

ID: 23i-2623

ASSIGNMENT # 3 [EE-1005]

Assigned Number: 7650

DIGITAL LOGIC & DESIGN (EE-1005)

ASSIGNMENT #3

ID: 23i-2623

NAME: Muneeb Lone

SECTION: B

Read the Instructions Carefully

- ❖ **NOTE:** Use Assigned number & Your Name
- ❖ **(Same as Assignment 1)**

- ❖ Your assigned number is given to you in excel sheet provided with assignment
- ❖ FOR EXAMPLE: Assigned Number if your assigned number is 0821

	Assign Digit 0	Assign Digit 1	Assign Digit 2	Assign Digit 3
Short for Assigned Digit	A0	A1	A2	A3
Write Assigned Number Digit By Digit	7	8	2	0

FOR EXAMPLE: Name is HAMAZADAUD

- ❖ Use your name instead of HAMZA
- ❖ If your name starts with MUHAMMAD kindly use your second name
- ❖ Convert repeated character to small letter or to other symbols to make them unique (see example for A, a & @)

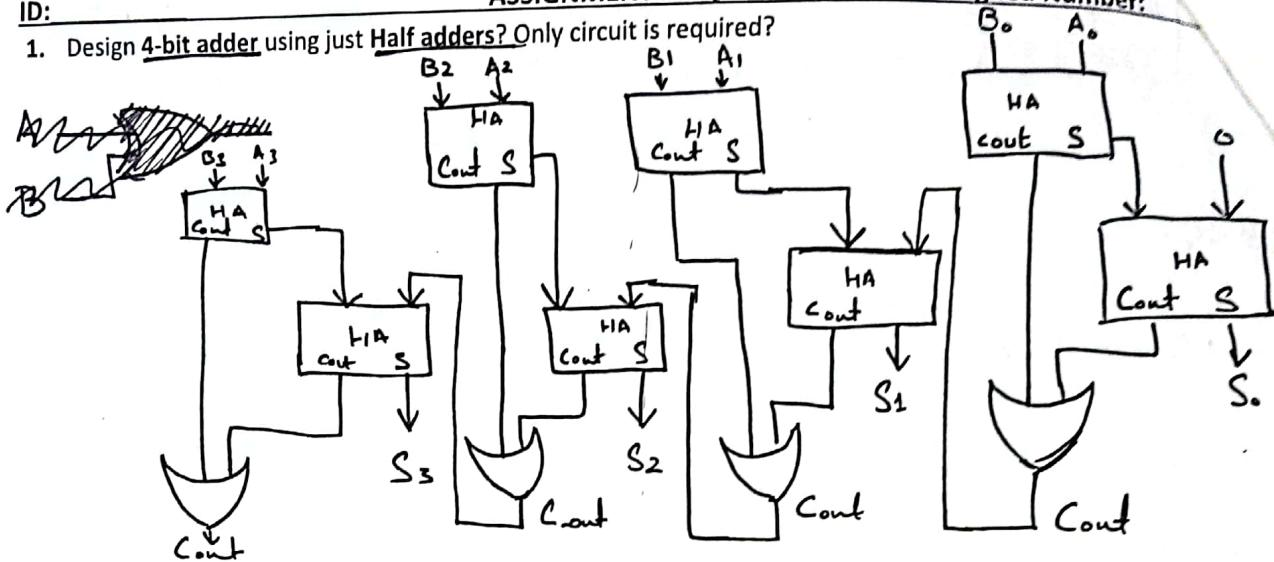
SIXTH CHARACTER OF YOUR NAME	FIFTH CHARACTER OF YOUR NAME	FOURTH CHARACTER OF YOUR NAME	THIRD CHARACTER OF YOUR NAME	SECOND CHARACTER OF YOUR NAME	FIRST CHARACTER OF YOUR NAME	ZERO CHARACTER OF YOUR NAME	
Short for CHARACTER	C0	C1	C2	C3	C4	C5	C6
YOUR NAME CHARACTER BY CHARACTER	\$	@	a	Z	M	A	H

ASSIGNMENT # 3 [EE-1005]

Assigned Number:

ID:

