Date: DLD

Digital Logic and Computer Design (M. MORRIS MANO)

chapters

Mid 1 - 4

Final 5 - 7

0 -> Max then carry on left

Octal to decimal

change octal to Binary then change to Hexa

octal 3 3 kepair
hexa 4 4 ka pair

	Octal	Hexa
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	10	8
9	11	9
10	12	A
11	13	B
12	14	C
13	15	D
14	16	E
15	17	F
16	20	10
		11
		12
		13
		14
		15
		16
		17
		18
		19
		1A
		1B
		1C
		1D
		1E
		1F
		20

Adress tells the amount of memory a computer allows to be added

00	
01	
10	
11	

The adresses should be unique and should be limited

2^{2} bit
4 byte Memory
hain address have unique adress and are not unlimited

2^{3} bit
8 byte Memory

000	
001	
010	
011	
100	
101	
110	

3 bit adress

2^{4} bit / 16 byte Memory
4 bit adresses

2^{5} = 32 byte Memory
5 bit adress

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1 K bytes = 1024 bytes

2^{10} → 10 bit addresses

64 K bytes = $2^6 \times 2^{10}$

2^{16} → 16 bit addresses

1 M Byte

1024 K bytes

1024 x 1024 byte

$2^{10} \times 2^{10}$ byte

2^{20} bytes → 20 bit

32 M byte

$2^5 \times 2^{20} = 2^{25}$ 25 bit

1 G byte

2^{30} byte

2^6 2^{30}

2^{36} = 64 GB → 36 bit adress

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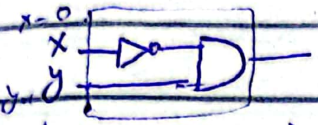
Boolean function : Answer is in Binary and inputs are also in Binary .

$f_1 = \bar{x} y$

x	y	$\bar{x}$	$\bar{x}y$
0	0	1	0
0	1	1	1
1	0	0	0
1	1	0	0

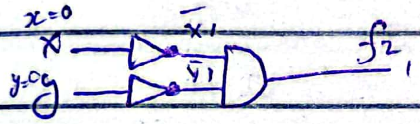
not this way



only inputs and output

x	y	f_1 $\bar{x}y$
0	1	0
0	1	1
1	0	0
1	0	0

$f_2 \quad \bar{x}\,\bar{y}$



x	y	f_2
0	0	1
0	1	0
1	0	0
1	1	0

$f_3 \quad \bar{x}\,\bar{y} + \bar{x}\, y$

x	y	f_3
0	0	1
0	1	1
1	0	0
1	1	0

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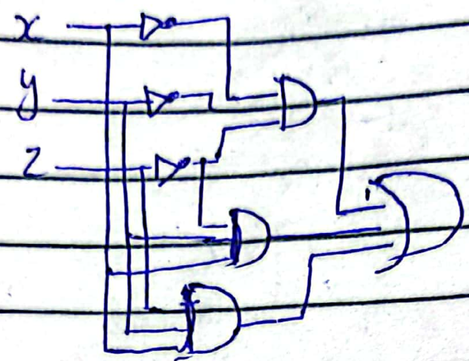
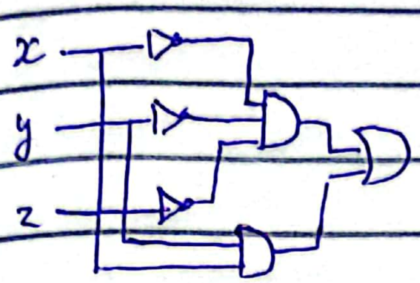
$f_{4} = \bar{x}\,\bar{y}\,\bar{z} + x \cdot y\,\bar{z} + x\,y\,z$



x	y	z	f_4
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

$f_5 \quad \bar{x}\,\bar{y}\,\bar{z} \quad + xy$



x	y	z	f_5
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

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

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

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

z	$\bar{z}$	
0	1	1
1	0	1

$z + \bar{z} = 1$

Any variable or with its compliment is 1

$z + \bar{z} = 1$

Any variable and with its complimentis 0

$z \cdot \bar{z} = 0$

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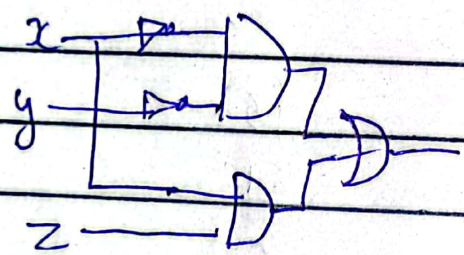
Simplified version's behaviour is same as unsimplified version only cost is low

$f_6 \quad \bar{x}\bar{y} + xz$



x	y	z	f_6
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
ϕ	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

Min Terms & Max Terms

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x y	Min		Minterm Product
0 0	$\bar{x}\bar{y}$	m_0	$0 \; \bar{x}$
0 1	$\bar{x}y$	m_1	$1 \; x$
0 0	$x\bar{y}$	m_2	
1 1	xy	m_3	

x y	Max	Sum Term	Maxterm Sum
0 0	$x+y$	M_0	$0 \; x$
0 1	$x+\bar{y}$	M_1	$1 \; \bar{x}$
1 0	$\bar{x}+y$	M_2	
1 1	$\bar{x}+\bar{y}$	M_3	

Minterm Maxterm
complement

$\overline{(A+B)} = A'.B'$

$(A.B)' = A'+B'$

Any function can be represented in
Sum of Minterm
Product of Maxterm

$z+\bar{z}=1$

$z\cdot\bar{z}=0$

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

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

$f = m_0 \quad m_1 \quad m_7 \quad m_6$

$f = \Sigma(0,1,6,7)$ This defines 1's

Both maxterms and minterms have same
Truthtable

Maxterm shows 0 Minterm shows 1

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x y z	f	$\bar{f} = f_2$
0 0 0	1	0
0 0 1	1	0
0 1 0	0	1
0 1 1	0	1
1 0 0	0	1
1 0 1	0	1
1 1 0	1	0
1 1 1	1	0

