Chapter : 4

(4.1)

32 16 8 4 2 1

(a)

A	B	C	D	F
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

(a)

SOP (sum of product) → গুণের যোগ → 1 এর জন্য

POS (product of sum) → যোগের গুণ → 0 এর জন্য

Sum of product :- [1 হলে একই থাকবে]

[0 হলে বার (-) হবে]

$\Rightarrow \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}B\bar{C}\bar{D} + \bar{A}BCD + A\bar{B}\bar{C}\bar{D}$

$+ A\bar{B}CD + AB\bar{C}D + ABC\bar{D} + ABCD$

Simplified :-

Gray

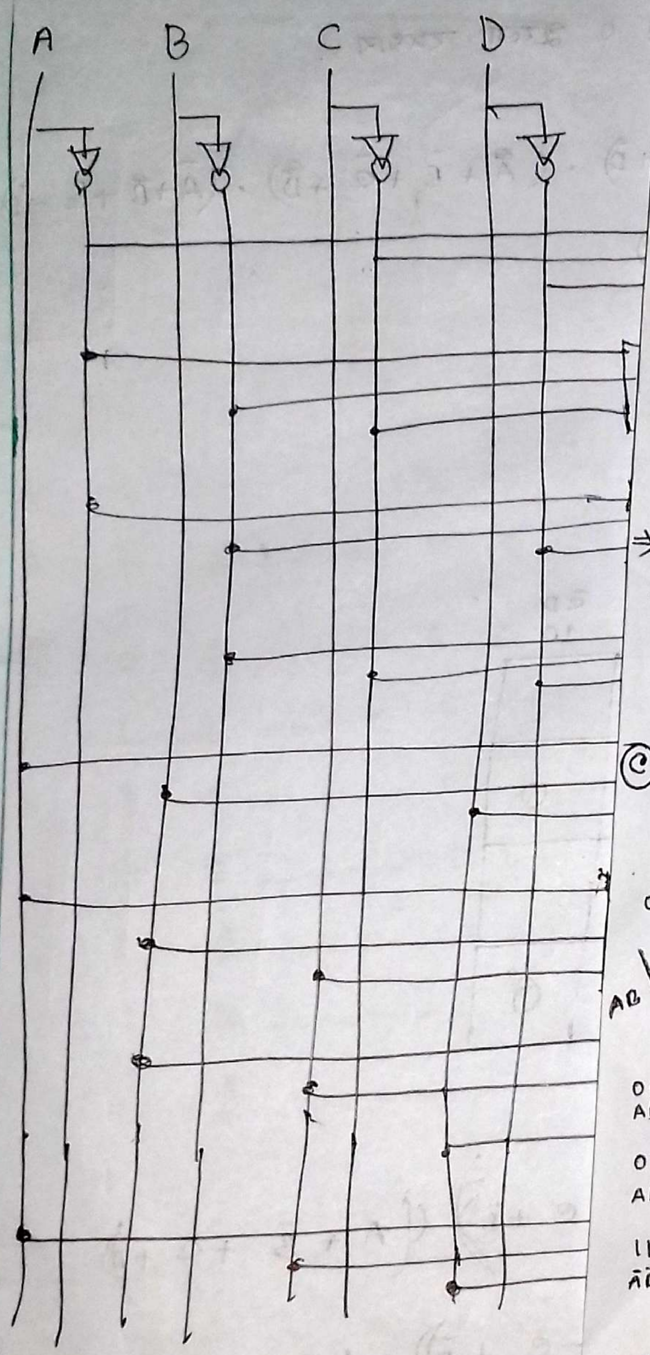
2^n

$2^4 = 16$

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	11	10
00	1	1	0	1
01	1	0	1	0
11	0	1	1	1
10	1	0	1	0

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

$+ ABC + ACD$



Ⓑ SOP

Simplified : 0 থাকলে বার (-) হবে

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
$\bar{A}\bar{B}$ 00	1	1	0	1
$\bar{A}B$ 01	1	0	1	0
AB 11	0	1	1	1
$A\bar{B}$ 10	1	0	1	0

$$\Rightarrow \bar{A}\bar{B}\bar{C} + \bar{A}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{D} + \bar{B}\bar{C}\bar{D} + ABD$$
$$+ ABC + BCD + ACD$$

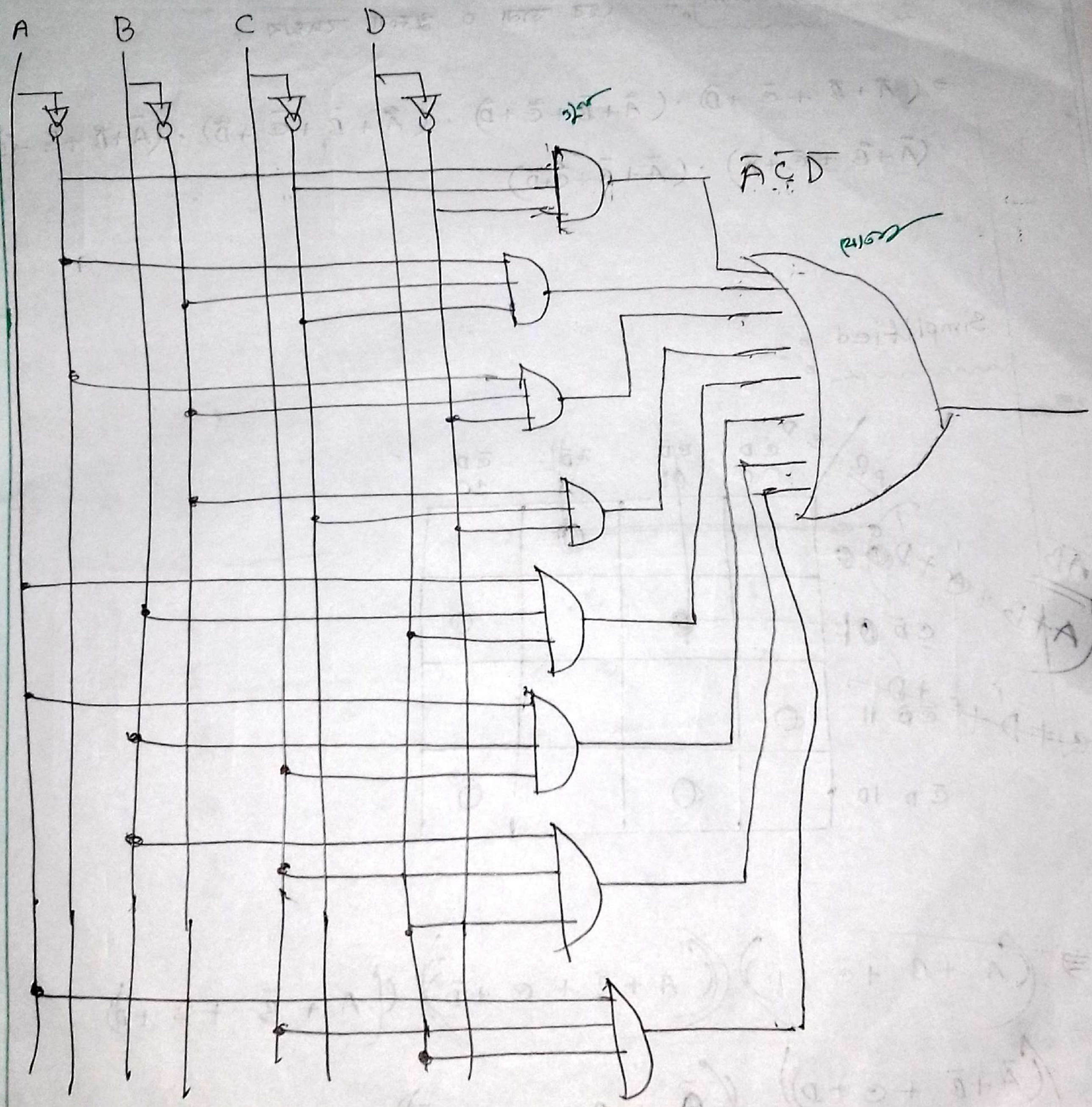
Ⓒ POS (product of sum) → যোগের গুণ

এক্ষেত্রে, 0 এর জন্য কাজ করতে হবে।

0 থাকলে একই হবে, 1 থাকলে (-) হবে।

AB \ CD	CD 00	$C\bar{D}$ 01	$\bar{C}\bar{D}$ 11	$\bar{C}D$ 10
00 AB			0	
01 $A\bar{B}$		0		0
11 $\bar{A}\bar{B}$	0			
10 $\bar{A}B$		0		0

$$\Rightarrow (A+B+\bar{C}+\bar{D})(A+\bar{B}+C+\bar{D})(A+\bar{B}+\bar{C}+D)$$
$$(\bar{A}+\bar{B}+C+D)(\bar{A}+B+C+\bar{D})(\bar{A}+B+\bar{C}+D)$$