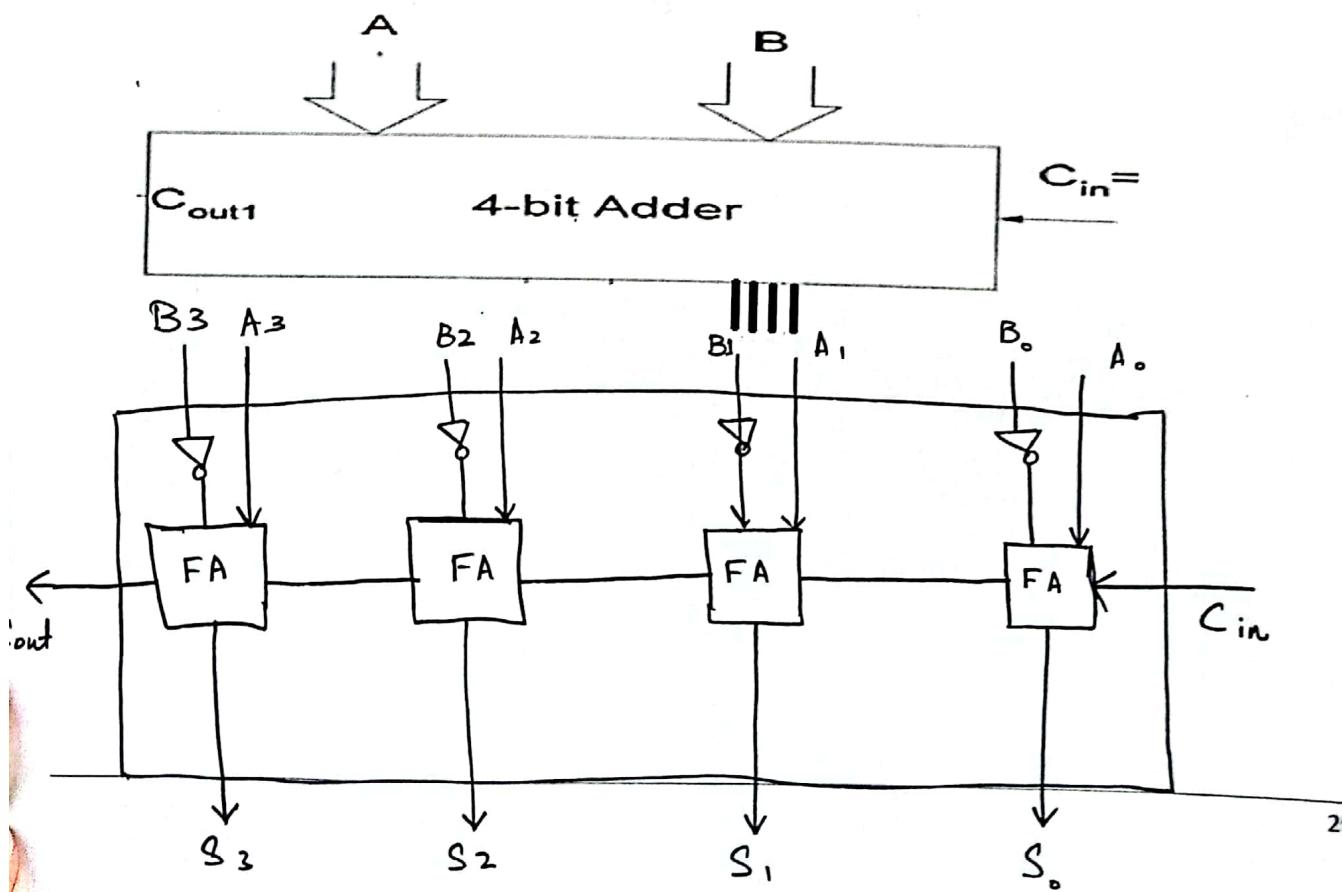
1. Design 4-bit adder using just Half adders? Only circuit is required?



2. Convert following 4-bit adder to 4-bit subtractor circuit? So it could perform operation A-B? Use the circuit you have designed to subtract binary (A₀-A₃) 7-5

HINT: could use 2's complement

$$\begin{array}{r}
 & 1 & 1 & 1 & 1 \\
 - & 0 & 1 & 0 & 1 \\
 \hline
 & 1 & 0 & 1 & 0
 \end{array}$$



Date: _____

$$3. (\bar{W} + \bar{X})(\bar{W} + \bar{Y} + \bar{Z}) \cdot (\bar{X} + \bar{Y}) + W \cdot \bar{X} + Y + Z$$

$$(E + \bar{A})(\bar{E} + \bar{B} + \bar{L}) \cdot (\bar{A} + \bar{B}) + E \cdot \bar{A} + \bar{B} \cdot L$$

$$(E + \bar{A})(\bar{E} \cdot \bar{B} + \bar{L}) \cdot (\bar{A} \cdot \bar{B}) + E \cdot \bar{A} \cdot \bar{B} + \bar{L}$$

$$(E + \bar{A})(\bar{E} \cdot \bar{B} + \bar{L}) \cdot (\bar{A} \cdot \bar{B}) + E \bar{A} \bar{B} + E \bar{L}$$

