CpE111 HW#2 Solutions.

1.

(f) $(x + y)(\bar{x} + z) = (x + y)\bar{x} + (x + y)z$ P4b

$= \bar{x}(x + y) + z(x + y)$ P3b

$= \bar{x}x + \bar{x}y + zx + zy$ P4b

$= x\bar{x} + \bar{x}y + zx + zy$ P3b

$= 0 + \bar{x}y + zx + zy$ P5b

$= \bar{x}y + zx + zy$ P2a

$= \bar{x}y + zx + zy \cdot 1$ P2b

$= \bar{x}y + zx + zy(x + \bar{x})$ P5a

$= \bar{x}y + zx + zyx + zy\bar{x}$ P4b

$= \bar{x}yz + \bar{x}y + xzy + xz$ P3a, P3b

$= \bar{x}y(z + 1) + xz(y + 1)$ P4b

$= \bar{x}y \cdot 1 + xz \cdot 1$ T2a

$= \bar{x}y + xz$ P2b

(g) $(x + y)(y + z)(x + z) = [(x + y)y + (x + y)z](x + z)$ P4b

$= [y(x + y) + z(x + y)](x + z)$ P3b

$= (yx + yy + zx + zy)(x + z)$ P4b

$= (yx + y + zx + zy)(x + z)$ T4b

$= (y + yx + yz + zx)(x + z)$ P3a

$= (y + zx)(x + z)$ T6a

$= (y + zx)x + (y + zx)z$ P4b

$= x(y + zx) + z(y + zx)$ P3b

$= xy + xzx + zy + zzx$ P4b

$= xy + xxz + yz + xzz$ P3b

$= xy + xz + yz + xz$ T4b

$= xy + (xz + xz) + yz$ P3a

$= xy + xz + yz$ T4a

(h) $x\bar{y} + y\bar{z} + \bar{x}z = x\bar{y} \cdot 1 + y\bar{z} \cdot 1 + \bar{x}z \cdot 1$ P2b

$= x\bar{y}(z + \bar{z}) + y\bar{z}(x + \bar{x}) + \bar{x}z(y + \bar{y})$ P5a

$= x\bar{y}z + x\bar{y}\bar{z} + y\bar{z}x + y\bar{z}\bar{x} + \bar{x}zy + \bar{x}z\bar{y}$ P4b

$= \bar{x}yz + \bar{x}y\bar{z} + \bar{y}zx + \bar{y}z\bar{x} + x\bar{z}y + x\bar{z}\bar{y}$ P3a, P3b

$= \bar{x}y(z + \bar{z}) + \bar{y}z(x + \bar{x}) + x\bar{z}(y + \bar{y})$ P4b

$= \bar{x}y \cdot 1 + \bar{y}z \cdot 1 + x\bar{z} \cdot 1$ P5a

$= \bar{x}y + \bar{y}z + x\bar{z}$ P2b

3.5. (continued)

(c)

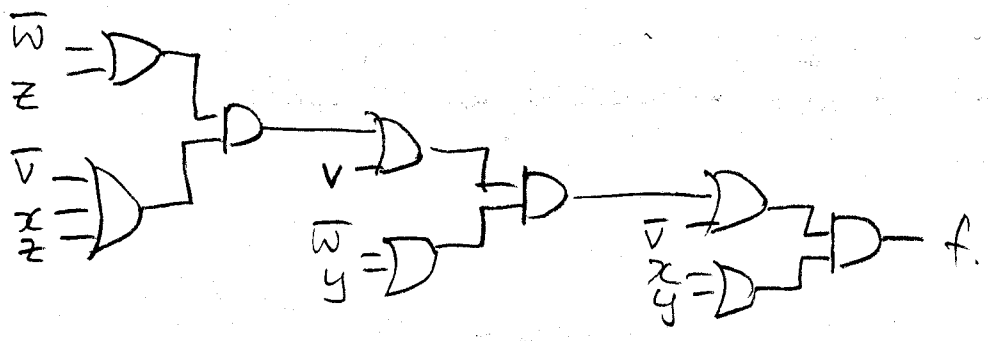
x	y	z	$\bar{x}$	$\bar{y}$	$x+\bar{y}$	$y+z$	$\bar{x}+z$	$(x+\bar{y})(y+z)$	f
0	0	0	1	1	1	0	1	0	0
0	0	1	1	1	1	1	1	1	1
0	1	0	1	0	0	1	1	0	0
0	1	1	1	0	0	1	1	0	0
1	0	0	0	1	1	0	0	0	0
1	0	1	0	1	1	1	1	1	1
1	1	0	0	0	1	1	0	1	0
1	1	1	0	0	1	1	1	1	1