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

0 থাকলে = Same হবে

1 থাকলে = বার(−) হবে

product of sum :- এর জন্য 0 গুলো দেখব :

$$\Rightarrow (\bar{A}+\bar{B}+\bar{C}+D)\cdot(\bar{A}+\bar{B}+\bar{C}+\bar{D})\cdot(\bar{A}+\bar{B}+\bar{C}+\bar{D})\cdot(\bar{A}+\bar{B}+\bar{C}+\bar{D})$$

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

Simplified :-

$AB \backslash CD$	CD 00	$C\bar{D}$ 01	$\bar{C}\bar{D}$ 11	$\bar{C}D$ 10
00			0	
$C\bar{D}$ 01		0		0
$\bar{C}\bar{D}$ 11	0			
$\bar{C}D$ 10		0		0

$\overline{AB}$ $\overline{A+B}+C+D$

~~$C+D+C+D$~~

$$\Rightarrow (A+B+\bar{C}+\bar{D})(A+\bar{B}+C+\bar{D})(A+\bar{B}+\bar{C}+D)$$

$$(\bar{A}+\bar{B}+C+D)(\bar{A}+B+C+\bar{D})(\bar{A}+B+\bar{C}+D)$$

$\Rightarrow$

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3 bit = 4+2+1 = 7

$\downarrow$

7^2

$\downarrow$

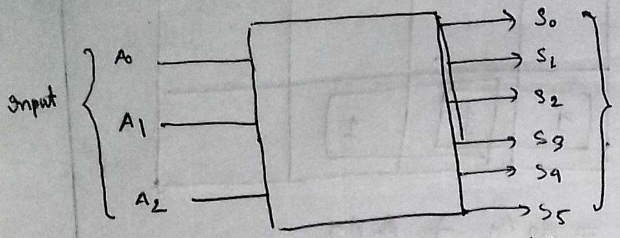
49

$\downarrow$

32 16 8 4 2 1

4.2 Input = 3 bit = 4 + 2 + 1 = 7

output = 6 bit = $7^2 \Rightarrow 49$ =



				32	16	8	4	2	1
	A_0	A_1	A_2	S_0	S_1	S_2	S_3	S_4	S_5
0	0	0	0	0	0	0	0	0	0
1	0	0	1	0	0	0	0	0	1
2	0	1	0	0	0	0	1	0	0
3	0	1	1	0	0	1	0	0	1
4	1	0	0	0	1	0	0	0	0
5	1	0	1	0	1	1	0	0	1
6	1	1	0	1	0	0	1	0	0
7	1	1	1	1	1	0	0	0	1

From the truth table, we can se that S_4 is equal to zero and all the output of S_5 is equal to A_2

So $S_4 = 0$

$S_5 = A_2$

For S_0 S_1 S_2 S_3 we need to solve through using K map

For S_0 : 1 এর জন্য মান বের করুন

A_0 \ A_1A_2	00 ($\bar{A}_1\bar{A}_2$)	01 ($\bar{A}_1A_2$)	11 (A_1A_2)	10 ($A_1\bar{A}_2$)
$\bar{A}_0$ 0				
A_0 1			$\boxed{1}$	$\boxed{1}$

$$S_0 = A_1 A_0$$

For S_1

A_0 \ A_1A_2	00 ($\bar{A}_1\bar{A}_2$)	01 ($\bar{A}_1A_2$)	11 (A_1A_2)	10 ($A_1\bar{A}_2$)
$\bar{A}_0$ 0				
A_0 1	1	1	1	

$$S_1 = A_0\bar{A}_1 + A_0A_2$$

For S_2

A_0 \ A_1A_2	00	01	11	10
0			1	
1		1		

$$S_2 = A_0\bar{A}_1A_2 + \bar{A}_0A_1A_2$$

$$= A_2(A_0 \oplus A_1)$$

For S_3

A_0 \ A_1A_2	00	01	11	10
0				1
1				1

$$S_3 = A_1\bar{A}_2$$

So Final excep is a.

$$S_0 = A_1A_0$$

$$S_1 = A_0\bar{A}_1 + A_0A_2$$

$$S_2 = A_2(A_0 \oplus A_1)$$

$$S_3 = A_1\bar{A}_2$$

$$S_4 = 0$$

$$S_5 = A_2$$

For S_0 : 1 এর জন্য মান বের করব

$A_0 \backslash A_1A_2$	$\bar{A}_1\bar{A}_2$ 00	$\bar{A}_1A_2$ 01	A_1A_2 11	$A_1\bar{A}_2$ 10
$\bar{A}_0$ 0				
A_0 1			1	1

$$S_0 = A_1 A_0$$

For S_1

$A_0 \backslash A_1A_2$	$\bar{A}_1\bar{A}_2$ 00	$\bar{A}_1A_2$ 01	A_1A_2 11	$A_1\bar{A}_2$ 10
$\bar{A}_0$ 0				
A_0 1	1	1	1	

$$S_1 = A_0\bar{A}_1 + A_0A_2$$

For S_2

$A_0 \backslash A_1A_2$	00	01	11	10
0			1	
1		1		

For S_3

$A_0 \backslash A_1A_2$	00	01	11	10
0				1
1				1

$$S_2 = A_0\bar{A}_1A_2 + \bar{A}_0A_1A_2$$

$$= A_2(A_0 \oplus A_1)$$

$$S_3 = A_1\bar{A}_2$$

So Final exeept is a.

$$S_0 = A_1A_0$$

$$S_1 = A_0\bar{A}_1 + A_0A_2$$

$$S_2 = A_2(A_0 \oplus A_1)$$

$$S_3 = A_1\bar{A}_2$$

$$S_4 = 0$$

$$S_5 = A_2$$

4.3

a

output line required

$$\begin{array}{cccc} & & a_1 & a_0 \\ & & b_1 & b_0 \\ \hline & c_1 & a_1 b_0 & a_0 b_0 \\ & & & \cancel{a_0 b_1} \\ & a_1 b_1 & a_0 b_1 & \times \\ \hline c_2 & a_1 b_1 + c_1 & a_1 b_0 + a_0 b_1 & a_0 b_0 \\ & & & \\ P_3 & P_2 & P_1 & P_0 \end{array}$$

$c_1 = c_2 =$ carry

There will be four output comes after the multiplication of two bit binary number.

b

simple [illegible]