Both have same Truth table min out way

write minterm in sum of minterm

$\bar{f} = \bar{x}y\bar{z} + \bar{x}yz + x\bar{y}\bar{z} + x\bar{y}z$

take complement

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

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

$= M_2 \cdot M_3 \quad M_4 \quad M_5$

$= \prod(2,3,4,5)$ This defines 0

$\bar{f} = [\bar{x}y + x\bar{y}]$

$(A+B)' = A' \cdot B'$

$(A \cdot B)' = A' + B'$

$f = (\bar{x}y)' \cdot (x\bar{y})'$

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

If in short

Find $\bar{f}$ then write $\prod$ direct

Don't do $\bar{f}$ then complement

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$f = \bar{x}\bar{y} + x\bar{z}$ $\quad$ If long

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

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

$f = m_0 \quad m_1 + \quad m_6 \quad m_4$

$f = \sum(0,1,4,6)$

If short only

$\Pi(2,3,5,7$

	x	y	z	f	$\bar{f}$
m_0	0	0	0	1	0
m_1	0	0	1	1	0
2	0	1	0	0	1
3	0	1	1	0	1
4	1	0	0	1	0
5	1	0	1	0	1
6	1	1	0	1	0
7	1	1	1	0	1

$\bar{f} = \bar{x}y\bar{z} + \bar{x}yz + x\bar{y}z + xyz$

Taking complement

$(\bar{f})' = \overline{(\bar{x}y\bar{z} + \bar{x}yz + x\bar{y}z + xyz)}$

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

$M_2 \quad . \quad M_3 \quad . \quad M_5 \quad . \quad M_7$

$f = \Pi(2,3,5,7)$

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add 0

$y + \bar{y} = 1$

$y \cdot \bar{y} = 0$

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

$$= (x + y + \bar{z})(\underbrace{\bar{x} + \bar{z}}_{A} + \underbrace{y \cdot \bar{y}}_{B \cdot C})$$

$$\therefore A + (B \cdot C) = (A + B) \cdot (A + C)$$

$$f = \underbrace{(x + y + \bar{z})}_{M_1}\underbrace{(\bar{x} + \bar{y} + y\bar{z})}_{M_5}\underbrace{(\bar{x} + \bar{y} + \bar{z})}_{M_7}$$

$$\pi(1, 5, 7)$$ zero on $M_1 M_5 M_7$

x	y	z	f	f'
0	0	0	1	0
0	0	1	0	1
0	1	0	1	0
0	1	1	1	0
1	0	0	1	0
1	0	1	0	1
1	1	0	1	0
1	1	1	0	1

Simply write Minterms where 1 is present

$$f = \bar{x}\bar{y}\bar{z} + \bar{x}y\bar{z} + \bar{x}yz + x\bar{y}\bar{z} + xy$$

$$f\ \Sigma(0, 2, 3, 4, 6)$$

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

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

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

$M_0 \quad M_2 \quad M_6 \quad M_1 \quad M_3$

$\pi(0, 1, 2, 3, 6)$

x	y	z	f
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

$f = x\bar{y}\bar{z} + x\bar{y}z + xyz$

$m_4 \quad m_5 \quad m_7$

$\Sigma(4, 5, 7)$

- number system
- Complements, subtraction using r and r-1 complement
- Gates
- Boolean functions
- Minterm & Maxterms.

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K-Mapping for Simplification

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

E XOR

x	y	$x \oplus y$
0	0	0
0	1	1
1	0	1
1	1	0

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

XNOR

$x \odot y$

x	y	$x \odot y$
0	0	1
0	1	0
1	0	0
1	1	1

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

2 variable

2 neighbour

	$\bar{y}$	y
$\bar{x}$	$\bar{x}\bar{y}$ m_0	$\bar{x}y$ m_1
x	$x\bar{y}$ m_2	xy.

3 variable

adjacent cells: which differ in 1 variable

3 neighbours

00 $\bar{x}\bar{y}$ 1
01 $\bar{x}y$ 2
11 xy 3
10 $x\bar{y}$ 4

	$\bar{x}\bar{y}$	$\bar{x}y$	xy	$x\bar{y}$
$\bar{z}$	m_0	m_1	m_3	m_2
z	m_4	m_5	m_7	m_6

4 variable

4 neighbours

	$\bar{x}\bar{y}$	$\bar{x}y$	xy	$x\bar{y}$
$\bar{w}\bar{x}$	m_0	m_1	m_3	m_2
$\bar{w}x$	m_4	m_5	m_7	m_6
wx	m_{12}	m_{13}	m_{15}	m_{14}
$w\bar{x}$	m_8	m_9	m_{11}	m_{10}.

remember

1
2
4
3

Date:

Grouping only in 2^n

2, 4, 8, 16

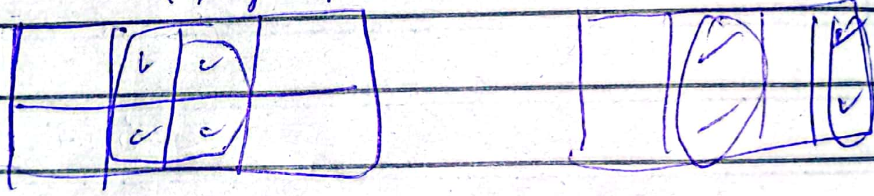
$f = \bar{x}\bar{y}\bar{z} + \bar{x}\bar{y}z$

$= \bar{x}\bar{y}$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1	1		
x				

no of var = no of neighbours

4 ka group answer 1



Rules

1. Single row or single column in grouping
2. if entire rows or entire column answer is 1 $\bar{x}$ x $\bar{y}$ y
3. if in any grouping half rows or half column the answer will be the common [illegible]

Date:

