bar{A}\bar{C} \\
 (A+B) + \bar{A}\bar{B} + \bar{A}\bar{C} \\
 (A+B) + \bar{A} + \bar{B}\bar{C}
 \end{aligned}$$

⑥ A) $A\bar{B} + \bar{A}B$

$$\begin{aligned}
 &= (A + \bar{B})(\bar{A} + B) \\
 &= (\bar{A} + \bar{B})(\bar{A} + B) \Rightarrow (\bar{A} + B)(A + \bar{B})
 \end{aligned}$$

B) $(\bar{v}w + x)y + \bar{z}$

$$\begin{aligned}
 &= (\bar{v}wy + xy) + \bar{z} \Rightarrow ((\bar{v} + \bar{w})y + xy) + \bar{z} \\
 &(\bar{v} + w + y)(x + y)(\bar{z}) \\
 \Leftrightarrow & (v + \bar{w} + \bar{y})(\bar{x} + \bar{y})z
 \end{aligned}$$

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

$$\begin{aligned}
 &A\bar{B}C + (\bar{A} + \bar{B})C + A(\bar{B} + \bar{C}) \\
 \Rightarrow & \bar{A}\bar{B}\bar{C} + (A + B)\bar{C} + \bar{A}(B + C)
 \end{aligned}$$