~~E~~

$$(E \bar{E} \bar{B} + E \bar{L} + \bar{A} \bar{E} \bar{B} + \bar{A} \bar{L})(\bar{A} \cdot \bar{B}) + E \bar{A} \bar{B} + E \bar{L}$$

$$(O + E \bar{L} + A \bar{E} \bar{B} + \bar{A} \bar{L})(\bar{A} \cdot \bar{B}) + E \bar{A} \bar{B} + E \bar{L}$$

$$(E \bar{L} + A \bar{E} \bar{B} + \bar{A} \bar{L})(\bar{A} \cdot \bar{B}) + E \bar{A} \bar{B} + E \bar{L}$$

$$\bar{B} \bar{A} \bar{E} \bar{L} + A \bar{A} \bar{E} \bar{B} \bar{B} + \bar{A} \bar{A} \bar{L} \bar{B} + E \bar{A} \bar{B} + E \bar{L}$$

$$\bar{A} \bar{B} \bar{E} \bar{L} + O + \bar{A} \bar{L} \bar{B} + E \bar{A} \bar{B} + E \bar{L}$$

$$\bar{A} \bar{B} \bar{E} \bar{L} + E \bar{L} + \bar{A} \bar{L} \bar{B} + E \bar{A} \bar{B}$$

$$E \bar{L} (\bar{A} \bar{B} + 1) + \bar{A} \bar{L} \bar{B} + E \bar{A} \bar{B}$$

$$E \bar{L} + \bar{A} \bar{L} \bar{B} + E \bar{A} \bar{B}$$

$$\bar{E}(E + \bar{A} \bar{B}) + \bar{A} \bar{L} \bar{B}$$

$$4. (\bar{W} + \bar{X})(Y + Z) + (W + X)(\bar{W} \cdot X) + \bar{Y} Z$$

$$\frac{(\bar{E} + \bar{A})(B + L)}{(\bar{E} + \bar{A})} + (E + A)(\bar{E} \cdot A + \bar{B} L)$$

$$\frac{(\bar{E} + \bar{A})}{(\bar{E} + \bar{A})} + \frac{(B + L)}{(B + L)} + (E + A)(\bar{E} + \bar{A} + \bar{B} L)$$

$$(\bar{E} \cdot \bar{A}) + (\bar{B} \cdot \bar{L}) + (E + A)(\bar{E} + \bar{A} + \bar{B} L)$$

$$E \cdot A + \bar{B} \bar{L} + E \bar{E} + E \bar{A} + E \bar{B} L + A \bar{E} + A \bar{A} + A \bar{B} L$$

$$E \cdot A + \bar{B} \bar{L} + O + E \bar{A} + E \bar{B} L + O + A \bar{E} + A \bar{B} L$$

$$E(A + \bar{A}) + \bar{B} \bar{L} + E \bar{B} L + E \bar{B} L + A \bar{E} + A \bar{B} L$$

$$E(1) + \bar{B}(\bar{L} + L + \bar{B} \bar{L} + E \bar{B} L + A \bar{E} + A \bar{B} L)$$

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$$E + E\bar{B}L + \bar{B}\bar{L} + A\bar{B}L + A\bar{E}$$

$$E + \bar{B}\bar{L} + A\bar{E} + A\bar{B}L$$

$$E + \bar{B}\bar{L} + A + ABL$$

$$E + \bar{B}\bar{L} + A$$

5. $\overline{W+(X+Y)(\overline{W}.Z)} + W.\overline{X+YZ} + \overline{W+X} \cdot (Y+Z)$

$$\overline{E+(A+B)(\overline{E}.L)} + E \cdot \overline{A+B}L + \overline{\overline{E+A}} \cdot (B+L)$$

$$\overline{E \cdot (A+B) + (\overline{E}.L)} + E \cdot (\overline{A})(\overline{B+L}) + \overline{E} \cdot \overline{A} \cdot (B+L)$$

$$E \cdot (\overline{A} \cdot \overline{B}) + (E \cdot L) + E(\overline{A})(\overline{B+L}) + \overline{E}\overline{A} \cdot (B+L)$$

$$\overline{A}\overline{B}E + EL + \overline{A}\overline{B}E + \overline{A}E\overline{L} + \overline{E}\overline{A}B + E\overline{A}L$$

$$\overline{A}\overline{B}E + EL + \overline{A}\overline{B}E + \overline{A}E\overline{L} + \overline{A}\overline{B}E + \overline{A}E\overline{L}$$

$$\overline{A}\overline{B}E + EL + \overline{A}E\overline{L} + \overline{A}\overline{B}E + \overline{A}E\overline{L}$$

$$\overline{A}\overline{B}E + EL + \overline{A}E\overline{L} + \overline{A}\overline{B}E$$

$$\overline{A}\overline{B}E + E(L + \overline{A}\overline{L}) + \overline{A}\overline{B}E$$

$$\overline{A}\overline{B}E + E(\overline{A} + L) + \overline{A}\overline{B}E$$

$$\overline{A}\overline{B}E + \overline{A}\overline{E} + EL + \overline{A}\overline{B}E$$