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

$= \bar{x}\bar{y} +$ single row half col

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1	1		
x				

R | C single row or col 2se

$f = \bar{x} \mid \bar{y}$

$f = \bar{x}\bar{y}$

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

$= \bar{y}\bar{z}$

~~single row~~

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1			
x	1			

R | C

$f = 1 \cdot \bar{y}\bar{z}$

$f = \bar{y}\bar{z}$

$f = \bar{x}\bar{y}\bar{z} + \bar{x}yz + \bar{x}\bar{y}z + \bar{x}y\bar{z} =$

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

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

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1	1	1	1
x				

if whole column than 1
if whole row 1

$f = \bar{x}$

$f = \Sigma(0, 1, 5)$

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

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

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

$A + B \cdot C = (A+B) \cdot (A+C)$

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

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

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

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1	1		
x		1		

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

Date:

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1	1	1	1
x	1	1		

$f = \bar{x} + \bar{y}$

$f(w, x, y, z) = \Sigma\, 0, 1, 2, 4, 5, 6, 8,$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{w}\bar{x}$	1	1		1 $\bar{w}\bar{z}$
$\bar{w}x$	1	1		1
wx				
$w\bar{x}$	1	$\bar{x}\bar{y}$ 1		

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

Ch 3 3.1 → 3.6

Solved Examples

DLD

K-Mapping

POS

$F = \bar{A}\bar{B}\bar{C} + \bar{B}C\bar{D} + \bar{A}BC\bar{D} + A\bar{B}\bar{C}$

$= \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}\bar{D} + A\bar{B}\bar{C}\bar{D}$

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1	1		1
$\bar{A}B$				1
AB				
$A\bar{B}$	1	1		1

SOP

$F = \bar{B}\bar{C} + \bar{B}\bar{D} + \bar{A}C\bar{D}$

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$			0	
$\bar{A}B$	0	0	0	
AB	0	0	0	0
$A\bar{B}$			0	

POS

min no of combination

if allowed then no pairing unnecessary

If can be done by 3 can't go for 4

if done by grouping by 0 then

$\bar{F} = B\bar{C} + AB + CD$

Complement $F = (\bar{C} + \bar{D})(\bar{A} + \bar{B}) \cdot (\bar{B} + C)$

POS

$F = (w, x, y, z) = \Sigma(1, 4, 5, 6, 12, 14,$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{w}\bar{x}$	1		1	3
$\bar{w}x$	1	1	8	2
wx	3	1	0	1
$w\bar{x}$	9	10	1	11

0	1	3	2
4	5	7	6
12	13	15	14
8	9	11	10

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

	1		
1	1		1
1		1	1

SOP

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

0		0	0
		0	
	0		
0	0	0	0

POS

$F = \bar{x}\bar{z} + w\bar{y}z \quad \bar{x}y + \bar{w}y\bar{z}$

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

Don't care conditions

Don't care	minterm	maxterm
represent X	1	0

Function is by d

$F = (A,B,C) = \Sigma(1,3,4)$

$d = (A,B,C) = \Sigma(5)$

	$\bar{B}\bar{C}$	$\bar{B}C$	BC	$B\bar{C}$
$\bar{A}$		1	1	
A	1	$\cancel{x}$		

2 And gate

after d $\quad F = \bar{A}C + A\bar{B}\bar{C}$

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	x
1	1	0	0
1	1	1	0

x can be treated as either 0 or 1

	$\bar{B}\bar{C}$	$\bar{B}C$	BC	$B\bar{C}$
$\bar{A}$		1	1	
A	1	X		

assume 1

Becz it gives more simple function

The more bigger group the less variable in expression

Date:

$F(A,B,C) = \Sigma(1,3,4)$
$d(A,B,C) = \Sigma(2)$

	1	1	X
1			

assume x as 0

if x favours in grouping of actual 1's
then take it as 1
if not take it as 0

if all 1's are in group you ignore don't care

$F(A,B,C) = \Sigma(3)$
$d(A,B,C) = \Sigma(2)$

		1	X

x will be taken as 1

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$F(A,B,C) = \Sigma(1,3,7)$

$d(A,B,C) = \Sigma(0,6)$

X	1	1	
X	X	1	X

X	1	1	
		1	X

SOP

$\bar{F} =$

X			0
0	0		X

if taken 1 in SOP

so we can still take any value

in POS

$\bar{F}$ the complement

X will b treated same in any case

Too Many Group and presence of X

doesn't change the answer

In Truth table

X → variable can be treated as 0 or 1

Ch 4 Q 1

Truth table banana hai

First Thing you want to

do is understand Statement

then make truth tabl

then function then mapp or simplify

Date: ____

Truth

x	y	z	F
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	

Function $\bar{x}\bar{y}\bar{z} \quad \bar{x}\bar{y}z + \bar{x}y\bar{z}$

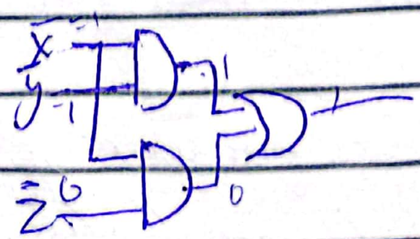
Simplify

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1	1		1
x				

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

New design

$x=0$
$y=0$
$z=1$



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Adders ⟶ Full adders (F/A)

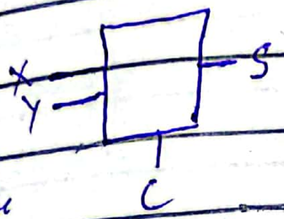
Half adders (H/A)

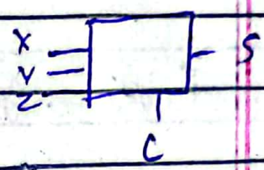
Adder has Sum & carry

(H/A) 2 outputs

Takes 2 Bits gives Sum & carry

Takes 3 bits gives Sum & carry





Procedure
Truth
Function
Simplification
Design

Design H/A circuit

Truth Table These 2 are functions

(I)