(b)

a_1	a_0	b_1	b_0		z_3	z_2	z_1	z_0	
0	0	0	0	—	0	0	0	0	
0	0	0	1	—	0	0	0	0	
0	0	1	0	—	0	0	0	0	
0	0	1	1	—	0	0	0	0	
0	1	0	0	—	0	0	0	0	
0	1	0	1	—	0	0	0	1	
0	1	1	0	—	0	0	1	0	
0	1	1	1	—	0	0	1	1	
1	0	0	0	—	0	0	0	0	
1	0	0	1	—	0	1	1	0	— ?
1	0	1	0	—	1	1	0	0	
1	0	1	1	—	0	1	1	0	
1	1	0	0	—	0	0	0	0	
1	1	0	1	—	0	0	1	1	
1	1	1	0	—	0	1	1	0	
1	1	1	1	—	1	0	0	1	

output

$$z_0 = \bar{a}_1 \cdot a_0 \cdot \bar{b}_1 b_0 + \bar{a}_1 a_0 b_1 b_0 + a_1 a_0 \bar{b}_1 b_0 + a_1 a_0 \cdot b_1 b_0$$

$$z_1 = \bar{a}_1 a_0 \cdot b_1 \bar{b}_0 + \bar{a}_1 a_0 b_1 b_0 + a_1 \bar{a}_0 \cdot \bar{b}_1 b_0 + a_1 \bar{a}_0 \cdot b_1 b_0 + a_1 a_0 \cdot \bar{b}_1 b_0 + a_1 a_0 b_1 \bar{b}_0$$

$$z_2 = a_1 \bar{a}_0 b_1 \bar{b}_0 + a_1 \bar{a}_0 \cdot b_1 b_0 + a_1 a_0 \cdot b_1 \bar{b}_0$$

$$Z_3 = a_1 a_0 b_1 b_0$$

Output

For z_0 =

a_1a_0 \ b_1b_0	$\bar{b}_1\bar{b}_0$ 00	$\bar{b}_1 b_0$ 01	$b_1 b_0$ 11	$b_1\bar{b}_0$ 10
$\bar{a}_1\bar{a}_0$ 00				
$\bar{a}_1 a_0$ 01		1	1	
$a_1 a_0$ 11		1	1	
$a_1\bar{a}_0$ 10				

$z_0 = a_0 \cdot b_0$

For z_1

a_1a_0 \ b_1b_0	$\bar{b}_1\bar{b}_0$ 00	$\bar{b}_1 b_0$ 01	$b_1 b_0$ 11	$b_1\bar{b}_0$ 10
$\bar{a}_1\bar{a}_0$ 00				
$\bar{a}_1 a_0$ 01			1	1
$a_1 a_2$ 11		1		1
$a_1\bar{a}_0$ 10		1	1	

$z_1 = a_1\bar{b}_1 b_0 + a_1\bar{a}_0 b_0 + \bar{a}_1 a_0 b_1 + a_0 b_1 \bar{b}_0$

For z_2

a_1a_0 \ b_1b_0	$\bar{b}_1\bar{b}_0$ 00	$\bar{b}_1 b_0$ 01	$b_1 b_0$ 11	$b_1\bar{b}_0$ 10
$\bar{a}_1\bar{a}_0$ 00				
$\bar{a}_1 a_0$ 01				
$a_1 a_0$ 11				1
$a_1\bar{a}_0$ 10			1	1

$z_2 = a_1\bar{a}_0 b_1 + b_1\bar{b}_0 a_1$

For z_3

a_1a_0 \ b_1b_0	00	01	11	10
00				
01				
11			1	
10				

$z_3 = a_1 a_0 b_1 b_0$

(4.4) Repeat problem 4.3 to form the sum of the two binary number.

4.5

For ; W

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
$\bar{A}\bar{B}$ 00	1	1		
$\bar{A}B$ 01				
AB 11	X	X	X	X
$A\bar{B}$ 10			X	X

$$W = \bar{A}\bar{B}\bar{C}$$

For ; X

AB \ CD	00	01	11	10
00			1	1
01	1	1		
11	X	X	X	X
10			X	X

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

For Y

AB \ CD	00	01	11	10
00			1	1
01			1	1
11	X	X	X	X
10			X	X

$$Y = C$$

For X

AB \ CD	00	01	11	10
00	0	2	4	3
01	5	6	8	7
11	13	14	16	15
10	9	10	12	11

8 4 2 1

1 0 0 1

AB \ CD	00	01	11	10
00	0	1	3	2
01	4	5	7	6
11	12	13	15	14
10	8	9	11	10

For Z

$$Z = D$$

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4.5 9's complement of a decimal numder "d" is = (9 - d)

input A	B	C	D	Decimal Number	9's complement	output w	x	y	z
0	0	0	0	0	(9-0) = 9	1	0	0	1
0	0	0	1	1	(9-1) = 8	1	0	0	0
0	0	1	0	2	(9-2) = 7	0	1	1	1
0	0	1	1	3	(9-3) = 6	0	1	1	0
0	1	0	0	4	(9-4) = 5	0	1	0	1
0	1	0	1	5	(9-5) = 4	0	1	0	0
0	1	1	0	6	(9-6) = 3	0	0	1	1
0	1	1	1	7	(9-7) = 2	0	0	1	0
1	0	0	0	8	(9-8) = 1	0	0	0	1
1	0	0	1	9	(9-9) = 0	0	0	0	0

output 1 আছে ignore

$w = \Sigma(0, 1) + d(10, 11, 12, 13, 14, 15)$

$x = \Sigma(2, 3, 4, 5) + d(10, 11, 12, 13, 14, 15)$

$y = \Sigma(2, 3, 6, 7) + d(10, 11, 12, 13, 14, 15)$

$z = \Sigma(0, 2, 4, 6, 8) + d(10, 11, 12, 13, 14, 15)$

4.5

FOR : W

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
$\bar{A}\bar{B}$ 00	1	1		
$\bar{A}B$ 01				
AB 11	X	X	X	X
$A\bar{B}$ 10			X	X

$W = \bar{A}\bar{B}\bar{C}$

FOR : X

AB \ CD	00	01	11	10
00	0	2	4	3
01	5	6	8	7
11	13	14	16	15
10	9	10	12	11

FOR ; X

AB \ CD	00	01	11	10
00			1	1
01	1	1		
11	X	X	X	X
10			X	X

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

8 4 2 1

1 0 01

AB \ CD	00	01	11	10
00	0	1	3	2
01	4	5	7	6
11	12	13	15	14
10	8	9	11	10

FOR Y

AB \ CD	00	01	11	10
00			1	1
01			1	1
11	X	X	X	X
10			X	X

$Y = C$

FOR Z

$Z = D$

(A.6) 2's complement এর ক্ষেত্রে

শেষে 0 থাকলে, যতক্ষণ 0 ততক্ষণ 0, 1 আসলে সব পরিবর্তন

শেষে 1 থাকলে অপরিবর্তিত থাকবে বাকি সব পরিবর্তন

0 0 0 1 → 1 1 1 1

0 0 1 0 → 1 1 1 0

0 0 1 0 0 0

1 1 1 0 0 0

A	B	C	D	Y_3	Y_2	Y_1	Y_0
0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1
0	0	1	0	1	1	1	0
0	0	1	1	1	1	0	1
0	1	0	0	1	1	0	0
0	1	0	1	1	0	1	1
0	1	1	0	1	0	1	0
0	1	1	1	1	0	0	1
1	0	0	0	1	0	0	0
1	0	0	1	0	1	1	1
1	0	1	0	0	1	1	0
1	0	1	1	0	1	0	1
1	1	0	0	0	1	0	0
1	1	0	1	0	0	1	1
1	1	1	0	0	0	1	0
1	1	1	1	0	0	0	1

$Y_3 = \Sigma(1, 2, 3, 4, 5, 6, 7, 8)$

$Y_2 = \Sigma(1, 2, 3, 4, 9, 10, 11, 12)$

$Y_1 = \Sigma(1, 2, 5, 6, 9, 10, 13, 14)$

$Y_0 = \Sigma(1, 3, 5, 7, 9, 11, 13, 15)$

FOR Y_3

AB \ CD	00	01 ($\bar{C}D$)	11 (CD)	10 ($D0$)
00		1	1	1
01	1	1	1	1
11				
10	1	ϕ		

$Y_3 = D\bar{A} + \bar{A}C + \bar{A}B + A\bar{B}\bar{C}\bar{D}$

4.7

(4.8)

64 32 16 8 4 2 1

Obtain a logic diagram whose output is 1 when the input contain any one of the six unused bit combination in the BCD code.