$$E\overline{A} + EL + \overline{A}B\overline{E}$$

$$EL + \overline{A}(B\overline{E} + E)$$

$$EL + \overline{A}(B + E)$$

$$EL + \overline{A}B + \overline{A}E$$

Date: _____

Q: $F(x, y, z) = \sum(0, A_2, A_3, (A_2+A_3), 6)$

$$\sum(0, 5, 0, 5, 6) \rightarrow \sum(0, 5, 6)$$

x	y	z	X
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

$$\bar{x}\bar{y}z + x\bar{y}z + xy\bar{z}$$

xy \ z	0	1
00	1	0
01	0	0
11	1	0
10	0	1

No groups so final answer is
 $\bar{x}\bar{y}z + x\bar{y}z + xy\bar{z}$

Prime implicants: $\bar{x}\bar{y}z, x\bar{y}z, xy\bar{z}$

Necessary: $\bar{x}\bar{y}z, x\bar{y}z, xy\bar{z}$

Date: _____

$$Q: F(l, m, n) = \Pi(1, 2, 5, 0, 5, 5) \rightarrow (0, 12, 5)$$

x	y	z	X
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

$$\begin{aligned} & (x+y+z)(x+y+\bar{z})(x+\bar{y}+z)(\bar{x}+y+\bar{z}) \\ & x+y(z+\bar{z}) * (x+\bar{y}+z)(\bar{x}+y+\bar{z}) \\ & (x+y) * (x+\bar{y}+z)(\bar{x}+y+\bar{z}) \end{aligned}$$

xy	z	0	1
00	0	0	0
01	0	1	1
11	1	1	1
10	1	0	0

$$(x+y) * (x+\bar{y}+z) * (\bar{x}+y+\bar{z})$$

xy	z	0	1
00	0	0	0
01	0	1	1
11	1	1	1
10	1	0	0

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

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Prime Imp: $(x+y)$, $(x+\bar{y}+z)$, $(\bar{x}+y+\bar{z})$

Essential: $(x+y)$, $(x+\bar{y}+z)$, $(\bar{x}+y+\bar{z})$

Q4: $A\bar{B}C + \bar{A}\bar{B} + A\bar{B}\bar{C}$

$$\bar{E}\bar{A}N + \bar{E}\bar{A} + E\bar{A}\bar{N} \cup$$

$$\bar{E}\bar{A}\bar{N}(U+\bar{U}) + \bar{E}\bar{A}(N+\bar{N})(\bar{U}+\bar{U}) + E\bar{A}\bar{N}\bar{U}$$

$$\bar{E}\bar{A}\bar{N}U + \bar{E}A\bar{N}\bar{U} + \bar{E}\bar{A}N\bar{U} + \bar{E}\bar{A}\bar{N}U + \bar{E}\bar{A}\bar{N}\bar{U} + E\bar{A}\bar{N}U$$

$$\Sigma(m_0, m_1, m_2, m_3, m_{10}, m_{11}, m_{13})$$

$$\Pi(M_4, M_5, M_6, M_7, M_8, M_9, M_{12}, M_{14}, M_{15})$$

$$(E + \bar{A} + N + U)(E + \bar{A} + N + \bar{U})(E + \bar{A} + \bar{N} + U)(E + \bar{A} + \bar{N} + \bar{U})(\bar{E} + A + N + U)(\bar{E} + A + N + \bar{U})(\bar{E} + \bar{A} + N + U)$$

$$(\bar{E} + \bar{A} + \bar{N} + U)(\bar{E} + \bar{A} + \bar{N} + \bar{U})$$

Q5: $(A + \bar{B})(B + C)$

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

$$(B + \bar{A} + E) \cancel{(B + \bar{A} + \bar{E})} (A + E + B)(A + E + \bar{B})$$