X	Y	C	S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

exclusive Or

$x \oplus y$	S
0	
1	
1	
0	

$S = x \oplus y$ can be designed by exclusive Or

so alternate design

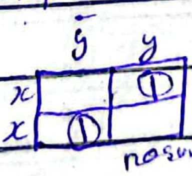
$S = x \oplus y$

$C = xy$

(II) $S = \bar{x}y + x\bar{y}$ ⟶

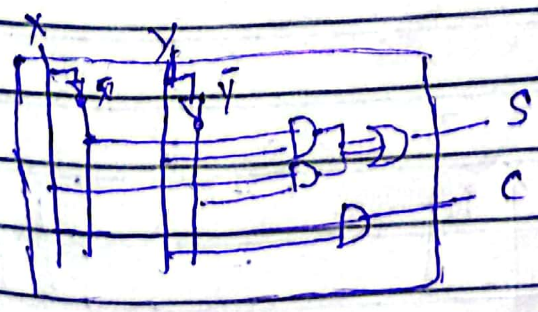
$C = xy$

(iii) Simp



no simplification

(IV)



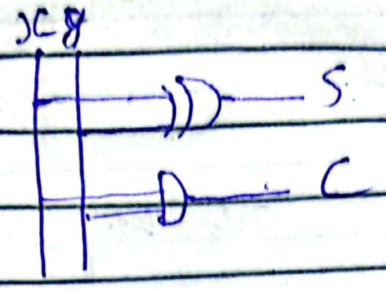
(V) Verify by putting values

Check if it works

Date: ____________

$S = x \oplus y$

$C = xy$ Alternate H/A



Full adder

X	Y	Z	C	S	$x \oplus y$
0	0	0	0	0	
0	0	1	0	1	
0	1	0	0	1	0
0	1	1	1	0	
1	0	0	0	1	
1	0	1	1	0	
1	1	0	1	0	
1	1	1	1	1	

$S = \bar{x}\bar{y}z + \bar{x}y\bar{z} + x\bar{y}\bar{z} + xyz$ $\quad S = x \oplus y \oplus z$

$C = \bar{x}\bar{y}z + x\bar{y}z + xy\bar{z} + xyz$

S

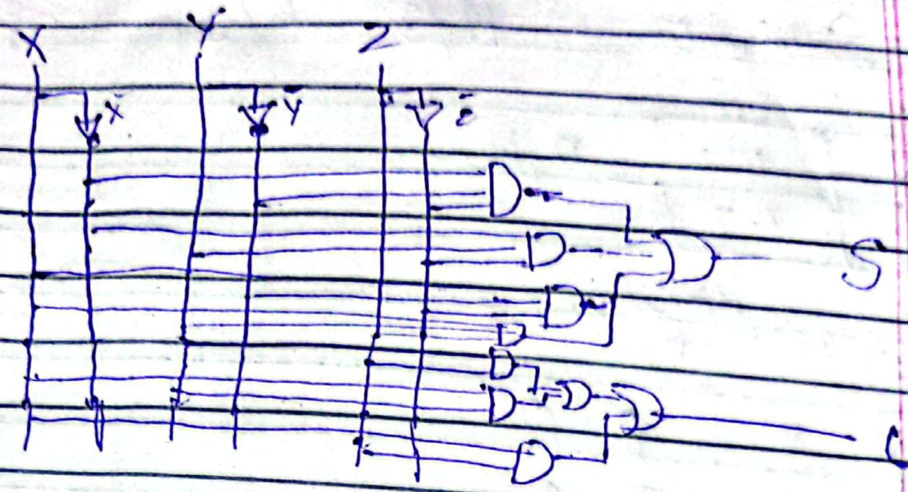
	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$		1		1
x	1		1	

C

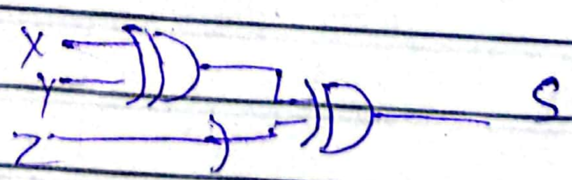
	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$			1	
x		1	1	1

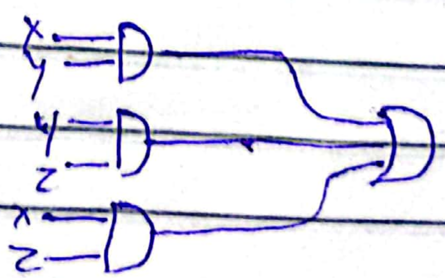
$C = yz + xy + xz$

Date:



x	y	z	$x \oplus y \oplus z$
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

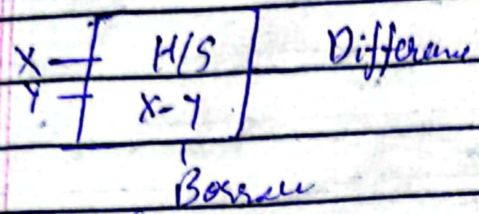




F/S Ch # 4 Book

Date:

Subtracter H/S F/S Truth table, Function



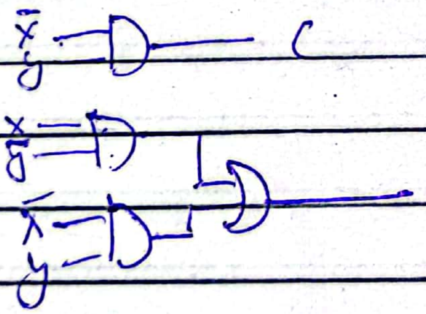
if $x \geq y$ no borrow

X	Y	B	D
0	0	0	0
0	1	1	1
1	0	0	1
1	1	0	0

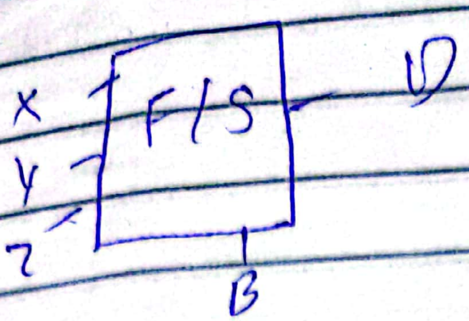
$B = \bar{x}y$

$D = \bar{x}y + x\bar{y}$

	$\bar{y}$	y
$\bar{x}$		1
x	1	



$g(x)$ $g(x)^2$



X	Y	Z	B	D
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	1	0
1	0	0	0	1
1	0	1	0	1
1	1	0	0	0
1	1	1	1	1

$$B = \bar{x}\bar{y}z + \bar{x}y\bar{z} + \bar{x}yz + xyz$$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$				
x				