Assume that input is a 4 bit BCD $\{x_3, x_2, x_1, x_0\}$ and the output is E

x_3 x_2 x_1 x_0 E

Decimal এ 0 থেকে 9 পর্যন্ত সংখ্যা আছে। 9 এর বেশি যে সংখ্যাগুলো অর্থাৎ (10, 11, 12, 13, 14, 15) এ সংখ্যা গুলোর জন্য Error দেখাবে।

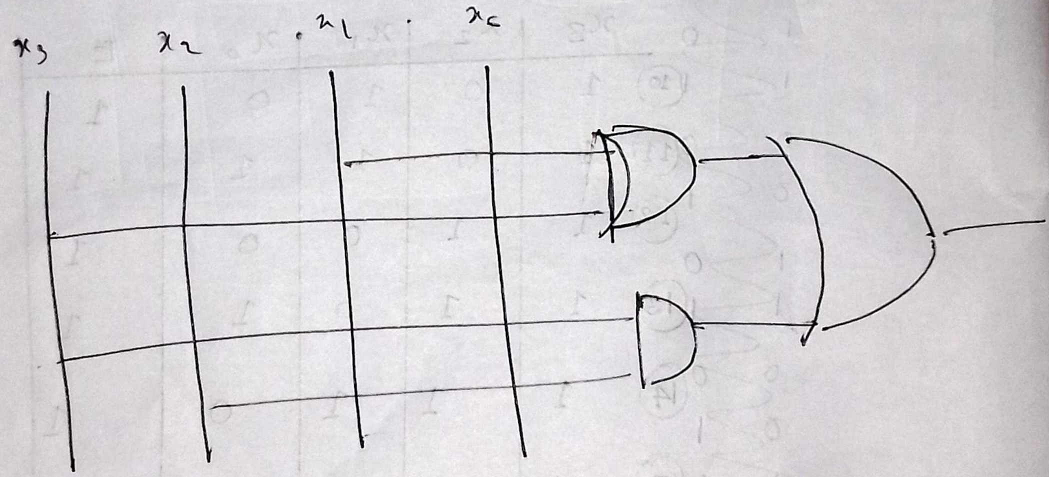
	x_3	x_2	x_1	x_0	E
10	1	0	1	0	1
11	1	0	1	1	1
12	1	1	0	0	1
13	1	1	0	1	1
14	1	1	1	0	1
15	1	1	1	1	1

$$E = (x_3 \bar{x}_2 . x_1 \bar{x}_0 + x_3 \bar{x}_2 x_1 x_0 + x_3 x_2 . \bar{x}_1 \bar{x}_0 + x_3 x_2 \bar{x}_1 x_0 + x_3 x_2 x_1 \bar{x}_0 + x_3 x_2 x_1 x_0)$$

Simplify

$x_3 x_2$ \ $x_1 x_0$	$\bar{x}_1 \bar{x}_0$ 00	$\bar{x}_1 x_0$ 01	$x_1 x_0$ 11	$x_1 \bar{x}_0$ 10
$\bar{x}_3 \bar{x}_2$ 00				
$\bar{x}_3 x_2$ 01			1	1
$x_3 x_2$ 11	1	1	1	1
$x_3 \bar{x}_2$ 10				

$$E = x_1 x_3 + x_3 x_2$$



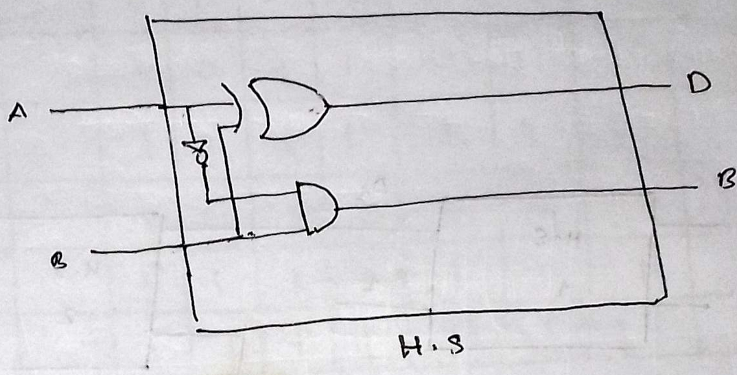
(4.9) Implement a full subtractor with two half subtractor or gate

$A - B \Rightarrow$ half subtractor

$A - B - C \Rightarrow$ Full subtractor

carry (থাকলেই 1 হবে)

A	B	D	B
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0



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

$= A \oplus B$

$B = \bar{A} B$

For Full subtractor :-

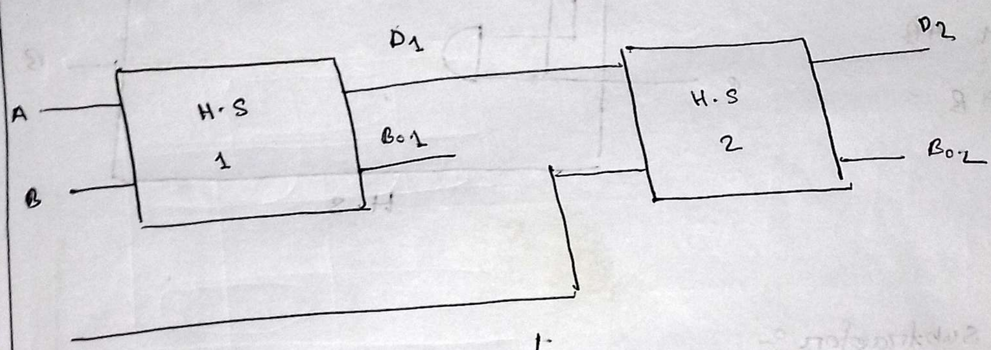
A	B	C	D	B
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

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

$= A \oplus B \oplus C$ মুখস্থ

$B = \bar{A}\bar{B}C + \bar{A}B\bar{C} + \bar{A}BC + ABC$

$= \bar{A}B + \bar{A}C + BC$ মুখস্থ



H.S.1

$D_1 = A \oplus B$

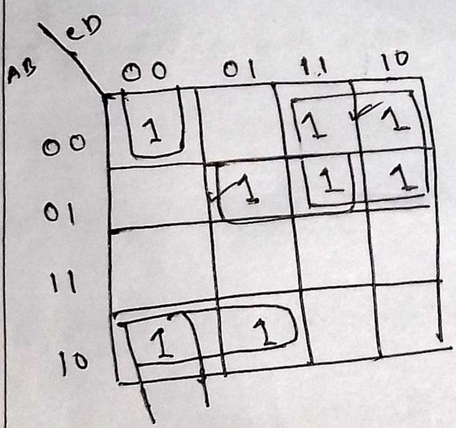
$B_{o1} = \bar{A}B$

$D_2 = D_1 \oplus C$

$B_{o2} = \bar{D_1}C$

(4.10)

A	B	C	D		a	b	c	d	e	f	g
0	0	0	0		1	1	1	1	1	1	0
0	0	0	1		0	1	1	0	0	0	0
0	0	1	0		1	1	0	1	1	0	1
0	0	1	1		1	1	1	1	0	0	1
0	1	0	0		0	1	1	0	0	1	1
0	1	0	1		1	0	1	1	0	1	1
0	1	1	0		1	0	1	1	1	1	1
0	1	1	1		1	1	1	0	0	0	0
1	0	0	0		1	1	1	1	1	1	1
1	0	0	1		1	1	1	1	0	1	1