(d)

w	x	y	z	$\bar{w}$	$\bar{y}$	wx	wxy	$\bar{y}+z$	$\bar{w}(\bar{y}+z)$	f
0	0	0	0	1	1	0	0	1	1	1
0	0	0	1	1	1	0	0	1	1	1
0	0	1	0	1	0	0	0	0	0	0
0	0	1	1	1	0	0	0	1	1	1
0	1	0	0	1	1	0	0	1	1	1
0	1	0	1	1	1	0	0	1	1	1
0	1	1	0	1	0	0	0	0	0	0
0	1	1	1	1	0	0	0	1	1	1
1	0	0	0	0	1	0	0	1	0	0
1	0	0	1	0	1	0	0	1	0	0
1	0	1	0	0	0	0	0	0	0	0
1	0	1	1	0	0	0	0	1	0	0
1	1	0	0	0	1	1	0	1	0	0
1	1	0	1	0	1	1	0	1	0	0
1	1	1	0	0	0	1	1	0	0	1
1	1	1	1	0	0	1	1	1	0	1

3. G3.18 b. $f = ((w+x)(\bar{v}+y+z)+\bar{w})((w+x)(\bar{v}+y+z)+v)$

4. G3.19 b.



5. $f = 1/0.25 \times 10^{-6} = 4\,MHz$

6. $f_1 = 600\,MHz$ & $f_2 = 800\,MHz$

$T_1 = 1/600 \times 10^6$ & $T_2 = 1/800 \times 10^6$

$\approx 1.667\,ns$ $\approx 1.25\,ns.$

$$\%\text{ decrease in } T = \frac{|1.667 - 1.25|}{1.667} \times 100$$

$$= 25.01\,\%$$

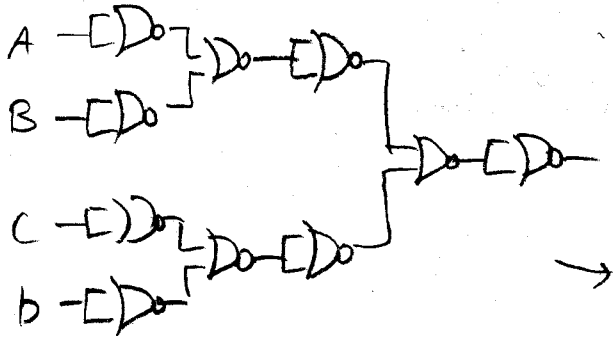
7. $W = \overline{A \cdot B} + \overline{C \cdot D} = (\overline{A} + \overline{B}) + (\overline{C} + \overline{D})$ DeMorgan's

$= \overline{\overline{(\overline{A} + \overline{B})} + \overline{(\overline{C} + \overline{D})}}$ Involution

$= \overline{\overline{(\overline{A} + \overline{B})} + \overline{(\overline{C} + \overline{D})}}$ Involution.

↳ NOR-only form.

Logic diagram:



→ NOR-gates only.

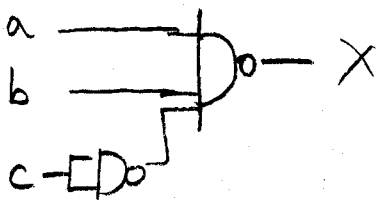
8. $X = (\bar{a} + \bar{b}) + c = \bar{a} + \bar{b} + c$ Commutative

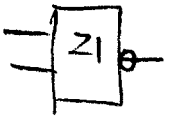
$= \overline{\overline{\bar{a} + \bar{b} + c}}$ Involution.

$= \overline{a \cdot b \cdot \bar{c}}$ DeMorgan's

↳ NAND-only.

Logic diagram.



9. replace =D- with 

10. replace =D- with 

11. $f = u \cdot v \cdot \bar{w} + u \cdot v = uv\bar{w} + uv(w + \bar{w})$

$= uv\bar{w} + uvw + uv\bar{w}$

$= uv\bar{w} + uvw$ #