ASCii +32 Small to Big case

Code Converters:-

Codes	BCD (A B C D)		Excess-3 (Add 3 to code the Binary) (W X Y Z)
0	0000	0+3 Binary	0011
1	0001	1+3	0100
2	0010	2+3	0101
3	0011	3+3	0110
4	0100	4+3	0111
5	0101	5+3	1000
6	0110	6+3	1001
7	0111	7+3	1010
8	1000	8+3	1011
9	1001	9+3	1100

Design a BCD to Excess 3 code converter

Assum A, B, C, D as inputs and W X Y Z as output

Make Truth table upper wala

Functions: $W = \Sigma(5, 6, 7, 8, 9)$ — can be written as these W X Y Z as independent function

$X = \Sigma(1, 2, 3, 4, 9)$

$Y = \Sigma(0, 3, 4, 7, 8)$

$Z = \Sigma(0, 2, 4, 6, 8)$

have to find don't cares first: $d = \Sigma(10, 11, 12, 13, 14, 15)$

- 4 bit has 16 combination if some are not used they will be used as don't cares

W	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$				
$\bar{A}B$		1	1	1
AB	x	x	x	x
$A\bar{B}$	1	1	x	x

$W = A + BD + BC$

X	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$		1	1	1
$\bar{A}B$	1			
AB	x	x	x	x
$A\bar{B}$		1	x	x

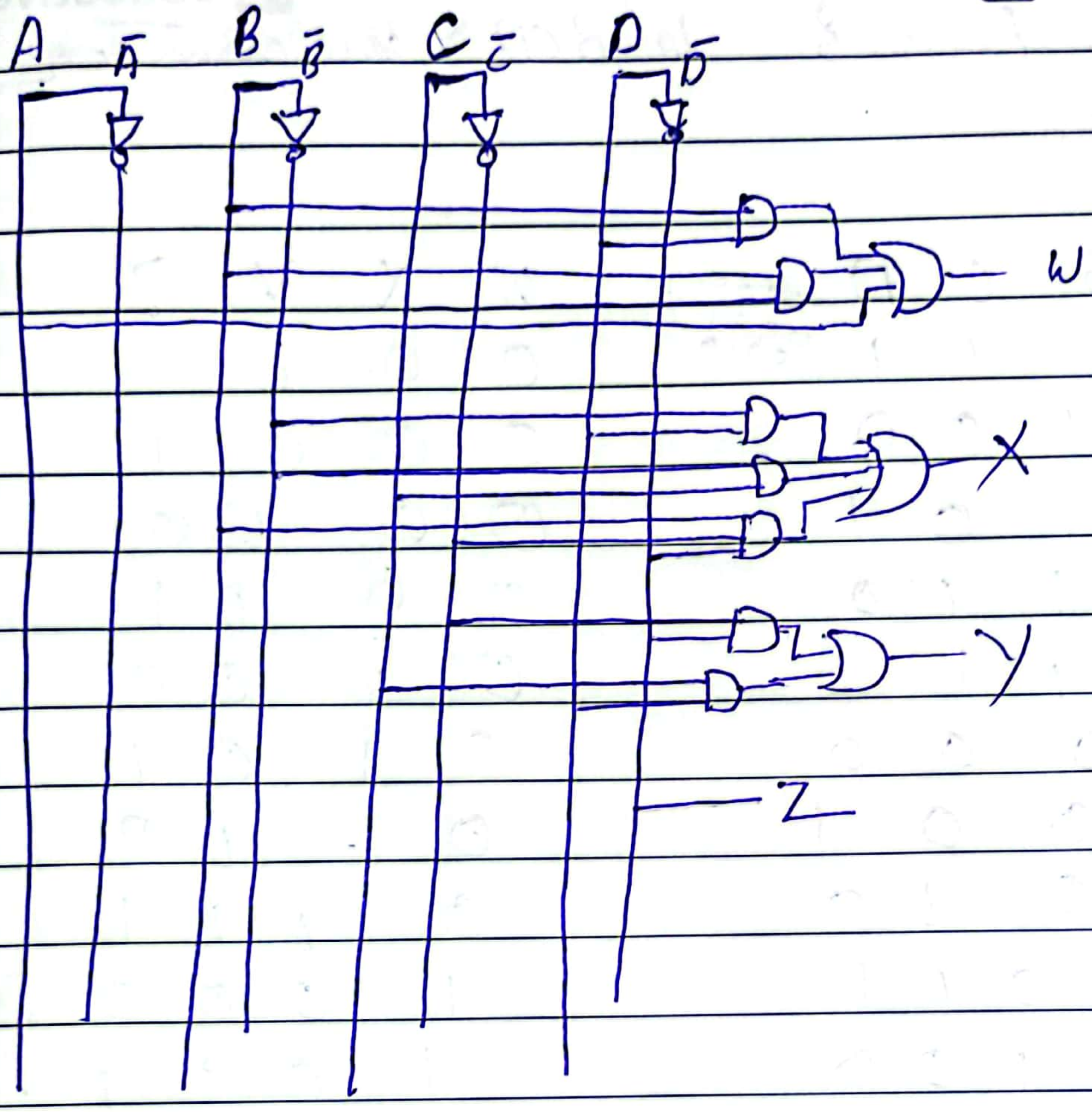
$X = \bar{B}D + \bar{B}C + B\bar{C}\bar{D}$

Y	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1		1	
$\bar{A}B$	1		1	
AB	x	x	x	x
$A\bar{B}$	1		x	x

Z	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1			1
$\bar{A}B$	1			1
AB	X	X	X	X
$A\bar{B}$	1		X	X