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

AB \ CD	00	01	11	10
00	1	1	1	1
01	1		1	
11				
10	1	1		

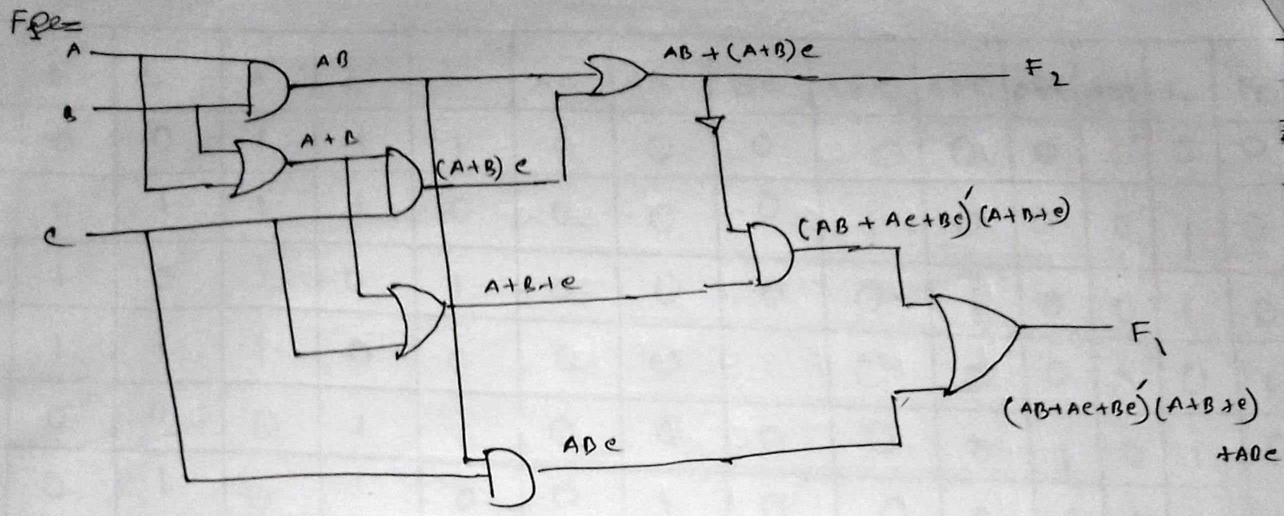
problem

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

AB \ CD				
	1	1	1	
	1	1	1	1
	1	1		

(4.11)

Boolean function for F_1 and F_2



NOW

$$F_1 = \overline{(AB+BC+AC)}'\,(A+B+C) + ABC$$

$$= \overline{AB}\ \overline{BC}\ \overline{AC}\ (A+B+C) + ABC$$

$$= (\bar A+\bar B)(\bar B+\bar C)(\bar A+\bar C)(A+B+C) + ABC$$

$$= (\bar A\bar B+\bar A\bar C+\bar B\bar B+\bar B\bar C)(\bar A+\bar C)(A+B+C) + ABC$$

$$= (\bar A\bar B+\bar A\bar C+\bar B\bar B+\bar B\bar C)(0+\bar AB+\bar AC+\bar CA+\bar CB+0) + ABC$$

$$= 0+0+\bar A\bar BC+0+0+0+0\ A\bar B\bar C+0+0+$$
$$\bar AB\bar C+0+0+\bar A\bar BC+A\bar B\bar C+0+0+$$
$$0+0+0+A\bar B\bar C+0+0+ABC$$

$$= \bar A\bar BC + A\bar B\bar C + \bar AB\bar C + ABC$$

$$F_2 = AB + (A+B)C$$

$$= AB + AC + BC$$

(4.12)

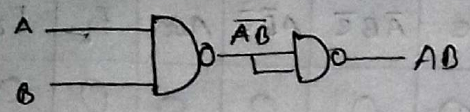
$F_1 = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC$

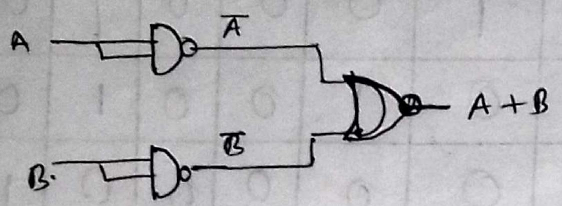
$F_2 = AB + AC + BC$

A	B	C	$\bar{A}$	$\bar{B}$	$\bar{C}$	AB	AC	BC	$\bar{A}\bar{B}C$	$\bar{A}B\bar{C}$	$A\bar{B}\bar{C}$	ABC	F_1	F_2
0	0	0	1	1	1	0	0	0	0	0	0	0	0	0
0	0	1	1	1	0	0	0	0	1	0	0	0	1	0
0	1	0	1	0	1	0	0	0	0	1	0	0	1	0
0	1	1	1	0	0	0	0	1	0	0	0	0	0	1
1	0	0	0	1	1	0	0	0	0	0	1	0	1	0
1	0	1	0	1	0	0	1	0	0	0	0	0	0	1
1	1	0	0	0	1	1	0	0	0	0	0	0	0	1
1	1	1	0	0	0	1	1	1	0	0	0	1	1	1