$$M_2, M_3, M_6, M_4$$

$$\Pi = (0, 2, 3, 4) \rightarrow \Sigma(1, 5, 6, 7)$$

$$\bar{B}\bar{A}E + B\bar{A}E + \bar{B}A\bar{E} + BA\bar{E}$$

Date: _____

Q6: $F(e, f, g, h) = \Pi(0, 7, 6, 5, 0, 7, 11, 5, 12, 14)$

$\Pi(0, 5, 6, 7, 11, 12, 14)$

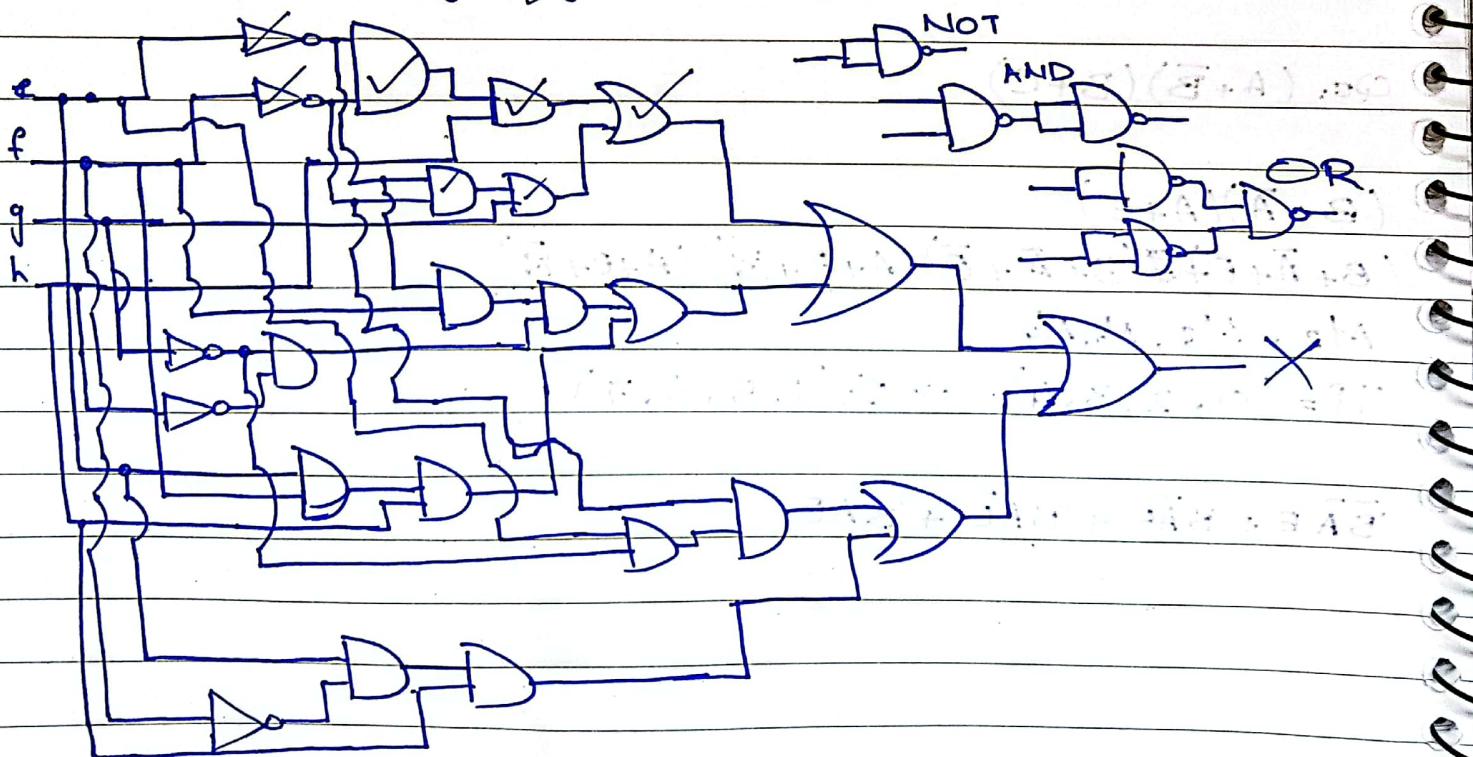
$\Sigma(1, 2, 3, 4, 8, 9, 10, 13, 15)$

ef\gh	00	01	11	10
00	0	(1)	(1)	(1)
01	(1)	0	0	0
11	0	(1)	(1)	0
10	(1)	(1)	0	(1)

$$\bar{e}\bar{f}h + \bar{e}\bar{f}g + \bar{e}\bar{f}\bar{g}\bar{h} + \bar{e}f\bar{h} + e\bar{f}\bar{g} + e\bar{f}\bar{h}$$

Prime Implicants: $\bar{e}\bar{f}h, \bar{e}\bar{f}g, \bar{e}\bar{f}\bar{g}\bar{h}, efh, e\bar{f}\bar{g}, e\bar{f}\bar{h}, egh$

Essentials: $\bar{e}\bar{f}h, \bar{e}\bar{f}g, \bar{e}\bar{f}\bar{g}\bar{h}, e\bar{f}\bar{h}, e\bar{f}\bar{g}, e\bar{f}\bar{h}$



