

CO221: Digital Design
Lab 4 - PreLab

E119/166

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$$\begin{aligned} 1. \quad F &= \bar{A} B \bar{C} + \bar{A} B C + A \bar{B} \bar{C} \\ &= \bar{A} B (\bar{C} + C) + A \bar{B} \bar{C} \quad (\text{Distributive Law}) \\ &= \bar{A} B \cdot 1 + A \bar{B} \bar{C} \quad (\text{complement rule}) \\ &= \bar{A} B + A \bar{B} \bar{C} \quad (\text{Identity law}) \\ &= \bar{A} B \cdot (C + \bar{C}) \end{aligned}$$

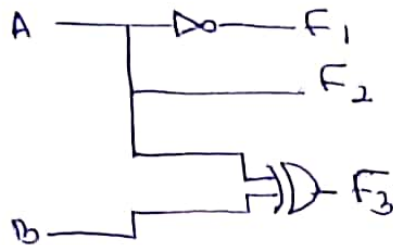
$$\begin{aligned} 2. \quad F_1 &= A' B' C' + A' B' C + A' B C' + A' B C \\ F_1 &= A' B' (C' + C) + A' B (C' + C) \quad (\text{Distributive Law}) \\ F_1 &= A' B' \cdot 1 + A' B \cdot 1 \quad (\text{complement rule}) \\ F_1 &= A' B' + A' B \quad (\text{Identity law}) \\ &= A' (B' + B) \quad (\text{Distributive law}) \\ &= A' \cdot 1 \quad (\text{complement rule}) \\ &= A' \quad (\text{Identity law}) \end{aligned}$$

$$A \xrightarrow{\text{NOT}} F_1$$

$$\begin{aligned} F_2 &= A B' C' + A B' C + A B C' + A B C \\ &= A B' (C' + C) + A B (C' + C) \quad (\text{Distributive law}) \\ &= A B' \cdot 1 + A B \cdot 1 \quad (\text{complement rule}) \\ &= A B' + A B \quad (\text{Identity law}) \\ &= A (B' + B) \quad (\text{Distributive law}) \\ &= A \cdot 1 \quad (\text{complement rule}) \\ &= A \quad (\text{Identity law}) \end{aligned}$$

$$A \xrightarrow{\text{Identity}} F_2$$

$$\begin{aligned}
 F_3 &= A' B C' + A' B C + A B' C' + A B' C \\
 &= A' B (C' + C) + A B' (C' + C) \quad (\text{Distributive law}) \\
 &= A' B \cdot 1 + A B' \cdot 1 \quad (\text{complement rule}) \\
 &= A' B + A B' \quad (\text{Identity law}) \\
 &= A \oplus B
 \end{aligned}$$

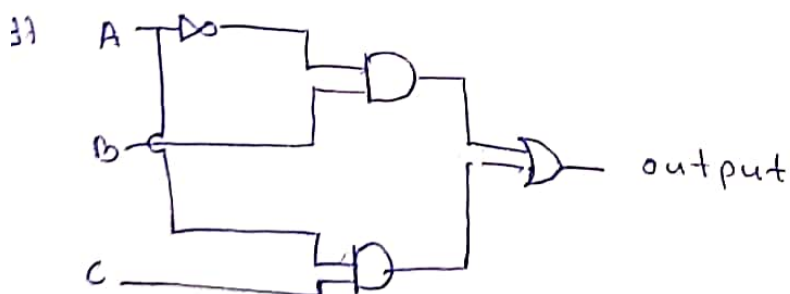


3(a) ~~bits~~ 3 bits

1b)

A	B	C	output
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

$$\begin{aligned}
 \text{c) output} &= A' B C' + A' B C + A B' C + A B C \\
 &= A' B (C' + C) + A C (B' + B) \quad (\text{Distributive law}) \\
 &= A' B \cdot 1 + A C \cdot 1 \quad (\text{complement rule}) \\
 &= A' B + A C \quad (\text{Identity law})
 \end{aligned}$$



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4. H)