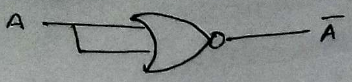
Scanned by CamScanner

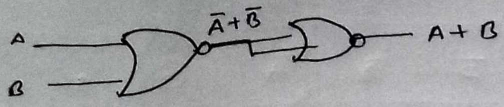
(4.13) NAND

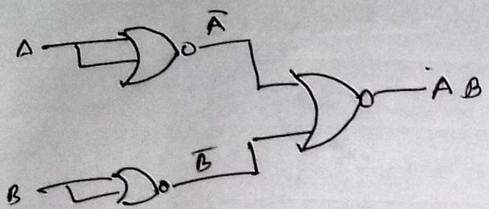




4.19

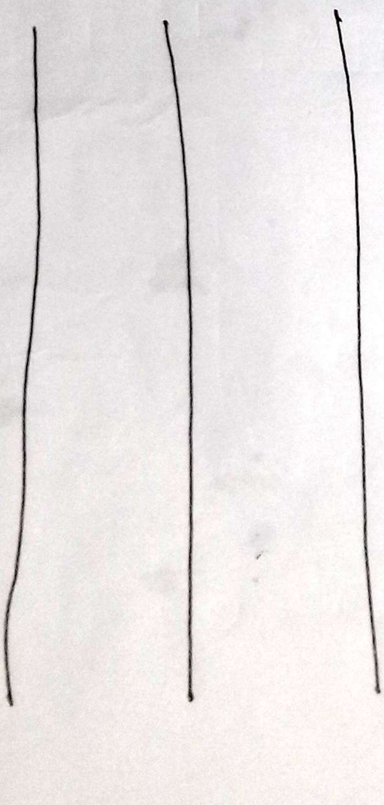




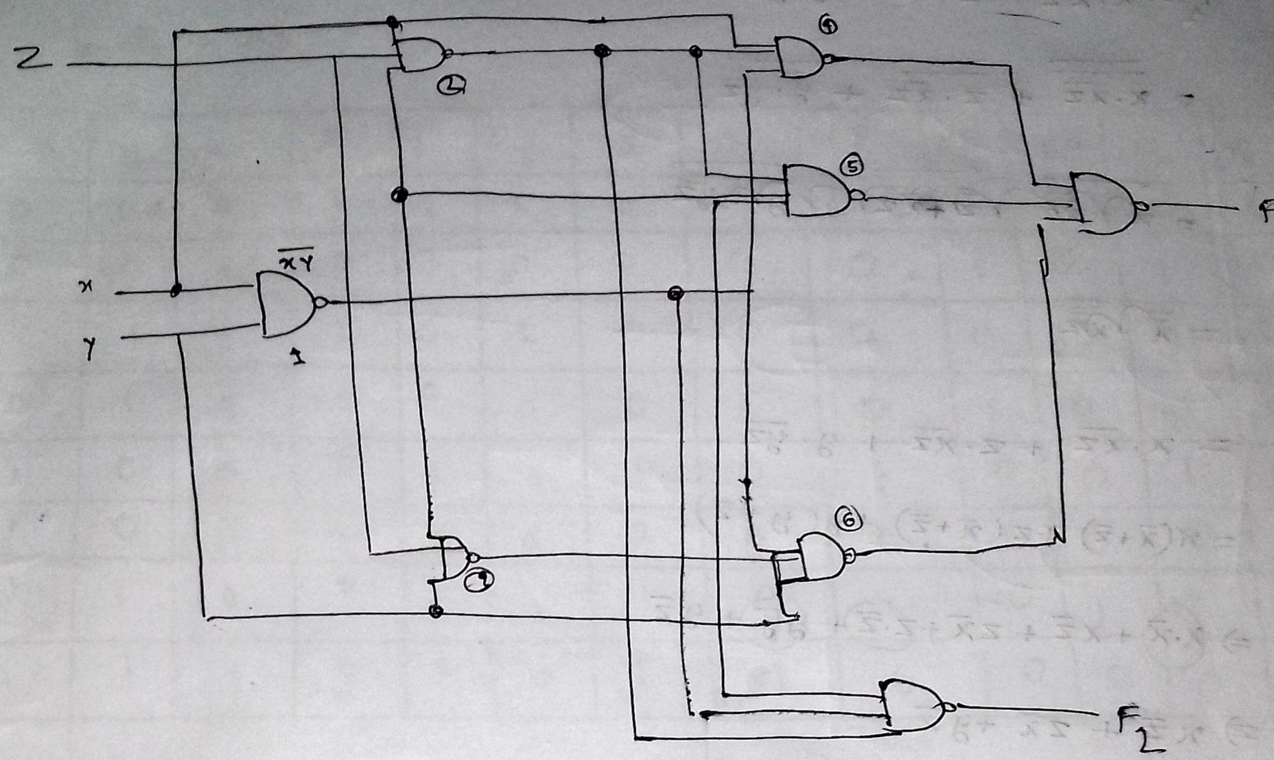


$$\overline{\bar{A}+\bar{B}} \Rightarrow \bar{\bar{A}} \cdot \bar{\bar{B}} = A \cdot B$$

A B C.



4.17



$1 = \overline{xy}$; $2 = \overline{xz}$; $3 = \overline{yz}$;

$4 = \overline{x \cdot 2}$
$= \overline{x \cdot \overline{xz}}$

$5 = \overline{2 \cdot z}$
$= \overline{\overline{xz} \cdot z}$

$6 = \overline{3 \cdot y}$
$= \overline{\overline{yz} \cdot y}$

$F_1 = \overline{4 \cdot 5 \cdot 6}$
$= \overline{\overline{x \cdot \overline{xz}} \cdot \overline{\overline{xz} \cdot z} \cdot \overline{\overline{yz} \cdot y}}$

=

(4)

$$F_1 = \overline{\overline{x \cdot \overline{xz}} \cdot \overline{z \cdot \overline{xz}} \cdot \overline{y \cdot \overline{yz}}}$$

$$= \overline{\overline{x \cdot \overline{xz}}} + \overline{\overline{z \cdot \overline{xz}}} + \overline{\overline{y \cdot \overline{yz}}}$$

$$= \cancel{\overline{\overline{x} + \overline{\overline{xz}}}\ \overline{\overline{z} + \overline{\overline{xz}}} \cdot \overline{\overline{y} + \overline{\overline{yz}}}}$$

$$= \cancel{\overline{\overline{x}} \cdot \overline{\overline{\overline{xz}}}}$$

$$= x \cdot \overline{xz} + z \cdot \overline{xz} + y \cdot \overline{yz}$$

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

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

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

$$F_2 = \overline{1 \cdot 2}$$

$$= \overline{\overline{xy} \cdot \overline{xz}}$$

$$= \overline{\overline{xy}} + \overline{\overline{xz}}$$

$$= xy + xz$$

4.18

(a)

$F_1 = x\bar{z} + z\bar{x} + y\bar{z}$

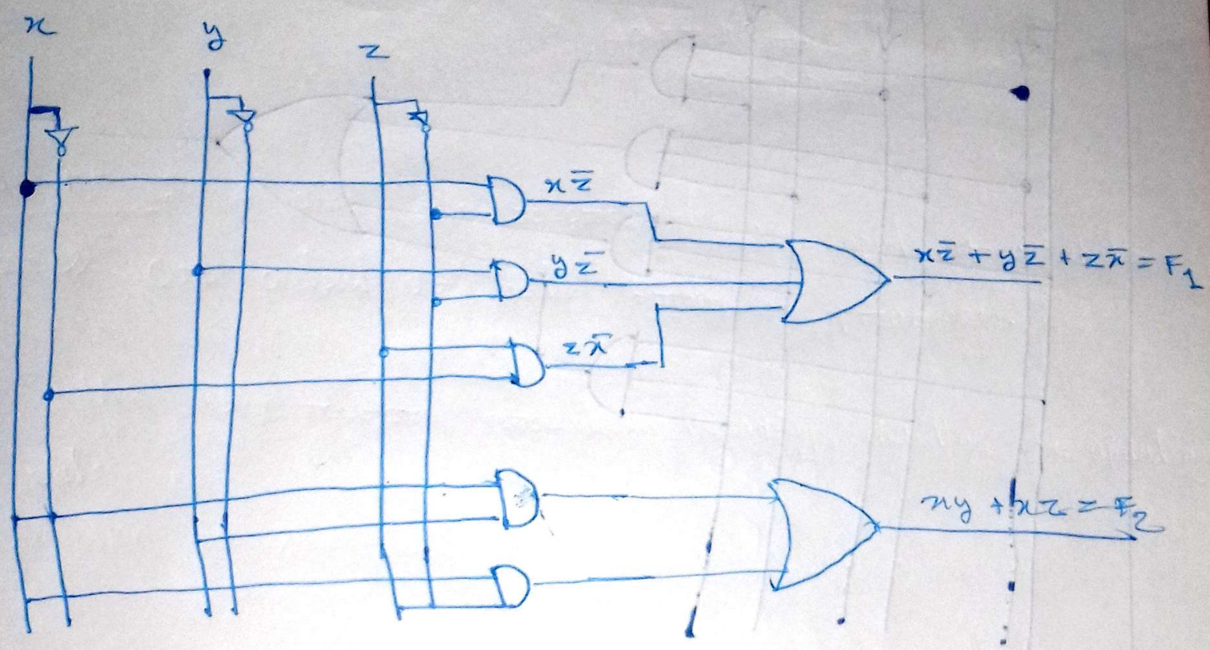
$F_2 = xy + xz$

x	y	z	$\bar{x}$	$\bar{y}$	$\bar{z}$	xy	xz	$x\bar{z}$	$z\bar{x}$	$y\bar{z}$	F_1	F_2
0	0	0	1	1	1	0	0	0	0	0	0	0
0	0	1	1	1	0	0	0	0	1	0	1	0
0	1	0	1	0	1	0	0	0	0	1	1	0
0	1	1	1	0	0	0	0	0	1	0	1	0
1	0	0	0	1	1	0	0	1	0	0	1	0
1	0	1	0	1	0	0	1	0	0	0	0	1
1	1	0	0	0	1	1	0	1	0	1	1	1
1	1	1	0	0	0	1	1	0	0	0	0	1