$Z = \bar{C}D + CD$

$Y = \cancel{\bar{C}\bar{D} + C\bar{D}}\ \bar{D}$



A
$\bar{A}$
B
$\bar{B}$
C
$\bar{C}$
D
$\bar{D}$
W
X
Y
Z

Design Excess 3 to BCD code converter

Don't care for our input

0000
0001
0010 X

	A	B	C	D	W	X	Y	Z
m3	0	0	1	1	0	0	0	0
m4	0	1	0	0	0	0	0	1
m5	0	1	0	1	0	0	1	0
6	0	1	1	0	0	0	1	1
7	0	1	1	1	0	1	0	0
8	1	0	0	0	0	1	0	1
9	1	0	0	1	0	1	1	0
10	1	0	1	0	0	1	1	1
11	1	0	1	1	1	0	0	0
12	1	1	0	0	1	0	0	1

$W = \Sigma(11, 12)$

$X = \Sigma(7, 8, 9, 10)$

$Y = \Sigma(5, 6, 9, 10)$

$Z = \Sigma(4, 6, 8, 10, 12)$

$d = \Sigma(0, 1, 2, 13, 14, 15)$

no				
	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

educative

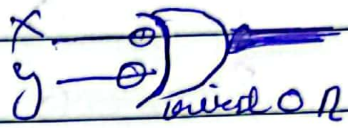
8~~4-2-1~~

	8	4	-2	-1	2	4	2	1
					2nd Half on		1st half on	
0	0	0	0	0	0	0	0	0
1	0	1	1	1	0	0	0	1
2	0	1	1	0	0	0	1	0
3	0	1	0	1	0	0	1	1
4	0	1	0	0	0	1	0	0
5	1	0	1	1	1	0	1	1
6	1	0	1	0	1	1	0	0
7	1	0	0	1	1	1	0	1
8	1	0	0	0	1	1	1	0
9	1	1	1	1	1	1	1	1

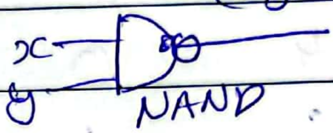
Design the following using NAND gate only

$F(x,y,z) = \bar{x}\bar{y}\bar{z} + \bar{x}\bar{y}z + xyz + xy\bar{z}$

$\overline{(x+y)} = \bar{x}\cdot\bar{y}$



$\overline{(xy)} = \bar{x}+\bar{y}$

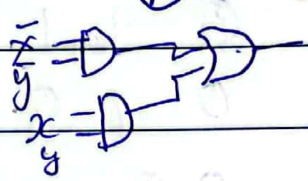


Step#1 simplify using SoP

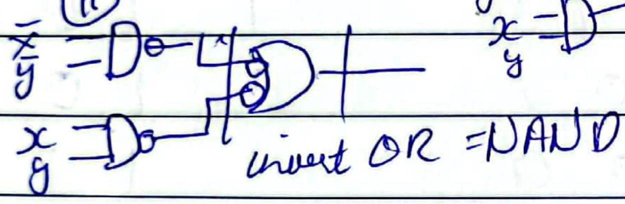
	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1	1		
x			1	1

$F = \bar{x}\cdot\bar{y} + xy$

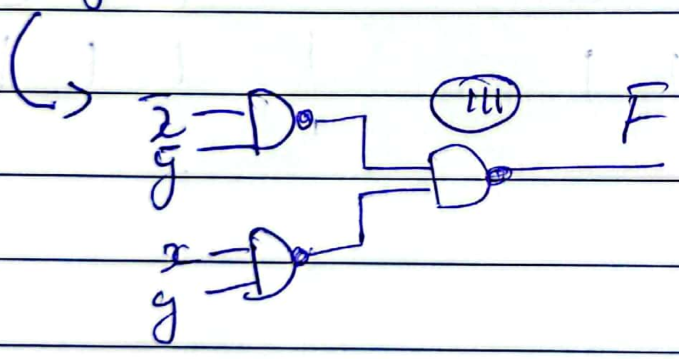
(i)



(ii)



(iii)



By NOR Have to convert to POS

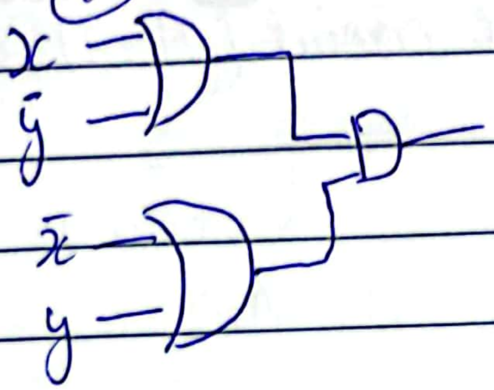
			0	0
	0	0		

$\bar{F} = \bar{x}y + x\bar{y}$

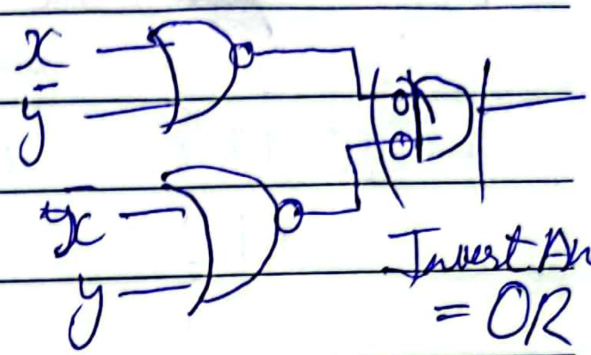
$F = (x+\bar{y})\cdot(\bar{x}+y)$

3 Steps have to do this

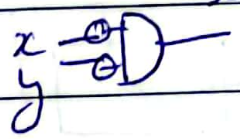
(i)