X	Y	P	Q	output
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

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$$4(b) F = x' y p' q' + x y' p' q' + x y' p' q + x y p' q' + x y p' q + x y p q'$$

$$= x' y p' q' + x y' p' q' + x y' p' q + x y (p' q' + p' q + p q')$$

(distributive law)

$$= x' y p' q' + x y' p' (q' + q) + x y (p' (q' + q) + p q')$$

(distributive law)

$$= x' y p' q' + x y' p' + x y (p' + p q')$$

(complement law)

$$= x' x p' q' + x y' p' + x y (p' + p) (p' + q')$$

(distributive law)

$$= x' y p' q' + x y' p' + x y p' + x y q'$$

(complement & distributive)

$$= x' y p' q' + x p' (y' + y) + x y q'$$

(distributive law)

$$= y q' (x + x' p') + x p'$$

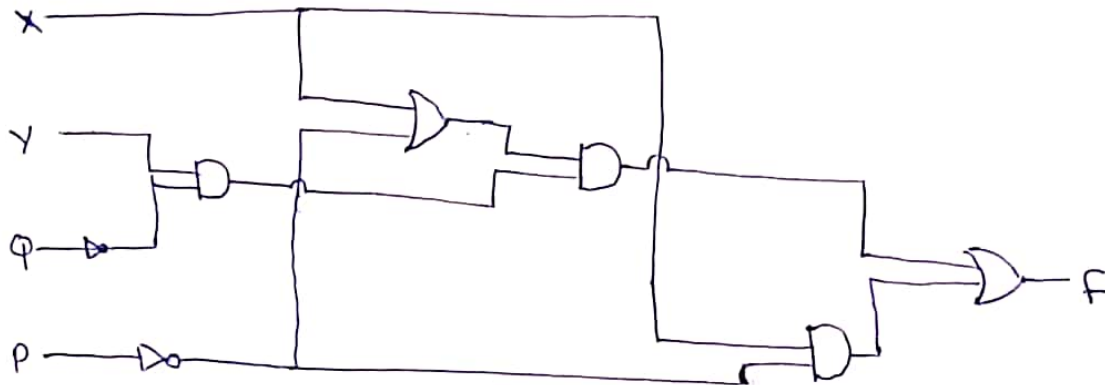
(complement law)

$$= y q' (x + x') (x + p') + x p'$$

(distributive law)

$$= y q' (x + p') + x p' \quad \parallel$$

(c)



5.17

x	y	z	p	q
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	1	0
1	0	1	1	1
1	1	0	1	1
1	1	1	0	0

$$\begin{aligned}
 1b) P &= x'y'z + x'y'z + x'y'z + x'y'z + x'yz' \\
 &= x'y'z + x'y'(z' + z) + x'yz' \quad (\text{Distributive law}) \\
 &= x'y'z + x'y' \cdot 1 + x'yz' \quad (\text{complement law}) \\
 &= x'y'z + x'y' + x'yz' \quad (\text{Identity law}) \\
 &= x'y'z + x'(y' + y'z') \quad (\text{Distributive law}) \\
 &= x'y'z + x'((y' + x) \cdot (y' + y) \cdot (y' + z')) \quad (\text{Distributive law}) \\
 &= x'y'z + x'((y' + x) \cdot 1 \cdot (y' + z')) \quad (\text{complement law}) \\
 &= x'y'z + x'((y' + x) \cdot (y' + z')) \quad (\text{Identity law}) \\
 &= x'y'z + x'(y' + y'z' + xy' + xz') \quad (\text{Distributive law}) \\
 &= x'y'z + x'(y'(1 + z') + xy' + xz') \quad (\text{Distributive law}) \\
 &= x'y'z + x'(y' \cdot 1 + xy' + xz') \quad (\text{Null law}) \\
 &= x'y'z + x'y' + xy' + xz' \quad (\text{Identity \& Distributive law}) \\
 &= x'y'z + x'y' + xz' \quad (\text{Idempotence law}) \\
 &= x'y'z + x'(y' + z') \quad (\text{Distributive law}) //
 \end{aligned}$$

$$\begin{aligned}
 Q &= x'y'z + x'y'z' + x'y'z + x'y'z' \\
 &= y'z(x' + x) + y'z'(x' + x) \quad (\text{Distributive law}) \\
 &= y'z \cdot 1 + y'z' \cdot 1 \quad (\text{complement law}) \\
 &= y'z + y'z' \quad (\text{Identity law}) \\
 &= y \oplus z //
 \end{aligned}$$