(4.19)

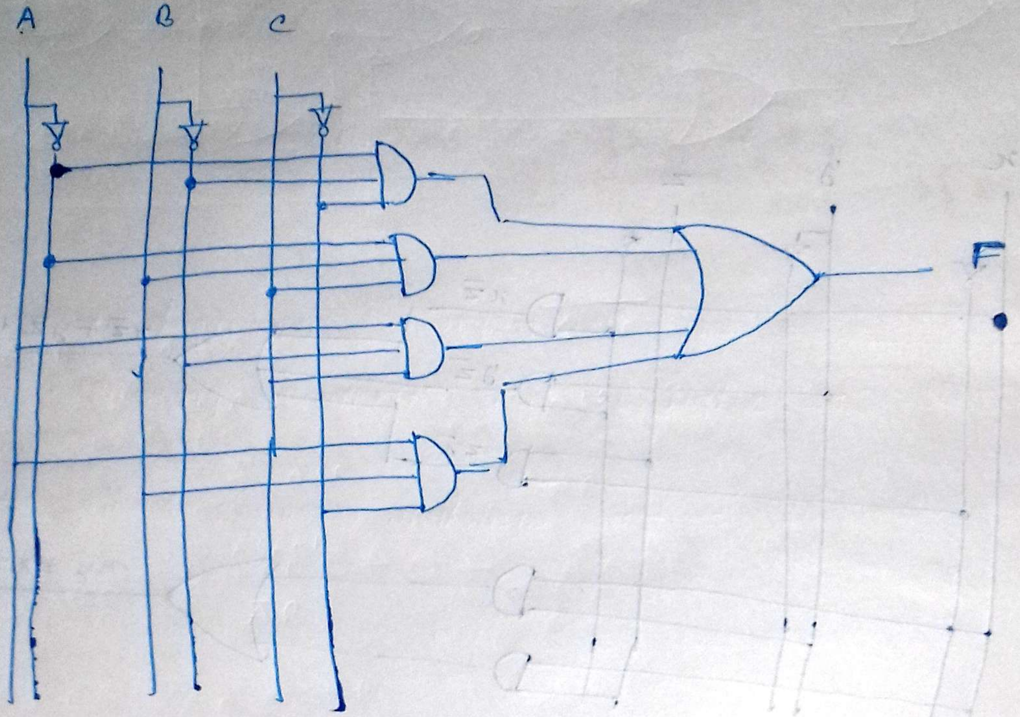
$F_1 = x\bar{z} + y\bar{z} + z\bar{x}$

$F_2 = xy + xz$

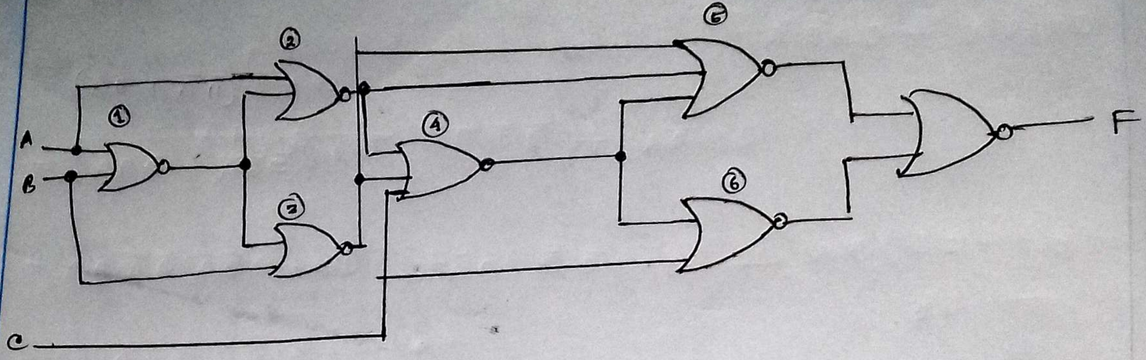


4.20

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



4.22



$1 = \overline{A+B}$; $2 = \overline{A + 1}$

$= \overline{A + \overline{A+B}}$

$= \bar{A} \cdot \overline{\overline{A+B}}$

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

$= \bar{A}B$

$3 = \overline{1 + B}$

$= \overline{\overline{A+B} + B}$

$= A\bar{B}$

$4 = \overline{2+3+C}$

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

$= \overline{\bar{A}B} \cdot \overline{A\bar{B}} \cdot \bar{C}$

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

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

$\Rightarrow (0 + AB + \bar{A}\bar{B} + 0)\bar{C}$

$\Rightarrow (AB + \bar{A}\bar{B})\bar{C}$

$$5 = \overline{3 + 2 + 4}$$

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

$$= \overline{A\bar{B}} \cdot \overline{\bar{A}B} \cdot \overline{(AB + \bar{A}\bar{B})\bar{C}}$$

$$= (\bar{A} + B)(A + \bar{B})\left(\overline{(AB + \bar{A}\bar{B})} + \bar{\bar{C}}\right)$$

$$= (0 + \bar{A}\bar{B} + AB + 0)\left((\overline{AB} \cdot \overline{\bar{A}\bar{B}}) + C\right)$$

$$= (\bar{A}\bar{B} + AB)\left((\bar{A} + \bar{B})(A + B) + C\right)$$

$$= \cancel{(\bar{A}B) + AB)\left((0 + \bar{A}B + A\bar{B} + \bar{B}) + C\right)}$$

$$= (\bar{A}\bar{B} + AB)(0 + \bar{A}B + A\bar{B} + 0) + C$$

$$= (\bar{A}\bar{B} + AB)\left((\bar{A}B + A\bar{B}) + C\right)$$

$$= 0 + 0 + \bar{A}\bar{B}C + 0 + 0 + ABC$$

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

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

$$= C\overline{(A \oplus B)}$$

$$\boxed{\bar{A}\bar{B} + AB = \overline{(A \oplus B)}}$$

$$6 = \overline{4+C}$$

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

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

$$= \overline{AB\bar{C}} \cdot \overline{\bar{A}\bar{B}\bar{C}} \;\; \bar{C}$$

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

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

$$= \bar{C}(0+\bar{A}B+\bar{A}C+A\bar{B}+0+\bar{B}C+AC+BC+C)$$

$$= (\bar{A}B\bar{C} + 0 + A\bar{B}\bar{C} + 0 + 0 + 0 + 0)$$

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

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

$$= \bar{C}(A \oplus B)$$

$$F = \overline{5+6}$$

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

$$= \overline{C\,\overline{(A\oplus B)} + \bar{C}(A\oplus B)}$$

$$= \overline{A \oplus B \oplus C}$$

4.24

A	B	C	D	parity error check
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

AB \ CD	00	01	11	10
00		1		1
01	1		1	
11		1		1
10	1		1	

$\therefore$ PEC =

$$PEC = \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}B\bar{C}\bar{D} + \bar{A}BCD + AB\bar{C}D$$

$$+ ABC\bar{D} + A\bar{B}\bar{C}\bar{D} + A\bar{B}CD$$

$$= \bar{A}\bar{B}(\bar{C}D + C\bar{D}) + \bar{A}B(\bar{C}\bar{D} + CD) + AB(\bar{C}D + C\bar{D})$$