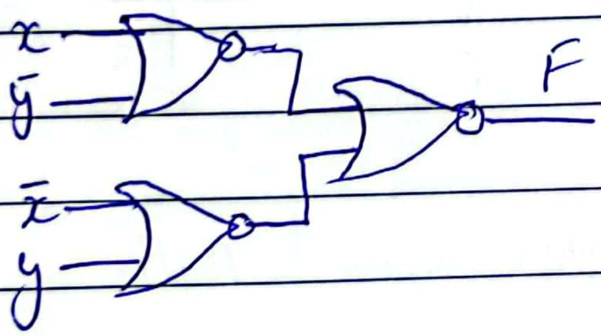
(ii)

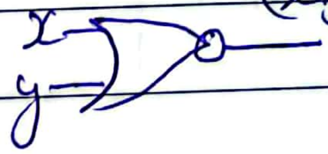


Invert And
= OR



(iii)





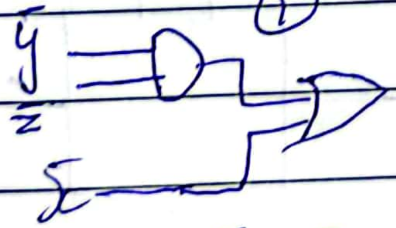
If Σ 0, 1, 2, 3, 4

1	1	1	1
1			

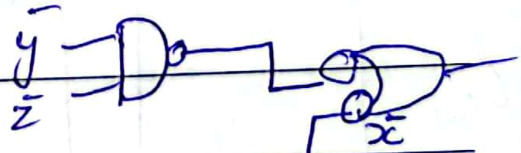
$F = \bar{y}\bar{z} + \bar{x}$

Have to do The Steps

(i)

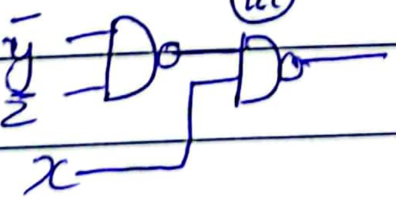


(ii)



Sign changed x
as no gate after x

(iii)

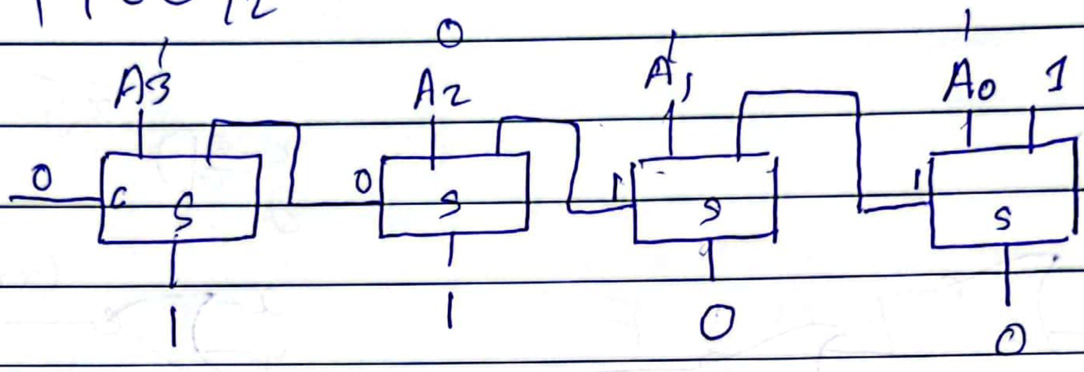


Design a 4 bit increment circuit (A+1)

```
  1011   11
 +   1
 ----
  1100   12
```

4 H/A

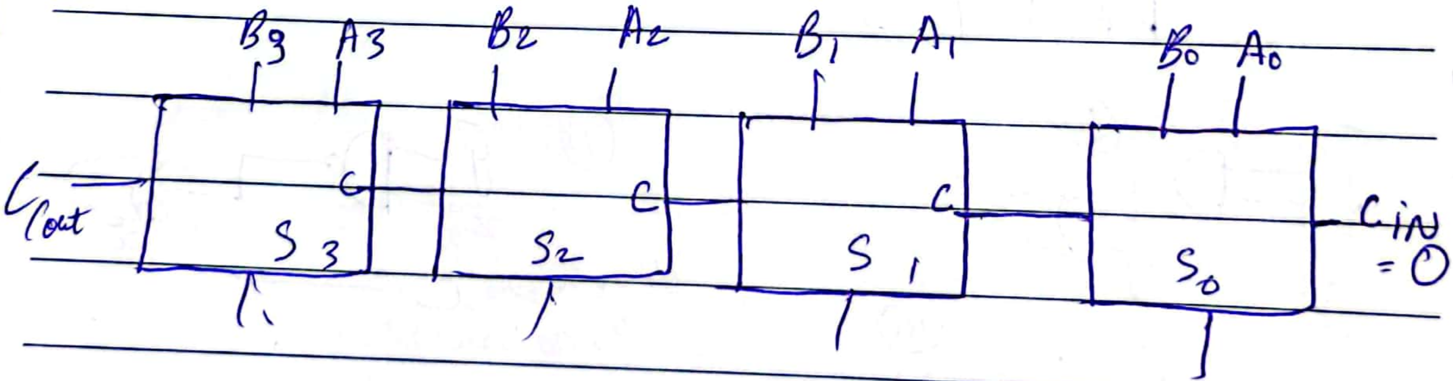
A_3 A_2 A_1 A_0



Design a 4 bit Binary adder circuit A+B

4 F/A

```
  0101 = 5
  0111 = 7
  ----
  1100 = 12
```



A+B And A−B have 1 thing common
4 F/A

If Cin 0 +
1 −

Design a 4 bit binary subtractor (A−B)

