- CENG 214 Logic Design Homework-2 - ①

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1. Question 1-)

a) $\bar{x}\bar{y} + \bar{x}y + xy = \bar{x} + y$

1. $\bar{x}(\bar{y}+y) + xy$ (by distributive laws)
2. $\bar{x} + xy$ (by $\bar{y}+y=1$)
3. $(\bar{x}+x)(\bar{x}+y)$ (by distributive laws)
4. $\bar{x}+y$ (by $\bar{x}+x=1$)

b) $\bar{A}B + \bar{B}\bar{C} + AB + \bar{B}C = 1$

1. $\bar{A}B + AB + \bar{B}\bar{C} + \bar{B}C$ (by commutativity)
2. $B(\bar{A}+A) + \bar{B}(\bar{C}+C)$ (by distributive laws)
3. $B + \bar{B}$ (by $\bar{x}+x=1$)
4. 1 (by $\bar{x}+x=1$)

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

1. $y + x\bar{y} + \bar{x}z$ (by commutativity)
2. $(y+x)(y+\bar{y}) + \bar{x}z$ (by distributive laws)
3. $(y+x) + \bar{x}z$ (by $y+\bar{y}=1$)
4. $(y+x+\bar{x})(y+x+z)$ (by distributive laws)
5. $(y+1)(y+x+z)$ (by $x+\bar{x}=1$)
6. $(y+x+z)$ (by $y+1=1$)
7. $x+y+z$ (by commutativity)

d) $\bar{x}\bar{y} + \bar{y}z + xz + xy + y\bar{z} = \bar{x}\bar{y} + xz + y\bar{z}$ (2)

1. $\bar{x}\bar{y} + \bar{y}z + xy + y\bar{z}$ (by consensus theorem
($\bar{x}\bar{y} + xz + \bar{y}z = \bar{x}\bar{y} + xz$)
2. $\bar{x}\bar{y} + xz + y\bar{z}$ (by consensus theorem)
($xz + y\bar{z} + xy = xz + y\bar{z}$)

2. Question-2)

a) $\bar{x}\bar{y} + xyz + \bar{x}y$ (to three literals)

$\bar{x}(\bar{y} + y) + xyz$

$\bar{x} + xyz = (\bar{x} + x)(\bar{x} + yz) = \boxed{\bar{x} + yz}$

reduced boolean expression

b) $x + y(z + \overline{x+z})$ to two literals

1. $x + y(z + \bar{x}\bar{z})$ (de morgan law)
2. $x + y((z + \bar{z})(z + \bar{x}))$ (by distributive law)
3. $x + y(z + \bar{x})$ (by $x + \bar{x} = 1$)
4. $x + yz + y\bar{x}$ (by distributive law)
5. $(x + x')(x + y) + yz$ (by distributive law)
6. $(x + y) + yz$ (by $x + x' = 1$)
7. $\boxed{x + y}$ (by simplification)
($x + xy = x$)

reduced boolean expression

c) $\bar{w}x(z\bar{z}+\bar{y}z)+x(w+\bar{w}yz)$ to one literal

1. $\bar{w}x\bar{z}+\bar{w}x\bar{y}z+wx+\bar{w}xyz$ (by distributive law)
2. $\bar{w}xz(x+x')+wx+\bar{w}x\bar{z}$ (by $x+x'=1$)
3. $\bar{w}xz+wx+\bar{w}x\bar{z}$
4. $wx(z+\bar{z})+wx$ (by distributive law)
5. $wx+wx$ (by $x+x'=1$)
6. $x(w+w)$ (by $x+x'=1$)
7. $\boxed{x}$

↓ reduced boolean expression

d) $(AB+\bar{A}\bar{B})(\bar{E}\bar{D}+CD)+\overline{AC}$ to four literals

1. $AB\bar{C}\bar{D}+ABCD+\bar{A}\bar{B}\bar{E}\bar{D}+ABCD+\overline{AC}$ (by distributive law)
2. $AB\bar{C}\bar{D}+ABCD+\bar{A}\bar{B}\bar{E}\bar{D}+\bar{A}\bar{B}CD+\bar{A}+\bar{C}$ (by demorgan law)
3. $\bar{A}+\bar{A}\bar{B}\bar{C}\bar{D}+\bar{A}\bar{B}CD+\bar{E}+AB\bar{C}\bar{D}+ABCD$ (by commutative law)
4. $\bar{A}(1+\bar{B}\bar{C}\bar{D}+\bar{B}CD)+\bar{E}(1+AB\bar{D})+ABCD$ (by distribuive law)
5. $\bar{A}+\bar{E}+ABCD$ (by $x+y+1=1$)
6. $\bar{E}+\bar{A}+ABCD$ (by commutative law)
7. $\bar{E}+(\bar{A}+AB)(\bar{A}+CD)$ (by distributive law)
8. $\bar{E}+(\bar{A}+A)(\bar{A}+B)(\bar{A}+CD)$ (by distributive law)
9. $\bar{E}+(\bar{A}+B)(\bar{A}+CD)$ (by $x+\bar{x}=1$)

10. $\bar{C} + \bar{A} + \bar{A}CD + B\bar{A} + BCD$ (by distributive law)

11. $\bar{C} + \bar{A} + B\bar{A} + BCD$ (by simplification)

12. $\bar{C} + \bar{A} + BCD$ (by simplification)

13. $\bar{A} + C\bar{C} + C)(\bar{C} + BD)$ (by distributive law)

14. $\boxed{\bar{A} + \bar{C} + BD}$ (by $x + x' = 1$)

reduced boolean expression