Date: _____ | _____ | _____

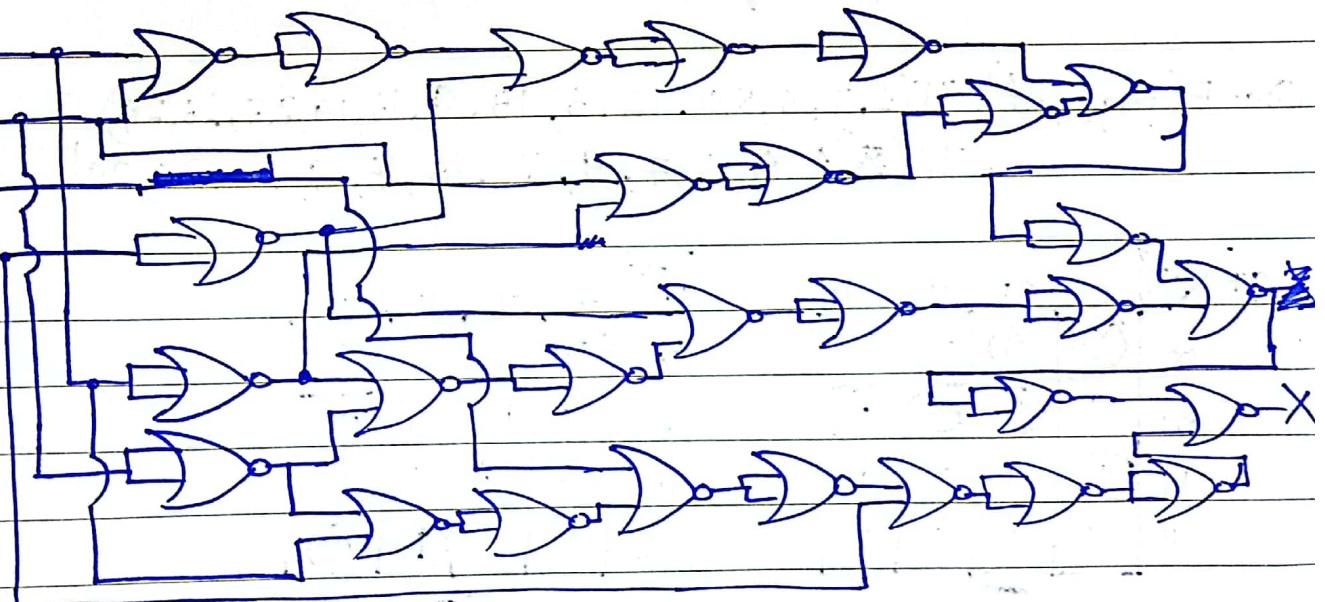
ij	kl	00	01	11	10	ij	kl	00	01	11	10
00	1	0	0	0	0	00	1	0	0	0	0
01	0	1	1	1	1	01	0	1	1	1	1
11	1	0	0	1	1	11	1	0	0	0	0
10	0	0	0	0	0	10	0	0	0	0	0

$$(i + \bar{j} + k + l)$$

$$((i+j+l)(\bar{i}+\bar{j}+\bar{l})(\bar{i}+j)(\bar{i}+k+\bar{l})(\bar{i}+\bar{k}+\bar{l})(j+\bar{l})(\bar{i}+j+\bar{l}))$$

→ Prime Implicants

Essential : $(\underline{i+j+l}), (\bar{i}+\bar{j}+\bar{l}), (\bar{i}+j), (i+\bar{j}+k+l)$



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$$Q8: F(a,b,c,d,e) = \sum(3, 7, 6, 5, 0, 12, 13, 13, 11, 17, 23, 27, 30) \\ = \sum(0, 3, 5, 6, 7, 11, 12, 13, 17, 23, 27, 30)$$

		abc		de				bc		de						
		00	01	11	10			00	01	11	10					
a	b	c	d	e		a	b	c	d	e		a	b	c	d	e
00	1	0	1	0		00	0	1	0	0		00	0	1	0	0
01	0	1	1	1		01	0	0	0	1	0	01	0	1	0	0
11	1	1	0	0		11	0	0	0	0	1	11	0	0	1	0
10	0	0	1	0		10	0	0	0	1	0	10	0	0	1	0

\bar{a}

a

Circuit on next page

Prime Implicants: $\bar{a}b\bar{c}d\bar{e} + \bar{a}\bar{b}cd + \bar{a}\bar{b}\bar{c}\bar{d}\bar{e} + \bar{a}\bar{b}\bar{c}d\bar{e} + a\bar{b}\bar{c}\bar{d}\bar{e}$
 $+ a\bar{b}cde + ab\bar{c}\bar{d}\bar{e} + \bar{a}\bar{b}\bar{c}d\bar{e}$

Essential same as prime.

$$Q9: F(p,q,r,s,t) = \prod(1, 7, 6, 5, 0, 12, 6, 18, 9, 16, 19, 27, 26, 29) \\ = \prod(0, 1, 5, 6, 7, 9, 12, 16, 18, 19, 27, 26, 29)$$

		qr		st				qr		st						
		00	01	11	10			00	01	11	10					
p	q	r	s	t		p	q	r	s	t		p	q	r	s	t
00	0	0	1	1		00	0	1	1	1		00	0	1	1	1
01	1	0	0	0		01	1	1	0	0		01	1	1	0	0
11	0	1	1	1		11	1	0	1	1		11	1	0	1	1
10	1	0	1	1		10	1	1	0	0		10	1	1	0	0