2s complement   Invert (2s complement)   +1

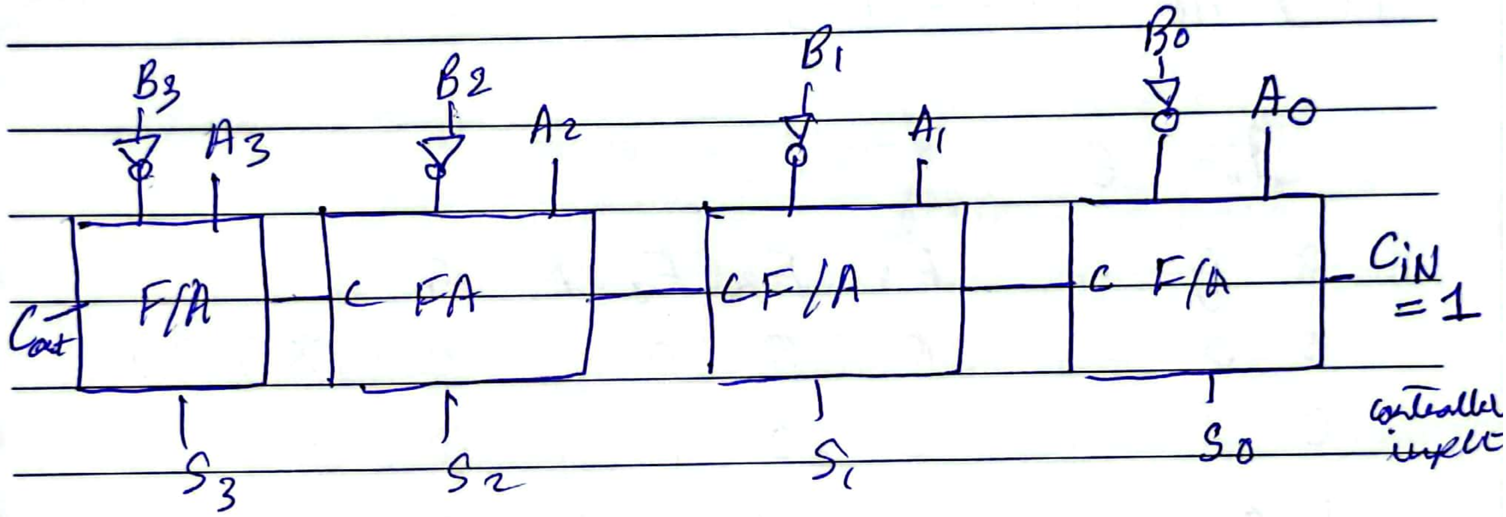
$A+(\bar{B}+1)$

A+(−B)
A 2s comp
B = 1011
B 1c = 0100
+1
2s

$A = A_3\ A_2\ A_1\ A_0$

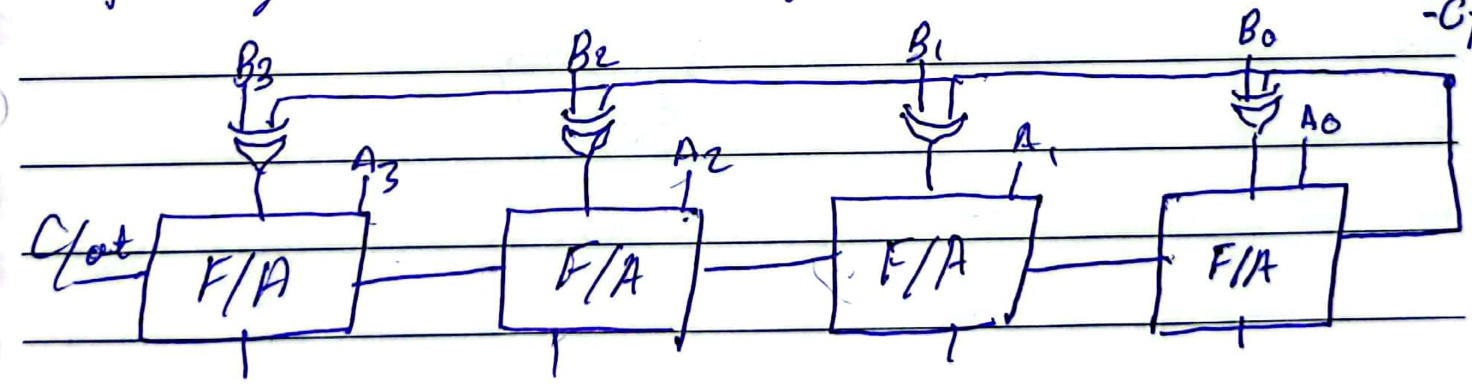
$\bar{B} = \bar{B}_3\ \bar{B}_2\ \bar{B}_1\ \bar{B}_0$

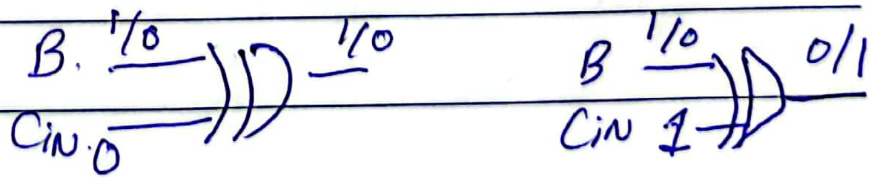
$+1$



If design 4 bit Adder / Subtractor

CiN 0 add
CiN 1 subtr





2bit 3 Se multiply

x	y	
0	0	
0	1	
1	0	
1	1	3

How many outputs

Multiply by largest number

$$\begin{array}{r} 3 \\ \times 3 \\ \hline 9 \end{array}$$

to store 9

we have to have 4 bit

3x6 = 18

11 x 110 $\boxed{10010}$

3bit 6

x	y	F_4	F_3	F_2	F_1	F_0
0	0	0	0	0	0	0
0	1	0	0	1	1	0
1	0	0	1	1	0	0
1	1	1	0	0	1	0

$\bar{x}y + xy$

F_2 $x \oplus y$ $F_1 = y$

Your work
solved ex
numericals

Number system
Compliments Substraction from compliment
gates
Boolean function
Minterms / Maxterms And conversions
(all variables) Sum of Minterms -> product of max
SOP -> POS

K-Mapping SOP / POS
Don't cares
Adders / Subtractor
Code converter
NAND / NOR Ch-3

4.1, 4.2, 4.3, 4.4, 4.10, 4.11,
4.13, 4.14