$$+ A\bar{B}(\bar{C}\bar{D} + CD)$$

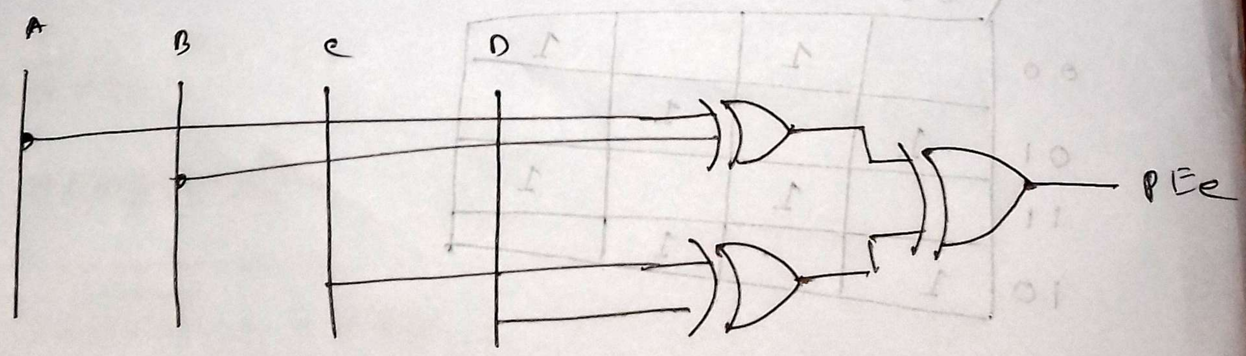
$$= \bar{A}\bar{B}(C \oplus D) + \bar{A}B(\overline{C \oplus D}) + AB(C \oplus D) + A\bar{B}(\overline{C \oplus D})$$

$$= C \oplus D(\bar{A}\bar{B} + AB) + (\overline{C \oplus D})(\bar{A}B + A\bar{B})$$

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

$$= (A \oplus B) \oplus (C \oplus D)$$

so the diagram is



(4.26) Implementing boolean function using 3 half adder circuit

$D = A \oplus B \oplus C$

$E = \bar{A}BC + A\bar{B}C$

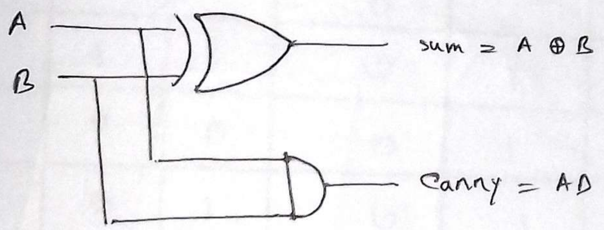
$= C(\bar{A}B + A\bar{B})$

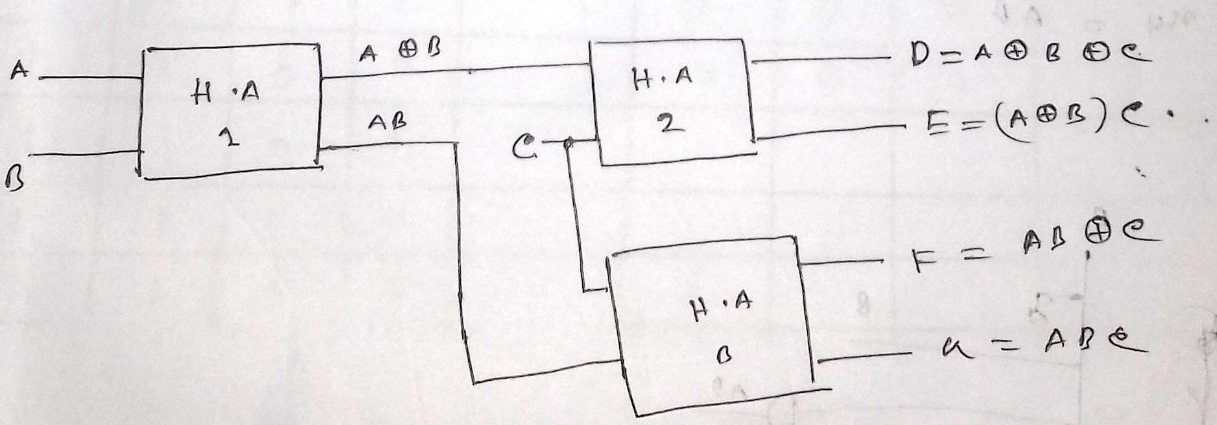
$= C(A \oplus B)$

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

$= (AB) \oplus C$

$G = ABC$





$(2n+1) \times (n+1)$ Rom for n-bit

32 16 8 4 2 1

4.27

2 bit input has range 0 to 3

A	B	x_4	x_3	x_2	x_1	x_0
0	0	0	0	0	0	0
0	1	0	0	0	0	1
1	0	0	1	0	0	0
1	1	1	1	0	1	1

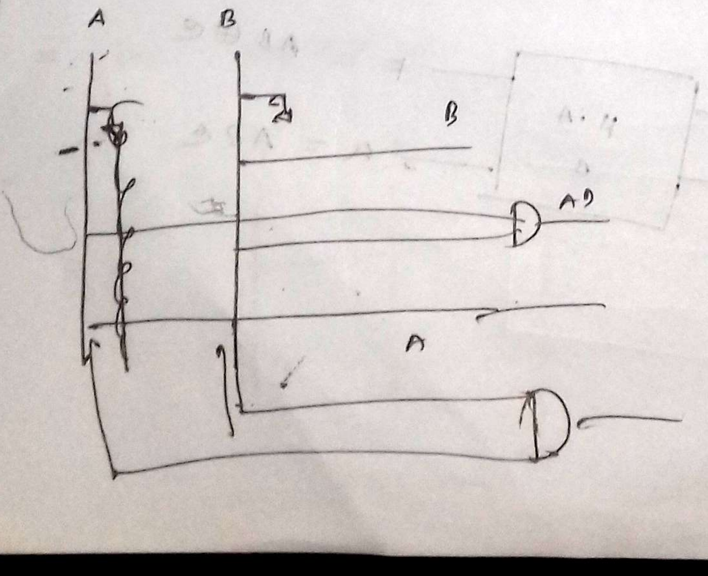
$x_0 = \bar{A}B + AB = B(\bar{A}+A) = B$

$x_1 = AB$

$x_2 = 0$

$x_3 = A\bar{B} + AB = A$

$x_4 = AB$



(4.28) 4 bit excess 3 code to 4 bit BCD code

Excess - 3				BCD				
A	B	C	D	w	x	y	z	
0	0	0	0					0 - 3 = -3
0	0	0	1					0 - 2 = -2
0	0	1	0					0 - 1 = -1
0	0	1	1	0	0	0	0	3 - 3 =
0	1	0	0	0	0	0	1	4 - 3 = 1
0	1	0	1	0	0	1	0	5 - 3 = 2
0	1	1	0	0	0	1	1	
0	1	1	1	0	1	0	0	
1	0	0	0	0	1	0	1	
1	0	0	1	0	1	1	0	
1	0	1	0	0	1	1	1	
1	0	1	1	1	0	0	0	
1	1	0	0	1	0	0	1	
1	1	0	1					
1	1	1	0					
1	1	1	1					

বুঝতে হবে

K-map

AB \ CD	00	01	11	10
00				
01	1			1
11	1			
10	1			1

AB \ CD	00	01	11	10
00				
01		1		1
11				
10		1	1	1

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

AB \ CD				
			1	
	1	1		1

AB \ CD				
	1			
			1	

4.30 BCD to 7 bit ASCII bit

A	B	C	D	S0	S_1	S_2	S_3	S_4	S_5	S_6	S_7
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	1	0	0	0	0	0	0	1
0	0	1	0	2	0	0	0	0	0	1	0
0	0	1	1	3	0	0	0	0	0	1	1
0	1	0	0	4	1	0	0	0	1	0	0
0	1	0	1	5	0	0	0	0	1	0	1
0	1	1	0	6	0	0	0	0	1	1	0
0	1	1	1	7	0	0	0	0	1	1	1
1	0	0	0	8	0	0	0	1	0	0	0
1	0	0	1	9	0	0	1	0	0	1	

Here, $S_0 = S_1 = S_2 = 0$

$S_6 = D$, $S_5 = C$, $S_4 = B$, $S_3 = A$