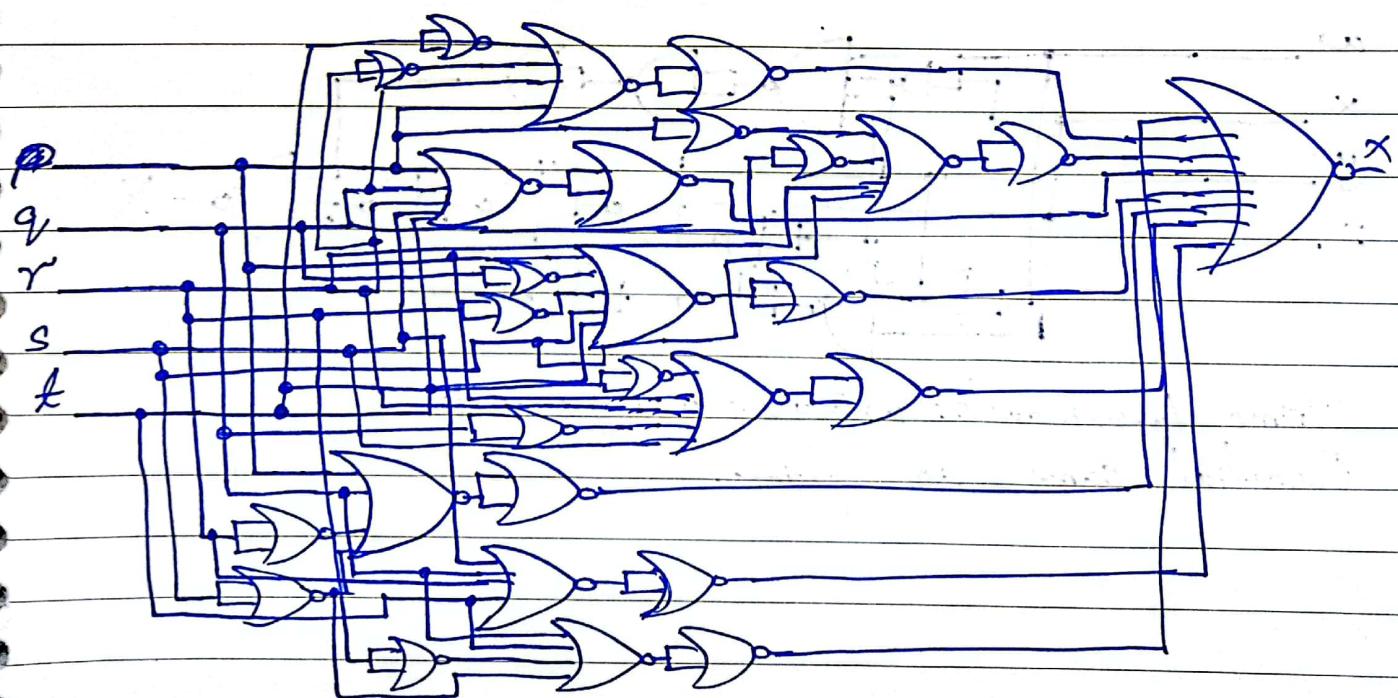
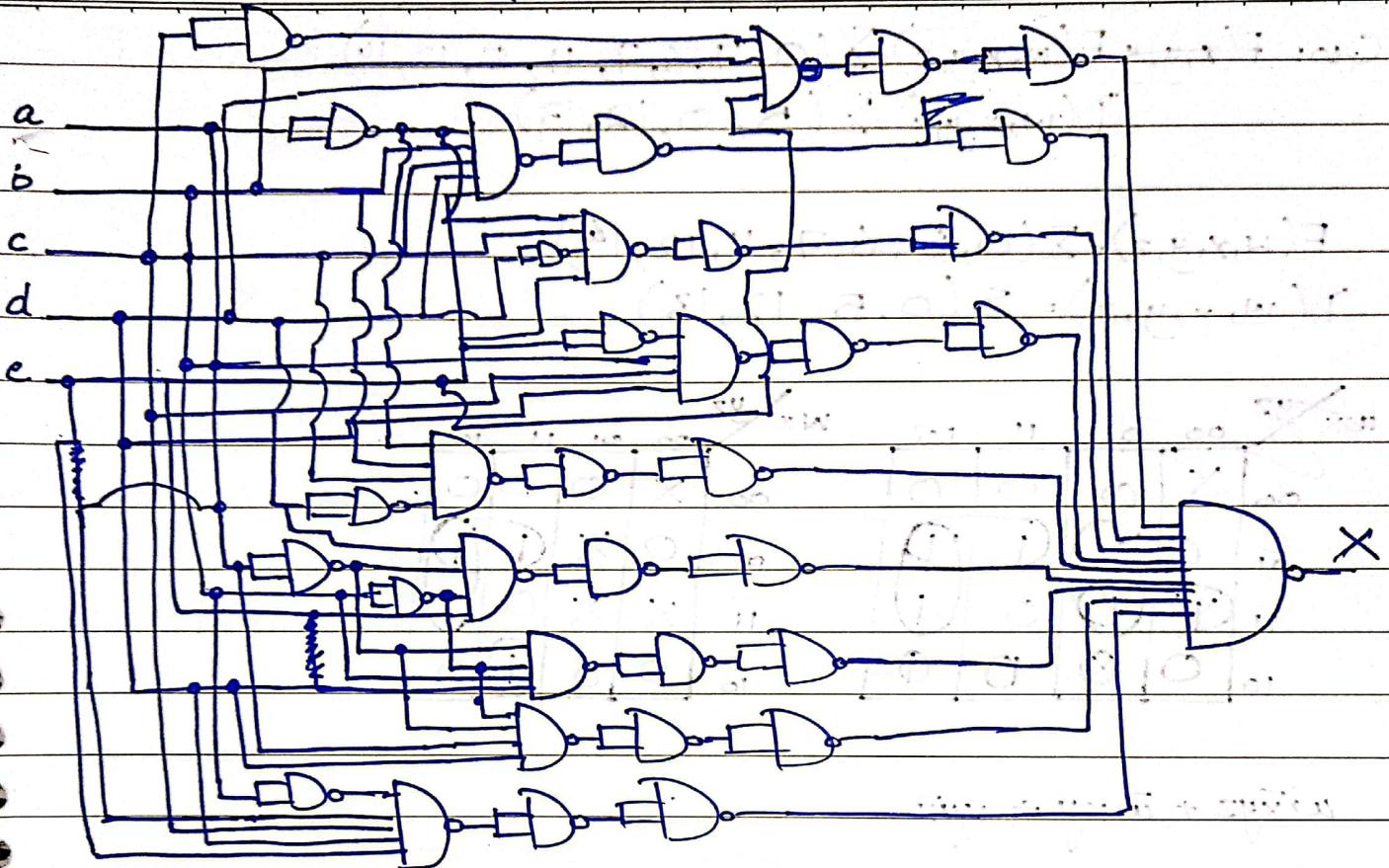
$\bar{p} \neq 0$

