ELEC 2607 Ass1 Solutions

1.

$\overline{a+b+c}$

a \ bc	00	01	11	10
0	1	0	0	0
1	0	0	0	0

$\overline{a+b}\cdot\overline{c}$

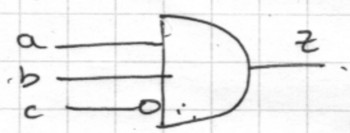
a \ bc	00	01	11	10
0	1	0	0	0
1	0	0	0	0

Maps are same.

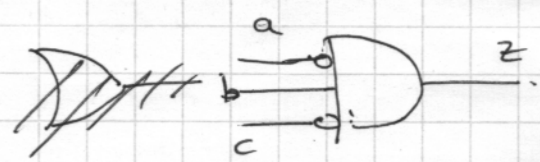
Therefore the expressions are equal.

2.

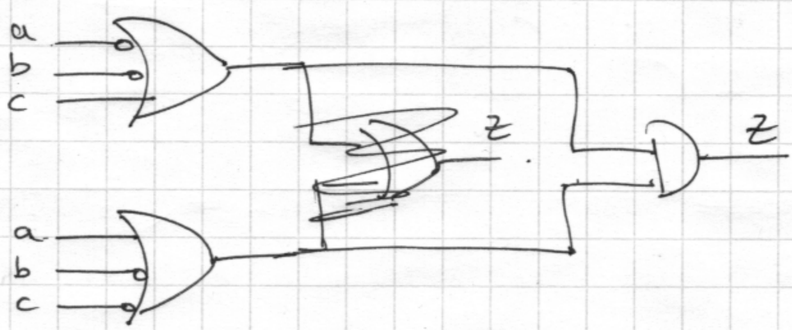
a)



b)



c)



3. a) $(X+Y+\bar{Y}Z)\overbrace{(Y+X)(Y+\bar{X})}^{Y} = (X+Y+\bar{Y}Z)\,Y$

$= \underbrace{XY+Y}_{\text{simplification rule}} + 0 = Y$

b) $(\underbrace{BCD+C}_{\text{simplification rule}})CD = C\cdot CD = CD$

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

$= AC(\bar{B}+1)+\bar{C}(A\bar{B}+B) = AC+\bar{C}(A+B)$

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

4. $LHS = (a+b)(b+c)(c+a) = (ab + ac + b + bc)(c+a)$.

$= (ac+b)(c+a) = ac \cdot c + bc + ac \cdot a + ab$

$= ac + bc + ab = RHS$

5. $\bar{a}\bar{b} + ab = (a+\bar{b})(\bar{a}+b)$.

Using duality $(\bar{a}+\bar{b})(a+b) = a\bar{b} + \bar{a}b$

$\Rightarrow$ ~~$\bar{a}b$~~ $\bar{a}b + a\bar{b}$ can be written as $(\bar{a}+\bar{b})(a+b)$

6) $\overline{a(b\bar{c}+de) + \overline{(d+a)}cg} = \bar{F}$

dual of F $\equiv \{a + (b+\bar{c})(d+e)\} \cdot \{\overline{d+a}(c+g)\}$.

simplify to $(\bar{d}+\bar{a})$

Inverting all variables $\{$ ~~$\bar{a}+\bar{b}+\bar{c}$~~ $\{\bar{a} + (\bar{b}+c)(\bar{d}+\bar{e})\}$ ~~$(d+a)(\bar{c}+\bar{g})$~~ $(d+a+\bar{c}+\bar{g})$

$= \bar{F}$

7. Can be solved in several ways:

By observation: y implements an even parity gate $\Rightarrow y = \overline{a \oplus b \oplus c}$

z is the inverse of a majority gate $\Rightarrow z = \overline{ab+bc+ca}$

By algebra: $y = \bar{a}\bar{b}\bar{c} + ab\bar{c} + a\bar{b}c + \bar{a}bc$

simplifying we get $y = \overline{a \oplus b \oplus c}$.

$z = \bar{a}\bar{b}\bar{c} + a\bar{c}\bar{b} + \bar{a}b\bar{c} + \bar{a}\bar{b}c$

simplifying we get $z = \bar{a}\bar{b} + \bar{b}\bar{c} + \bar{a}\bar{c}$

this by the way is the same as $\overline{ab+bc+ca}$. Try proving it.