\bar{p}

Prime Implicants: ~~$(p+q+r+s)(p+q+\bar{r}+\bar{t})(p+q+\bar{r}+\bar{s})$~~
 ~~$(p+\bar{q}+\bar{r}+s+t) * (p+\bar{q}+r+s+t) (p+q+r+s+t) (q+\bar{r}+\bar{s}+t)$~~
 ~~$(\bar{p}+\bar{q}+\bar{r}+s+t) + (\bar{p}+\bar{q}+r+s)$~~

Date: _____

Circuit Q8



Date: _____

Q10: $F(x,y,z) = F(w,x,y,z) = \sum(0, 1, 6, 7, 11, 5, 12, 14)$

$D(w,x,y,z) = \sum(5, 0, 12, 13)$

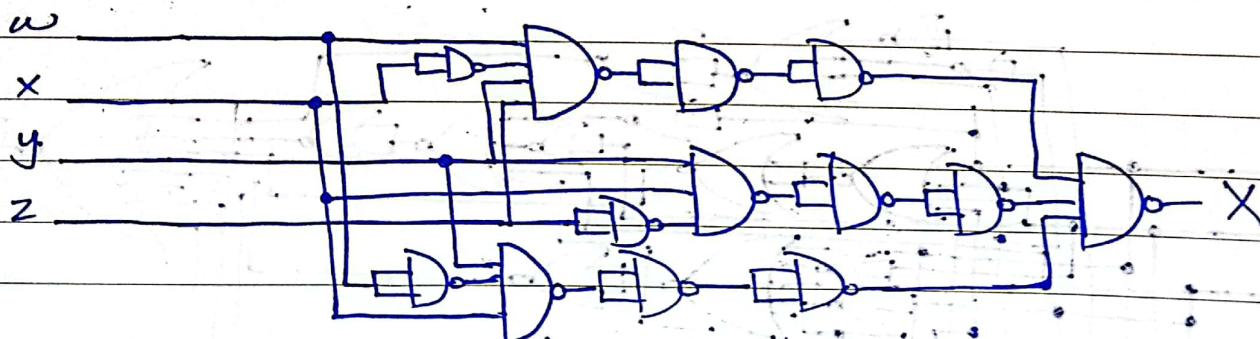
$F(w,x,y,z) = \sum(0, 5, 6, 7, 11, 12, 14)$

$D(w,x,y,z) = \sum(0, 5, 12, 13)$

wx	yz	00	01	11	10
00	X	0	0	0	0
01	0	X	1	1	1
11	X	0	0	1	1
10	0	0	0	1	0

wx	yz	00	01	11	10
00	X	0	0	0	0
01	0	X	1	1	1
11	X	0	0	0	1
10	0	0	0	1	0

$$w\bar{x}yz + \bar{w}xy + xy\bar{z}$$



Prime Implicants: $w\bar{x}yz + \bar{w}xy + xy\bar{z}$

Essential same as prime.

Date: _____

Q11. ~~F~~ $F(w, x, y, z) = \prod(1, 5, 0, 7, 11, 12, 14)$ $\prod(0, 1, 5, 7, 11, 12, 14)$
 $D(w, x, y, z) = \sum(7, 6, 9, 10, 11)$ $\sum(6, 7, 9, 10, 11)$

wx	yz	00	01	11	10
00	0 0	0	1	1	
01	1 0	0	X	X	
11	0 0	1	1	0	
10	1 X	X	X	X	

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

